agriculture, rural development,
land & environmental affairs
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA
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Litiko Letekulima, Kutfutfukiswa Kwetindzawo Tasemakhaya, Temhlaba Netesimondzawo

Departement van Landbou, Landelike Ontwikkeling, Grond en Ongewing Sake

umNyango weZelimo UkuThuthukiswa kweeNdawo zemaKhaya, iNarha neeNdaba zeBhoduluko

Application form for the rectification of unlawful commencement or continuation of a listed activity in terms of S24G of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

2017

Kindly note that:

1. This application form must be completed for all applications in terms of S24G of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

2. An independent EAP must be appointed to complete the application form on behalf of the applicant; the declaration of independence must be completed by the independent EAP and submitted with the application.

3. In cases where an activity applied for commenced during the ECA and other activities commenced during NEMA, two applications forms must be submitted.

4. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the application form have been published or produced by the relevant competent authority.

5. The content of the application for rectification form comprises of:

   Section A: Application Information
   Section B: Activity Information
   Section C: Description of Receiving Environment
   Section D: Preliminary Impact Assessment
   Section E: Alternatives
   Section F: Appendices
   Section G: Declarations
   Annexure A: S24G Fines Regulations

6. It is compulsory to comply and complete Annexure A of this application.

7. Incomplete applications will be returned to the applicant for revision and re-submission.

8. The required information must be typed within the spaces provided. The sizes of the spaces provided are not necessarily indicative of the amount of information to be provided. The space provided extend as each space is filled with typing. A legible font type and size must be used when completing the form. The font size should not be smaller than 10pt (e.g. Arial 10).

9. The use of *"not applicable"* in the application form must be done with circumspection.

10. No faxed or e-mailed applications will be accepted. This application form must be submitted by hand or mailed to the Department.

11. Unless protected by law, all information contained in and attached to this application form may become public information on receipt by the competent authority. Upon request, any interested and affected party must be provided with the information contained in and attached to this application form.

12. This application form constitutes the initiation of the S24G application process.

13. **Activities which result in detrimental impacts to the environment are considered in a serious light by the Department and accordingly Applicants must understand that by lodging an application for the continuation of activities that commenced/ was undertaken unlawfully does not necessarily imply that the activity will be authorised. In terms of the NEMA, the MEC may either refuse to issue an EA, conditionally authorise the activity or direct you, the Applicant, to provide further information or take further steps prior to making a decision.**

DEPARTMENTAL DETAILS

DEPARTMENT DETAILS

Applications must be submitted by hand to:

S24G Unit Manager : **Ms T Tanda**
E-mail : ttanda@mpg.gov.za
Contact : **072 249 1384**
: And Ms Zandile Ngobeni
: dlaminiz@mpg.gov.za
: **079 365 9296**
Mpumalanga Department of Agriculture,Rural Development, Land and Environmental Affairs
Physical Address :2nd Floor Block 4,**Office Number 231 / 237**
Cycard Building, East Tower
Riverside Office Park (Opposite Audi Entrance Gate)
Aqua Street
Nelspruit
1200
S24G Regional Assistant Directors:
Gert Sibande : Mr Musa Luhlanga
Email : mmluhlanga@mpg.gov.za
Contact : 082 769 4478
Nkangala : Mr Quinton Shakwane
Email : kqshakwane@mpg.gov.za
Contact : 082 597 9758
Ehlanzeni : Ms Nocawe Nkosi
Email : nocawe@mpg.gov.za
Contact : 082 683 0594
Mpumalanga Department of Agriculture,Rural Development, Land and Environmental Affairs
Tel: Head Office 013 766 6067/8

SECTION A: APPLICATION INFORMATION

1. APPLICANT PROFILE INDEX

Cross out the appropriate box "☒".

1.1	The applicant is an individual	YES	NO
1.2	The applicant is a company	YES	NO
1.3	The applicant is a state-owned enterprise or municipality	YES x	NO
1.4	Other (specify)	YES	NO
1.5	There is more than one individual / company responsible for the unlawful commencement of listed activities	YES	NO

Name of Project applicant:	Chief Alfred Luthuli Local Municipality		
RSA Identity number:			
Contact person:	Ephraim Thabethe		
Position in company	Municipal Manager		
Registered Name of Company/ Closed Corporation	N/A		
Trading name (if any):	Chief Alfred Luthuli Local Municipality		
Registration number	N/A		
Postal address:	Corner Voortrekker & Versveld Streets,		
	Carolina, Mpumalanga	Postal code:	1185
Telephone:	(017) 843 4000/26	Cell:	N/A
E-mail:	thabetheme@albertluthuli.gov.za	Fax:	( )

Please Note: In instances where there is more than one individual / company responsible for the unlawful commencement of listed activities, please attach a list of with all contact details to the back of this page.

Environmental Assessment Practitioner (EAP):	Mang Geoenviro Services		
Contact person:	Phakwago M.Kabelo		
Postal address:	687 Silverlakes Road, Unit 11 Kingfisher Building		
	Hazeldean Office Park	Postal code:	0081
Telephone:	(012) 770 4022	Cell:	079 054 7652
E-mail:	kabelo@manggeoenviro.co.za	Fax:	( )
EAP Qualifications	Advanced Diploma in Environmental Sciences		
EAP Registrations/Associations	Reg.EAP (2021/3538) & Cand. Sci. Nat (134805)		

Name of Landowner(s):	Chief Albert Luthuli Local Municipality		
Contact person(s):	Ephraim Thabethe		
Postal address:	Corner Voortrekker & Versveld Streets,		
	Carolina, Mpumalanga	Postal code:	1185
Telephone:	(017) 843 4000/26	Cell:	N/A
E-mail:	thabetheme@albertluthuli.gov.za	Fax:	( )

Please Note: In instances where there is more than one landowner, please attach a list of landowners with their contact details to the back of this page.

Municipality in whose area of jurisdiction the activity falls:	Chief Albert Luthuli Local Municipality		
Contact person:	Ephraim Thabethe		
Postal address:	Corner Voortrekker & Versveld Streets,		
	Carolina, Mpumalanga	Postal code:	1185
Telephone	(017) 843 4000/26	Cell:	N/A
E-mail:	thabetheme@albertluthuli.gov.za	Fax:	( )

Please Note: In instances where there is more than one Municipality involved, please attach a list of Municipalities with their contact details to the back of this page.

Project title:	The proposed formalization of the Nhlazatshe 1 informal settlements on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT in Mpumalanga Province.					
Property location:	Nhlazatshe 1					
Farm/Erf name & number (incl. portion):	portions of farm portions Eerste Hoek 172-IT and Eersthoek 235-IT					
SG21 Digit code:	T0IS00000000015000006					
Co-ordinates:	Latitude (S):			Longitude (E):		
	26°	4'	6.62"	30°	45'	37.91"

Please Note:
Where a large number of properties are involved (e.g. linear activities), attach a list of property descriptions to the back of this page.
Indicate the position of the activity using the latitude and longitude of the center point of the site for each alternative site. The co-ordinates must be in degrees, minutes and seconds. The minutes must be given to at least three decimals to ensure adequate accuracy. The EAP is required to contact the relevant competent authority with regards to the projection that must be used.

Street address:	The site can be accessed through unnamed road from the R541.
Magisterial District or Town:	Chief Albert Luthuli

Please Note: In instances where there is more than one town or district involved, please attach a list of towns or districts as well as complete physical address information for the entire area to the back of this page.

Closest City/Town:	Elukwatini	Distance	8.5km

Zoning of Property:	Agriculture

Please Note:In instances where there is more than one zoning, please attach a map clearly indicating zoning of the different portions.

Was a rezoning application required?	YES	NO x
Was a consent use application required?	YES	NO x

Please Note: Where planning approvals have been granted please attach the relevant approvals.

Owners consent:	**Letters of consent from all landowners or a detailed explanation by the applic explaining why such letters of consent are not furnished must be attached to application form. .**

2. APPLICATION HISTORY

(Cross out the appropriate box "☒" and provide a description where required).

Has any national, provincial or local authority considered any development applications on the property previously?	Yes	No x
If so, please give a brief description of the type and/or nature of the application/s: (In instances where th were more than one application, please attach a list of these applications)		
Not applicable, the DEA screening tool did not identify any applications on the property in question. Screening report attached.		
Which authority considered the application(s):		
Not Applicable		
Has any one of the previous application/s on the property been approved or rejected so provide a list of the successful and unsuccessful application/s and the reasons decision/s.	Yes	No x
Not Applicable		
Provide detail on the period of validity of decision(s) and expiry dates of the above applications/ permits etc.		
Not Applicable		

I hereby apply in terms of Section 24 G of the National Environmental Management Act (Act no 107 of 1998 as amended) for the rectification of the unlawful commencement or continuation of the listed activity(ies) in Section B of the application form:

Applicant (Full names) ________________________________

Signature ____________________________

Place ____ Date: _____________________________

EAP (Full names)____________________________________

Signature____________________________

Place ____ Date: ______________________________

SECTION B: ACTIVITY INFORMATION

1. ACTIVITIES APPLIED FOR:

Separate applications are required for one development site where more than one listed activity has commenced and where these unlawfully commenced activities constitute offences in terms of different EIA regulations (refer to Table 1 & 2 of the S24G guideline).

Applicants and EAPs are strongly advised to discuss the merits of a combined application *(if deemed applicable)* with the relevant competent authority prior to the completion of this application form and submission thereof.

The Department will use its discretion in deciding to allow one application for more than 1 Section 24F contravention on one development site.

All potential listed activities associated with the development must be indicated below. (See Annexures B, C, D and E). Only those activities for which the applicant applies will be considered.

Where the EIA activity/ies applied for commenced during 2006, 2010 and 2014 listed activity regimes, the corresponding activity listed in the 2017 listings must be indicated in Table 6.

Where the Waste Management activity/ies applied for commenced during 2009 and 2013 listed activity regimes, the corresponding activity/ies listed in the 2017 listings must be indicated in Table 9.

The onus is on the applicant to ensure that all the applicable listed activities are included in the application.

Listed activities applied for. Identify the relevant listed activities applied for below:

<u>National Environmental Management Act, 1998</u>

Table 1:

ECA EIA Contraventions: Between 08 September 1997, end of day 09 May 2002 and still listed in terms of 2010 Regulations.	
Activities unlawfully commenced with on or after 08 September 1997 and before end 09 May 2002: EIA Regulations promulgated in terms of the ECA, Act No 73 of 1989, as amended and are still in terms of 2010 Regulations.	
Listed Activity(ies)	Details of Activity(ies)

Table 2:

ECA EIA Contraventions: Between 10 May 2002 and before end of day 03 June 2006 and still listed in terms of 2017 EIA Regulations	
Activities unlawfully commenced with on or after 10 May 2002 and before end of day 02 June 2006: EIA Regulations promulgated in terms of the ECA, Act No 73 of 1989, as amended and are still listed in terms of 2010 Regulations.	
Listed Activity(ies)	Details of Activity(ies)

Table 3:

NEMA EIA Contraventions: Between 03 June 2006 and before end of day 01 August 2010	
Activities unlawfully commenced with in terms of the NEMA, Act No 107 of 1998 (as amended) after 03 July 2006 and ended 01 August 2010	
Government Notice No. R386 Activity No(s):	Details of Activity(ies) requiring Basic Assessment
Government Notice No. R387, Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA

Table 4:

NEMA EIA Contraventions: From 02 August 2010 and before end of day 7 December 2014	
Activities unlawfully commenced with in terms of the NEMA, Act No 107 of 1998 on/after 02August 2010 and ended 7 December 2014	
Government Notice No. R544Activity No(s):	Details of Activity(ies) requiring Basic Assessment
Government Notice No. R545, Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA
Government Notice No. R546, Activity No(s):	Details of Activities that occurred in specific identified geographical areas only and requires a Scoping Report and EIA

Table 5:

NEMA EIA Contraventions: From 08 December 2014 and before end of day 6 April 2017	
Activities unlawfully commenced with in terms of the NEMA, Act No 107 of 1998 on/ after 08 December 2014 and ended 6 April 2017	
Government Notice No. R983 Activity No(s):	Details of Activity(ies) requiring Basic Assessment
9	The proposed development includes installation of bulk infrastructure for water or stormwater purposes.
10	The bulk reticulation to cater for the proposed development will be required.

12	A bufferzone of 30m within any watercourse will have to be kept for the proposed development.
23	The proposed development include the formalization of a cemetery on an extent area of 7.6 hectares.
28	The proposed formalization of Nhlazatshe 1 informal township include residential area, business area, educational facility, institutional facilities, municipal facility and public open spaces on an area currently zoned agriculture.
Government Notice No. R984, Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA
15	The proposed development entails clearance and preparing an extent area of 191.3 hectares for formalization of Nhlazatshe 1.
Government Notice No. R985, Activity No(s):	Details of Activities that occurred in specific identified geographical areas only and requires a Scoping Report and EIA

Table 6:

NEMA EIA Contraventions: From 07April 2017	
Activities unlawfully commenced with in terms of the NEMA, Act No 107 of 1998 on/ after 07 April 2017	
Government Notice No. R983, as amended, Activity No(s):	Details of Activity(ies) requiring Basic Assessment
Government Notice No. R984, as amended, Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA
Government Notice No. R985,as amended, Activity No(s):	Details of Activities that occurred in specific identified geographical areas only and requires a Scoping Report and EIA

National Environmental Management: Waste Act, 2009.

Table 7:

NEMWA Activity, 2009: From 03 July 2009 and before end of day 28 November 2013

Activities unlawfully commenced with in terms of the NEMWA, 2008 promulgated in terms of the NEMA, Act No 107 of 1998 on/after 03 July 2009 and ended 28 November 2013	
Government Notice No. 718 List of Waste Management Activities No(s):	Details of Activity(ies) requiring Basic Assessment
Government Notice No. 718 List of Waste Management Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA

Table 8:

NEMWA Activity, 2009: From 01 July 2013 and before end of day 10 October 2017	
Activities unlawfully commenced with in terms of the NEMWA, 2008 promulgated in terms of the NEMA, Act No 107 of 1998 on/after 29 November and ended 10 October 2017	
Government Notice No. 921 List of Waste Management Activities No(s) Category A:	Details of Activity(ies) requiring Basic Assessment
Government Notice No. 921 List of Waste Management Activity No(s) (Category B):	Details of Activity(ies) requiring a Scoping Report and EIA

Table 9:

NEMWA Activity, 2009: From 11 October 2017	
Activities unlawfully commenced with in terms of the NEMWA, 2008 promulgated in terms of the NEMA, Act No 107 of 1998 on/after 11 October 2017	
Government Notice No. 921, as amended, List of Waste Management Activities No(s): Category A:	Details of Activity(ies) requiring Basic Assessment
Government Notice No. 921, as amended, List of Waste Management Activity No(s), (Category B):	Details of Activity(ies) requiring a Scoping Report and EIA

2. ACTIVITY DESCRIPTION

(Cross out the appropriate box"☒" and provide a description where required).

(a) Is/was the project a new development or an upgrade of an existing development?	New x	Upgrade

(b) Clearly describe the activity and associated infrastructure commenced with, indicating what has been completed, what still has to be completed and applicable commencement dates.
The Chief Albert Luthuli Local Municipality is proposing formalization of Nhlazatshe 1 informal settlements on an extent area of 191.3 hectares. The proposed development is situated on portions of farm portions Eerste Hoek 172-IT and Eersthoek 235-IT which requires formalization of the following infrastructure: • 1504 Residential 1 - residential • 8 Business 1 - business • 1 Educational - school • 4 Institutional – place of worship • 15 Public open space - park • 1 Municipal - cemetery • Streets The proposed development will include provision of bulk infrastructures to the Nhlazatshe 1 township. However, the proposed development site is currently occupied by illegal occupants. This resulted in clearance of indigenous vegetation and erection of infrastructures which falls under listed activities in terms of NEMA EIA Regulations (2014).

(c) Provide details of all components of the activity and attach diagrams (e.g. architectural drawings or perspectives, engineering drawings, process flow charts etc.).		
Buildings	YES	NO x
Provide brief description:		
The proposed development site is partially erected with infrastructures which are utilized by illegal occupants.		
Infrastructure (e.g. roads, power and water supply/ storage)	YES	NO x
Provide brief description:		
The existing infrastructures on the proposed development site includes residential, school, church, business and a cemetery.		

Processing activities (e.g. manufacturing, storage, distribution)	YES	NO x
Provide brief description:		
Not Applicable		
Storage facilities for raw materials and products (e.g. volume and substances to be stored)		
Provide brief description	YES	NO x
Not Applicable		
Storage and treatment facilities for solid waste and effluent generated by the project	Yes	No x
Provide brief description		
Not Applicable		
Other activities (e.g. water abstraction activities, crop planting activities)	Yes	No x
Provide brief description		
Not Applicable		

3. ACTIVITY NEED AND DESIRABILITY

Describe the need and desirability of the activity:
The proposed development will address the issue of resettlement of people in informal settlements. There is also a high risk of encroachment on this land should the development not be approved as planned for by Chief Albert Luthuli Local Municipality. The proposed development will prompt other developments in the area as there will be decentralization of services into the main central business areas of the Chief Albert Luthuli Local Municipality which will benefit the society in having access to services in close proximity. It will also improve and aid in more business opening in the areas. The proposed development will create job opportunities during the construction phase. This will result in the development providing a much-needed short term socio-economic return. It is strongly recommended that local subcontractors and laborers should be prioritized in the construction contract. This would increase the socio-economic return of the development.
Indicate the benefits that the activity has/had for society in general and also indicate what benefits the activity has/had for the local communities where it is located:
It will create job opportunities (permanent and temporary), ensure social upliftment of the area, create investment opportunities and create a sustainable development environment. Furthermore, the development will eventually be integrated with the environment, have proper service provision and it will be well planned.

4. PHYSICAL SIZE OF THE ACTIVITY

Indicate the physical spatial size of the activity as well as associated infrastructure (footprints):	***1913003m²***
Indicate the area that has been transformed / cleared to allow for the activity as well as associated infrastructure	***1913003m²***
Total area (sum of the footprint area and transformed area)	***1913003m²***

5. SITE ACCESS

Was there an existing access road?	YES x	NO
If no, what was the distance over which the new access road was built?		*m*
Describe the type of access road constructed: [indicate the position of the access road on the site plan]		
The site can be accessed through unnamed road from the R541.		

6. SITE PHOTOGRAPHS

Color photographs of the site and its surroundings (taken of the site and from the site), both before (if available) and after the activity commenced, with a description of each photograph must be attached to this application. The vantage points from which the photographs were taken must be indicated on the site plan, or locality plan as applicable. If available, please also provide past and recent aerial photographs. It should be supplemented with additional photographs of relevant features on the site. Date of photographs must be included. Photographs must be attached under Appendix D to this form.

7. APPLICABLE LEGISLATION, POLICIES AND/OR GUIDELINES

Please list all legislation, policies and/or guidelines that were or are relevant to this activity.

Legislation	Administering Authority	Type Permit/ license/ authorization/comment	Date (if already obtained):
National Heritage Resource Act 1999, (Act 1999 No.25 of 1999)	South Africa Heritage Resource Act (SAHRA)	Record of Decision	-
National Environmental Management Act, 1998 (Act No. 107 of 1998)	DARDLEA	Environmental Authorisation	-

2014 Environmental Impact Assessment Regulations, promulgated in terms of Section 24(5) of NEMA (as amended on 07 April 2017)	DARDLEA	Environmental Authorisation	-
Constitution of the republic of South Africa 108 of 1996	South African Government	Constitution makes provision for access to safe environment, housing and education	-

POLICY/ GUIDELINES	ADMINISTERING AUTHORITY
Chief Albert Luthuli Integrated Development Plan (IDP) 2022/2021	Municipal (District)
Chief Albert Luthuli Spatial Development Framework 2021/2022	Municipal (District)
Municipal Systems Act 32 of 2000	Chief Albert Luthuli Local Municipality

SECTION C: DESCRIPTION OF RECEIVING ENVIRONMENT

Site/Area Description

For linear activities (pipelines etc) as well as activities that cover very large sites, it may be necessary to complete copies of this Section for each part of the site that has a significantly different environment. In such cases please complete copies of Section C and indicate the area which is covered by each copy No. on the Site Plan.

Section C Copy No. (e.g. 1, 2, or 3): | |

1. GRADIENT OF THE SITE

Indicate the general gradient of the site(s) (cross out the appropriate box).

Flat	Flatter than 1:10	1:10 – 1:5	Steeper than 1:5

2. LOCATION IN LANDSCAPE

Indicate the landform(s) that best describes the site (cross out ("☒") the appropriate box (es).

Ridgeline	Side slope of ridge	Plain	Ridge	Other
If other, provide details.				

3. GROUNDWATER, SOIL AND GEOLOGICAL STABILITY OF THE SITE

Is the site(s) located on or near any of the following [cross out ("☒") the appropriate boxes]?

Shallow water table (less than 1.5m deep)	YES	NO	UNSURE
Seasonally wet soils (often close to water bodies)	YES	NO	UNSURE
Unstable rocky slopes or steep slopes with loose soil	YES	NO	UNSURE
Dispersive soils (soils that dissolve in water)	YES	NO	UNSURE
Soils with high clay content	YES	NO	UNSURE
Any other unstable soil or geological feature	YES	NO	UNSURE
An area sensitive to erosion	YES	NO	UNSURE
If any of the answers to the above are "YES" or "UNSURE", specialist input may be requested by the Department. Information in respect of the above will often be available at the planning Sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by Geological Survey may also be used.			

4. SURFACE WATER

Indicate the surface water present on and or adjacent to the site and alternative sites (cross out ("☒") the appropriate boxes)?

Perennial River	YES	NO	UNSURE
Non-Perennial River	YES	NO	UNSURE
Permanent Wetland	YES	NO	UNSURE
Seasonal Wetland	YES	NO	UNSURE
Artificial Wetland	YES	NO	UNSURE
If any of the answers to the above are "YES" or "UNSURE", specialist input may be requested by the Department. Information in respect of the above will often be available at the planning Sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by Geological Survey may also be used.			

5. VEGETATION AND GROUNDCOVER

5.1 VEGETATION / GROUNDCOVER (PRE-COMMENCEMENT, IF KNOWN)

Cross out ("☒") the block or describe (where required) the vegetation types / groundcover present on the site before commencement of the activity.

Indigenous Vegetation - good condition		Indigenous Vegetation with scattered aliens	x	Indigenous Vegetation with heavy alien infestation	
Describe the vegetation type above:		Describe the vegetation type above: Vegetation type of the proposed development site falls under the Grassland Biome vegetation. The site is composed of Barbertin Serpentine Sourveld and Legogote Sourveld. It is also dominated by domesticated fruit trees. According to the ecological study; the site is composed of different plant species which includes trees, shrubs, grass and herbs. Furthermore, Sesbania punicea was identified along the wetlands which is a highly invasive plant with the potential to replace native species and other species where it grows.		Describe the vegetation type above:	
Provide ecosystem status for above: Vulnerable		Provide ecosystem status for above: The area of the proposed formalization of the township is situated on a degraded piece of land. The sites' original vegetation was damaged due to previous vegetation clearing for housing plot marking, and gravel roads and cattle grazing. Access roads leading to the site are existing. The proposed site for formalization of the township is already modified by the disruption in natural vegetation composition, structure and ecosystem functioning due to previous activities that took place on the specific site. At a local scale the site is degraded. No species of conservation concern were found present or are likely expected to be present. The property is surrounded by transformed and degraded habitat making recovery to a functional and representative ecosystem highly unlikely and very slow. This property is not of high conservation significance for habitat preservation or ecological functionality persistence in support of the surrounding ecosystem or broader vegetation type. All alien invasive plants must be located, removed, and destroyed by burning in controlled conditions. No alien invasive plants must be		Provide Ecosystem status for above:	

	left in a condition to bear fruit, to spread by seed dispersal or propagate through vegetative means. It is anticipated that the development will have a low level of impact on the conservation status of the vegetation type and the ecological functioning of the ecosystem. The reason for the latter is because of the low significance of the current state of the vegetation found on the site. It is further recommended that the excavation and construction be restricted to the footprint to preserve the surrounding natural areas that might still be intact. Due to land availability and service connections, the proposed site is the only site that has been identified for establishing a township during the consultation process with the Local Municipality. Therefore, no alternative site has been identified or considered during this study. The construction of the proposed development will transform the existing surface vegetation inside the development footprint as most to all vegetation within the project footprint will be cleared during the construction phase. The surface hardness and roughness of the footprint will also be changed due to vegetation removal, possible compaction, paving of surfaces and excavation on the premises. The area is modified and degraded by the disruption in natural vegetation composition, structure and ecosystem functioning due to previous activities, soil compaction and clearance of vegetation. A loss of natural habitat, biota and basic ecosystem functions has occurred. The latter because the area is degraded as well as partly invaded by invasive species. However, the development will add to the cumulative disturbance to the ecosystem structure and function, caused by the previous disturbance on the proposed site. The latter because most vegetation will be cleared, and construction of a human settlement will take place. The area is not ecologically important and sensitive at any scale. Biodiversity is usually ubiquitous and not sensitive to flow and habitat modifications. It is classified as a Degraded Area although the vegetation type (when in pristine condition) is classified as Endangered. At a local scale the site is degraded and poses very little significance ecologically. No species of conservation concern were found present or are likely expected to be present. The property is surrounded by transformed land cover, mainly housing and previous agricultural activities, making recovery to a functional and representative ecosystem unlikely and very slow.	

Indigenous Vegetation in an ecological corridor or along a soil boundary / interface	Veld dominated by alien species	Distinctive soil conditions (e.g. Sand over shale, quartz patches, limestone, alluvial deposits, termitaria etc.) – describe
Bare soil	Building or other structure x	Sport field
Other (describe below)	Cultivated land	Paved surface

5.2. VEGETATION / GROUNDCOVER (POST-COMMENCEMENT)

Cross out ("☒") the block or describe (where required) the vegetation types / groundcover present on the site after commencement of the activity.

Indigenous Vegetation - good condition		Indigenous Vegetation with scattered aliens	x	Indigenous Vegetation with heavy alien infestation	
Describe the vegetation type above:		Describe the vegetation type above: Vegetation types are described in section 5.1 above. Some of disturbance to this vegetation has taken place within the development footprint which needs to be rehabilitated.		Describe the vegetation type above:	
Provide ecosystem status for above:		Provide ecosystem status for above:		Provide Ecosystem status for above:	
Indigenous Vegetation in an ecological corridor or along a soil boundary / interface		Veld dominated by alien species		Distinctive soil conditions (e.g. Sand over shale, quartz patches, limestone, alluvial deposits, termitaria etc.) – describe	
Bare soil		Building or other structure x		Sport field	
Other (describe below)		Cultivated land		Paved surface	
Please note: The Department may request specialist input/studies depending on the nature of the vegetation type / groundcover and impact(s) of the activity/ies.					

5.3 VEGETATION / GROUNDCOVER MANAGEMENT

Describe any mitigation/management measures that were adopted and the adequacy of these:

No apparent mitigation measures were available for implementation.

6. LAND USE CHARACTER OF SURROUNDING AREA (PRE-COMMENCEMENT)

Cross out ("☒") the block that reflects the past land uses and/or prominent features that occur/red within +/- 500m radius of the site and neighbouring properties if these are located beyond 500m of the site. Please note: The Department may request specialist input/studies depending on the nature of the land use character of the area and impact(s) of the activity/ies.

Untransformed area x	Low density residential x	Medium density residential x	High density residential	Informal residential x
Retail x	Commercial & warehousing	Light industrial	Medium industrial	Heavy industrial
Power station	Office/consulting room	Military or police base/station/compound	Casino/entertainment complex	Tourism & Hospitality facility
Open cast mine	Underground mine	Spoil heap or slimes dam	Quarry, sand or borrow pit x	Dam or reservoir
Hospital/medical center	School	Tertiary education facility	Church x	Old age home
Sewage treatment plant	Train station or shunting yard	Railway line	Major road (3 lanes or more)	Airport
Sport facilities	Golf course	Polo fields	Filling station	Landfill or waste treatment site
Plantation	Agriculture	River, stream or wetland x	Nature conservation area	Mountain or ridge
Museum	Historical building	Graveyard x	Archaeological site	
Other land uses (describe):				

7. REGIONAL PLANNING CONTEXT

Is/was the activity permitted in terms of the property's existing land use rights? Please explain

Yes, the activity is permitted in terms of the existing land use right.			
Is/was the activity in line with the following?			
○ Provincial Spatial Development Framework (PSDF)	YES x	NO	Please explain

Specific activities in Nhlazatshe falls outside of these planning. The area is within the boundaries of residential communities; therefore, the proposed development will be utilized for activities associated with the nearby land uses.			
○ Urban edge / Edge of Built Environment for the area	YES	NO x	Please explain
The site falls outside the urban edge.			
○ Integrated Development Plan of the Local Municipality	YES x	NO	Please explain
The Chief Albert Luthuli Local Municipality believes the principles call for the emergence of settlement patterns which create benefits accessible to the people of Nhlazatshe. For this approach to be realised all settlements in Nhlazatshe should strive to achieve the following qualities: • To generate a wide range of economic opportunities; • To be convenient to inhabitants to conduct their daily activities, easily and as inexpensively as possible, • To offer a choice of living conditions to all, • To be equitable in the sense that all inhabitants have reasonable access to the opportunities and facilities which support living in settlements, • To promote the efficient use of resources, and • To give dignity to people through the quality of the public spatial environment. The proposed development meets all the principles mentioned above for settlements opportunities.			
○ Spatial Development Framework of the Local Municipality	YES x	NO	Please explain
The Chief Albert Luthuli Local Municipality believes the principles call for the emergence of settlement patterns which create benefits accessible to the people of Nhlazatshe. For this approach to be realised all settlements in Nhlazatshe should strive to achieve the following qualities: • To generate a wide range of economic opportunities; • To be convenient to inhabitants to conduct their daily activities, easily and as inexpensively as possible, • To offer a choice of living conditions to all, • To be equitable in the sense that all inhabitants have reasonable access to the opportunities and facilities which support living in settlements, • To promote the efficient use of resources, and • To give dignity to people through the quality of the public spatial environment. The proposed development meets all the principles mentioned above for settlements opportunities.			

○ Approved Structure Plan of the Municipality	YES x	NO	Please explain
The municipality aims to improve the following: • Housing backlogs and incomplete housing projects: illegal settlements and land invasions in areas/ lands. • Accelerating development of seven land parcels with mixed development trajectory.			
○ Any other Plans	YES	NO x	Please explain
Not Applicable			

8. SOCIO-ECONOMIC CONTEXT

8.1 SOCIO-ECONOMIC CONTEXT (PRE-COMMENCEMENT)

Describe the pre-commencement social and economic characteristics of the community in order to provide baseline information.

Prior to the project commencing, the social and economic characteristics of the surrounding communities can be described as follows: • High level of unemployment • Low income • Low level of education   ***<u>Positive Socio-Economic Impacts:</u>*** The proposed development will result in job creation during the construction phase of the project.   ***<u>Negative Socio-Economic Impacts:</u>*** • An increase in criminal activities in the local regions of the proposed activity. • Safety impacts may occur as a result of improper safety management on site.

8.2 SOCIO-ECONOMIC CONTEXT (POST-COMMENCEMENT)

Describe the post commencement social and economic characteristics of the community in order to determine any change.

As with the pre-commencement social and economic characteristics, the post-commencement social and economic characteristics are unlikely to change. This is because the development is not anticipated to have a significant impact on the surrounding communities during construction given the limited number of temporary jobs created and the short duration of the construction period of shacks (less than 2 months).

9. CULTURAL/HISTORICAL FEATURES

Were there any signs or evidence (unearthed during construction) of culturally or historically significant elements including archaeological or paleontological sites, on or in close proximity to the site?		YES	NO x
		UNCERTAIN	
If YES, explain:			
If uncertain, the Department may request that specialist input be provided to establish whether such possibilities occurred on or close to the site.			
Briefly explain the findings of the specialist if one was already appointed:			
Were any buildings or structures older than 60 years affected in any way?		YES	NO x
Was it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?		YES	NO x
If yes, please submit or, make sure that the applicant or a specialist submit the necessary application to SAHRA or the relevant provincial heritage agency and attach proof thereof to this application.			

SECTION D: PRELIMINARY IMPACT ASSESSMENT

<u>Please note, the impacts identified below refer to general impacts commonly associated with development activities. The list below is not exhaustive and may need to be supplemented. Where required, please append the information on any additional impacts to this application.</u>

1. WASTE, EFFLUENT AND EMISSION MANAGEMENT

(a) Solid waste management

Did/does the activity produce any general waste (e.g. domestic-, commercial-, certain industrial waste, including building rubble also known as solid waste) during the construction phase <u>and/or</u> the operational phase?	YES x	NO

If yes, briefly describe what type of waste was produced (i.e. green waste, building rubble, etc.) in which phase.	
General waste was produced during the erection of infrastructures such as residential houses, businesses, schools, etc.	
What quantity was/is produced during the construction period?	m^3
What was/is the estimated quantity that will be produced per month during the operational phase?	m^3

Did/does the activity produce any <u>hazardous</u> waste (e.g. chemical, medical waste, infectious, nuclear etc.) during the construction and/or the operational phase?	YES	NO x
If yes, briefly describe what type of waste was produced (i.e. infectious waste, medical waste, etc.) in which phase.		
Not Applicable		
What quantity was/is produced during the construction period?	m^3	
What was/is the estimated quantity that will be produced per month during the operational phase?	m^3	

Where and how was/is waste treated / disposed of (describe each waste stream)?			
Has the municipality or relevant authority confirmed that sufficient capacity exist for treating / disposing of the solid waste to be generated by this activity(ies)? If yes, provide written confirmation from municipality or relevant authority		YES	NO x
Does/did the activity produce solid waste that was/will be treated and/or disposed of at another facility other than into a municipal waste stream?		YES	NO x
If yes, did/has this facility confirmed that sufficient capacity exist for treating / disposing of the solid waste to be generated by this activity(ies)? Provide written confirmation from the facility and provide the following particulars of the facility:		YES	NO x
Did/does the facility have an operating license? (If yes, please attach a copy of the license.)		YES	NO x
Facility name:			
Contact person:			
Postal address:			
		Postal code:	
Telephone:		Cell:	
E-mail:		Fax:	

(b) Effluent

Did/does the activity produce sewage and or any other effluent?	YES	NO x
Not Applicable		
What was/is the estimated quantity produced per month?	m^3	
Was/is the effluent treated and/or disposed of in a municipal system?	YES	NO x

If Yes, did/has the Municipality or relevant authority confirmed that sufficient **unallocated** capacity exist for treating / disposing of the sewage or any other effluent generated by this activity(ies)? Provide written confirmation from the Municipality or relevant authority.		
Not Applicable		
Was/is any effluent produced be treated and/or disposed of on site?	YES	NO x
If yes, briefly describe the nature of the effluent and how it was/will be disposed of:		
Not Applicable		
Did/does the activity produce effluent that was/will be treated and/or disposed of at another facility?	YES	NO x
If yes, did/has this facility confirmed that sufficient capacity exist(ed) for treating / disposing of the liquid effluent generated by this activity(ies)? Provide written confirmation from the facility and provide the following particulars of the facility:	YES	NO
Does the facility have an operating license? (If yes, please attach a copy of the license.)	YES	NO x

Facility name:	
Contact person:	
Postal address:	
	Postal code:
Telephone:	Cell:
E-mail:	Fax:

Describe the measures that was/will be taken to ensure the optimal reuse or recycling of waste water, if any:

(c) Emissions into the atmosphere

Did/does the activity produce emissions that will be disposed of into the atmosphere?	YES	NO x
If yes, did/does it require approval in terms of relevant legislation? If yes, attach a copy to this application	YES	NO x
Describe the emissions in terms of type and concentration and how it was/will be treated/mitigated:		
Not Applicable		

(d) Describe any mitigation/management measures that were adopted and the adequacy of these:

No mitigation measures were implemented.

2. WATER USE

(a) Please indicate the source(s) of water for the activity by crossing out ("☒") the appropriate box(es)

Municipal	Water Board	Groundwater	River, Stream, Dam or Lake	Other	The activity did/does not use water

If water was/is extracted from a groundwater source, river, stream, dam, lake or any other natural feature, please indicate the volume that

was/is extracted per month:	Not measured

Please provide proof of assurance of water supply eg. letter of confirmation from Municipality/water user associations, yield of borehole etc.		
Did/does the activity require a water use permit / license from DWAF? If yes, attach a copy to this application	YES	NO x
If yes, please submit the necessary application to Department of Water Affairs and Forestry and attach proof thereof to this application.		

(b) Describe any mitigation/management measures that were adopted and the adequacy of these:

Minimal water is used on site.

3. POWER SUPPLY

(a) Please indicate the source of power supply eg. Municipality / Eskom / Renewable energy source.

Municipality

Has the Municipality or relevant service provider confirmed that sufficient electricity capacity (i.e. generation, supply and transmission) exist for activity(ies)? If yes, provide written confirmation from Municipality or relevant service provider.	YES x	NO

If power supply was/is not available, where was/is it sourced from?
Not Applicable

(b) Describe any mitigation/management measures that were adopted and the adequacy of these:

Not Applicable

4. ENERGY EFFICIENCY

(a) Describe the design measures, if any, that have been taken to ensure that the activity is energy efficient:

Energy measures such as LED lights and solar power will be considered for some of the institutional facilities of the project.

(b) Describe how alternative energy sources have been taken into account or been built into the design of the activity, if any:

Alternative energy for the development includes LED lights gas installations and solar power for the township development.

5. NOISE IMPACTS

(a) Did/does the activity result in any noise impacts?	YES	NO x
If yes, please describe and indicate the measures implemented to mitigate and manage these impacts?		
Not Applicable		

Please note: The Department may request specialist input/studies depending on the nature of the land use character of the area and potential noise impact(s) of the activity/ies.

6. VISUAL IMPACTS

(a) Did/does the activity result in any visual impacts?	YES	NO x
If yes, please describe and indicate the measures implemented to mitigate and manage these impacts?		
Not Applicable		
(b) Did/does the activity result in potential lighting impacts at night?	YES	NO x
If yes, please describe and indicate the measures implemented to mitigate and manage these impacts?		
Not Applicable		
(c) Were/are there any alternatives available to address this impact?	YES	NO x
If yes, please describe these alternatives?		
Not Applicable		

Please note: The Department may request specialist input/studies depending on the nature of the land use character of the area and potential visual impact(s) of the activity/ies.

7. SOCIO-ECONOMIC IMPLICATIONS OF THE ACTIVITY

(a) What was/is the expected capital value of the activity on completion?	Unknown	
(b) What was/is the expected yearly income or contribution to the economy that will be generated by or as a result of the activity?	Unknown	
(c) Did/does the activity contribute to service infrastructure?	YES x	NO
(d) How many permanent new employment opportunities were created?	Unknown	
(e) What was/is the expected current value of the employment opportunities to date?	Unknown	
(f) What percentage of this accrued to previously disadvantaged individuals?	Unknown	

How was (is) this (to be) ensured and monitored (please explain):
Not Applicable

8. PRELIMINARY IMPACT ASSESSMENT

Briefly describe the impacts (as appropriate), significance rating of impacts and significance rating of impacts after mitigation. This must include an assessment of the significance of all impacts. Please note: This is a preliminary impact statement. The Department may request specialist input/studies depending on the type and nature of the impact(s) of the activity/ies.

Possible Impacts	Significance rating of impacts after mitigation (Low, Medium, Medium-High, High, Very High):
Pollution to surrounding area (Waste Management)	Medium
Sanitation	Medium
Loss of vegetation	High
Air emission	Low

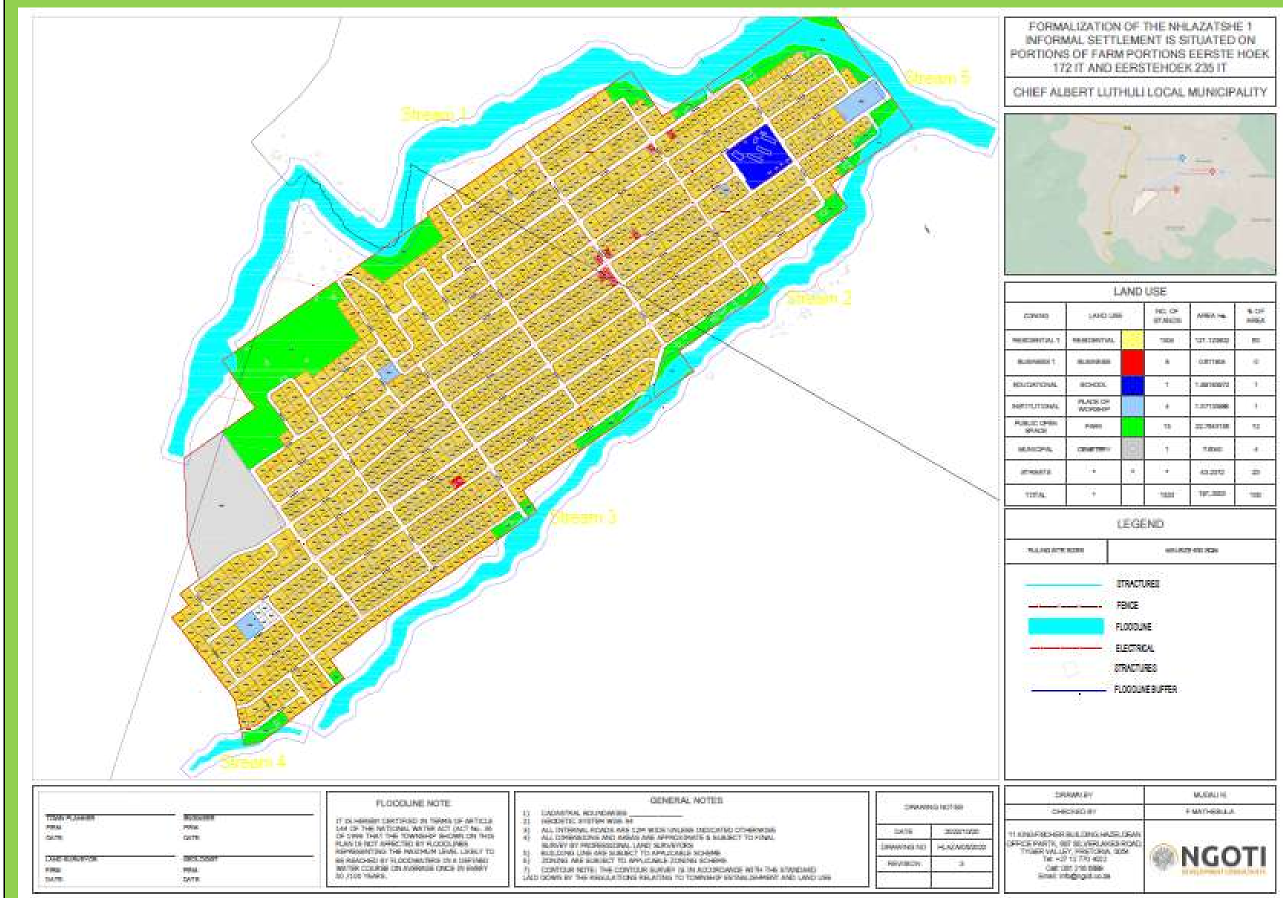
SECTION E: ALTERNATIVES

As part of this report, consideration must be given to alternatives that are/may have been possible had an environmental impact assessment been undertaken prior to the commencement of the activity. Please provide a detailed description of the alternatives (whether location, technology or environmental) that were/are possible in terms of this application.

Site Alternative (Preferred Alternative)

The proposed development is situated on portions of farm portions Eerstehoek 172-IT and Eesterhoek 235-IT within the Chief Albert Luthuli Local Municipality in Mpumalanga Province. The proposed development site can be accessed via an unnamed road from the R541. The geographical coordinates of the site are: 26°4'6.62" S, 30°45'37.91".

Layout-Plan Alternative (Preferred Alternative)



No-Go Alternative

This option would come into effect if phase as well as the benefits associated with the provision of houses, schools and other much needed social facilities. A high negative socio-economic impact significance would occur if the proposed development is not constructed.

The “no-go” alternative will however result in the visual environment staying the same with the natural character of the area contributing to the “sense of place”. If the development proposal is not authorized, the vegetation in the current natural parts will remain largely intact which is clearly a positive factor for the biodiversity in the area. The socio-economic benefits of this project however largely outweigh the impacts in an area The No-Go Alternative is therefore not recommended.

SECTION F: APPENDICES

The following appendices must be attached where appropriate:

Appendix	Cross out ("☒") the box if Appendix is attached
Appendix A: Location map	
Appendix B: Site plan(s)	
Appendix C: Owner(s) consent(s)	
Appendix D: Photographs	
Appendix E: Permit(s) / license(s) from any other organ of state including service letters from the municipality	
Appendix F: Additional Impact Assessment Information	
Appendix G: Report on alternatives	
Appendix H: Any Other (describe)	
Annexure A: Forms and Preliminary Public Participation	

SECTION G: DECLARATIONS

G1: Declarations of the EAP

1. The Independent Environmental Assessment Practitioner

I, _Phakwago M. Kabelo________________________declare under oath that I –

a. act as the independent environmental assessment practitioner in this application ;
b. do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the S24G of the National Environmental Management Act, read together with the relevant Environmental Impact Assessment Regulations;
c. do not have and will not have a vested interest in the proposed activity proceeding;
d. have no, and will not engage in, conflicting interests in the undertaking of the activity;
e. undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the S24G of the National Environmental Management Act, read together with the Environmental Impact Assessment Regulations, 2014, as amended;
f. will ensure that all documents will contain all relevant facts in respect of the application & that all documentation is distributed or made available to interested and affected parties. I will ensure that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced for the rectification application.
g. will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
h. **will keep a register of all interested and affected parties that participated in a public participation process; and**
i. **will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.**

Signature of the environmental assessment practitioner:

Mang Geoenviro Services

Name of company:

17 October 2022

Date:

Signature of the Commissioner of Oaths:

Date:

Designation:

Official stamp:

G2: Declarations of the Applicant

2. The Applicant

I, ___________________________________ ,declare under oath that I -

a. **am the applicant in this application;**
b. **appointed the environmental assessment practitioner as indicated under G1 above to act as the independent environmental assessment practitioner for this application;**
c. **will provide the environmental assessment practitioner and the competent authority with access to all information at my disposal that is relevant to the application;**
d. **am responsible for complying with the directive or conditions of any environmental authorisation issued by the competent authority;**
e. **understand that I will be required to pay an administration fine in terms of S24G (4) of the Act and that a decision in this regard will only be forthcoming after payment of such a fine; and**
f. **hereby indemnify, the government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of the content of any report, any procedure or any action for which the applicant or environmental assessment practitioner is responsible in terms of the Act.**

____

Signature of the applicant:

____

Name of company:

____

Date:

____

Signature of the Commissioner of Oaths:

____

Date:

____

Designation:

Official stamp (below):

ANNEXURE A TO THE SECTION 24G APPLICATION FORM

SECTION A: DIRECTIVE

Section 24G(1) of the National Environmental Management Act, 1998 (Act 107 of 1998) ("NEMA") provides that on application by a person who has commenced with a listed or specified activity without an environmental authorisation in contravention of section 24F(1); or a person who has commenced, undertaken or conducted a waste management activity without a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) ("NEM:WA ") the Minister, the Minister responsible for mineral resources or the MEC concerned (or the official to which this power has been delegated), as the case may be, may direct the applicant to -

i	immediately cease the activity pending a decision on the application submitted in terms of this subsection	
ii	investigate, evaluate and assess the impact of the activity on the environment	
Iii	remedy any adverse effects of the activity on the environment	
iv	cease, modify or control any act, activity, process or omission causing pollution or environmental degradation	
v	contain or prevent the movement of pollution or degradation of the environment	
vi	eliminate any source of pollution or degradation	
vii	compile a report containing -	
	aa	A description of the need and desirability of the activity
	bb	assessment of the nature, extent, duration and significance of the consequences for or impacts on the environment of the activity, including the cumulative effects and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity
	cc	description of mitigation measures undertaken or to be undertaken in respect of the consequences for or impacts on the environment of the activity
	dd	description of the public participation process followed during the course of compiling the how the issues raised have been addressed
	ee	an environmental management programme
	Provide such other information or undertake such further studies as the Minister, Minister responsible for mineral resources or MEC, as the case may be, may deem necessary.	

You are hereby provided with an opportunity to make representations on any or all of the abovementioned instruction, including where you are of the opinion that any of these instructions are not relevant for the purposes of your application, setting out the reasons for your assertion. Kindly note further that, after taking your representations into account, a final directive may be issued.

SECTION B: DEFERRAL

Section 24G(7) of the NEMA provides that if at any stage after the submission of an application it comes to the attention of the Minister, the Minister responsible for mineral resources or the MEC, that the applicant is under criminal investigation for the contravention of, or failure to comply with, section 24F(1) of the NEMA or section 20(b) of the NEM:WA, the Minister, Minister responsible for mineral resources or MEC may defer a decision to issue an environmental authorisation until such time as the investigation is concluded and-

(a) The National Prosecuting Authority has decided not to institute prosecution in respect of such contravention or failure;
(b) The applicant concerned is acquitted or found not guilty after prosecution in respect of which such contravention or failure has been instituted; or
(c) The applicant concerned has been convicted by a court of law of an offence in respect of such contravention or failure and the applicant has in respect of the conviction exhausted all the recognised legal proceedings pertaining to appeal or review.

Kindly answer the following questions:

Are you, the applicant, being investigated for a contravention of section 24F(1) of the NEMA in respect of a matter that is not subject to this application and in any province in the Republic?	YES	NO X	UNCERTAIN
If yes provide details of the offence being investigated and authority conducting the investigation, If uncertain provide details of the activity or activities in relation to which you suspect you may be under investigation.			
Are you, the applicant, being investigated for the contravention of section 20(b) of the NEMWA in respect of a matter that is not subject to this application and in any province in the Republic?	YES	NO X	UNCERTAIN
If yes provide details of the offence being investigated and authority conducting the investigation. If uncertain provide details of the activity or activities in relation to which you suspect you may be under investigation.			
Are you, the applicant, being investigated for an offence in terms of section 24F(1) of the NEMA or section 20(b) of the NEMWA in terms of which this application directly relates?	YES	NO x	UNCERTAIN
If yes provide details of the offence being investigated and authority conducting the investigation. If uncertain provide details of the activity or activities in relation to which you suspect you may be under investigation.			

If you have answered yes or uncertain to any of the above questions, you are hereby provided with an opportunity to make representations as to why the Minister, Minister responsible for mineral resources or

MEC, as the case may be, should not defer the application as he or she is entitled to do under section 24G(7).

SECTION C: QUANTUM OF THE SECTION 24G FINE

In terms of section 24G(4) of the NEMA, it is mandatory for an applicant to pay an administrative fine as determined by the competent authority before the Minister, Minister responsible for mineral resource or MEC may take a decision on whether or not to grant an ex post facto environmental authorisation or a waste management licence as the case may be. The quantum of this fine may not exceed R5 million.

Having regard to the factors listed below, you are hereby afforded with an opportunity to make representations in respect of the quantum of the fine and as to why the competent authority should not issue a maximum fine of R5 million.

Please note that Part 1 of this section must be completed by an independent environmental assessment practitioner after conducting the necessary specialist studies, copies of which must be submitted with this completed application form.

Please also include in your representations whether or not the activities applied for in this application (if more than 1) are in your view interrelated and provide reasons therefore.

PART 1: THE IMPACTS OR POTENTIAL IMPACTS OF THE ACTIVITY/ACTIVIITIES

Index: Socio Economic Impact	Place an "X" in the appropriate box
Description of variable	
The activity is not giving, has not given and will not give rise to any negative socio-economic impacts	X
The activity is giving, has given, or could give rise to negative socio- economic impacts, but highly localized	
The activity is giving, has given, or could give rise to significant negative socio-economic and regionalized impacts	
The activity is resulting, has resulted or could result in wide-scale negative socio-economic impacts.	
Motivation:	

Index: Biodiversity Impact	Place an "X" in the appropriate box
Description of variable	
The activity is not giving, has not given and will not give rise to any impacts on biodiversity	

The activity is giving, has given or could give rise to localised biodiversity impacts	X
The activity is giving, has given or could give rise to significant biodiversity impacts	
The activity is, has or is likely to permanently / irreversibly transform/ destroy a recognised biodiversity 'hot -spot' or threaten the existence of a species or sub -species.	
Motivation:	

Index Sense of Place Impact and 1 or Heritage Impact	Place an "X" in the appropriate box
Description of variable	
The activity is in keeping with the surrounding environment and I or does not negatively impact on the affected area's sense of place and /or heritage	X
The activity is not in keeping with the surrounding environment and will have a localised impact on the affected area's sense of place and/or heritage	
The activity is not in keeping with the surrounding environment and will have a significant impact on the affected area's sense of place and/ or heritage	
The activity is completely out of keeping with the surrounding environment and will have a significant impact on the affected area's sense of place and/ or heritage.	
Motivation:	

Index Pollution Impact	Place an "X" in the appropriate box
Description of variable	
The activity is not giving, has not given and will not give rise to any pollution	
The activity is giving, has given or could give rise to pollution with low impacts,	X
The activity is giving, has given or could give rise to pollution with moderate impacts.	
The activity is giving, has given or could give rise to pollution with high impacts.	
The activity is giving, has given or could give rise to pollution with major impacts.	
Motivation:	

PART 2: COMPLIANCE HISTORY AND KNOWLEDGE OF THE APPLICANT	
Index: Previous administrative action (i.e. administrative enforcement notices) issued to the applicant in respect of a contravention of section 24F(1) of the National Environmental Management	Place an "X" in the

Act and/ or section 20(b) of the National Environmental Management Waste Act	appropriate box
Description of variable	
Administrative action was previously taken against the applicant respect the abovementioned provisions.	
No previous administrative action was taken against the applicant but previous administrative action was taken against a firm(s) on whose board one or more of the applicant's directors sit or sat at the relevant time when the administrative action was taken.	
Administrative action was not previously taken against the applicant in respect of the abovementioned provisions.	X
Explanation of all previous administrative action taken in respect of the above:	

Index: Previous Convictions in terms of section 24F (1) of the National Environmental Management Act and/or section 20(b) of the National Environmental Management Waste Act	Place an "X" in the appropriate box
Description of variable	
The applicant was previously convicted in terms of either or both of the abovementioned provisions.	
No previous administrative action was taken against the applicant but previous administrative action was taken against a firm(s) on whose board one or more of the applicant's directors sit or sat at the relevant time when the administrative action was taken.	
The applicant has not previously been convicted in terms of either or both of the abovementioned provisions.	X
Explanation of all previous convictions in respect of the above:	

Index: Number of section 24G applications previously submitted by the applicant	Place an "X" in the appropriate box
Description of variable	
Number of section 24G applications previously submitted by the applicant	
No previous applications have been submitted by the applicant but a previous application(s) have been submitted by a firm(s) on whose board one or more of the applicant's directors sit or sat at the relevant time.	
No previous applications have been submitted by the applicant but the applicant sat on the board of a firm that previously submitted an application.	X
Explanation in respect of all previous applications submitted in terms of section 24G:	

PART 3: APPLICANT'S PERSONAL CIRCUMSTANCES	
Index: Applicant's legal persona	Place an "X" in the appropriate box
Description of variable	
The applicant is a natural person.	
The applicant is a firm.	X
Describe the firm: The Chief Albert Luthuli Local Municipality as the applicant is the organ of state.	

Index: Any other relevant information that the applicant would like to be considered.
Motivate and explain fully:

NOTE: An explanation as to why the applicant did not obtain an environmental authorisation and/or waste management licence must be attached to this application.

SECTION D: PRELIMINARY ADVERTISEMENT

When submitting this application form, the applicant must attach proof that the application has been advertised in at least one local newspaper in circulation in the area in which the activity was commenced, and on the applicant's website, if any.

The advertisement must state that the applicant commenced a listed or specified activity or activities or waste management activity or activities without the necessary environmental authorisation and/or waste management license and is now applying for ex post facto approval. It must include the following:

- the date;
- the location;
- the applicable legislative provision contravened; and
- The activity or activities commenced with without the required authorisation.

Interested and affected parties must be provided with the details of where they can register as an Interested and affected party and I or submit their comment. At least 20 days must be provided in which to do so.

This advertisement shall be considered as a preliminary notification and he competent authority may direct the applicant to undertake further public participation and advertising after receipt of this application form.

NOTE: Unless protected by law, all information contained in and attached to this application form may become public information on receipt by the competent authority. This application must be attached to any documentation or information submitted by am applicant further to section 24G(1).

Appendix A: Locality Map

LEGEND

SITE

NHLAZATSHE 1

The proposed formalization of Nhlazatshe 1 on portions of farm portions Eerstehoek 172-IT and Eerstehoek 235-IT within the Chief Albert Luthuli Local Municipality in Mpumalanga Province.

LOCALITY MAP

DATE	27/06/2022

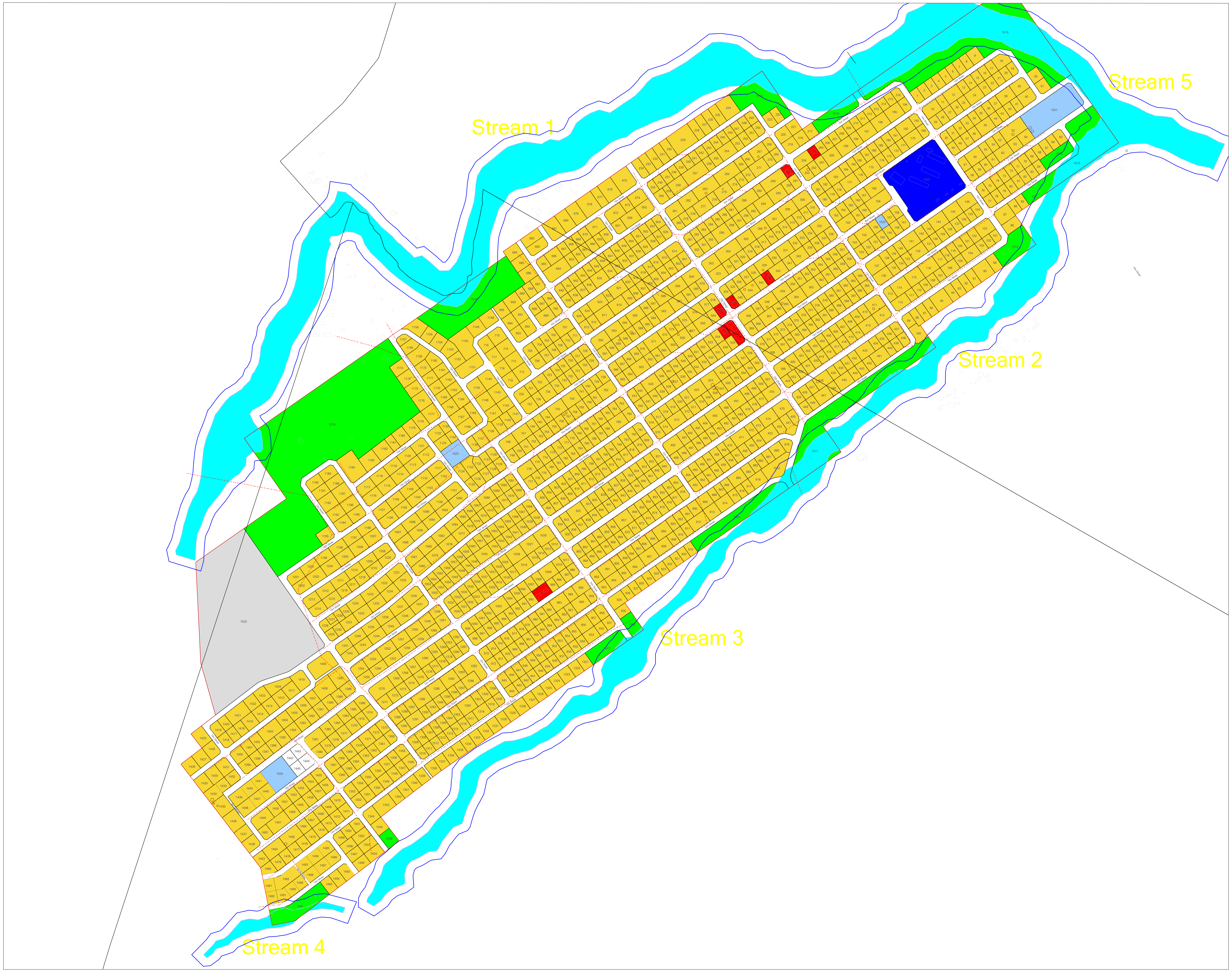
mang
GEOENVIRO SERVICES

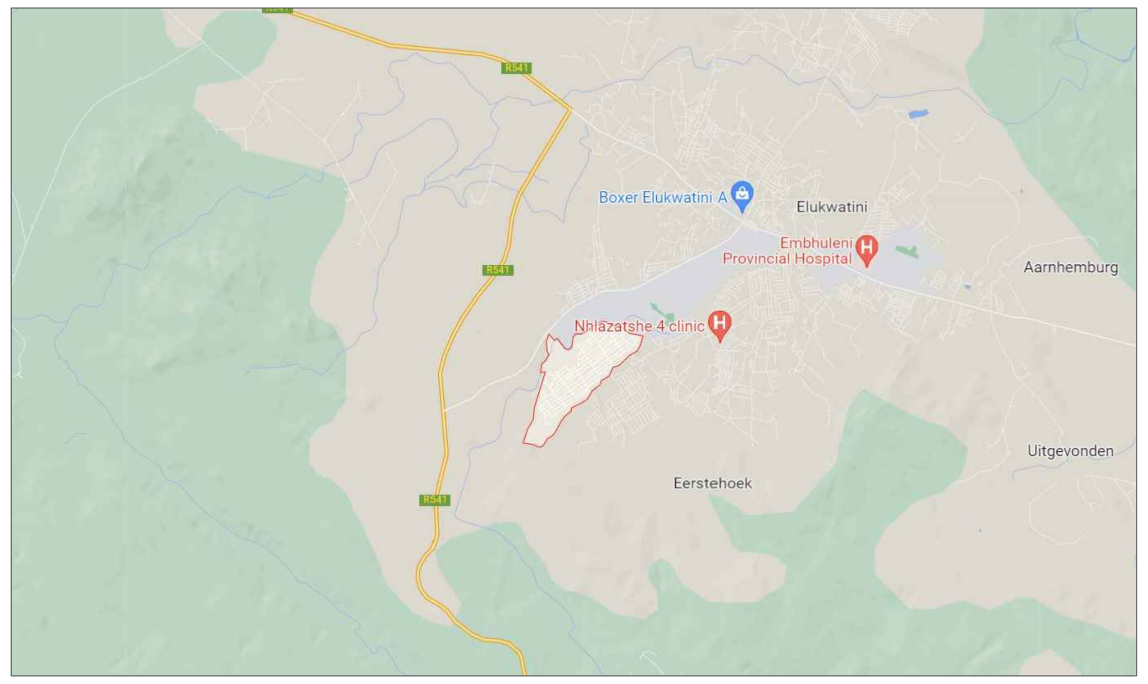
Head Office: Hazeldean Office Park,
King Fisher Building Unit 11,
687 Silverlakes Road, Tyger Valley
Pretoria, 0054.
Tel: +27 12 770 4022
Cell: +27 79 054 7652
Email: kabelo@manggeoenviro.co.za

Appendix B: Layout Plan

FORMALIZATION OF THE NHLAZATSHE 1 INFORMAL SETTLEMENT IS SITUATED ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172 IT AND EERSTEHOEK 235 IT

CHIEF ALBERT LUTHULI LOCAL MUNICIPALITY





LAND USE

ZONING	LAND USE		NO. OF STANDS	AREA Ha.	% OF AREA
RESIDENTIAL 1	RESIDENTIAL		1504	121.123802	63
BUSINESS 1	BUSINESS		8	0.611804	0
EDUCATIONAL	SCHOOL		1	1.99183972	1
INSTITUTIONAL	PLACE OF WORSHIP		4	1.57133988	1
PUBLIC OPEN SPACE	PARK		15	22.7643156	12
MUNICIPAL	CEMETERY		1	7.6040	4
STREETS	*	*	*	43.2372	23
TOTAL	*		1533	191,3003	100

LEGEND

RULING SITE SIZES	MIN-SIZE 600 SQM

STRACTURES

FENCE

FLOODLINE

ELECTRICAL

STRACTURES

FLOODLINE BUFFER

TOWN PLANNER
FIRM:
DATE:

ENGINEER
FIRM:
DATE:

LAND SURVEYOR
FIRM:
DATE:

GEOLOGIST
FIRM:
DATE:

FLOODLINE NOTE

IT IS HEREBY CERTIFIED IN TERMS OF ARTICLE 144 OF THE NATIONAL WATER ACT (ACT No. 36 OF 1998 THAT THE TOWNSHIP SHOWN ON THIS PLAN IS NOT AFFECTED BY FLOODLINES REPRESENTING THE MAXIMUM LEVEL LIKELY TO BE REACHED BY FLOODWATERS IN A DEFINED WATER COURSE ON AVERAGE ONCE IN EVERY 50 /100 YEARS.

GENERAL NOTES

1) CADASTRAL BOUNDARIES ______________
2) GEODETIC SYSTEM WGS 84
3) ALL INTERNAL ROADS ARE 12M WIDE UNLESS INDICATED OTHERWISE
4) ALL DIMENSIONS AND AREAS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY BY PROFESSIONAL LAND SURVEYORS
5) BUILDING LINE ARE SUBJECT TO APPLICABLE SCHEME
6) ZONING ARE SUBJECT TO APPLICABLE ZONING SCHEME
7) CONTOUR NOTE: THE CONTOUR SURVEY IS IN ACCORDANCE WITH THE STANDARD LAID DOWN BY THE REGULATIONS RELATING TO TOWNSHIP ESTABLISHMENT AND LAND USE

DRAWING NOTES	
DATE	2022/10/20
DRAWING NO	HLAZA/05/2022
REVISION	3

DRAWN BY	MUDAU KI
CHECKED BY	F MATHEBULA

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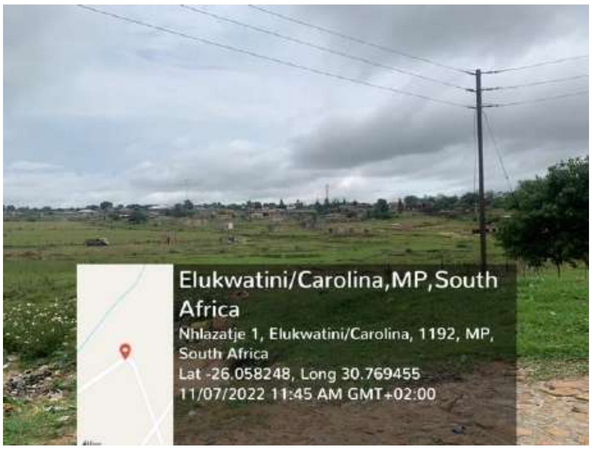
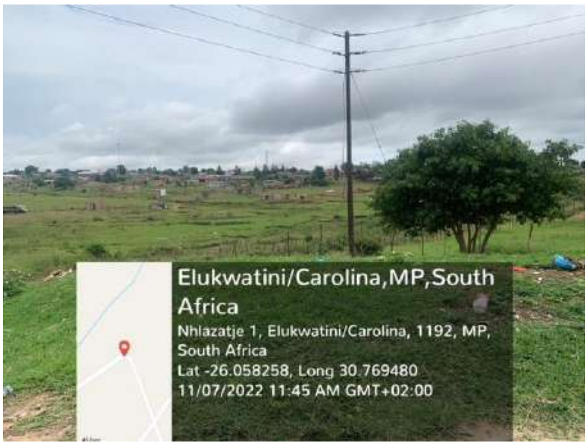
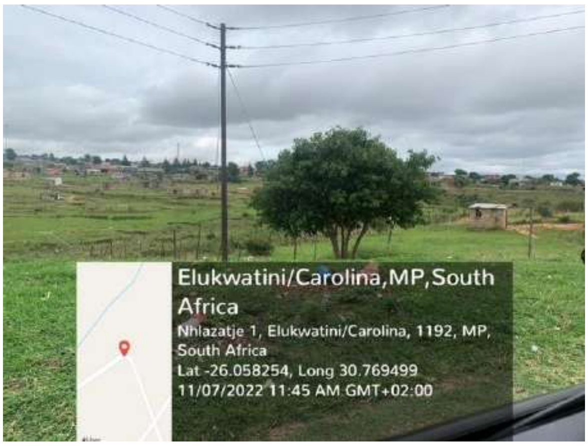
NGOTI DEVELOPMENT CONSULTANTS

Appendix C: Site Photos

SITE PHOTOGRAPHS







Appendix D: Impact Assessment Report

1 IMPACT ASSESSMENT

An environmental Impact Assessment must take into account the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages from planning, through construction and operation to the decommissioning phase. Where necessary, the proposal for mitigation or optimization of an impact is noted.

1.1 Methodology to assess the Impacts

To assess the impacts on the environment, the process has been divided into two main phases namely the Construction phase and the Operational phase. The activities, products and services present in these two phases have been studied to identify and predict all possible impacts.

In any process of identifying and recognizing impacts, one must recognize that the determination of impact significance is inherently an anthropocentric concept. Duinker and Beanlands, (1986) in DEAT 2002, Thompson (1988), (1990) in DEAT 2002 stated that the significance of an impact is an expression of the cost or value of an impact to society.

However, the tendency is always towards a system of quantifying the significance of the impacts so that it is a true representation of the existing situation on site. This has been done by using wherever possible, legal and scientific standards which are applicable.

The significance of the aspects/impacts of the process have been rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

Nature	**Classification of whether the impact is positive or negative , direct or indirect**
Extent	**Spatial scale of impact and classified as:** **Site**: the impacted area is the whole site or a significant portion of the site **Local**: within a radius of 2 km of the construction site. **Regional**: the impacted area extends to the immediate, surrounding and neighboring properties. **National**: the impact can be considered to be of national significance.
Duration	**Indicates the lifetime of the impact and is classified as:**

	Short term: the impact will either disappear with mitigation will be mitigated through natural processes in a span shorter than the construction phase. **Medium term:** the impact will last for the period of the construction phase, where after it will be entirely negated. **Long term:** the impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory. **Permanent:** mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
Intensity	**Describes whether an impact is destructive or benign** **Low:** impact affects the environment in such a way that natural, cultural and social functions and processes are not affected. **Moderate**: affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way. **High:** natural, cultural and social functions and processes are altered to extent that they temporarily cease. **Very high:** natural, cultural and social functions and processes are altered to extent that they permanently cease.
Probability	**Describes the likelihood of an impact to occur:** **Improbable:** likelihood of the impact materializing is very low. **Possible:** the impact may occur. **Highly probable**: most likely that the impact will occur. **Definite:** the impact will occur.
Significance	**Based on the above criteria the significance of issues was determined. The total number of points scored for each impact indicates the level of significance of the impact, and is rated as follows:** **Low**: the impacts are less important. **Medium**: the impacts are important and require attention, mitigation is required to reduce the negative impacts. **High**: the impacts are of great importance. Mitigation is therefore crucial.
Cumulative	**In relation to an activity, means the impact of an activity that in itself may not be significant but nay become significant when added to the existing and**

	potential impacts eventuating from similar or diverse activities or undertakings in the area.
Mitigation	**Where negative impacts are identified, mitigation measures (ways of reducing impacts) have been identified. An indication of the degree of success of the potential mitigation measures is given per impact.**

Criteria for the rating of impacts				
Criteria	Description			
Extent	National	Regional	Local	Site
Duration	Permanent	Long-term	Medium-term	Short-term
Intensity	Very high	High	Moderate	Low
Probability	Definite	Highly probable	Possible	Improbable
Points allocation	4	3	2	1
Significance Rating of classified impacts				
Impact	Points	Description		
Low	4-6	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.		
Medium	7-9	Mitigation is possible with additional design and construction inputs.		
High	10-12	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.		
Very high	13-16	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/ or operational phases. The effects of the impact may affect the broader environment.		
Status	Perceived effect of the impact			
Positive (+)	Beneficial impact			
Negative (-)	Adverse impact			
Negative impacts are shown with a (-) while positive ones are indicated as (+)				

2 ASPECTS, RELATED IMPACTS, SIGNIFICANCE AND PROPOSED MITIGATION MEASURES

In this section, all the possible impacts that can be predicted in both the construction and operational phases are addressed. Specific mitigation measures are proposed and the significance of these impacts given with and without mitigation measures.

Any development will have a profound impact on the environment in that most of the herbaceous and shrub layers will be destroyed.

Impacts	Significance Rating Before Mitigation Measures	Proposed Mitigation Measures	Significance Rating After Mitigation Measures
Planning/ Designing Phase			
Poor Design – Structural failures	High (Negative)	Ensure compliance with the industry standards	Low (Negative)
Disregard of legislative requirement	High (Negative)	Ensure compliance with relevant legislation and legal standards	Low (Negative)
Construction Phase			
Alteration of topography due to stockpiling of soil, building material and debris and waste material on site.	Medium (Negative)	All stockpiles must be restricted to designated areas and are not to exceed a height of 2 metres. • Stockpiles created during the construction phase are not to remain during the operational phase. • The contractor must be limited to clearly defined access routes to ensure that sensitive and undisturbed areas are not disturbed.	Low (Negative)
Consumption and use of surface water for construction purposes (i.e. water tankers for dust suppression).	Medium (Negative)	The Municipality to comment and advice on surface water availability and integrity.	Low (Negative)

Contaminated run-off: • Spillage of fuels, lubricants and other chemicals; • Inadequate stormwater management around the site; the dumping of construction material, including fill or excavated material into, or close to surface water features that may then be washed into these features; • Construction-related activities such as cement batching; • Construction equipment, vehicles and workshop areas will be a likely source of pollution as a non-point source; and • Lack of provision of ablutions that may lead to the creation of 'informal ablutions' within or	Medium (Negative)	• Bunded areas should be used to store chemicals. • Clean-up of spills as soon as they occur. • Keep construction activities away from the surface water resources. • Adequate provision of ablutions for construction employees. • Wastewater must not be allowed to come into direct contact with exposed soils or run across the site. Vehicles and machinery may not be washed on site. All wastewater must be collected in a sealed container and disposed of by an approved waste contractor.	Low (Negative)

close to a surface water resource.			
Clearance of alien vegetation already present on portions of the study area.	High (Negative)	All alien vegetation within the proposed development footprint should be removed from site and disposed of at a registered waste disposal site for the duration of construction, and continuous monitoring of seedlings need to occur until construction is complete.	Low (Negative)
Erosion, degradation and loss of topsoil due to construction activities as well surface and stormwater run-off.	High (Negative)	• Minimise the clearance of vegetation to avoid exposure of soil. • Protect areas susceptible to erosion with mulch or a suitable alternative. • Implement the appropriate topsoil and stormwater runoff control management measures as per the EMPr to prevent the loss of topsoil. • Topsoil should only be exposed for minimal periods of time and adequately stockpiled to prevent the topsoil loss and run-off.	Medium (Negative)
Removal and use of local flora for firewood.	Low (Negative)	• No cutting down of trees for firewood. • Utilise commercially sold wood or other sources of energy.	Low (Negative)

		• Training of contractors on environmental awareness and the importance of flora.	
Contamination of the surface and site with general waste. General waste produced on site includes: • Office waste (e.g. food waste,paper, plastic); • Operational waste (clean steel, wood, glass); and • General domestic waste (food, cardboards, paper, bottles, tins).	Low (Negative)	An adequate number of general waste receptacles, including bins must be arranged around the site to collect all domestic refuse, and to minimize littering. • Bins must be provided on site for use by employees. • Bins should be clearly marked and lined for efficient control and safe disposal of waste. • Different waste bins, for different waste streams must be provided to ensure correct waste separation. A fenced area must be allocated for waste sorting and disposal on the site. • General waste produced on site is to be collected in skips for disposal at the local municipal waste site. Hazardous waste is not to be mixed or combined with general waste earmarked for disposal at the municipal landfill site. • Under no circumstances is waste to be burnt or buried on site. • Waste bins should be cleaned out on a regular basis to prevent any windblown waste and/or visual disturbance.	Low (Negative)

		• All general waste must be removed from the site at regular intervals and disposed of in suitable waste receptacle.	
with general and hazardous waste. Hazardous waste produced on site includes: • Oil and other lubricants, diesel, paints, solvent; • Containers that contained chemicals, oils or greases; and • Equipment, steel, other material (rags), soils, gravel and water contaminated by hazardous substances (oil, fuel, grease, chemicals or bitumen).	Medium (Negative)	Hazardous Waste Landfill Site. The Environmental Manager must have as part of his/her records the waste manifest for each batch based disposal. • Hazardous waste bins must be clearly marked, stored in a contained area (or have a drip tray) and covered (either stored under a roof or the top of the container must be covered with a lid). • A hazardous waste disposal certificate must be obtained from the waste removal company as evidence of correct disposal. • In the case of a spill of hydrocarbons, chemicals or bituminous, the spill should be contained and cleaned up and the material together with any contaminated soil collected and disposed of as hazardous waste to minimize pollution risk.	Low (Negative)
Generation and disposal of sewage waste of temporary construction toilets.	Low (Negative)	• On-site chemical toilets will be provided for domestic purposes during construction phase. • The contractors will be responsible for the maintenance of the chemical toilets.	Low (Negative)

		• Should any spills or incidents occur; the material will be cleaned up immediately and disposed of appropriately. • All incidents must be reported to the responsible site officer as soon as it occurs.	
Dust and emissions during construction generated by debris handling and debris piles, truck transport, bulldozing, general construction.	Low (Negative)	• Dust must be suppressed on the construction site and during the transportation of material during dry periods by the regular application of water. Water used for this purpose must be used in quantities that will not result in the generation of run-off. • Loads could be covered to avoid loss of material in transport, especially if material is transported off site. • Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. • Facilities for the washing of vehicles should be provided at the entry and exit points. • A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas. • During the transfer of materials, drop heights should be minimized to control the dispersion of mater being transferred.	Low (Negative)

		• The height of all stockpiles on site should be a maximum of 2m. Use of dust retardant road surfacing if made necessary due to the exceedance of Air Quality Guidelines.	
Generation of fumes from vehicle emissions may pollute the air.	Low (negative)	• All earth moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability in order to prevent smoke emissions	Low (Negative)
During the construction phase there is likely to be an increase in noise pollution from construction vehicles and construction staff.	Medium (negative)	• All construction activities should be undertaken according to daylight working hours between the hours of 07:00 – 17:00 on weekdays and 7:30 – 13:00 on Saturdays. • No construction activities may be undertaken on Sunday. • Provide all equipment with standard silencers. Maintain silencer units in vehicles and equipment in good working order. • All earth moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability. • Construction staff working in area where the 8-hour ambient noise levels exceed 60 dBA must have the appropriate Personal Protective Equipment (PPE).	Low (Negative)

		• All operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No. 85 of 1993).	
Disturbance of sites of archaeological, historical and cultural significance.	Low (negative)	• There were no sites or objects of archaeological, historical and cultural significance identified, however, if during construction any possible finds are made, the operations must be stopped and a qualified archaeologist be contacted for an assessment of the find. • It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on: • The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.	Low (Negative)
During the construction phase there is likely to be an increase in traffic from construction vehicles.	Medium (Negative)	• Construction vehicles are to avoid main roads during peak traffic hours. • All vehicles entering the Site are to be roadworthy. • Seatbelts are to be worn at all times.	Low (Negative)

		• When using heavy or large vehicles / equipment, "spotters" are to be present to assist the driver with his blind spots. • Any incident or damage to a vehicle must be reported immediately.	
The development will result in job creation and provision of employment.	Medium (Positive)	• All labour (skilled and unskilled) and contractors should be sourced locally where possible. • A labour and recruitment policy must be developed, displayed and implemented by the contractor. • Recruitment at the construction site will not be allowed. • Where possible, labour intensive practices (as opposed to mechanised) should be practiced. • The principles of equality, BEE, gender equality and non-discrimination will be implemented.	High (Positive)
Job creation during the construction phase could result in the influx of people to the area.	Medium (positive)	• If possible all labour should be sourced locally. • Contractors and their families may not stay on site. • No informal settlements will be allowed.	High (Positive)
Public safety during construction.	Medium (Negative)	• Members of the public adjacent to the construction site should be notified of construction activities in order to limit unnecessary disturbance or interference.	Medium (Negative)

		• Construction activities will be undertaken during daylight hours and not on Sundays.	
Construction staff safety during construction.	High (Negative)	• Ensure the appointment of a Safety Officer to continuously monitor the safety conditions during construction. • All construction staff must have the appropriate PPE. • The construction staff handling chemicals or hazardous materials must be trained in the use of the substances and the environmental, health and safety consequences of incidents. • Report and record any environmental, health and safety incidents to the responsible person.	Medium (Negative)
Operational Phase			
Leaks of untreated water from pipelines may occur and impact on the shallow groundwater quality.	Medium (Negative)	• Any leaks should be fixed immediately and areas rehabilitated as needed.	Low (Negative)
Increased urban run-off from urban infrastructure and roads.	Low (Negative)	• The stormwater management plan must be implemented.	Low (Negative)
Emergency evacuation plan	Low (Negative)	• Upon completion of the construction phase, an emergency evacuation plan must be drawn up to ensure the safety of the land users in the case of an emergency.	Low (Negative)

Increase in Environmental Degradation & Pollution	Low (Negative)	• Prevent any influx of run-off water (from residences) or effluent into wetland habitat. • Run-off water from gardens typically contains seeds of exotic and garden-variety plants that pose a threat to wetland vegetation and ecology. Run-off water should be diverted to storm water management services and infrastructures;	Low (Negative)
Generation and disposal of sewage waste by the proposed development.	Medium (Negative)	• Upgrade the existing Bethal WWTW. • The development can be phased so that the existing Bethal WWTW capacity is not exceeded. • The proposed development installs an onsite sewer package plant, until the Bethal WWTW upgrade is completed. This will require a water use licence from the Department of Water and Sanitation.	Low (Negative)
Generation and disposal of domestic waste by the proposed development.	Medium (Negative)	Waste will be collected by an accredited waste company and disposed of at an appropriate and licensed waste disposal facility.	
Increase of traffic on the Road R35 and N17 T-Junction	Medium (Negative)	• Access Road need to be upgraded along with the signal timing. The intersection will require an upgrade from an existing give way yield control to a signalized control in order to provide enough capacity for the proposed trips generated by the township.	Low (Negative)

The development will result in job creation and provision of employment.	Medium (Positive)	• The principles of gender equality, maximizing local employment should be implemented in the provision and establishment of jobs. • Jobs for the maintenance of infrastructure and services will be created following the completion of the development. These jobs might be made available to existing labour there creating long term employment. • Service contractors could have access to other developments or projects in the area thereby creating long term employment	Medium (Positive)
Dust from cleared areas	Medium (Negative)	• Exposed soil surfaces should be wet down where required to avoid dust emissions. • Vehicles transporting construction material such as building sands should remain at a speed limit of 40km/h and if required cover their loads with a tarpaulin to avoid dust emissions. • The height of stockpiles should be limited to 1.5m. • Newly cleared and exposed areas must be managed for dust and landscaped with indigenous vegetation to avoid soil erosion. Where necessary, temporary stabilization measures must be used until vegetation establishes.	Low (Negative)

Increase in soil erosion	Low (Negative)	• All reasonable measures should be implemented during the Operational Phase to minimise erosion. • Remedial action must be taken at the first signs of erosion.	Low (Negative)
Decommissioning Phase			
Due to the permanent nature of the development, no decommissioning is foreseen. If the project is to be decommissioned the same mitigations contained in the construction phase will apply.			

3 KEY ENVIRONMENTAL IMPACTS

The following possible environmental impacts were identified

Environmental issues	Possible cause	Potential impacts
Air Pollution and Noise		
Smoke	- Vehicle emissions. - Fires.	- Health problems. - Air pollution. - Public nuisance. - Noise pollution.
Dust	- During construction. - Vehicle operation on roads. - Vegetation clearing.	
Fumes	- Fumes from vehicles. - Fumes from machinery.	
Noise	- Construction machinery and vehicles. - Presence of construction camp. - Operation noise (music and people).	
Environmental issues	**Possible cause**	**Potential impacts**
Water quality		
Pollution of water sources	- Spillage of fuel & oil from vehicles. - Spillage of building material e.g. cement etc. - Migration of contaminants off the site. - Solid waste in storm water. - Littering.	- Pollution of surface and groundwater. - Health risk. - Lower water quality. - Soil degradation. - Erosion. - Siltation.
Silt deposition in surface water	- Erosion risk due to increased run-off from built up area. - Erosion from cleared areas during construction.	

Pollution from sanitation system	- Leakages of system and incorrect management of sanitation system. - Inadequate measures to prevent sewage spillages. - Overflow of sewage to groundwater.	
Environmental issues	**Possible cause**	**Potential impacts**
Water quantity		
Impact on amount of water resources available	Over-utilisation of available water.	- Lose scarce resource - Increased pressure on ground water supply sources.
Environmental issues	**Possible cause**	**Potential impacts**
Land/Soil degradation		
Soil contamination and degradation	- Spillages of oil, chemicals from machinery & vehicles. - Removal of vegetation during clearing for construction. - Sewerage spillages. - Erosion due to increased runoff from built-up areas. - Increased erosion of drainage channels. -Site clearing during construction.	- Soil degradation - Loss of topsoil - Dust formation - Erosion
Environmental issues	**Possible cause**	**Potential impacts**
Biodiversity		
Decline in fauna and flora diversity	- Cleaning of site for construction. - Pollution of soil. - Pollution of water resources. - Physical establishment of development.	- Loss of biodiversity. - Loss of habitat. - Negative impact on biodiversity.

	- Loss of habitat due to establishment of development.	- Negative impact on rare /endangered/ endemic species and habitats.
Environmental issues	**Possible cause**	**Potential impacts**
Cultural/Heritage		
Possible loss of heritage sites	- Damage / loss during construction. - Damage / loss during operation.	- Possible loss of cultural heritage.
Environmental issues	**Possible cause**	**Potential impacts**
Visual impact		
Impact of the proposed development of sense of place.	- The physical existence of the development.	- Negative impact on landscape quality character. - Negative impact on sense of place.
Visual impact	- Construction site and buildings. - Lights at night. - Presence of new development. - Overhead power lines.	- Obstruction. - Visual intrusion. - Public nuisance.
Environmental issues	**Possible cause**	**Potential impacts**
Health and Safety		
Security	- Influx of people to area including construction workers and others after completion.	- Loss of safe and secure environment. - Threat to health. - Danger to human life.
Fires	- Accidental fires. - Burning of waste. - Cooking with fires.	

Environmental issues	Possible cause	Potential impacts
Socio-economic impacts		
Impact from change of land use from agriculture to township.	- Change of land use to residential, business, institutional, educational, public open spaces and streets.	- Impact negatively on agricultural production. - Land will no longer be used for agriculture.
Impact of the residential and other development on adjacent landowners	- Noise from construction activities, - Dust generated by construction vehicles and from site preparation. - The visual impact of lights. -The visual impact of residential and other units (business, institutional etc.)	- Nuisance and disruption. - Noise pollution. - Air pollution. - Negative visual impact.
Impacts related to the establishment of a construction camp with accommodation	- Location of construction camp. - Environmental impacts of construction activities e.g. spillage of hazardous liquids such as oil and fuel onto the soil surface. - Accommodation of construction teams on site - Littering, accidental fires, collecting of firewood and poaching. - Undesirable visitors to the area.	Adverse impact on the environment. - Resentment from neighbouring residents.
Impact ground and water pollution from littering and waste disposal during construction and operational phases	- The presence of a large work force and equipment and machinery during construction causing littering and dumping refuge and builder's rubble on site. -Construction activities from heavy vehicles and machinery.	- Soil and water pollution
	- The construction of structures such as open trenches and earth heaps might also hold safety risks for people.	- Safety risks for motorists, passengers, pedestrians and residents of the area

	- A lack of proper ablution facilities for temporary workers during construction.	- Soil and water pollution - Unhygienic conditions - Health risk.
Impact from the provision of structures and infrastructure services	- The development, construction and provision of infrastructure services.	- Pollution from sanitation systems - Pollution of water resources. - Negative visual impact of overhead power lines and electricity supply and waste removal. - Soil erosion as a result of the construction of internal roads and water reticulation networks.
Impact on archaeological /cultural / social features	- The development of structures and infrastructure services for residential and other sites. - Clearing of construction sites. - Construction of access roads. - Excavation of trenches for the installation of underground pipelines and cables.	- Negative impact on cultural or heritage resources.
Job creation Ownership	- Temporary jobs during construction phase. - Permanent jobs during operation. - New housing. - New businesses. - New schools.	- Positive impact – job Creation.

Appendix E: Report on Alternatives

1 FEASIBLE AND REASONABLE ALTERNATIVES

1.1 Site Alternatives:

Site alternatives are not applicable for this project due to the fact that the proposed development is the establishment a township within boundaries of an existing residential area. The site was also selected so that mainly disturbed land will be developed.

1.2 Activity Alternatives:

1.2.1 Transport, Traffic noise and vibrations

The major impacts that can be brought about by the development are soil erosion. Options that exist to reduce these impacts are:

- Rehabilitation of affected areas after the construction phase is finished.
- Avoiding of unnecessary vegetation clearance.
- Proper management of topsoil throughout the development.

1.3 Design Alternatives:

The unique character and appeal of Emzinoni were taken into consideration with the design philosophy. Various layout alternatives were considered by the applicant and town planners, also taking terrain and environmental constraints into account, the current design plan being the result.

1.4 No-go option:

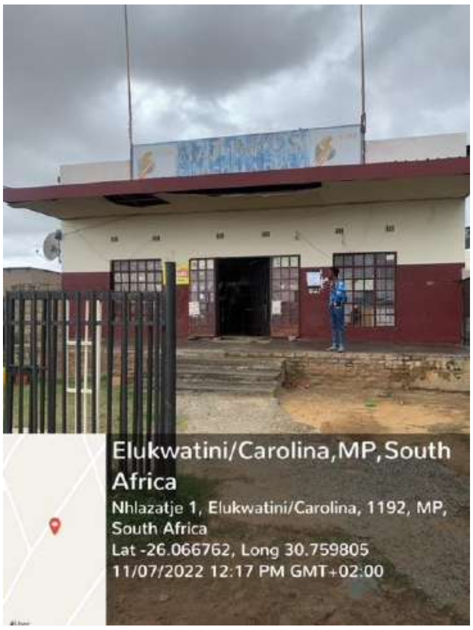
This option would come into effect if this assessment reveals fatal flaws in the process. To date no fatal flaws have been revealed. The no-go alternative of not developing the proposed site would leave the environment in the current state.

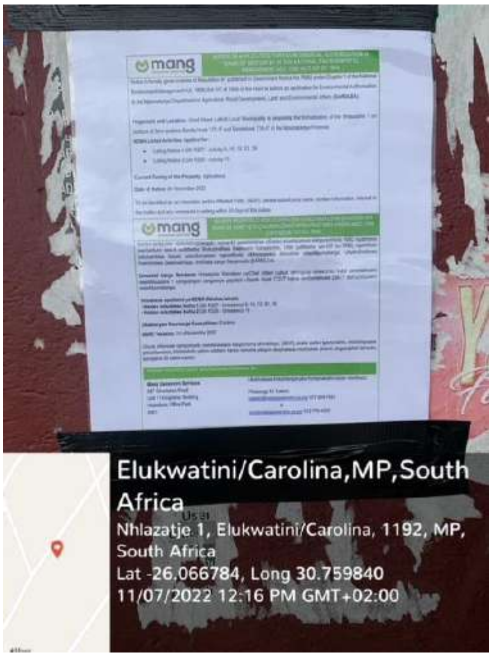
The no-go would not be the preferred alternative from a socio-economic perspective, as the development in general would result in a variety of employment opportunities and provide an economic boost to the area.

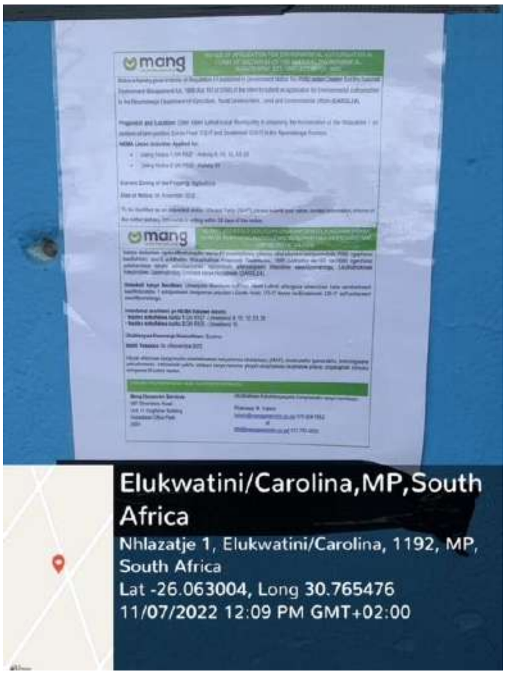
Appendix F: Public Participation

Site Notices

SITE NOTICES





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Elukwatini/Carolina,MP,South Africa
Nhlazatje 1, Elukwatini/Carolina, 1192, MP, South Africa
Lat -26.059971, Long 30.769545
11/07/2022 11:53 AM GMT+02:00


SUNBAKE
Elukwatini/Carolina,MP,South Africa
Nhlazatje 1, Elukwatini/Carolina, 1192, MP, South Africa
Lat -26.059727, Long 30.769533
11/07/2022 11:53 AM GMT+02:00


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GPS Map Camera
Elukwatini/Carolina,MP,South Africa
Nhlazatje 4, Elukwatini/Carolina, 1192, MP, South Africa
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GPS Map Camera
Elukwatini/Carolina,MP,South Africa
Nhlazatje 4, Elukwatini/Carolina, 1192, MP, South Africa
Lat -26.054101, Long 30.765914
11/07/2022 11:40 AM GMT+02:00

Newspaper Advert

Communication to IAPs

Comments from IAPs

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: Nurse Nkambule

Organization: Umhlali

Postal Address: P.O. box 70
Elukwatini
1192

Email Address: ....

Tel: 0719086 3063 .... Fax: ....

Comments/ Issues/ Concerns:

Ngiyavuma

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
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Name: Lindokuhle Mabanga

Organization: Ward Committee

Postal Address: P.O. Box 886
Elukwatini
1192.

Email Address: lindom.mabanga@gmail.com

Tel: .... Fax: ....

Comments/ Issues/ Concerns:

I fully support the proposed initiative of formalizing Nhlazatshe 1.

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
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Name: Mphikeleli Johannes Nkosi

Organization: Ward committee

Postal Address: P.O. Box 5150
Elukwatini
1192

Email Address: siminkosi@gmail.com

Tel: 0636062678 Fax: N/A

Comments/ Issues/ Concerns:

I do appreciate the development because it will grow the economy of Nhlazatshe. it will change the life of the people and youth will have activies such as park.

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: N/A

Postal Address: N/A

Tel: N/A Email:

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

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Name: Tsidu Doreh Nyongane

Organization: community member

Postal Address: P.O Box 955
Elukwatini
1192

Email Address: ...

Tel: 0765380072 Fax: ...

Comments/ Issues/ Concerns:

I Accept

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ...

Postal Address: ...

Tel: ... Email: ...

mang
GEOENVIRO SERVICES

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+27 12 770 4022

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Name: Erna Magagula

Organization: Umhlalu

Postal Address: P.O Box 5315
Elukwatin
1192

Email Address:

Tel: 06653691 0 Fax:

Comments/ Issues/ Concerns:

TEBO NGIYAVUMA

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

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6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
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Name: PATRIC NKAMBULE

Organization: Umhlali

Postal Address: 2294
ELUKWATINI
1192

Email Address:

Tel: 0727571898 Fax:

Comments/ Issues/ Concerns:

Mine ngiyavuma kutsi ingacubeka Ngobe singumphakatsi sidzinga kwaluleka endzaweni yetfu

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

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6 Eros Road, Faerie Glen, Pretoria 0004
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I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: Maria

Organization: Community Member

Postal Address: 431

Elukwatini

1192

Email Address: ....

Tel: 0793317437 .... Fax: ....

Comments/ Issues/ Concerns:

Jabo Ngiyavuma

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
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Name: Thandi Nomsa Magagula

Organization: Community Member

Postal Address: Box 97
Elukwatini
1192

Email Address: ....

Tel: 076 6162109 Fax: ....

Comments/ Issues/ Concerns:

I ACEPT.

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

mang GEOENVIRO SERVICES

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6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

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Name: Maria Mnisi

Organization: Community member

Postal Address: P.o box 1007
Elukwatini
1192

Email Address: ....

Tel: 0766118951 .... Fax: ....

Comments/ Issues/ Concerns:

Lebo Ngiyavuma!

....

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

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6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

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Name: SIDUDLA NKOSI

Organization: COMMUNITY MEMBER

Postal Address: P. O BOX 5568
ELUKWATINI
1192

Email Address:

Tel: 0827917206 Fax:

Comments/ Issues/ Concerns:

TEBO NGIJAVUMA

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

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6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: BUSISIWE SIBANTON

Organization: COMMUNITY Member

Postal Address: P.O. BOX 5568
ElukWATINI
1192

Email Address: ....

Tel: 076 397 7127 Fax: ....

Comments/ Issues/ Concerns:

I ACCEPT

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ....

Postal Address: ....

Tel: .... Email: ....

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: Annah Sibeko

Organization: Comunity member

Postal Address: P. O. Box 5357
Elukwatini
1192

Email Address:

Tel: 079 535 4499 Fax:

Comments/ Issues/ Concerns:

I ACCEPT.

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: THULANI MAHALA

Organization: Umhlali

Postal Address: P.O. Box 108
Elukwatini
1192

Email Address:

Tel: 072 2422583 Fax:

Comments/ Issues/ Concerns:

Mina ngiyawamukutsile projkoject
Silethule inthuthukoeleni

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

Block 9 Unit 2 Boardwalk Office Park,
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Name: Abel July Nkosi

Organization: CALM Ward CLLR 25

Postal Address: P.O BOX 70
ELUKWATINI
1192

Email Address: abel nkosi 91 @gmail.com

Tel: 076 7505315 Fax:

Comments/ Issues/ Concerns:

I ACCEPT THE DEVELOPMENT

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation: ……

Postal Address: ……

Tel: …… Email: ……

I hereby wish to register as an Interested and Affected Party (I&AP) for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Name: THOMBI THOMO

Organization: Community member

Postal Address: P. O. Box 656
Elukwatini
1192.

Email Address:

Tel: 063 6245768 Fax:

Comments/ Issues/ Concerns:

I accept

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
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Name: Sonto Zulu

Organization: Community Member

Postal Address: P. O Box 1389
Elukwatini
1192

Email Address:

Tel: 066 0338429 Fax:

Comments/ Issues/ Concerns:

Ngiyavuma

Do you know anyone who can be registered as an Interested and Affected Party?

If yes, kindly assist with the following:

Name and Organisation:

Postal Address:

Tel: Email:

Register

Register

Block 9 Unit 2 Boardwalk Office Park,
6 Eros Road, Faerie Glen, Pretoria 0004
info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

Date: 07/11/2022

Proof of delivery of Background Information Documents to the IAPs for the proposed formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eerstehoek 235-IT within Chief Albert Luthuli Local Municipality for the Scoping and EIA Process.

Recipient Name	Contact Details	Address	Recipient Signature
Abel Jody Nkosi	Email: abelnkosi91 @gmail.com Tel: 0767505318	STAND 577 Nhlazatshe	[signature]
Lindokuhle Mabanga	Email: Tel: 071 391 1709	924 Nhlazatshe 1	Lindo
Maria Mnisi	Email: Tel: 0766118951	Nhlazatshe 1	M. mnisi
Maria Vilakazi	Email: Tel: 0793317437	485 NHLazatshe 1	MBVilakazi
Sibudia	Email: Tel: 0827917206	NHLaZatshe	SN
Johannes Nkosi	Email: SIJMJNKOSI@gmail.com Tel: 0636062678	NHlazatsheNo3	Nkosi
Thulani Nhlazla	Email: Tel: 072 2422580	NHLAZATSHE No 2	T. Nhlazla
PATRIC NKAMBULE	Email: Tel: 0727571898	906 NHLAZATSHE 1	Nkambule
Erna Maqaqula	Email: Tel: 0665376910	864 Nhlazatshe 4	Erna
Tsidi Nyoma	Email: Tel: 0765380072	STAND 880 Nhlazatshe	TNyoma
Annah Sibeko	Email: Tel: 0795354499	207 Nhlazatshe 2	A.L. Sibeko
Busi Sibanyoni	Email: Tel: 0763977127	Nhlazatshe 2	B Sibanyoni
Nomsa Maqaqula	Email: Tel: 0766162109	734 Nhlazatshe 1	N Maqaqula

mang
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info@manggeoenviro.co.za
www.manggeoenviro.co.za
+27 12 770 4022

Date: 07/11/2022

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Recipient Name	Contact Details	Address	Recipient Signature
Sonto Zulu	Email: Tel: 0660338429	Nhlazatje 2	[signature]
Toytoy Nkambule	Email: Tel: 079 086 3063	Nhlazatje 4	N.Nkambule
THEMBI THOMO	Email: Tel: 0796037441	Nhlazatje 2	[signature]
MKOMZULU Sbongor	Email: Tel: 0760779946	Nhlazatje 2	[signature]
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		
	Email: Tel:		

Appendix G: Specialist Reports

Ecological Report

(EIA)BIODIVERSITY STUDY REPORT FOR THE PROPOSED FORMALIZATION OF THE NHLAZATSHE TOWNSHIP WITHIN THE CHIEF ALBERT LUTHULI LOCAL MUNICIPALITY IN MPUMALANGA PROVINCE

Prepared by Africa Ecological and Development Services

P.O. Box 1163

Fauna Park

0787

Contact Person: Munzhelele E

Cell: 082 549 4612

Email: africaresources18@gmail.com

Client: mang GEOENVIRO SERVICES

Block 09suite 2 Boardwalk office park;06 Eros Road, Faerie Glen, Pretoria 0004

info@manggeoenviro.co.za,Tel 012 770 4022

REPORT IDENTIFICATION

Report number: AF NKMPNHLA25 2022

Project Title: Proposed formalization of the Nhlazatshe township within Chief Albert Luthuli Local Municipality in Mpumalanga Province

Specialist report: Biodiversity study

Date produced: 10 September 2022

Prepared by: Mr Munzhelele ED

Reviewed approved by: Mr Munzhelele ED

SACNASP Pr No 100011/11 Aquatic science

Qualifications

Master of Science in Natural Sciences, University of Venda (2013).

Bachelor of Science Honors in Natural Sciences, University of Venda (2005).

Bachelor of Science Degree in Aquatic Biology, University of Venda (2004).

This report is certified correct and represents the findings on the proposed site capability and suitability to support intended development

I declare that this report reflects a true reflection of what is existing on site and we have no conflict of interests to the project proposed.

Report signed off: **Mr Munzhelele HE**

10/09/2022

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EXECUTIVE SUMMARY

The project is for the formalization of an existing Nhlazatshe township. Therefore, Africa ecological and development services was appointed by Manggeoenviro services to conduct biodiversity of the area.

An extensive survey was undertaken on 02 September 2022 to survey the site and produce report of the findings. The area is an existing established township.

Prior to site visit a desktop study was undertaken to review details of existing literature about the area. Relevant existing literatures were also reviewed to establish background data of the proposed site.

Mpumalanga Biodiversity sector plan was also reviewed to compliment relevant data.

Site is located along the Nhlazatshe river which flows from the southwestern side to the east. Its riparian zone has some degraded wetlands. Degradation is associated to sand mining by local people.

Due to the nature of the potential impacts of the existing development on the local ecology, an Ecological study is required. This was required to determine the potential presence of ecologically significant species, habitats or wetland areas within the existing township footprint which could have been affected by the established township. Proposed mitigation and management measures in accordance with the NEMA (Act 107 of 1998) mitigation hierarchy is also recommended for further measures to address the existing problem.

NTRODUCTION

1.1 Background and Rationale

As stipulated in the master National environmental management Act and National Environmental management biodiversity Act and other environmental legislations; South African government is committed to sustainable development without a compromise on both human needs and protection of natural resources. Sustainable development principles are well observed and followed when considering authorizations for all development projects.

It is important for each proposed or existing development to undergo or to have undergone biological diversity study. Assessment for the land use and natural resources status of the site was done.

Locality of proposed site to determine its suitability was done intensively to verify any environmental problems that could have been caused by human activities.

This specialist report provides a baseline and impact assessment that was done on the ecosystems on the study site. This report gives details of the vegetation survey and habitat survey which were done to determine the current ecological state of the area.

All three of Mpumalanga's biomes were also reviewed as presented on the Mpumalanga biodiversity sector plan.

1.2 Aim and objectives

The aims of this study were as outlined below:

- Provide baseline data on habitat and species on and adjacent to the site
- Investigate potential impacts that may have occurred during construction and/or operational stages of the existing township.
- Provide advice on legislative framework relating to habitats and species on site.

- Suggest mitigation measures to be employed for constructed houses; schools; churches and businesses.
- Identify and assess the possible impacts that are likely to have been caused by the existing developments and their significant.
- Check and assess possibility for existence of threatened ecosystems and protected species.

2. STUDY AREA

2.1 Geographic Area

The area is located at Nhlazatshe 01 within the Albert Luthuli Local Municipality in Mpumalanga Province.

Site is located at the following geographical positioning system recorded point (GPS):

Latitude: -26,07557

Longitude: 30,75629

Altitude: 1175 m

Nhlazatshe 01 is located on the southeastern side of Elukwatini town. Is surrounded by the two streams that joins at the bottom of the catchment.

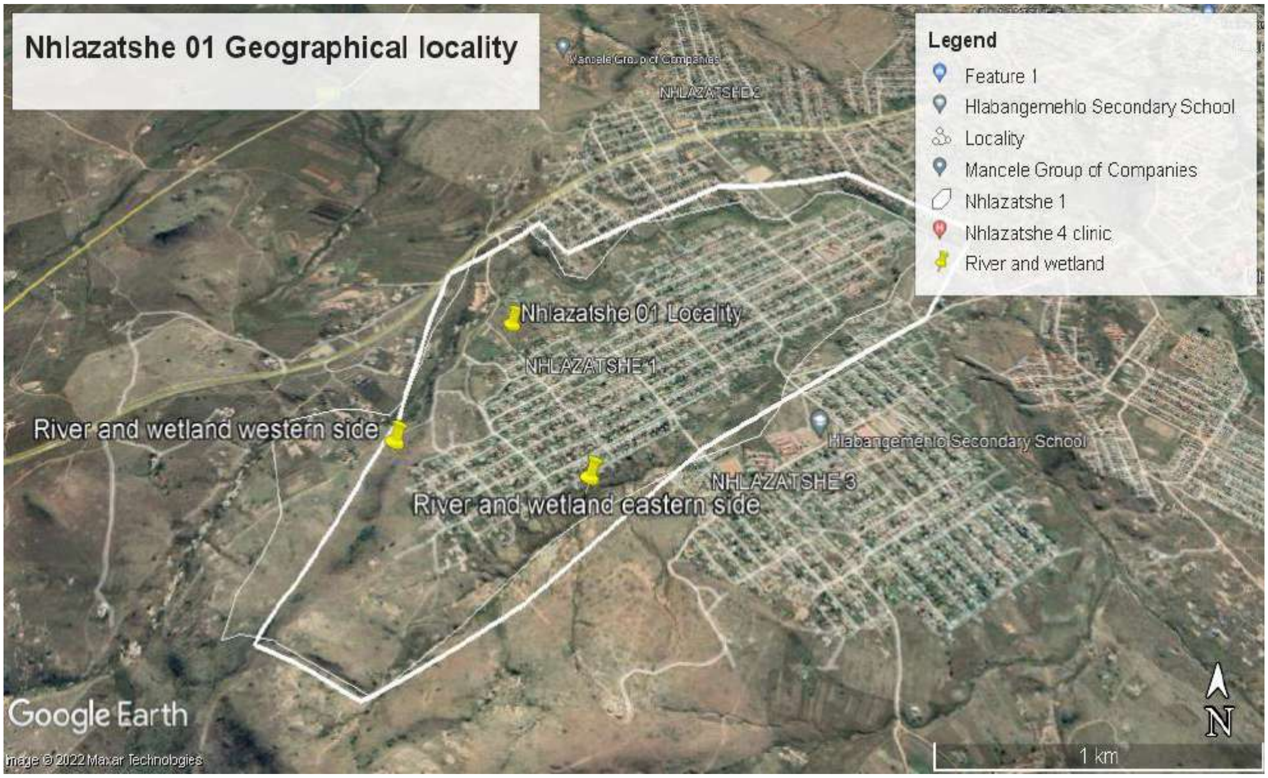


Figure 2.1.1: Locality map and aerial photo

2.2 Drainage Areas

The proposed area of the development is located within komati and crocodile river catchment with komati being the main one. Drainage system of the area is characterized by streams; wetlands; and flood plains. The nearest river to proposed site is Nhlazatshe river.

The drainage is mainly fragile to erosion due to high population which has posed lot of pressure on natural resources which resulted to their exploitation.

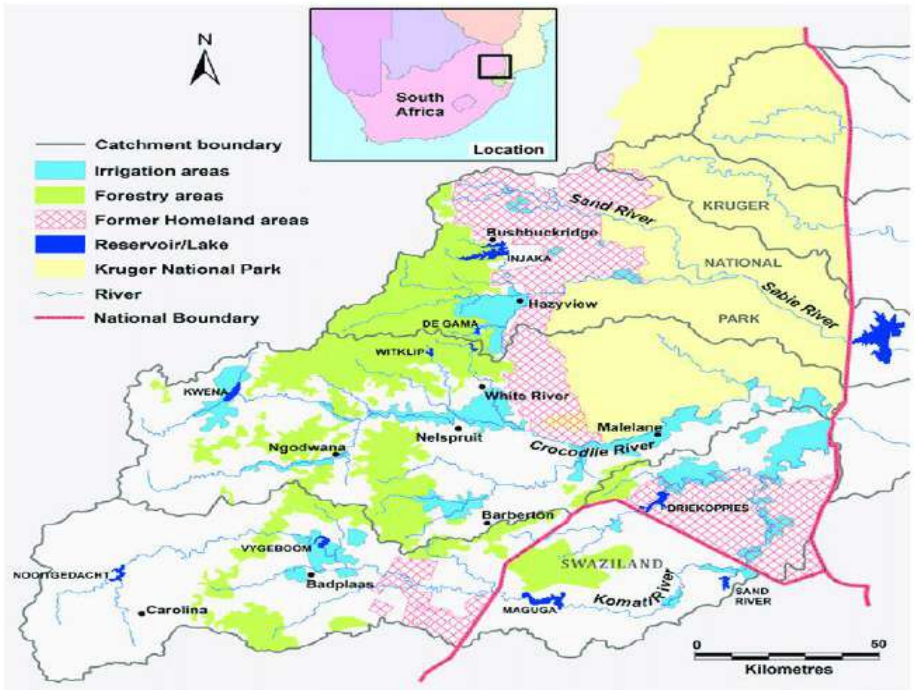


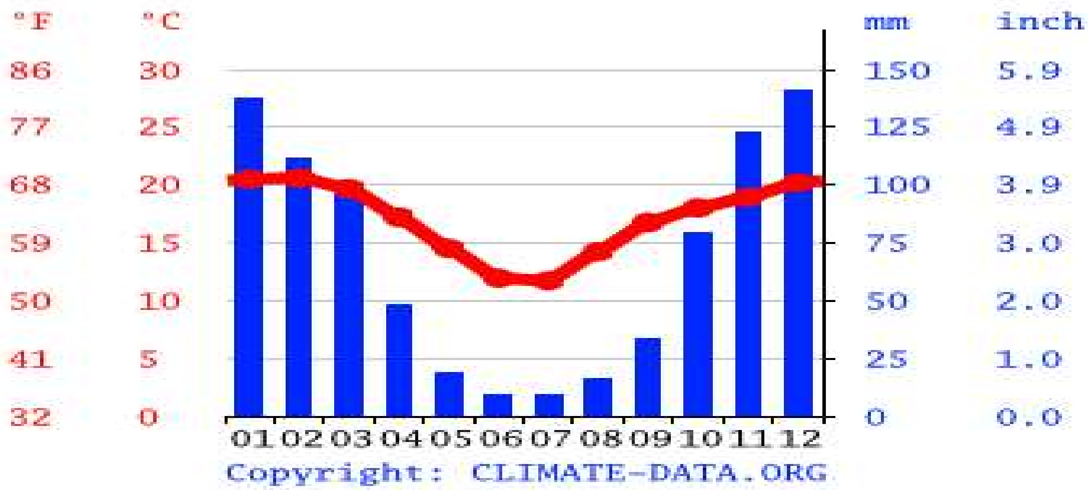
Figure 2.2.1: indication of drainage systems for komati river

2.3 Relief and Topography

Topography of the area is characterized of flat, gentle, and undulating slopes. Mountains are located on the western side. High areas are at average of about 3000m above sea level., regional landscapes span a high degree of topographic and climatic variability, including the more temperate and higher-altitude regions of the Highveld and North-Eastern Escarpment, and the hotter, more tropical, and lower-lying regions of the 'Lowveld'. Mainly characterized by wet areas that surround the resided areas.

2.4 Climate

Mpumalanga falls into a generally warm, summer rainfall area. In Mpumalanga, the summers are warm, muggy, and wet; the winters are short, cool, and dry; and it is mostly clear year-round. Over the course of the year, the temperature typically varies from 43°F to 79°F and is rarely below 38°F or above 86°F. The *cool season* lasts for *2.3* months, from May 29 *to* August 7, with an average daily high temperature below *70°F*. The coldest day of the year is June 30, with an average low of *43°F* and high of *68°F*.



2.4.1: Rainfall and temperature averages

3. Land use

Main Land use in the regional level varies from mines; conservation areas; industrial; game farming and agricultural land uses. Specific to the area of study main land uses are agricultural farms that include small scale farming. On the proposed area main land use is currently a grazing land and local people also benefit for various ecosystem services.

4. METHODOLOGY

The scope of the fieldwork was informed by research informed by desktop data analysis, knowledge of the study area, discussions with Darlington Borough Council, E3 Partnership Report 2005, and the timing and timescale of the study. A detailed field survey was undertaken with focus on all biological diversity aspects. Variety of surveys that were undertaken are indicated with their findings in this report.

The proposed assessment area was assessed on foot and visual observations/identifications were made of habitat conditions, ecologically sensitive areas, and relevant species present.

Species were listed and categorized as per the Red Data Species List; Protected Species List of the National Forests Act (Act 84 of 1998), Invasive Species List of the National Environmental Management: Biodiversity Act (Act 10 of 2004), Alien and Invasive Species Regulations, 2014

This study considered collection of data considering all existing previous record to have informative data for decision making. The following surveys were done as outlined below. Data was collected for both fauna and flora by means of field surveys.

The Present Ecological State (PES) of the proposed project area was assessed and rated as per the table below.

The Present Ecological State (PES) refers to the current state or condition of an area in terms of all its characteristics and reflects the change to the area from its reference condition. The value gives an indication of the alterations that have occurred in the ecosystem.

Ecological Category	Score	Description
A	**> 90-100%**	Unmodified, natural, and pristine.
B	**> 80-90%**	Largely natural. A small change in natural habitats and biota may have taken place but the ecosystem functionality has remained essentially unchanged.
C	**> 60-80%**	Moderately modified. Moderate loss and transformation of natural habitat and biota have occurred, but the basic ecosystem functionality has remained predominantly unchanged.
D	**> 40-60%**	Largely modified. A significant loss of natural habitat, biota and subsequent basic ecosystem functionality has occurred.
E	**> 20-40%**	Seriously modified. The loss of natural habitat, biota and basic ecosystem functionality is extensive.
F	**0-20%**	Critically/Extremely modified. Transformation has reached a critical level and the ecosystem have been modified completely with a virtually complete loss of natural habitat and biota. The basic ecosystem functionality has virtually been destroyed and the transformation is irreversible.

Table 4.1: Criteria for present ecological state (PES) calculations

The Ecological Importance and Sensitivity (EIS) of the study area was assessed and rated as per the table below.

The Ecological Importance and Sensitivity (EIS) of an area is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales, and both abiotic and biotic components of the system are taken into consideration. Sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

EIS Categories	Score	Description
Low/Marginal	D	Not ecologically important and/or sensitive on any scale. Biodiversity is ubiquitous and not unique or sensitive to habitat modifications.
Moderate	C	Ecologically important and sensitive on local or possibly provincial scale. Biodiversity is still relatively ubiquitous and not usually sensitive to habitat modifications.
High	B	Ecologically important and sensitive on provincial or possibly national scale. Biodiversity is relatively unique and may be sensitive to habitat modifications.
Very High	A	Ecologically important and sensitive on national and possibly international scale. Biodiversity is unique and sensitive to habitat modifications.

Table 4.2: Criteria for ecological Importance and Sensitivity (EIS) calculations.

4.1. Provincial Habitat and Biomes overview

Assessment has been done for both terrestrial ecosystems and aquatic ecosystems as outlined below:

4.1.1 Regional background as confirmed on existing literature

As confirmed on various research papers together with Mpumalanga biodiversity sector plan several details are summarized below:

The vision of the MBSP is that healthy and sustainably managed biodiversity assets and ecological infrastructure of Mpumalanga continue to underpin widespread, shared human benefits through the ongoing delivery of a range of ecosystem services. Its specific objectives are to:

Serve as the primary source of biodiversity information for all land-use planning and decision-making in Mpumalanga, to be used in conjunction with information from other sectors.

Ensure that Mpumalanga's ecological infrastructure is maintained, ecosystem fragmentation and loss is avoided, and the resilience of ecosystems and human communities to the impacts of climate change is strengthened.

Provide a spatial framework for environmentally sustainable development and resource-use.

Inform municipalities and other land-use planners and regulators about spatial biodiversity priorities to promote the wise management of biodiversity, and to streamline and monitor land-use decision-making.

Focus on-the-ground conservation and restoration action in biodiversity priority areas, thus supporting the MTPA in implementing its biodiversity mandate, including working with landowners to consolidate and expand the provincial protected area network.

Mainstream biodiversity conservation into the day-to-day activities of a range of development and production sectors whose primary business is not biodiversity conservation, thus promoting greater synergy between biodiversity conservation and development through implementation of the MBSP.

Terrestrial ecosystems:

Different Biomes that characterize the region include grasslands; forests and grasslands of which their nature and characteristics differ based on where they are located.

Mpumalanga incorporates elements of three different biomes grassland (occurring in the central highveld and escarpment regions, and covering the bulk of the province), savanna (occurring on the foothills and plains), and forest (on south and east-facing slopes and in river valleys).

Mpumalanga’s grasslands are mainly found in the cool, open highveld landscapes of the province, above 1 000 m and with an average rainfall of over 700 mm/yr. Frost, hail storms and lightning strikes are common. These events, combined with the natural occurrence of fire, favour grassland plants over woody species and helps maintain the mostly open, treeless character of these landscapes.

Mpumalanga’s grasslands occur mostly on deep, fertile soils of high agricultural value. For this reason, a large proportion of this landscape has already been modified for the cultivation of crops and timber or for intensive animal production. Extensive livestock grazing can be reasonably biodiversity-friendly, provided good management and sustainable stocking rates are applied.

The many rare and endangered species characteristic of Mpumalanga’s grasslands is amazing biodiversity asset. However, because of their localised distributions and short flowering durations, they are difficult to account for in environmental impact assessments, and specialist skills are required to locate and identify them reliably. Highest plant biodiversity is usually found in rocky grassland habitats and on sandy soils, and lowest on clay soils (except on soils derived from dolomite).

Savanna, found in the hotter lower-lying areas of the province, is characterized by a mixture of trees, shrubs, and grass; it is commonly referred to as ‘bushveld’, and, at lower altitudes, ‘low-end’. Mpumalanga’s savannas include tall, dense woodland in the warmer, wetter areas as well as more open woodland in the drier and cooler areas; it incorporates wooded, shrubby hill slopes, dense thickets, and grassy plains with scattered trees or bush-clumps. Such habitat diversity results from complex interactions between climate and fire, topography, geology and soils, and herbivory (by animals ranging

Mpumalanga, forests occur in small, scattered patches associated with steep, south-facing and often fire-free slopes, on sensitive soils not suited to cultivation. In many instances, forest patches occur in deeply incised river valleys in the escarpment region. They require high rainfall (over 770 mm/yr) and are supported through the dry season by groundwater from associated streams and added precipitation in the form of mist. Indigenous forests *protect* water sources rather than dry them out, as is the case with timber plantations of pine and gum trees.

Despite their scattered distribution and small patch size (with an average size of 4 ha), Mpumalanga's forests support a rich diversity of plant and animal species. Maintaining these forests in a healthy state is dependent on the connectedness of patches, achieved through riverine linkages that allow access by specialised forest fauna such as birds and monkeys.

Biome	Area(km^2)	%Mpumalanga	% Old ands	% Natural	Number of vegetation types
Grasslands	49 284	64	8.9	5,07	23
Savannah	26 649	35,5	3.2	76.8	29
Forests	400	0.5	0.1	96	14

Table 4.1.1.1 Biomes regional coverage statistics

Threatened ecosystems and endemic vegetation types

Nearly one quarter (20%) of the vegetation types in Mpumalanga are nationally gazetted as threatened. This means that these ecosystems have lost — or are at risk of losing – vital aspects of their structure, function, or composition, and have been classified as vulnerable (V), endangered (EN) or critically endangered (CR). The assessment of ecosystem threat status is based on the proportion of each ecosystem that remains intact relative to a set of thresholds. (Readers requiring a more detailed explanation of how ecosystem threat status is calculated are referred to Chapter 3 of the National Biodiversity Assessment 2011: Synthesis Report).

Most of the threatened ecosystems in Mpumalanga occur in grasslands, with most of them falling into the Vulnerable or Endangered categories. It is concerning that in the years since the publication of the MBCP, a greater proportion of Mpumalanga's ecosystems have become threatened, and have shifted from being classed as vulnerable to endangered

Freshwater Ecosystems

Mpumalanga contains over 4 000 wetlands, numerous river systems (including five major catchment areas) and a large proportion of South Africa’s Strategic Water Source Areas (areas accounting for more than 50% of annual run-off). Most of the wetlands occur in grasslands of the wetter highveld and escarpment regions, with the greatest concentration of pans in the Chrissiesmeer area near Ermelo. These wetlands represent high value ecological infrastructure for securing water for human use.

Most of the wetlands in Mpumalanga fall into the category commonly referred to as ‘palustrine’, which includes seepage wetlands and pans

Although all of them are of high biodiversity and ecological value, there are three wet-land areas that are of particular significance in Mpumalanga

The Wakkerstroom wetland complex in the south-east of the province, supports an exceptionally rich diversity of birds, including rare and threatened species such as the endemic Rudd’s lark, the white-winged flufftail and the wattled crane (all of which are critically endangered), as well as rare mammals such as the endangered oribi antelope, endemic golden moles and the Cape molerat. This area has become a popular birding destination and is at the heart of a thriving ecotourism industry.

The wetlands in the Wakkerstroom complex feed the headwaters of the Buffalo, Pongola, Usuthu and Vaal Rivers. The Wakkerstroom wetlands, and the grasslands in which they occur, have been recently placed under formal protection as a Protected Environment. There are, however, also significant coal deposits in the surrounding area, which means that a careful balance must be sought between biodiversity conservation and mining activity.

Verloren Valei, on the Steenkampsberg plateau near the town of Dullstroom, is a declared Ramsar site (a wetland of international importance). It is of high value for both bio-diversity conservation and water supply, feeding the upper catchments of the Olifants and Crocodile Rivers, two of South Africa’s most important river systems which ultimately flow into Mozambique. It supports several Red List bird, frog and mammal species, and provides suitable breeding habitat for, amongst other species, the critically endan-gered wattled crane. It also has a high species richness of ground orchids, six endemic butterfly species, and it provides important breeding habitat for numerous fish, amphib-ians and reptiles. This wetland system is currently protected within a provincial nature reserve.

The Chrissiesmeer Pan Area, near Ermelo (also called the Mpumalanga Lake District), includes more than 270 wetlands within a 20 km radius, representing the highest concentration of pans and wetlands, and the largest freshwater lake in South Africa. It quali-fies as a Ramsar Site. Has been identified as an Important Bird Area (IBA) because it supports extremely high numbers of birds (especially wetland-dependent species). It is a threatened ecosystem and has been delineated as a Freshwater Ecosystem Priority Area and a Critical Biodiversity Area. The headwaters of the Vaal, Olifants and Komati Rivers are fed by the wetlands in this area. For all of these reasons, the Chrissiesmeer Panveld area has been included in a recently proclaimed Protected Environment, through the Mpumalanga biodiversity stewardship programme

Centers of endemism

Although the Province occupies only 6% of South Africa’s land surface, it accounts for approximately 21% of its plant species diversity and contributes significantly to high levels of endemism in plants, mammals, and fish. This diversity is not evenly distributed throughout the province, but instead is concentrated in four of centres of endemism and species richness, which fall into a broad region of endemism within Mpumalanga, known as the Drakensberg Afromontane Region. This occurs along the high-lying mountainous areas in the east and is demarcated by groups of plants with similar geographical distributions, very often correlated with underlying geology. They contain many narrowly endemic, Red Data listed species that have highly restricted distributions, and consequently can be easily lost through habitat modification

The **Barberton Centre of Endemism** is dominated by surface outcrops of ancient volcanic (ultramafic) and sedimentary rocks which have associated with them many unusual and unique species. Outcrops of serpentine (so-called ‘greenstone’) occur throughout the Barberton Centre, giving rise to soils with high magnesium: calcium ratios

and high concentrations of heavy metals such as nickel and chromium that are potentially toxic to many plants. This has resulted in a distinctive flora including many edaphic (soil) specialists, most of which occur in grassland areas, with a few woody serpentine-endemic plants occurring in lower-lying, savanna areas.

Species of special concern

Species of special concern are those that have ecological, economic, or cultural importance and include those that are rare, endemic, or threatened; species with unusual distributions; and medicinal and other indigenous species that are exploited commercially or for traditional use. Mpumalanga is home to approximately 334 plant species alone that are of special conservation concern; these species are rare, endemic, threatened, declining or data-deficient, and are included in the Red Data List of South African Plants. Figures for animal groups are less readily available, as the Red Lists for these groups of organisms are still in preparation.

The species of plants found in Mpumalanga account for 21% of South Africa's flora. An estimated 189 species are endemic to the province, 146 are classified as threatened (19 Critically Endangered, 31 Endangered, and 96 Vulnerable) and 334 are of high conservation concern. The majority (64 %) of these plant species are soft herbs and bulbous plants (geophytes) situated in the grassland biome, including taxa such as *Aloe* (15 species), *Gladiolus* (12 species), *Disa* (10 species), *Ledebouria* (9 species), *Streptocarpus* (11), *Brachystelma* (9) and 10 species of cycads. Many of the local endemics are of conservation concern and these are found in the centers of endemism described

Mpumalanga is faunally very diverse, and accounts for about 65% of the mammalian species found in South Africa. The province hosts four species that are provincially endemic (3 species of golden moles and 1 species of bat), seven that are South African endemics (4 species of golden moles, 1 species of mole-rat, 1 other rodent species and 1 species of primate), two taxa endemic to South Africa & Lesotho (1 golden mole & 1 antelope) and one taxon (antelope) endemic to South Africa, Lesotho & Swaziland. These species make a significant contribution to the high rate of mammalian endemism in the southern African sub-region, and the province plays an important role in the conservation of these taxa and their genetic variability. Most of the endemic taxa occur in grassland landscapes. Currently, 14 mammalian species in Mpumalanga are classed as threatened on the IUCN Red List (1 CR, 3 EN and 10 VU). The Mpumalanga Province offers a wide variety of habitats within the savanna, forest, and grassland biomes and this definitely accounts for the high species richness in the province.

Mpumalanga is home to approximately 67% of South Africa's bird species. 71 of the 575 bird species in the province appear in the Red Data List, including critically endangered species such as Rudd's Lark, the White-winged Flufftail, the Eurasian Bittern, the blue swallow, and the Wattled Crane. Although Mpumalanga does not host any provincial endemics, it forms an important part of the distribution range of red-listed South African endemics such as the Yellow-breasted Pipit, Rudd's Lark, and Botha's Lark. It is also the stronghold of several threatened grassland and wetland-dependent bird species with restricted distributions. Certain species such as the Saddle-Billed Stork, White-headed Vulture and Lappet-faced Vulture are dependent on the savannas of the Mpumalanga Lowveld for survival. Twelve Important Birding Areas (IBAs

Mpumalanga has the second highest number of endemic freshwater fish species in South Africa. Fish are usually at the top of the food chain in aquatic ecosystems and form an important food source for terrestrial animals such as mammals and birds, and people. Catchments and fish sanctuaries in the eastern part of Mpumalanga are most important for conservation of threatened fish species, whose survival is placed at risk by decreased perennial flows of clean, sediment-free water. The placement of structures such as weirs and dams obstruct fish migration pathways and breeding patterns, and stocking rivers with alien, predatory fish species such as bass, reduces the chances of survival of indigenous fish species in Mpumalanga

Based on a provincial assessment, 65% of the reptile species that occur in Mpumalanga are threatened, despite their widespread distributions. Four species are known to be endemic to Mpumalanga including: Haacke's flat gecko, Mariepskop flat gecko and Rondavel flat gecko (both undescribed species of the genus *Afroedura*), and Wilhelm's flat lizard. The giant girdled lizard (the 'sungazer') although shared with other provinces is endemic to mesic grasslands and the lizards are considered threatened due to loss of suitable habitat.

None of the amphibians in Mpumalanga are known to be endemic, but many (nearly 16%) are threatened or have restricted distributions and limited breeding habitat. Many of the wetlands and pans along Mpumalanga's escarpment are important for the conservation of threatened amphibian species, although the greatest diversity occurs in the warm lowveld areas.

Eight species are considered important for setting conservation priorities because they have a restricted distribution within the province. These include: the Karoo toad, Natal cascade frog, spotted shovel-nosed frog, yellow-striped reed frog, plain stream frog, the greater leaf-folding frog, and the whistling rain frog. Although the giant bullfrog occurs

elsewhere in South Africa, the Mpumalanga populations are greatly at risk due to the limited distribution in the province, a declining population and ongoing habitat modification from various land-use pressures.

This neglected group of organisms plays an essential role in maintaining ecosystem functioning, but there is little data available on the invertebrate species of Mpumalanga. It is known, however, that the central, grassland regions of the province are important for the conservation of threatened species of invertebrates, especially butterflies, dragonflies, and damselflies.

Of Mpumalanga's 383 butterfly species, nine are threatened (1 CR, 7 EN and 1 VU), one near-threatened and a further six species rare or extremely rare. The province also contains about 48% of all taxa covered in the recent red listing conservation assessment for butterflies for RSA, Lesotho, and Swaziland and around 18% of the endemic taxa in the atlas region.

Overall area is amongst one of the critical habitat sites although specific site proposed is now a degraded and fragmented habitat due to encroached residential sites. Critical and endangered ecosystems do not occur on the proposed area.

Assessment for possible feeding grounds: proposed site is a highly feeding ground supporting area kind of habitat for most of species. Underground burrowing animals also likely to exist in the area.

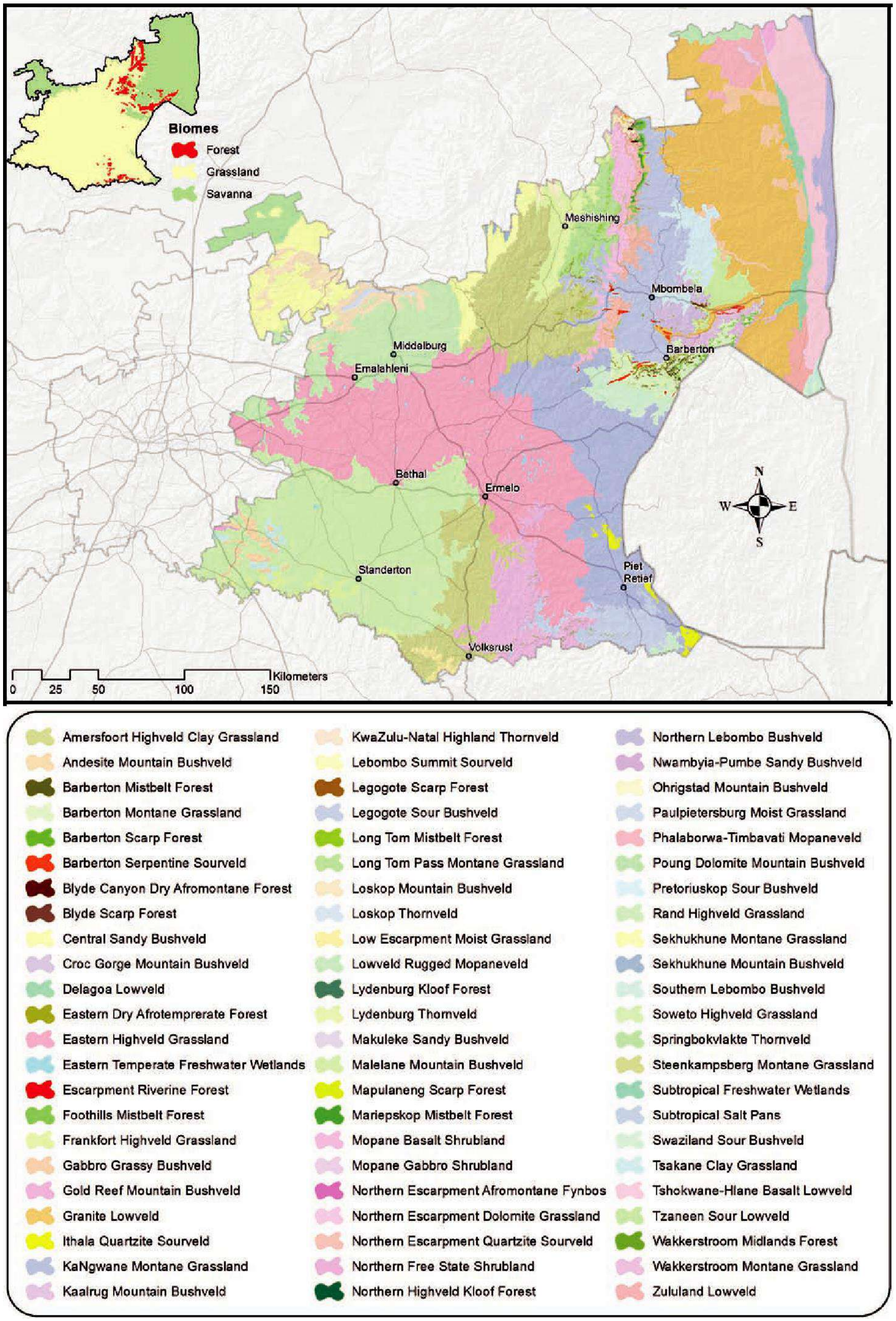
Nesting sites assessment: this was done to check existence of rare species such as parrots and ground horn bill. No sites were located.

Species movement patterns was also explored to test if there are any species with consideration of most dominant plant keystone species that might be influential, but none was confirmed.

4.2. Vegetation survey

A desktop review study confirmed that the area falls under grassland biome vegetation characterized by sparse vegetation on the upper catchment. Is also have existence of Barberton Serpentine Sourveld. Legogote sourveld is one of the types of vegetation that occur on greater parts of the area. Due to site being an existing township to be formalized it is dominated by domesticated fruit trees.

During vegetation survey different plant species were identified on site and recorded focusing on specific site to be formalized. This included trees, shrubs and grass and herbs. The identified species are presented on a table below as per their different categories. Protected tree species as per National Forest Act 84 of 1998 are also indicated on the table below. Area is still rich in species composition.



4.2.1 Map showing vegetation types of Mpumalanga

Scientific name	Common names	Occurrence level	%Cover Dominancy	Protected	Indigenous /Invasive	Life Form
Pittosporum viridiflorum	Cheese wood	Few	1%	Yes	Ind	Tree
Grinidia burchellii	Meisn	Few	2%		Ind	Tree
Aloe Marlothii	Flat flowered aloe	Many	10.8%		Ind	Tree
Rhus leptodictya	Mountain karee	Many	8%		Ind	Tree
Celtis Africana	White mulberry	Few	4%		Ind	Tree
Rhuslancea	Karee	Many	17%		Ind	Tree
Morus Alba	Common mulberry	Few	11%		Invasive	Tree
Ficus ingens	Red leaved fig	Medium	3%		Ind	Tree
Dichrostachyscinerea	Sickle bush	Many	23%		Ind	Shrub
Eryobotya japonica	Japanese plum	Few	4,8%		Exotic	Tree
Prunus persica	Peach tree	Many	36%		Exotic	Tree
Nerium oleander	Oleander	Many	13.5%		Invasive	Shrubs
Ficus sur	Broom cluster fig	Few	1,9%		Ind	Tree
Protea gaguedi	African protea	Few	7.3%		Ind	Tree
Acacia tortilis	Umbrella thorn	Few	1,11%		Ind	Tree
Erythrina lysistemon	Sacred coral tree	Few	9%		Ind	Tree
Sesbania punicea	Crimson	Many	28%		Invasive	Shrub
Cerus jamacaru	Queen of the night	Few	5.2%		Invasive	Tree
Agave americana	American aloe	Few	2,12%		Invasive	Cacti
Euphorbia cooperi	Bushveld candelabra	Few	1,9%		Ind	Tree
Psidium guajava	Common guava	Many	45%		Invasive	Tree per
Persea americana	Avocado	Many	26%		Exotic	Tree
Solanum mauritianum	Bug weed	Many	13,9%		Invasive	Tree
Eucalyptus grandis	Rose gum	Few	12%		Invasive	Tree
Melia azedarach	Syringa	Many	14,7%		Invasive	Tree
Jacaranda mimosifolia	Blue jacaranda	Many	14,09%		Invasive	Tree
Vangueria infausta	Wild melda	Few	0.02%		Ind	Tree

Table 4.2.1 shows vegetation species composition occurrence on proposed site

Vegetation survey revealed that it is part of escarpment and montane type. Is falling under a grassland biome. Upper layers are comprised of woody species which include trees and shrubs while the lower layer comprised of herbs; grass with no climbers and runners which are scares to exist in grassland biome. Dominant trees are fruit tress that are in homes of the people. As listed on the table above fruit tress are the ones in higher existence mostly peach, guava and avocados.

Cheese wood tree was identified on top of the catchment along the gorges and is the only protected tree identified. Big trees are very scattered since the area is a grassland.

The area falls under a zero protected area according to Mpumalanga biodiversity sector plan. Refer to a map below by red line.

Common problems on vegetation included cutting for domestic use. This was confirmed by trees that their branches and stems were cut. Along riparian zone vegetation highly degraded from top of the catchment to the bottom.

Invasive plant species are the ones that dominate the area as confirmed during surveys throughout the study area. Gum trees were found growing on the riparian zone at the bottom of the catchment. Grinidia burchellii was found to be growing on riparian zones and where it looked to wet and being part of seasonal and temporary wetland zones.

Sesbania punicea (red sesbania) was found to be growing along the wetlands and were river dried due to sediments. It was confirmed that its seeds got spread during previous flooding when it rained. This is one of highly invasive plant which have high potential to replace other species where it grows.

Mpumalanga province is having more protected areas and areas that are demarcated as those having endemic species. But having consulted existing reports and various historical data the area of study is not falling under endemism category.

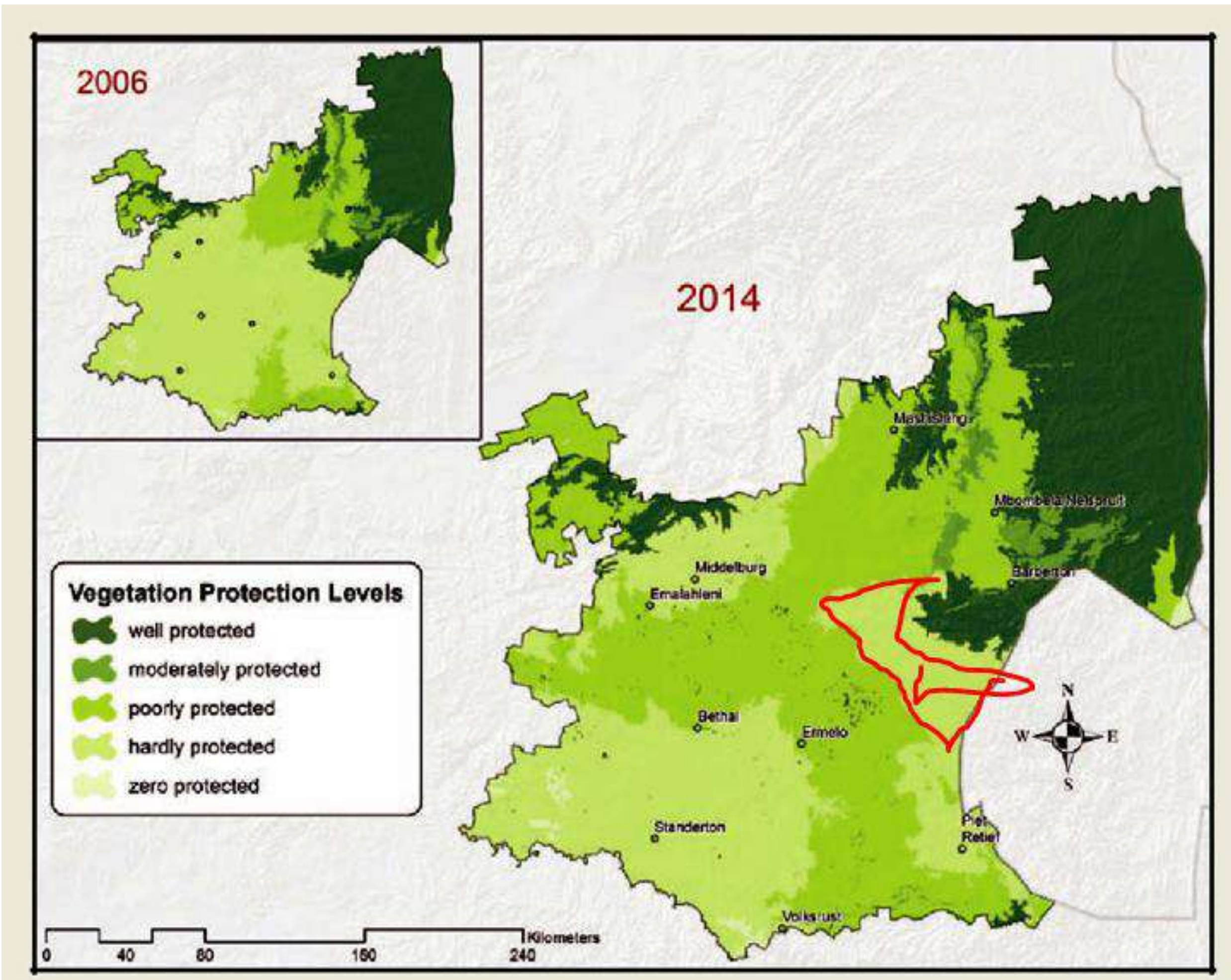


Figure 4.2.1 Map showing protection levels of Mpumalanga's ecosystems, based on the proportion of the biodiversity target for each ecosystem (vegetation type) that is included in a protected area (indicated by red line for the study area).

Protected areas that exist are not part of the study area as seen by color coding on the map above. The aera of study itself is an existing residential area which is now considered for formalization as a township that is near Elukwatini town.

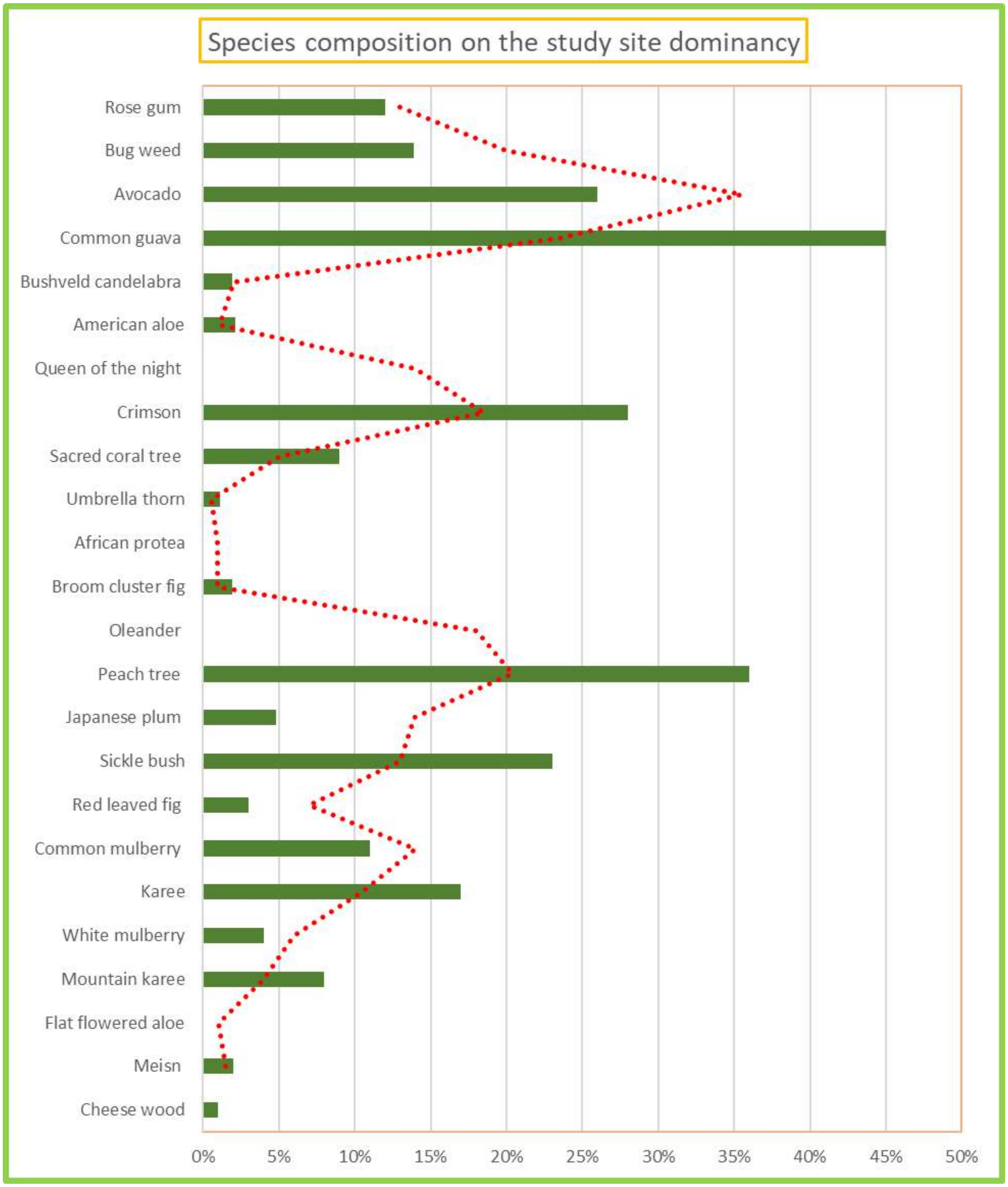


Figure 4.2.2: Graph showing species composition trend

Grass species were identified during field survey by means of walking through a line transect which was demarcated at an interval of 10m apart and 30m long. Grass are one of the important habitat species as they also comprise a habitat biome. Grass plays an essential role in nature as they are a major source of food. They provide shelter and nesting material. They also form important part of food chain for those species that utilize grass. They play a major habitat for rodents, birds, and insects' species. During field survey grasses were found to be grazed condition. The area being a grassland biome is having high grass species composition which includes wetland grass and sedges. Existence of site on the grassland biome is also shown on maps below.

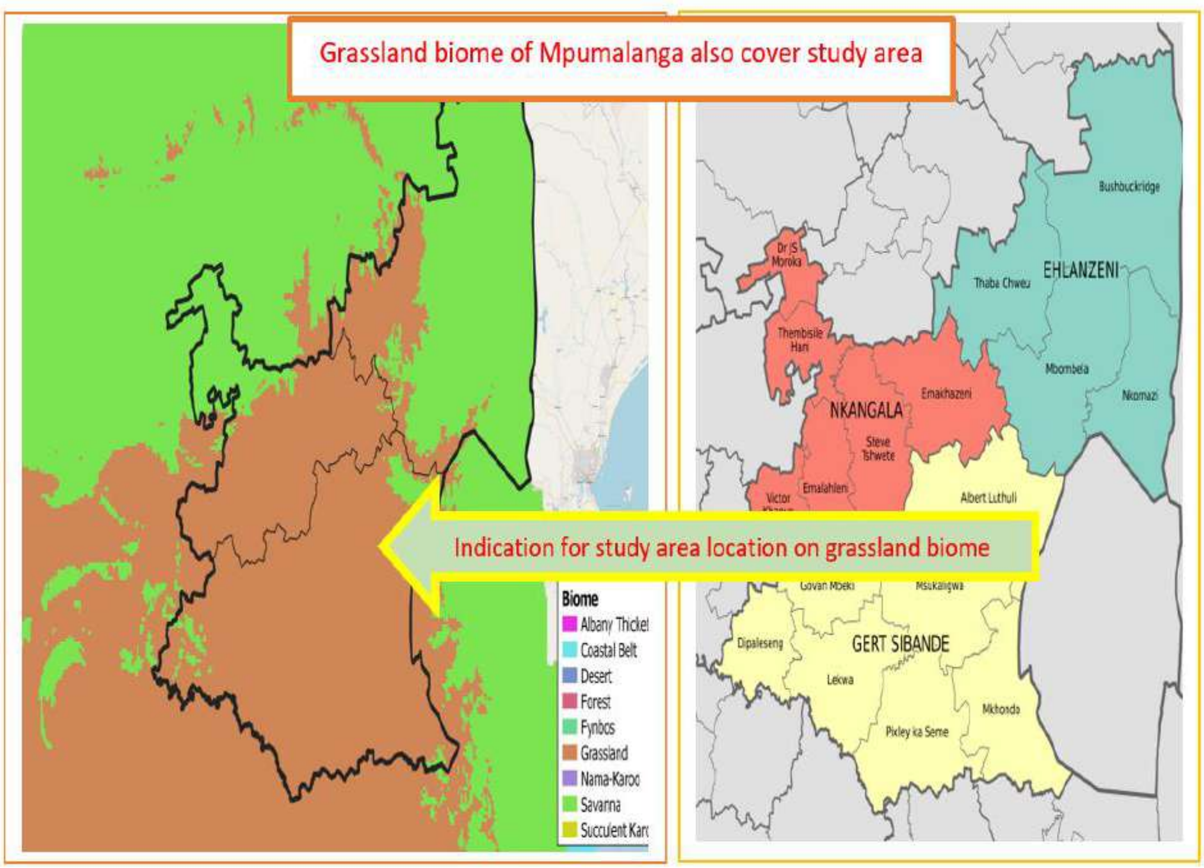


Figure 4.2.3: Map showing locality of study site being on the grassland biome.

Scientific name	Common name
Typha capensis	Common bulrush
Sporobolus africanus	Rat's tail dropseed
Cenchrus ciliaris	Foxtail buffalo grass
Panicum maximum	Guinea grass
Eragrostisrigidior	Curly leaf grass
Monocymbiumcresiiforme	Boat grass
Hyparrherniatamba	Berg gras
Setaria incrassate	Vlei bristle grass
Eragrostis racemosa	Narrow heart love grass
Merxmuelleradisticha	Mountain wire grass
Tragus berteronianus	Carrot seed grass
Andropogon Gayanus	Blue grass
Monocymbium ceresiiforme	Boat grass
Heteropogon Contortus	Spear grass
Elionurus Muticus	Wire grass
Setaria Sphacelata	Golden bristle grass

Table 4.1.2: Shows grass composition of the proposed area

4.2.1 Problem plants and herbaceous plants identified

Most of the identified plants were the indicators of disturbed area. These were identified near and surrounding homes. They are located mostly on corners where community dump their mixed waste on open spaces. Dumping of waste was determined to be the one playing major role on spreading of the problem plants. Along the riparian zone some problem plants were identified in association with degraded land.

Scientific Name	Common Names	Life form	Category
Boerhavia diffusa	spiderling	Herb	Exotic
Achyranthes aspera	Burweed, Moxato	Herb	Probably exotic
Amaranthus deflexus	Perennial pig weed	Herb	Indigenous
Amaranthus hybridus	Pig weed	Herb	Exotic
Amaranthus spinosus	Thorny pig weed	Herb	Exotic
Amaranthus viridis	Slender amaranth	Herb	Exotic
Ageratina adenophora	Crofton weed	Herb	Exotic
Bidens pilosa	Common black jack	Herb	Exotic
Conyza sumatrensis	Tall fleabane	Herb	Exotic
Portulaca oleracea	porslein	Herb	Exotic
Senecio consanguineous	Starvation senecio	Herb	Exotic
Tagetes minuta	Tall khaki weed	Herb	Exotic
Xanthium strumarium	Large cocklebur	Herb	Exotic
Crotalaria sphaerocarpa	Wild lurcene	Herb	Indigenous
Mirabilis jalapa	Four-o'clocks	Herb	Exotic
Datura ferox	Large thorn apple	Herb	Exotic
Solanum elaeagnifolium	Silver leaf bitter apple	Herb	Exotic
Richardia brasiliensis	Mexican richardia	Herb	Exotic
Tribulus terrestris	Devil's thorn	Herb	Indigenous
Stylochiton natalensis	Bushveld arum	Herb	Indigenous

Table 4.2.1.1: Shows problem plant species composition

4.3. Reptile and amphibian survey

This was done by direct observation during a transect walk and indirect observation of callings from amphibians and reptile movement over the dry plants. No reptiles were identified during field visit although the following are likely to be found includes Chameleons, and Lizards various snakes. These are indicated on the attached appendix(s). Amphibians are highly likely to be found in the area since the area do have some seasonal wetlands and non-perennial river. Although snakes were not physically sighted, they exist in this suitable habitat. Rare species and threatened frog species are also likely to be occurring on this site because of wetland habitats that exist.

4.4. Bird survey

Birds are known to be some of the mobile species that once and again fly over to different habitats searching for food and for breeding sites. Birds were observed during site assessment. protected bird species were not identified during field visit or either on existing documents, but they are highly likely to be sighted considering data from Mpumalanga biodiversity sector plan which indicated some species that exist in the province. Since bird species are not stationed at one area; they are likely to be observed and or be occurring on the nearby habitats. In general, this area falls under the area of high ecological value which tends to support more bird species such as doves because of tree species that are loved by birds. More bird's callings were heard during field survey although couldn't easily be spotted.

Scientific name /common name	**Conservation status**
Dark capped bulbul (Black eye ring)	Safe
Speckled mousebird (black mask, black and white bill)	Safe
Brew rostris (*Hadida iris*)	Safe
Bronze mannikin (*Lonehura cucullata*)	Safe
Corvus albicollis (White necked raven	Safe
Streptopelia capicola (Laughing dove)	Safe
Streptopelia capicola semitorquata (Red eyed dove)	Safe

Table 4.4.1: Bird species that were seen on site

4.5 Mammal survey

Mammals are one of the species that are sensitive to disturbed and human settlement areas. Although mammals were not sighted, they are likely to be occurring in the area. It is still favorable habitat for most of small mammals.

4.6 Butterfly; Beetles; Locusts, Ants, and dragon fly survey

Butterflies and dragon fly are species that like to be found in wet areas and during flowering season. Although this is the case none of these species were identified in the area; and are also likely to be found during wet seasons when temporary ponds can be established after rains. None of protected species or rare have been identified under this category. Dragon flies are also having a potential of existing in this area. Ants were seen although not identified for rare species; locusts were sited also but no key threatened species identified.

4.7 Stream; wetland survey and existence of sensitive area(s)

The area is located on Inkomati and crocodile river catchment which is highly supportive and conducive for most of wetlands. wetlands zones were located. The type of soil also sandy to clay loamy greyish in color soil and loamy dark grey in color. Wetland delineation assessment was also commissioned to assess and present results; this is presented on a separate report.

Type of stream which has been identified is a non-perennial one which only flow water when it rains. Sensitive sites are wetlands on study site.
Nhlazatshe river is the main river located on the western side flowing from the mountain to the bottom. Along the riparian zone on sand mining was seen as the one causing degradation.

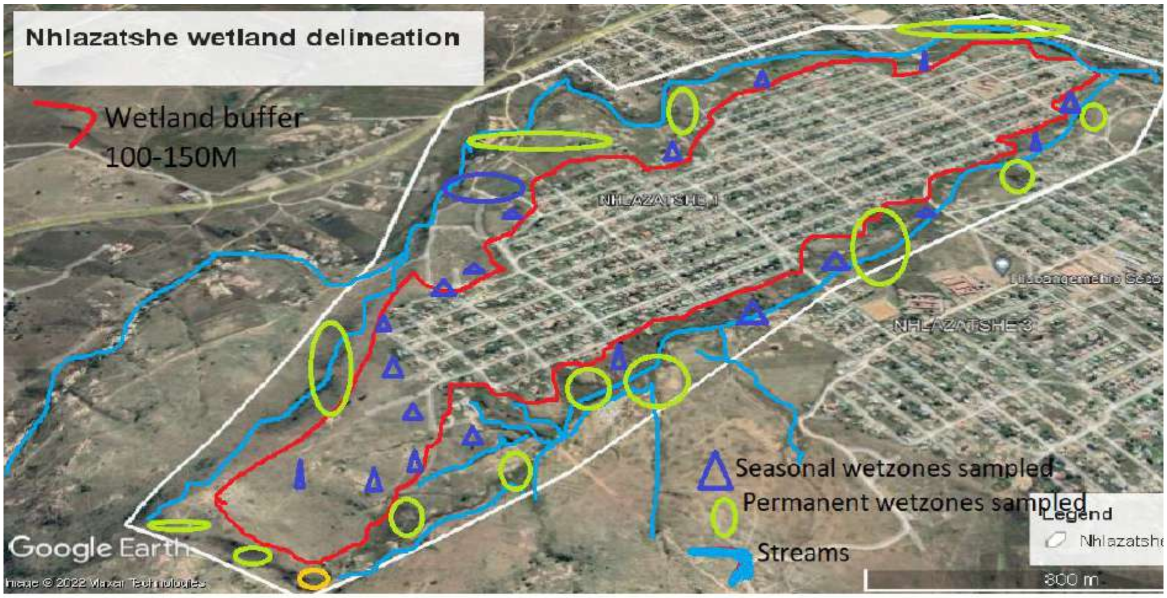


Figure 4.7.1: Wetland delineation map

4.8 **CRITICAL BIODIVERSITY AREAS ASSESSMENT**

A confirmation has been done using desktop analysis on GIS and field validation to confirm status of critical biodiversity area.

As confirmed during field survey the area is under a natural area remaining layer remnants due to its locality in a rural area which makes it become a grazing area.

Does have connections with existing habitats on the western side only due to existing land uses on both sides.

Most of critical biodiversity areas that exist in the region does not cover an area where proposed site is located.

5. MITIGATION MEASURES TO BE TAKEN INTO ACCOUNT

The following mitigation measures must be taken enforced on the area before and after the formalization process because damage has already occurred and is still taking place.

The Impact Mitigation Hierarchy (DEA et al., 2013)

5.1 Restrictions based on findings to minimize ecological impacts

Nhlazatshe 01 is having more households which indicate that population pressure on the natural resources is high which resulted to the following environmental problems:

Problem	Location	Proposed solution
Dumping of solid waste (Pollution)	Riverbanks; open spaces, along-streets. Wetlands and on flowing water. Riparian zones	Awareness-raising. Environmental education. Provision for mobile dumping containers stations
Sand mining	On riparian zone	Stop and demarcate new sites. Environmental education and environmental monitors
Washing clothe in the river	Near apostolic mission church	Environmental education
Soil erosion	Along riparian zones	Environmental education
Over grazing	Wetland; riparian; open space	Promote controlled grazing Livestock-reduction. Agricultural-extension-and education
Invasive alien plants	Wetlands; coridors;riparian	Clearing and control

Table 5.1.1 Environmental problems caused by humans in the area

6. RED DATA PLANT EXISTENSE ON SITE

A review on red data plant list was done to check their existence on proposed site and those that were identified are indicated on a table list below

SA AFRICAN RED DATA PLANT LIST BASED ON IUCN CLASSIFICATION		
SCIENTIFIC NAME	**COMMON NAMES**	**CATEGORY**
Pittosporum viridiflorus	Sims	Least concern(LC)
Dichrostachyscinerea	Sickle bush	Least concern(LC)
Acacia tortilis	Umbrella thorn	Least concern(LC)

Table 6.1: shows red data plant species

7. EVALUATION OF PRESENT ECOLOGICAL STATE (EPS); ECOLOGICAL IMPORTANCE AND SENSITIVITY (EPIS) AND ECOLOGICAL IMPACTS

Site is falling under present ecological state class E which is a seriously modified ecosystem. Most of damage have occurred which led to site having less functionality in support of the ecosystems and connection with other ecosystems.

The Ecological Importance and Sensitivity (EIS) of the assessment area is therefore classified as Class D (low) as it not ecologically important and/or sensitive on any scale. Biodiversity is ubiquitous and not unique due to the extremely vast and homogenous and largely undeveloped surrounding natural landscape. The assessment area is not viewed as being of high conservational significance for habitat preservation or ecological functionality persistence in support of the surrounding ecosystem, broader vegetation type or surface water catchment and drainage area.

The criteria for the description and assessment of environmental impacts were drawn from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April1998) in terms of the Environment Conservation Act (ECA), 1989 (Act 107 of 1989). Although the ECA EIA Regulations have been repealed, the Guideline Document still provides good guidance for significance determination (Charles J.K.1994).

The level of detail as depicted in the EIA regulations were fine-tuned by assigning specific values to each impact. To establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. The impact assessment criteria used to determine the impact of the proposed development are as follows:

- Nature of the impact.
- The Source of the impact.
- Affected stakeholders.
- Extent - The physical and spatial scale of the impact.
- Duration - The lifetime of the impact, that is measured in relation to the lifetime of the proposed development.

Below table outline impact ranking of the proposed development in and around the proposed area considering its ecological footprint.

Considering that proposed area has been demarcated for residential stands; for it being in the rural area where most of rural activities does not have extensive impact on vegetation system it will automatically get vegetation kept safe and will also lead to promotion of vegetation safeguarding.

During site survey it was confirmed that community led to degradation of vegetation.

Rating below is for impacts that are taking place and occurred as the area is developed.

Nature of Impact	Development stage associated with	PRESENT IMPACT RANKING, WEGHING AND SCALING							
		extent	Duration	Intensity	Probability	Weighting factor	Significance rating	Mitigation efficiency	Significance following
Removal of vegetation	**A**	**5**	**3**	**4**	**5**	**5**	**10-1**	**2.0**	**0-1**
Destabilization of soil	**A** **B**	5	2	5	5	5	20-39	3	20-39
Compaction of soil	**A** **B**	**2**	**2**	**3**	**3**	**3**	**20-39**	**1.0**	**20-39**
Spread of invasive alien plant seeds	**A**	4	4	4	6	5	20-39	0.6	20-39
Habitat fragmentation	**A**	3	3	3	3	3	0-19	1.0	0-1

Figure 7.1: Assessment of impact which has occurred and still occurring.

Cumulative impacts present on site	**Impact description rate**	**Impact percentage of present occurrence**
Removal of vegetation	Medium	15%
Destabilization of soil	High	40%
Compaction of soil	Medium	10%
Spread of invasive alien plant seeds	High	30%
Habitat fragmentation	Low	5%

Table 7.1.1: Present cumulative impact assessment

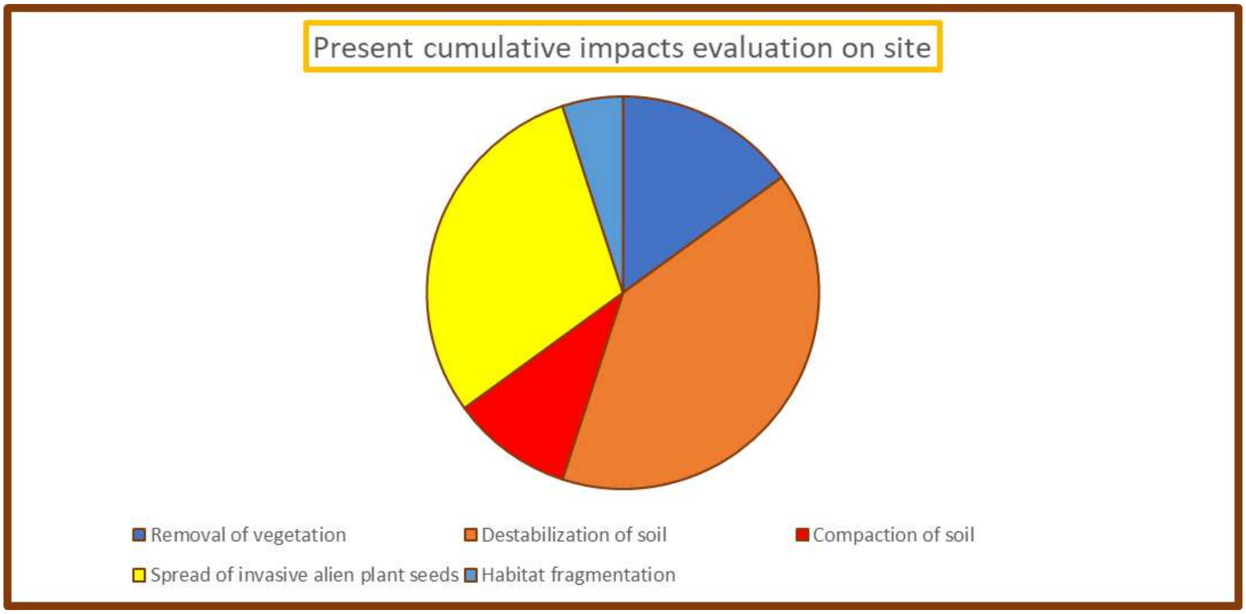


Figure 7.1.1.: Chart showing present cumulative impacts analysis

8. RECOMMENDATIONS

The proposed township formalization will require compliance to the following recommendations:

- A specialist (Environmental officer) must be appointed to deal with all environmental issues as indicated on the impact assessment. This will assist in implementing an environmentally friendly development.
- A license to disturb or cut indigenous trees and protected trees must be applied for from the Department of Agriculture, forestry and fisheries as per National Forest Act, 1998 (Act No. 84 of 1998)

- National Environmental management biodiversity 2004 (Act No 10 of 2004) (NEMBA) must also be considered when dealing with invasive alien plants so that all measure can be based on this legislation and its regulations.
- Environmental management plan must be developed to cater for detailed mitigations for all identified direct and indirect impacts.
- Minimize cutting down of big indigenous trees where possible but also ensure that protected tree is not removed.
- Transportation of material must be done with care to minimize the transportation of alien plants seeds from one point to another.
- People must be educated on planting of indigenous local trees.
- Municipality must promote an eco-town ship greening in the area to safeguard existing vegetation.
- A buffer zone of 100m must be complied to without any compromise to protect riparian vegetation.
- Sand mining must be controlled.
- Municipality must provide sub waste dump station in the community vicinity.
- Implement an adequate Alien Invasive Species Establishment Management and Prevention Plan during the construction phase. Such a management plan must be compiled by a suitably qualified and experienced ecologist.
- Alien invasive species individuals currently on site must be actively eradicated from the assessment area and adequately disposed of in accordance with the National Environmental Management: Biodiversity Act (Act 10 of 2004); Alien and Invasive Species Regulations, 2014.

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APPENDIX A: LEGISLATION CONSIDERED AND RELEVANT

The criteria it was necessary to list relevant legislation for reference while working in the area and further guidance in order to improve compliance. Therefore, all legislations applicable are listed below:

Name	Overview
National Environmental Management Act (Act No. 107 of 1998)	To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith.
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity within the framework set out by NEMA and the protection of species and ecosystems that warrant national protection.
National Environmental Management: Protected Areas Act (Act No. 57 of 2003)	The Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas, and for matters in connection therewith.
National Spatial Biodiversity Assessment, 2004	The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on its biophysical characteristics, which are ranked according to priority levels.
National Biodiversity Assessment, 2011 (NBA)	The purpose of the NBA is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors.
National Biodiversity Framework (NBF)	The purpose of the NSF is to provide a framework to co-ordinate and align the efforts of the many organisations and individuals involved in conserving and managing South Africa's biodiversity, in support of sustainable development. The NBF provides a framework for conservation and development which is detailed in 33 Priority Actions.
List of Threatened species / ecosystems	The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems. Threatened ecosystems are identified using different criteria such as: • Irreversible loss of natural habitat • Ecosystem degradation and loss of integrity • Limited extent and imminent threat • Threatened plant and animal species associations • Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan

National Forests Act (Act No. 84 of 1998):	This Act provides for the management, utilisation and protection of forests through the enforcement of permitting requirements associated with the removal of protected tree species, as indicated in a list of protected trees (first promulgated in 1976 and updated since).
The National Water Act (Act No. 36 of 1998)	This Act aims to provide management of the national water resources to achieve sustainable use of water for the benefit of all water users.
Municipal Systems Act (Act No. 32 of 2000)	This Act aims to empower local government to fulfil its Constitutional objects, regulate key municipal organisational, planning participatory and service delivery systems.
Spatial Planning and Land Use Management Act (Act No. 16 of 2013)	This Act is a framework act for all spatial planning and land use management legislation in South Africa. It seeks to promote consistency and uniformity in procedures and decision-making in this field.
Convention of Biological Diversity (CBD)	South Africa is a signatory to the CBD, which requests countries to: • Establish a system of protected areas to conserve biodiversity; • Develop guidelines for the selection, establishment and management of protected areas;
National Environmental Management Act (Act No. 107 of 1998)	To provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith.
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APPENDIX B: Red data Species Checklist Considered

(National Environmental Management Biodiversity Act (Act 10 of 2004)

REPTILIA

SCIENTIFIC NAME	COMMON NAME	CRITICALLY ANDANGERED	ENDANGERED	VULNERABLE	PROTECT ED	LIKELY TOEXIST ON PROPOSED AREA
Caretta caretta	Loggerhead Sea Turtle	✓				
Dermochelys coriacea	Leatherback Sea Turtle	✓				
Eretmochelys imbricate	Hawksbill Sea Turtle	✓				
Chelonia mydas	Green Turtle		✓			
Cordylus giganteus	Giant Girdled Lizard		✓			
Lepidochelys olivacea	Olive Ridley Turtle		✓			
Psarnrnobates geornetricus	Geometric Tortoise		✓			
Bitis gabonica	Gabon Adder				✓	
Bitis schneideri	Namaqua Dwarf Adder				✓	
Bradypodion taeniabronchum	Smith's Dwarf Chameleon				✓	
Cordylus cataphractus	Armadillo Girdled Lizard				✓	
Crocodylus niloticus	Nile crocodile				✓	
Python natalensis	African Rock Python				✓	✓

AVES

SCIENTIFIC NAME	COMMON NAME	CRITICALLY ANDANGERED	ENDANGERED	VULNERABLE	PROTECT ED	LIKELY TOEXIST ON PROPOSED AREA
Grus carunculatus	Wattled Crane	✓				
Hirundo atrocaerulea	Blue Swallow	✓				
Neophron percnopterus	Egyptian Vulture	✓				
Poicephalus robustus	Cape Parrot			✓		
Trigonoceps occipitalis	White-headed Vulture			✓		
Aquila rapax	Tawny Eagle			✓		

A rdeotis kori	Kori Bustard			✓		
Ciconia nigra	Black Stork			✓	✓	
Circaetus fasciolatus	Southern Banded Snake Eagle			✓	✓	
Eupodotis caerulescens	Blue Korhaan			✓	✓	
Falco fasciinucha	Taita Falcon			✓		
Falco naumanni	Lesser Kestrel			✓		
Falco peregrinus	Peregrine Falcon			✓		
Geronticus calvus	Bald Ibis			✓		
Neotis ludwigii	Ludwig’s Bustard			✓		
Polemaetus bellicosus	Martial Eagle			✓		
Terathopius ecaudatus	Bateleur			✓		
Tyto capensis	Grass Owl			✓		
Bucowus leadeateri	Southern Ground-Hornbill				✓	
Circus ranivorus	African Marsh Harrier				✓	
Neotis denhami	Denham’s Bustard				✓	
Sphensiscus demersus	Jackass Penguin				✓	
MAMMALIA						
SCIENTIFIC NAME	**COMMON NAME**	**CRITICALLY ANDANGERED**	**ENDANGERED**	**VULNERABLE**	**PROTECTED**	**LIKELY TOEXIST ON PROPOSED AREA**
Bunolagus monticularis	Riverine Rabbit	✓				
Chrysospalax villosus	Rough-haired Golden Mole	✓				
Arnblysomus robustus	Robust Golden Mole					
Damaliscus lunatus	Tsesebe			✓		
Diceros bicornis	Black Rhinoceros		✓			
Lycaon pictus	African Wild Dog		✓			
Neamblysomus gunningi	Gunning's Golden Mole		✓		✓	
Ourebia ourebi	Oribi		✓		✓	
Paraxerus palliates	Red Squirrel		✓		✓	
Acinonyx jubatus	Cheetah		✓			

Cricetomys gambianus	Giant rat		✓			
Manis temminckii	Pangolin		✓			
Neamblysomus julianae	Juliana's Golden Mole		✓			
Otomops martiensseni	Large-eared Free-tailed Bat		✓			
*Panthera **leo***	Lion		✓			
Panthera pardus	Leopard		✓			
Philantomba monticola	Blue Duiker		✓			
Atelerix frontalis	South African Hedgehog		✓			
Connochaetes gnou	Black Wildebeest		✓			
Crocuta	Spotted Hyena		✓			
Felis nigripes	Black-footed Cat		✓			
Parahyaena brunnea	Brown Hyena		✓			
Loxodonta africana	African elephant		✓			
Lutra maculicollis	Spotted-necked Otter		✓			
Mellivora capensis	Honey Badger		✓			
Redunca arundinum	Reedbuck		✓			
INVERTEBRATA						
SCIENTIFIC NAME	**COMMON NAME**	**CRITICALLY ANDANGERED**	**ENDANGERED**	**VULNERABLE**	**PROTECT ED**	**LIKELY TOEXIST ON PROPOSED AREA**
Colophon spp - All species	Stag Beetles		✓			
Aloeides clarki	Coega Copper Butterfly					
Ceratogyrus spp - All species	Horned Baboon Spiders					
Echinodiscus bisperforatus	Pansy Shell			✓		
Dromica spp - All species	Tiger Beetles		✓			
Graphipterus assimilis	Velvet Ground Beetle					
Xadogenes spp - All species	Flat Rock Scorpions					

Halite's midae	South African Abalone				✓	
Xarpactira spp - All species	Common Baboon Spiders				✓	✓
Ichnestoma spp - All species	Fruit Chafer Beetles				✓	
Manticora spp - All species	Monster Tiger Beetles				✓	
Megacephala asperata	Tiger Beetle				✓	
Megacephala regalis	Tiger Beetle				✓	
Nigidius auriculatus	Stag Beetle				✓	✓
Oonotus adspersus	Stag Beetle				✓	
Oonotus interioris	Stag Beetle				✓	✓
Oonotus rex	Stag Beetle				✓	
Oonotus sericeus	Stag Beetle				✓	
Opisthacanthus spp - All species	Creeping Scorpions				✓	
Opistophthalmus spp - All species	Burrowing Scorpions				✓	
AMPHIBIA						
SCIENTIFIC NAME	**COMMON NAME**	**CRITICALLY ANDANGERED**	**ENDANGERED**	**VULNERABLE**	**PROTECTED**	**LIKELY TOEXIST ON PROPOSED AREA**
Pyxicephalus adspersus	Giant Bullfrog				✓	
Pyxicephalus edulis	African Bullfrog				✓	

The above red data species evaluation was done and verified using existing data and consulted Mpumalanga biodiversity sector plan. For the unticked species some might occur on the surrounding habitats.

Photos: Listed photos below shows view of the site in terms of vegetation cover and condition of the land as found during field surveys.

Photo 1: ***Protea gaguedi*** (African protea) growing on higher escarpment

Photo 2: ***Pittosporum viridiflorum*** (Cheese wood) protected specie

Photo 3: Ficus tree as the main standing tree on grassland top part

Photo 4: Top of the catchment grassland with gorges and few plants

Photo 5: ***Aloe marlothii*** growing on top of the catchment grassland

Photo 6: ***Ficus ingens***

Photo 7: River (Nhlazatshe) and wetland on top part of the catchment

Photo 8: Nhlazatshe river flowing over the rocks

Photo 9: Trees within home yards

Photo 10: Road passing through the Nhlazatshe river to Elukwatini on the western side

Photo 11: Cow grazing on wetland with waste on its side

Photo 12: People washing their clothe on the river with some fetching water

Photo 13: Mission church located at the bottom of the catchment on wetland edge

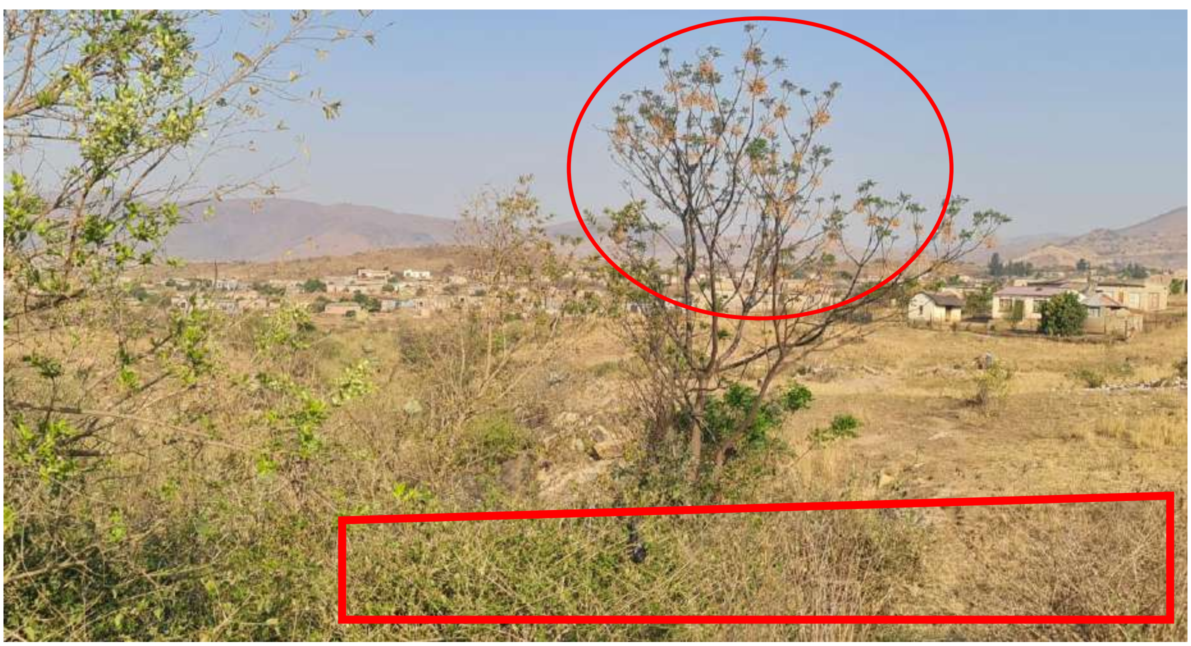

Photo 14: Invasive alien plants (Syringa and lantana) growing on the stream

Photo 15: Bottom to middle part of Nhlazatshe river and associated wetland

(people build on the edge of the river and wetland zone)

Photo 16: Building sand dumped on the wetland (Risk to cause sedimentation)

Photo 17: Wetland invaded by ***sesbania punicea*** (red sesbania) alien plant

Photo 18: Waste dumped on riparian zone and wetland

Photo 19: View of wetland on top of the catchment where it starts

Photo 20: ***Syzgium cordatum*** (water berry) growing on valley channel wetland.

Photo 21: ***Eucalyptus grandis*** *(red gum) growing on the river.*

Photo 22: Nerium oleander

Photo 23: Silver leaf bitter apple

Photo 24: Peach plant

Photo 25: Ficus tree which has been cut.

Photo 26: ***Agave americana*** (Century plant)

Photo 27: Household with peach trees in the yard.

Photo 28: Wetland water polluted with green algae

Photo 29: View of sand mining damage on riparian zone and wetland

Photo 30: Overview of the middle of catchment

Photo 31: View of site on the middle from east to south

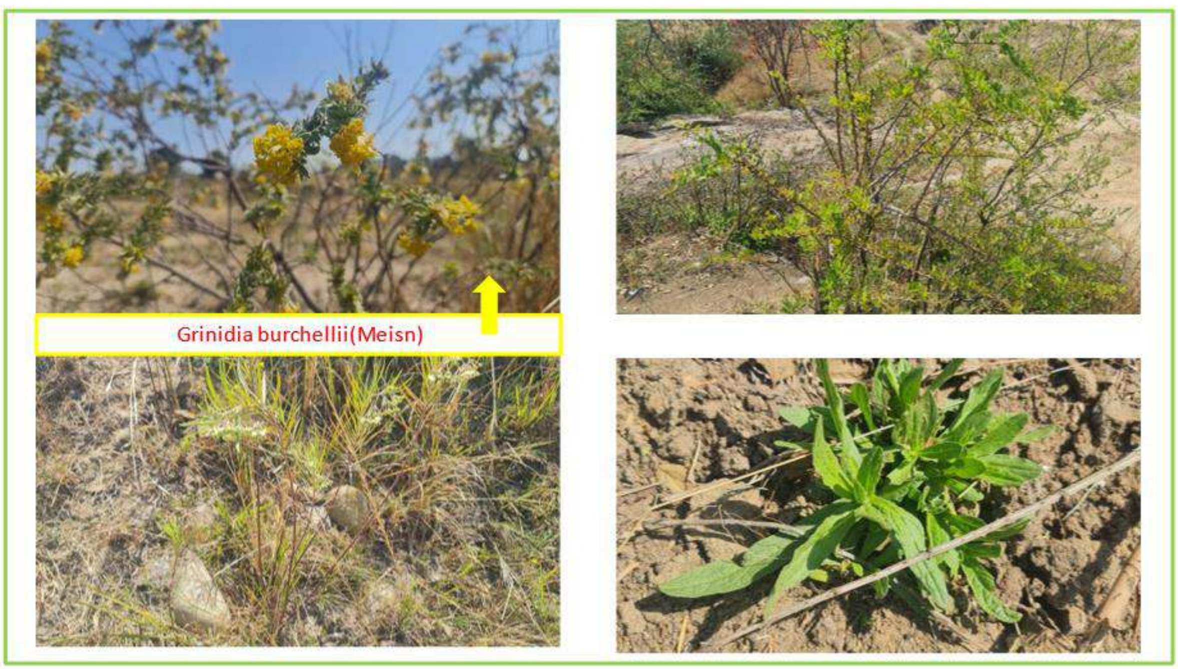

Photo 32: Plants located on riparian zone.

SENSITITY OVERVIEW AS REVEALED DURING ENVIRONMENTAL SCREENING

An overview of the area was undertaken through a desktop study using a recommended screening environmental tool as mandated by the national department of environmental forestry and fisheries which gazette that for every environmental impact assessment to be done for development projects screening for environmental sensitivity must be done.

Existing development footprint has impact on the local area which extends to a buffer zone outlined. Sensitive sites which include wetlands have been impacted.

Development footprint determination

Magnitude of the developed area is medium to high with its limitations of the footprint remaining locally. Potential to expand out of the region is low.

Geotechnical Report

OCTON

OCTON GEOLOGICAL CONSULTANTS

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED FORMALIZATION OF THE NHLAZATSHE TOWNSHIP WITHIN THE CHIEF ALBERT LUTHULI LOCAL MUNICIPALITY IN MPUMALANGA PROVINCE

Report NO: **OGT_2209002**

October 2022

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Reviewed by	Mushiana, K.R.	Geologist	17 October 2022	

EXECUTIVE SUMMARY

This geotechnical report contains the findings and development recommendations for the proposed demarcation of sites in Nhlazatshe 1, Elukwatini within the jurisdiction of Albert Luthuli Local Municipality in the Gert Sibande District, Mpumalanga Province of South Africa.

The co-ordinates that can be used to locate the site are 26°03'52.5"S, 30°45'44.8"E

Five disturbed samples were taken from the test pit excavations for laboratory analysis of Foundation Indicators. The laboratory test results are included in Appendix B. The main geotechnical constraints to the development will be erodible soils.

The major geological formations underlaying the area are the lithologies of the Onverwacht Group and Tonalite and Trondhjemite Gneiss. Onverwacht Group is comprised of grey, medium to coarse grained biotite-hornblende gneiss. Tonalite and Trondhjemite rocks are intrusive rocks with typical granitic composition i.e., quartz and feldspars but containing only a small portion of potassium feldspar.

In terms of SABS 1200D intermediate excavation is anticipated from the surface to depths of about 1.5 m below natural ground level. No groundwater seepage was observed in any of the pits excavated during field investigations. The site classified as R and C2 in accordance with the NHBRC Residential Class Designation. The soil was found to be erosible materials.

The foundation indicator test results indicate that the gravely sandy soil on site has a high amount of sand 49.0%, followed by gravel averaging at 38.75%, and 9.35% of silt and 2.9 % of clay; with a corresponding low Grading Modulus averaging at 1.78; which is indicative of medium to coarse-grained material. The soil sampled from the test pits classify as SC according to the Unified Soil Classification (USC). The Potential for Expansiveness is low according to Van Der Merwe's Activity Chart.

Based on the geotechnical investigation findings (geotechnical characteristics, geological settings, and laboratory results) the site is potentially suitable for the proposed development, but certain geotechnical constraints, such as potentially problematic soils may

affect development costs. The options for suitable foundations are Raft foundation, Stiffened strip footings, Stiffened or cellular raft and piled or split construction.

It is considered that the conditions prevailing on site are such that the site is considered suitable for the proposed development, provided the recommendations outlined here are adhered to.

Please note that this executive summary does not fully relate our findings and opinions. Those findings and opinions are only presented through our full report.

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1. INTRODUCTION

Octon Geological Consultants (Pty) Ltd was appointed by Mang Geo Environmental in September 2022 to conduct a geotechnical investigation for the proposed formalization of the Nhlazatshe township within the chief Albert Luthuli local municipality in Mpumalanga Province.

The investigation was carried out in accordance with the requirements of the National Department of Housing Generic Specification GFSH-2 (2002). This report presents the findings of the geotechnical investigation and provides recommendations for the appropriate foundation design and precautionary measures to mitigate the identified risks.

2. OBJECTIVES

The primary objective of the geotechnical investigation was to gather information on subsurface conditions at the site. The objectives can be stated as:

- Provide a description of the location geology of the proposed site;
- Define the ground conditions and classify the conditions through detailed soil profile descriptions and groundwater occurrences within the zone of influence of foundations;
- Identify potential geotechnical hazards;
- Comment upon any geotechnical constraints that may impact upon the design and construction of the proposed development (Dolomite area, etc.); and
- Provide the geotechnical basis for safe and appropriate land use planning, infrastructure, and housing unit design as well as formulation of precautionary measures and risk management procedures.

3. SITE DESCRIPTION

3.1. LOCALITY

The proposed development site (here after referred to as "the site") is in Elukwatini Nhlazatshe 1 in Mpumalanga province. The site is situated approximately 27.37 km southwest of Badplaas, 35.32 km northeast of Mbabane, 77.65 km east of Carolina and 115.08 km southwest of Nelspruit. The site covers an area of approximately 240ha. **Figure 1** and **Figure 2** show the site locality map and satellite map respectively. **Figure 3** shows photos of the site. The central co-ordinates that can be used to locate the site are:

- 26°03'52.5"**S**, 30°45'44.8"**E**

3.2. SITE DESCRIPTION

3.2.1. TOPOGRAPHY

The highest on-site topographical elevation point was recorded as 1248 mamsl (meters above mean sea level) and the lowest point at 1044 mamsl, with an elevation loss of 204 m over a lateral distance of ~3040 m. The topography of the area is generally rolling terrain. The topography on the site dips north-eastwards.

3.2.2 LANDUSE, INFRASTRUCTURE AND SOIL COVER

There are established buildings and other infrastructure like schools, roads, churches, and powerlines within the proposed site. The surface conditions were generally dry to slightly moist at the time of the investigation. Other existing infrastructure encountered adjacent to the site included a filling station, roads, houses, and overhead powerlines.

3.3.3. CLIMATE

The climate in Elukwatini is warm and temperate. The climate here is classified as Cbw by the Köppen-Geiger system. When compared to winter, the summers have much more rainfalls. The driest month is June, with approximately 9 mm of rain. The greatest amount of precipitation occurs in December, with an average of 141 mm. The annual rainfall in Elukwatini is 822 mm. The average annual temperature here is 17.0 °C. The temperatures are highest on average in February, at around 20.6 °C. The coldest month of the year is July with an average around of 11.7 °C.

3.3.4. DRAINAGE

The proposed site is in Inkomati -Usuthu Catchment Management Area. The study area falls within water management area number 03– Inkomati-Usuthu. WMA 03 includes the following major rivers: Nwanedzi, Sabie, Crocodile (East), Komati and Usuthu Rivers. Water management area 03 primarily drains in region X.

The site is drained by means of run-off, with storm water collection northeast of the site or drained to the Nhlazatshe river and its tributary on the northwest and southeast of the site respectively.

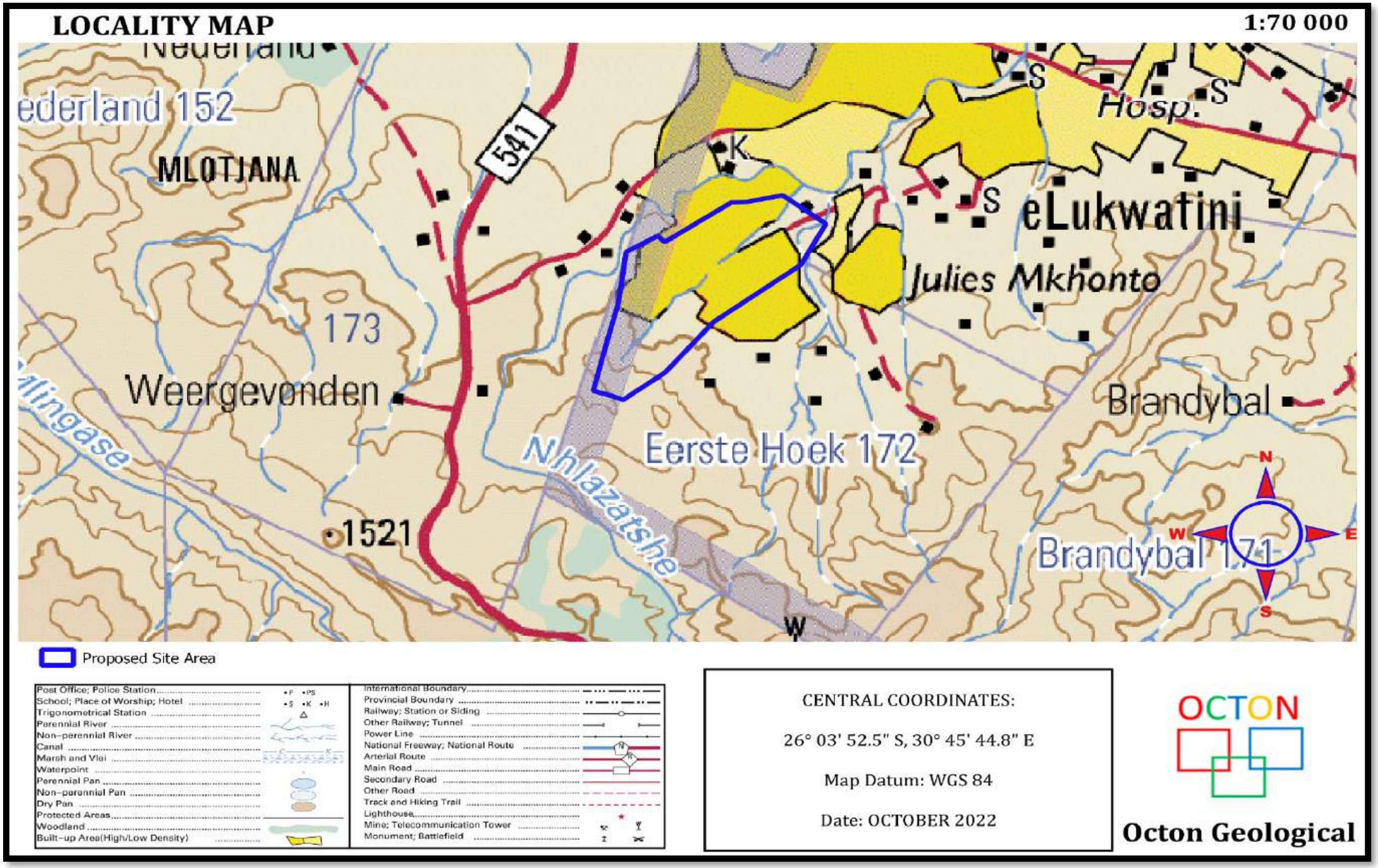


Figure 1: Locality Map.

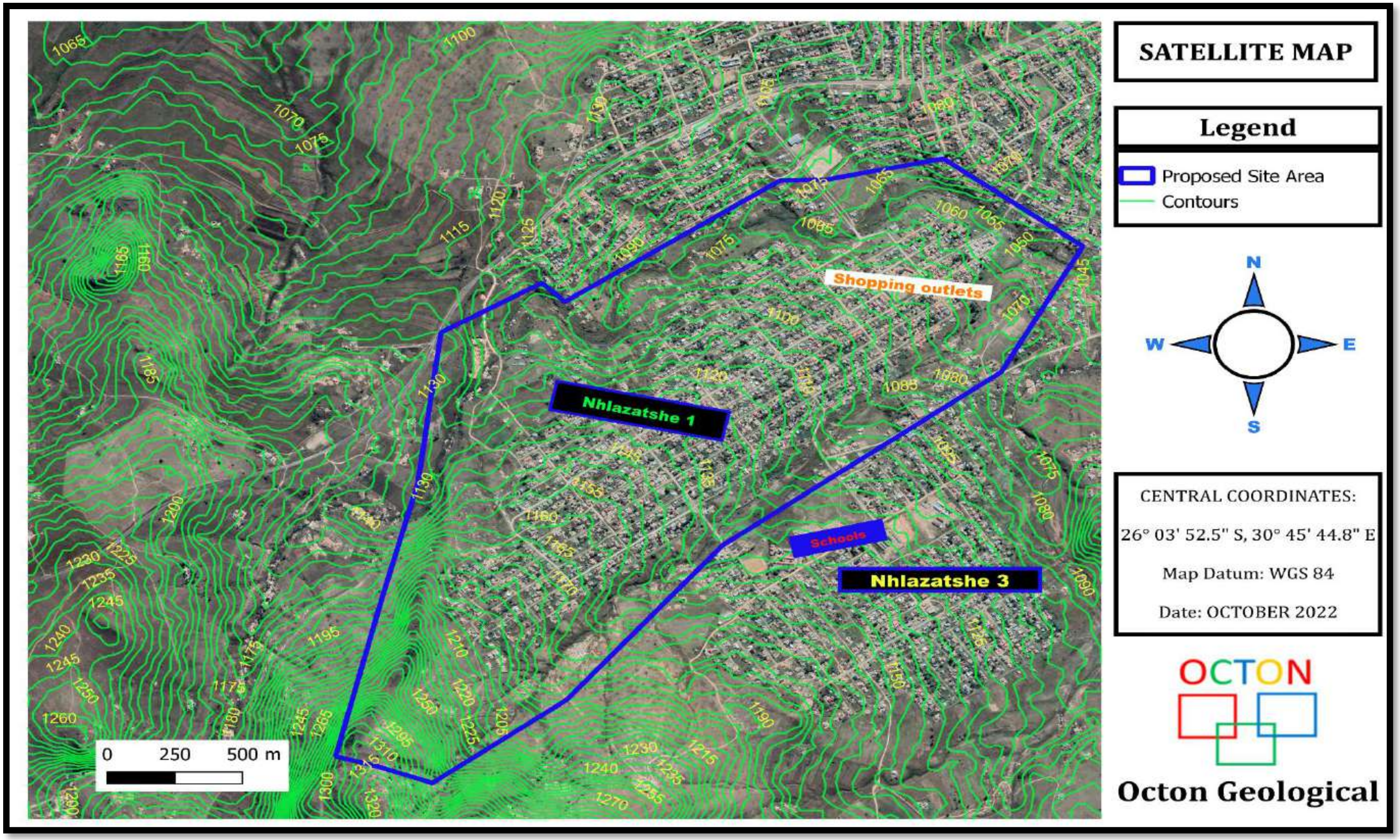
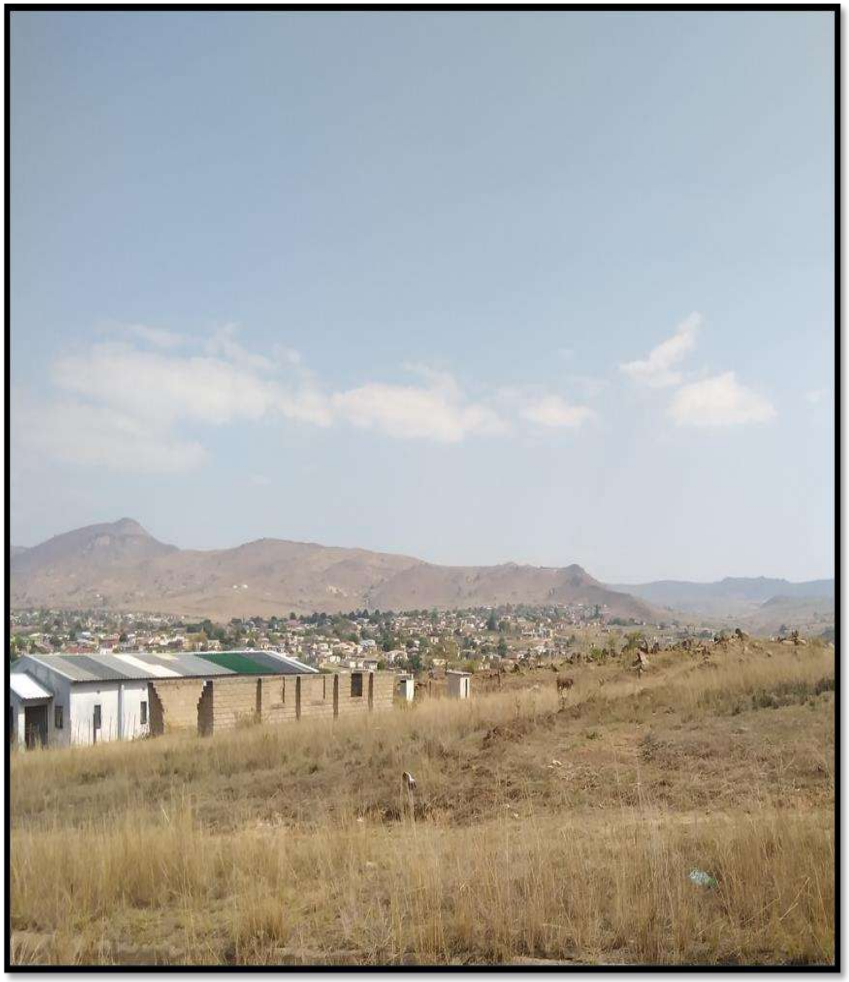


Figure 2: Satellite Map



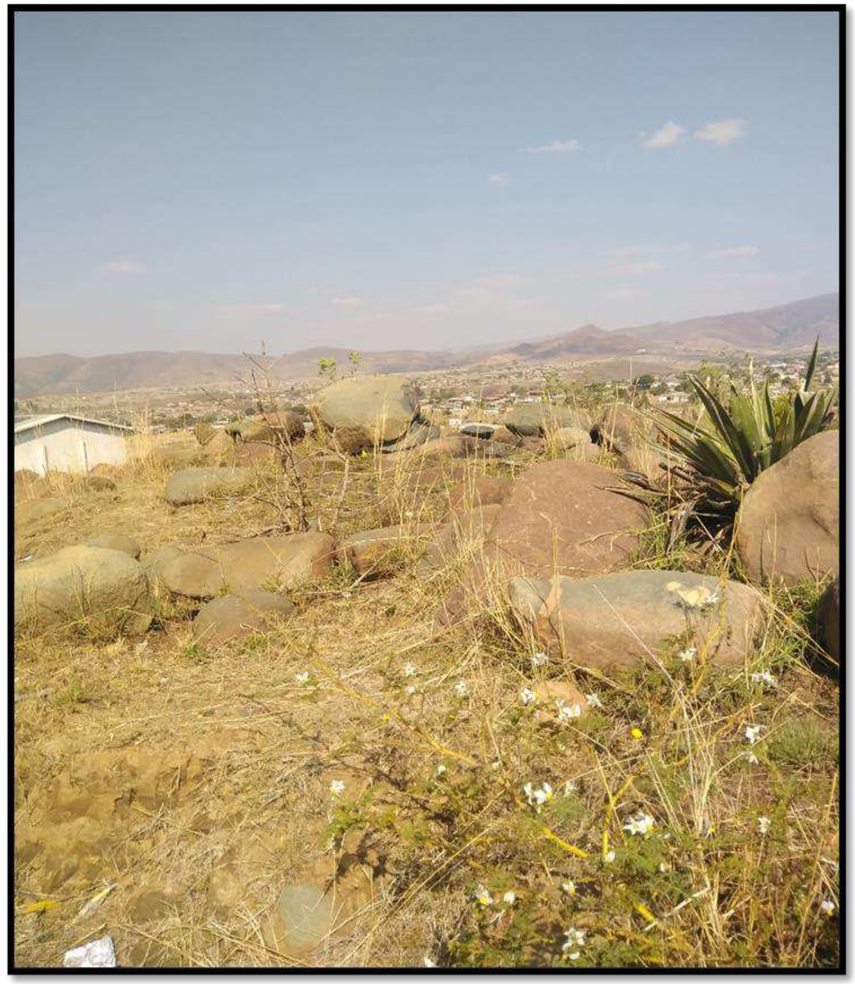


Figure 3: Photos of Site.

4. METHOD OF INVESTIGATION

4.1. DESKTOP STUDY

Desk study included a study of published geological and topographic maps, aerial photographs, ortho-photographs, geo-hydrological maps, or any other relevant data from previous work on and around the site. The purpose of the desk study was to:

- Provide background information and technical guidance as well as to refine the scope of work for the follow-up geotechnical assessment; and
- Identify potential geotechnical significant features such as tension cracks, slope failures and bulging of faces to be confirmed during site walkover.

4.2. GEOTECHNICAL INVESTIGATION

A geotechnical investigation was conducted, during which geotechnical significant features across the site such as potential seepage zones, tension cracks and bulging of faces were recorded. This phase of investigation relied on intrusive investigation methods such as test pitting, in-situ testing to collect and provide interpretive information to make recommendations regarding foundation and structural design.

The geotechnical investigation was carried out involved the excavation of thirteen (13) test pits (TP1 to TP13) using a TLB from the ground surface to maximum depths of around 1.5 m below ground level or machine refusal.

The test pits were positioned on various sections of the area under investigation considering the anticipated ground conditions, existing land use and the proposed development. The test pits positions were recorded in the field using a handheld Global Positioning System (GPS) with an accuracy of 3 m, and their coordinates appear on the soil profile log that is included in **Appendix A** of this report. The test pits were profiled by a geologist according to standard practice to define ground conditions and groundwater occurrences within the zone of influence of foundation work. **Figure 4** shows the position of the test pits and geotechnical zonation of the site.

4.3. LABORATORY TESTING

Laboratory testing forms an essential part of the geotechnical investigation. Representative disturbed samples were randomly retrieved from soil horizons for examination, identification, and laboratory testing. The laboratory test results are discussed in **Section 7** of this report. All test pits were backfilled with the in-situ material immediately after profiling.

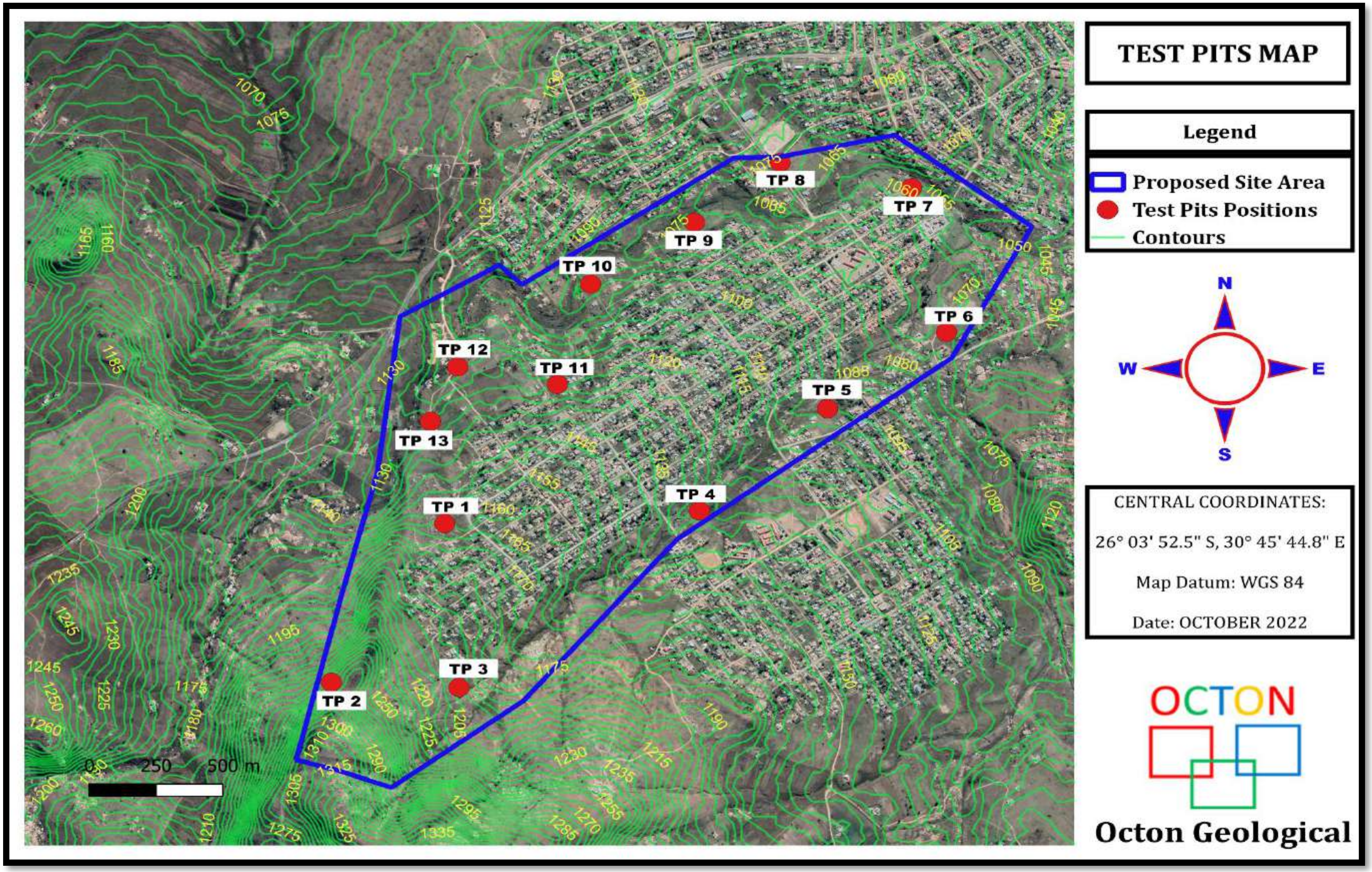


Figure 4: Trial Pit Positions

5. GEOLOGY

The study area is predominantly characterized by lithologies of the Onverwacht Group and Tonalite and Trondhjemite Gneiss.

5.1 ONVERWACHT GROUP

The Onverwacht Group in the Barberton Greenstone Belts is a major stratigraphic unit comprising the lower part of the Barberton Supergroup. The Onverwacht group is a predominantly volcanic sequence bounded by several major faults. Majority of the proposed mining area is comprised of grey, medium to coarse grained biotite-hornblende gneiss of the Onverwacht group.

5.2. TONALITE AND TRONDJEMITE GNEISS

Tonalite and Trondhjemite rocks are intrusive rocks with typical granitic composition i.e., quartz and feldspars but containing only a small portion of potassium feldspar. with phaneritic (coarse-grained) texture.

This site does not reflect any risk for the formation of the sinkholes or subsidence caused by the presence of the soluble rocks (dolomite or limestone), and no evidence of mining activity beneath the study area has been revealed.

The lithologies present in the study area are illustrated in **Figure 5** below.

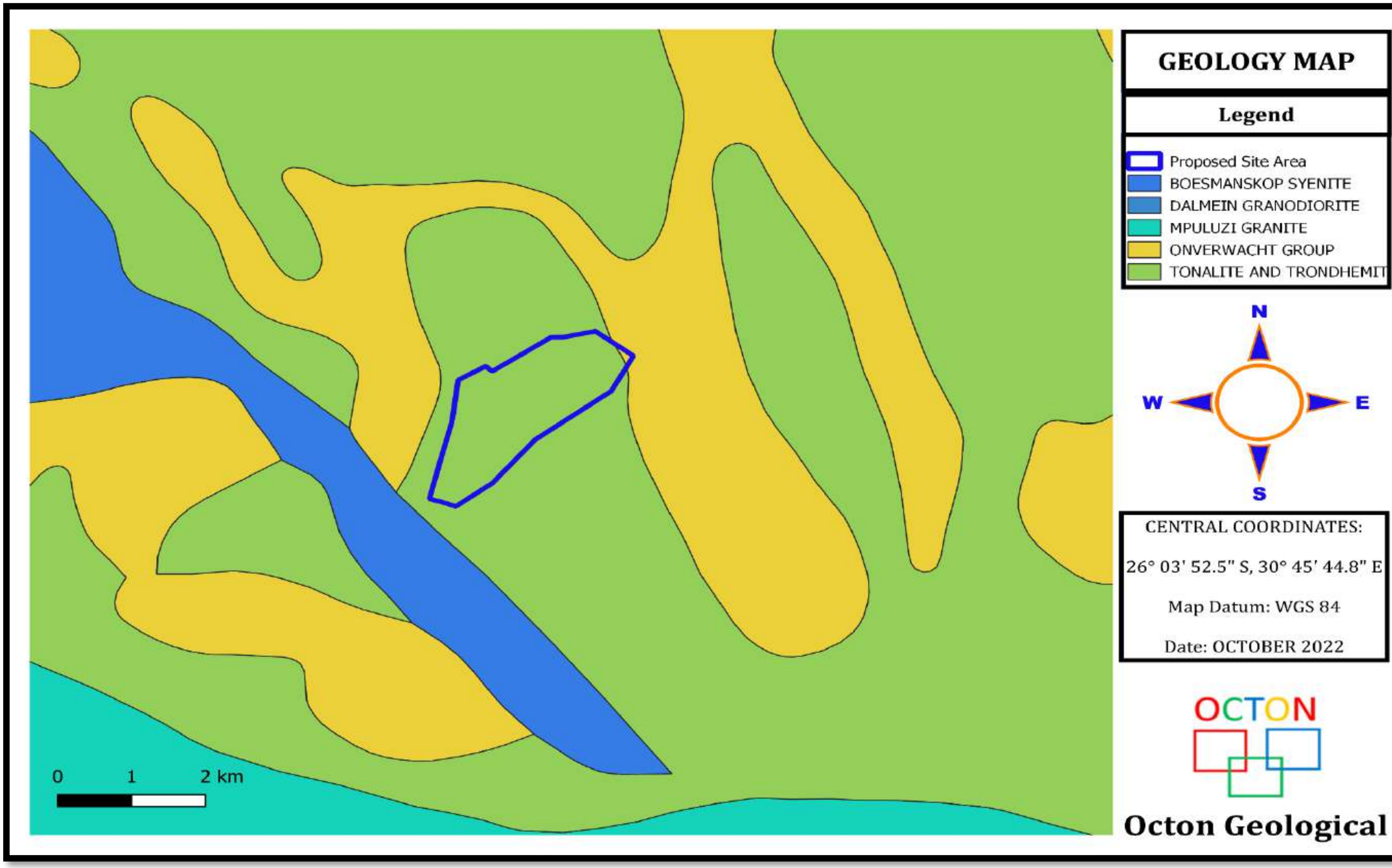


Figure 5: Regional Geological Map

6. SOIL PROFILE

A brief description of the various soil horizons encountered during these investigations is given below with a summary in **Table 1**. Detailed test pits profiles are given in **Appendix A** of this report.

6.1 TOP LAYER, GRAVELLY SANDY MATERIAL

A relatively thin layer that described as dry, light brown to dark brown, loose sandy material covers the site. The soil consistency generally described as loose with some open structured as caused by ground insects and water.

This layer ranged in depths between 0.0 m to 0.4 m as encountered in all this test pits excavated.

6.2 GRAVELY SAND LAYER

This layer generally described as gravelly sand with relatively small amounts of silts, slightly moist, medium dense, intact, dark brown to dark reddish brown.

This layer was encountered at depths ranging between 0.2 m – 0.8 m.

6.3 GRAVELY CLAYEY LAYER

The site is underlain by a thick layer of dark brown and light reddish orange, medium dense to coarse gravel sandy soils with slightly weathered gneiss grains. This horizon was encountered from depths of about 0.6 m.

The thickness of this layer could not be confirmed.

Table 1: Summary of Test Pit Profile Logs.

TEST PIT NO.	TOTAL DEPTH (M)	THICKNESS OF LAYERS (M)			GROUNDWATER SEEPAGE (M)	ZONE
		FILL	TRANSPORTED SOILS	RESIDUAL SOILS /BEDROCK		
TP1	1.5	0 - 0.4	0.4 – 0.7	0.7 – 1.5	-	2
TP2	1.3	0 – 0.3	0.3 – 0.7	0.7 – 1.3	-	2
TP3	1.1	0 – 0.4	0.4 – 0.8	0.8 – 1.1	-	2
TP4	1.4	0 – 0.3	0.3 – 0.6	0.6 – 1.4	-	2
TP5	1.0	0 – 0.2	0.2 – 0.6	0.6 – 1.0	-	2
TP6	1.3	0 – 0.4	0.4 – 0.7	0.7 – 1.1	-	2
TP7	1.2	0 – 0.4	0.4 – 0.8	0.8 – 1.3	-	2
TP8	1.2	0 – 0.2	0.2 – 0.6	0.6 – 1.2	-	2
TP9	1.2	0 – 0.3	0.3 – 0.7	0.7 – 1.2	-	2
TP10	1.0	0 – 0.2	0.2 – 0.7	0.7 – 1.0	-	2
TP11	1.1	0 – 0.4	0.4 – 0.6	0.6 – 1.1	-	2
TP12	1.0	0 – 0.3	0.3 – 0.7	0.7 – 1.0	-	2
TP13	1.0	0 – 0.4	0.4 – 0.6	0.6 – 1.0	-	2

The soil profile composition and thickness were found to be highly consistent throughout the test pits. **Table 2** shows a summary of soil description.

Table 2: Summary of Soil Description.

AVERAGE DEPTH (m)	DESCRIPTION
0 – 0.7	Dry, dark brown to light brown sandy soil, loose with open structures caused by water and ground insects.
0.2 – 0.8	Gravelly sand with relatively small amounts of silts, slightly moist, medium dense, intact, dark brown to dark reddish brown.
0.6 – 1.5	Dark brown and light reddish orange, medium dense to coarse gravel sandy soils with slightly weathered gneiss grains.

6.4. GROUNDWATER

No groundwater seepage was observed in any of the pits excavated during the geotechnical investigation. The test pits were excavated in a dry season. The potential for perched water table conditions to develop, particularly after heavy or prolonged periods of precipitation must also not be discounted.

7. GEOTECHNICAL EVALUATION

7.1. LABORATORY TEST RESULTS

Laboratory tests were scheduled to confirm the on-site investigation, provide a more accurate classification, and to establish engineering parameters for the soils. A total of five (5) disturbed soil samples recovered from the test pits, were subjected to laboratory testing (as per SANS 3001 test methods).

Testing was undertaken by a SANAS accredited material laboratory *RoadLab North* in Centurion, Gauteng Province. The results are attached in **Appendix B** and are summarized in **Table 3**. The following tests were scheduled:

- Sieve analysis of soil sample to 0.075mm,
- Atterberg Limits (Liquid Limit, Plastic Limit and Linear Shrinkage),
- Foundation indicators.

7.1.1. FOUNDATION INDICATORS

The foundation indicator test results indicate that the gravely sandy soil on site has a high amount of sand 49.0%, followed by gravel averaging at 38.75%, and 9.35% of silt and 2.9 % of clay; with a corresponding low Grading Modulus averaging at 1.78; which is indicative of medium to coarse-grained material. The soil sampled from the test pits classify as SC according to the Unified Soil Classification (USC). The Potential for Expansiveness is low according to Van Der Merwe's Activity Chart.

- TP1

The material sampled on TP1S2 had a Plasticity Index (PI) value of 9% while Linear Shrinkage (LS) value obtained was 4.0% and the Liquid Limit of 29%. The material classified as A-2-4 (0) and is considered suitable to be used in road or structural applications as it indicates a good to excellent soils. The potential for expansiveness is low. According to the Unified Soil Classification (USC) the soil material found on TP1 classifies as SC and the grading modulus is 1.47, which is indicative of medium to coarse-grained material. The sampled material was found to be erodible.

- TP4

The silty gravelly sandy material sampled on TP4S3 had a Plasticity Index (PI) value of 8.0%, with a Linear Shrinkage (LS) value of 4.0%. The Liquid limit was at 25%. The material classified as A-2-4(0) and is considered suitable for use in road or structural applications. The Potential for expansiveness is low according to Van Der Merwe's Activity Chart. According to the Unified Soil Classification (USC) the soil material classifies as SC, and the grading modulus is 1.59, which is indicative of medium to coarse grained material. The material is erodible.

- TP8

The sandy gravelly material sampled on TP8S2 had a Plasticity Index (PI) value of 10.0 %, with a Linear Shrinkage (LS) value of 4.5 %, and the Liquid Limit was at 25%. The materials further classified as A-6(5) and are considered not suitable for use in road or structural applications. The grading modulus is 2.14, which is indicative of medium to coarse-grained material. The potential for expansiveness is low according to Van Der Merwe's Activity Chart. According to the Unified Soil Classification (USC) the soil material classifies as SC. The material is erodible.

- TP12

The material sampled on TP12S3 had a Plasticity Index (PI) value of 20%, Liquid limit was at 38 % and a Linear Shrinkage (LS) value of 12.5%. The material classified as A-2-6(0) and is suitable for use in road or structural applications. The Potential for Expansiveness is low according to Van Der Merwe's Activity Chart. According to the Unified Soil Classification (USC) the soil material classifies as SC, and the grading modulus is 1.92, which is indicative of medium to coarse grained material. The material is good.

Most of the soil samples collected from the study area indicated that the material is erodible.

Fine grained soils (clays/silts) drain slowly and can be challenging to work with and compact in wet conditions. Clay soils may be also active, requiring improvement of foundations to stabilize heave. Sandy topsoil material with low fines content (less than 20% passing the 0.075mm sieve) can be useful as a source of designated fill material, at the preference of the engineer on site. Coarse grained soils (sand/gravel) drain faster and can be not challenging to work with and compact in wet conditions.

Table 3 shows a summary of the Laboratory Test Results, detailed test results of the soil samples are included as Appendix B of this report.

Detailed analysis has been carried out to facilitate appropriate design for earthworks and layer-works suitability, as well as foundation characteristics. The various tests and pertinent information from these tests are highlighted below.

Table 3: Summary of Laboratory Results.

TEST POSITION	DEPTH (M)	MATERIAL DESCRIPTION	ATTERBERG LIMITS			GRADING				MOD		GM	CLASSIFICATION		EXPANSIVENESS	COLTO
			LL	PI	LS	CLAY	SILT	FINE SAND	COARSE SAND	MDD	OMC		HRB	UNIFIED		
TP 1 S2	0.4-0.7	GRAVELLY SAND	29	9.0	4.0	3.9	9.9	66.5	19.7	---	---	1.47	A-2-4(0)	SC	LOW	---
TP 2 S3	0.7-1.3	SILTY GRAVELLY SAND	25	8.0	4.0	3.5	10.6	57.0	28.9	---	---	1.59	A-2-4(0)	SC	LOW	---
TP 8 S2	0.2-0.6	SAND GRAVELLY	25	10	4.5	1.8	6.9	35.4	55.6	---	---	2.14	A-2-4(0)	SC	LOW	---
TP 12 S3	0.6-1.0	SILTY SAND GRAVELLY	28	11	5.0	2.4	10.0	37.1	50.5	---	---	1.92	A-2-6(0)	SC	LOW	---

*ABBREVIATIONS			
MDD	Maximum Dry Density (kg/m3)	GM	Grading Modulus
UCS	Unconfined Compressive Strength (MPa)	PE	Potential Expansiveness
OMC	Optimum moisture Content (%)	SC	Clayey silty sand with gravel
PI	Plasticity Index	SM	Silty sand with gravel
LL	Liquid Limit	NP	Non-Plastic
LS	Linear Shrinkage	CBR	California Bearing Ratio
UCS	Unconfined Compressive Strength (MPa)	PE	Potential Expansiveness

7.1.2. ENGINEERING AND MATERIAL CHARACTERISTICS

Two (02) representative disturbed soil sample, recovered from the test pit, was subjected to moisture / density relationship and CBR (strength) testing and the results are attached in **Appendix B** and summarized in **Table 4** below.

The result of the compaction tests on the residual dark reddish brown, medium dense gravely sand on TP3 yielded a maximum dry density of 1994 kg/m^3 at optimum moisture contents of 8.4%.

The compaction tests result on the residual dark red orange, medium dense to coarse, intact, sandy gravely soils on TP6 yielded a maximum dry density of 1833 kg/m^3 at optimum moisture contents of 13.8%. The results of the CBR test on TP6 indicate a good strength of 13% at 93% MOD AASHTO. The results from the MOD/CBR tests for TP6 classified the materials as G8, these materials are of good to fair quality and are suitable for use in road or structural applications

All material classifications were assessed in accordance with TRH14 (1985).

Table 4: Summary of Compaction Characteristics and CBR Results.

TP ID.	DEPTH (M)	DESCRIPTION	OMC (%)	MDD (KG/M3)	CBR AT MOD. AASHTO COMPACTION EFFORT						COLTO
					90%	93%	95%	97%	98%	100%	
TP 3 S3	0.8-1.1	Light red brown, Gravelly Sand	8.4	1994	3	4	5	6	7	8	G10
TP 6 S3	0.8-1.3	Dark red orange, Sandy Gravel	13.8	1833	12	13	13	13	14	14	G8

7.2. EXCAVABILITY AND SIDEWALL STABILITY

Excavability is defined as the ease with which the ground can be dug. This is important for developments as increased costs are associated with installing services or foundations in areas where difficulty is experienced with excavation.

Based on SANS 1200D classifications, excavability of soil on site categorized as intermediate from surface (0 m) to 1.5 m. No excavability problems are foreseen between surface and 1.5m therefore, excavation is possible with a TLB. No refusal was encountered at the site. Rock outcrops were evident within the site.

Test pits sidewalls were found to be unstable from surface to 0.4 m.

7.3. SLOPE STABILITY

This refers to an area comprising unstable geological materials that can move either gradually (creep) or suddenly as a slump or slide. The risk of movement is determined by factors such as the nature of the slope, gradient, role of water, type and nature of vegetation covered, seismicity and impact of human activities.

There are no signs of global slope instability on the site. The probability of landslides and mudslides occurring at this area are rare. This is primarily due to the low climatic conditions and composition of residual and transported materials in this area.

7.4. EROSION

The erosion of soils is a function of the resistance of slope materials to entrainment and transport, and the potential of slope processes that promotes erosion. The resistance of soils to erosion is also related to the mechanical strength, cohesion, and particle size of the material.

Indications for highly erosive soils are evident on site i.e., dongas. The natural slope gradients are low at about 6.7 %, dipping northeastwards.

7.5. DRAINAGE

The stormwater from the township flow and results into dongas. Dongas were visible throughout the site, they are a result of runoff towards the rivers.

Adequate drainage is an important factor in the promotion of a stable site. Drainage should be such that any rainfall is diverted to the nearest storm water drainage system. Both surface and subsurface drainage should be constructed such that no water ingress into the subsurface soils in and around the foundation base is possible. It is recommended that the installation of underground services and surface drainage is undertaken in accordance with SANS 1200 LF-1983.

7.6. SITE STABILITY

The site does not classify as dolomite land and no instability caused by dolomite will therefore occur. No mining activities that led to any undermining of the site are present.

7.7. SITE CLASSIFICATION AND FOUNDATION RECOMMENDATIONS

The proposed residential sites development requires the construction of sound foundations to limit settlements. From on the information obtained from this investigation, it was clear that a similarity of in-situ materials exists at the proposed site. Based on the material characteristics and the typical soil profiles, the site falls under three geotechnical zone that classifies for Residential Site Class Designations according to NHBRC GFSH-2 document as R and C2. The results of this classification are dealt with in the subsequent paragraphs. **Figure 6** Shows the Geotechnical Zonation map.

7.7.1. ZONE 1 (NHBRC SITE CLASS DESIGNATION R)

The following foundation options as defined by the GFHS-2 are recommended for single storey masonry house structures to be erected at Zone 1:

- Normal.

7.7.2. ZONE 2 (NHBRC SITE CLASS DESIGNATION C2)

The following foundation options as defined by the GFHS-2 are recommended for single storey masonry house structures to be erected at Zone 2:

- Stiffened strip footings
- Stiffened or cellular raft
- Compaction of in-situ soils below individual footings
- Deep strip foundations
- Piled or pier foundations
- Soil raft

7.8. SPECIAL PRECAUTIONARY MEASURES

There are no special geotechnical engineering measures envisaged for this site.

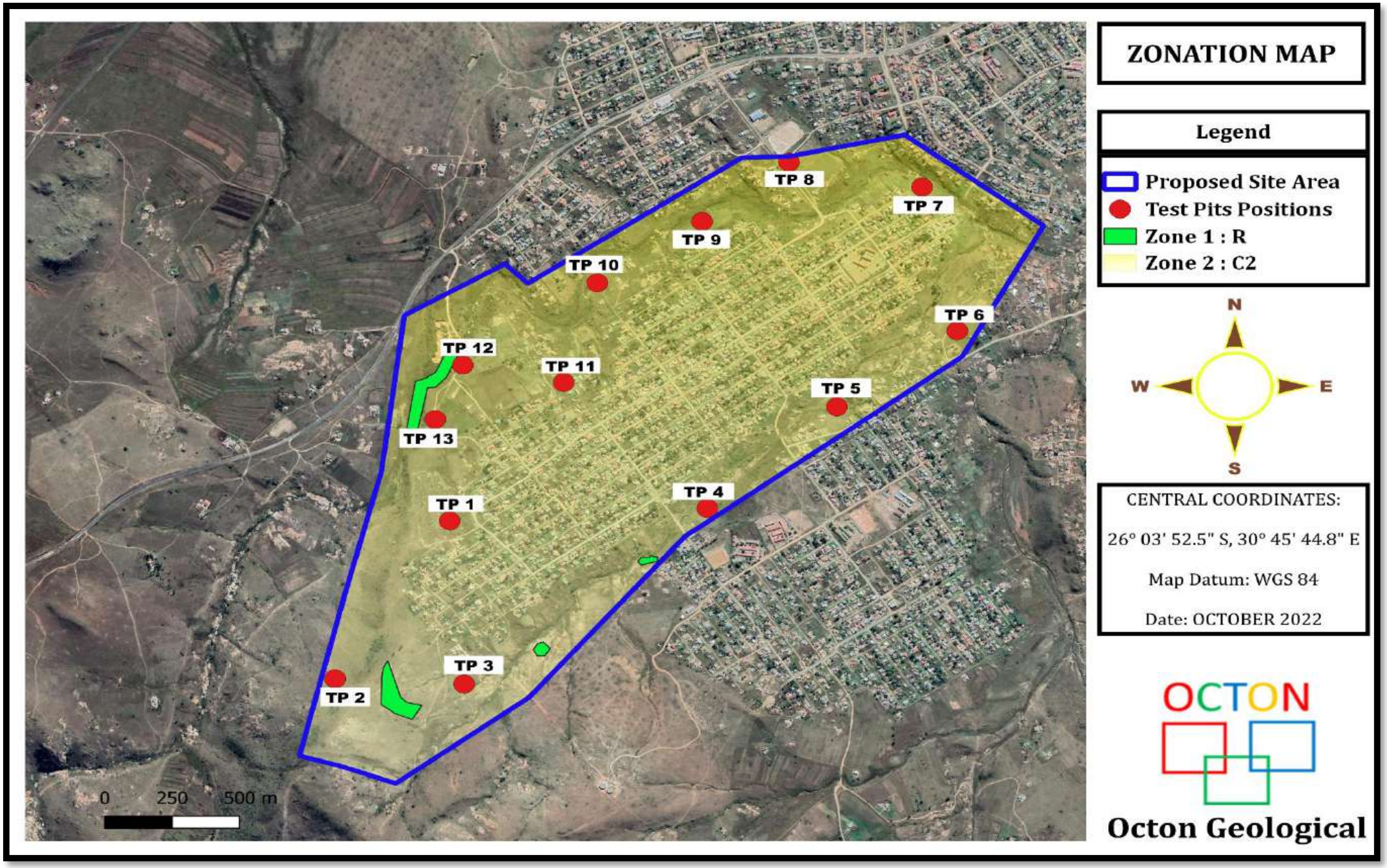


Figure 6: Geotechnical Zonation map.

8. CONCLUSIONS

Octon Geological Consultants (Pty) Ltd was appointed by Mang Geo Environmental in September 2022 to conduct a geotechnical investigation for the proposed demarcation of site in Nhlazatshe 1, Elukwatini within the jurisdiction of Albert Luthuli local Municipality in the Gert Sibande District, Mpumalanga Province.

This geotechnical investigation aimed to identify potential hazards for the development, determine the ground conditions at the site to provide the recommendations for safe and appropriate design.

The major geological formations underlaying the area are the lithologies of the Onverwacht Group and Tonalite and Trondhjemite Gneiss. Onverwacht Group is comprised of grey, medium to coarse grained biotite-hornblende gneiss. Tonalite and Trondhjemite rocks are intrusive rocks with typical granitic composition i.e., quartz and feldspars but containing only a small portion of potassium feldspar.

In terms of SABS 1200D intermediate excavation is anticipated from the surface to depths of about 1.5 m below natural ground level. No groundwater seepage was observed in any of the pits excavated during field investigations. The site classified as R and C2 in accordance with the NHBRC Residential Class Designation. The soil was found to be erosible materials.

It is recommended that the structural engineer determine the best economical foundation preference for the proposed development based on the type of development based on the different available construction methods. Conditions prevailing at the site suggest that no problems are foreseen for the development of the proposed structures, provided the recommendations outlined in the report are adhered to.

It must be understood that the ground conditions described in this report refer specifically to those encountered at the inspection positions on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the property.

In terms of the geotechnical information gained from the investigation, the site is suitable for the proposed development.

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LIMITATIONS

Octon Geological Consultant' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Reports are a geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore consider the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed Engineer.

The recommendations contained herein are not intended to dictate construction methods or sequences. They are furnished to help designers identify potential construction problems related to foundation and earth plans and specifications. Recommendations may also be useful to personnel who observe construction activity.

Potential contractors for the project must evaluate potential construction problems based on their review of the contract documents, their own knowledge of and experience in the local area, and based on similar projects in other localities, considering their own proposed methods and procedures

APPENDIX

APPENDIX A: TEST PITS PROFILES

PROJECT:	Proposed Sites Dermacation	TEST PIT	TP 1 DATE	22-Sep-22
SITE:	Elukwatini, Nhlazatshe 1	LOGGED BY:	Mushiana K	Octon Geo
CLIENT:	Ngoti Development Consultants	COORDINATES:	26° 3' 34" S, 30° 45' 7" E	OCTON
CONSULTANT:	Octon Geological Consultants	MACHINE:	TLB	

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2 0.3 0.4		Light brown, sandy, loose, slightly moist with grass rootlets.	NOTES:
0.5 0.6 0.7		Light red brown, gravelly sandy soils, medium dense, slightly moist, intact	No water table was encountered
0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5		Light red brown, slightly moist, gravelly sandy, intact, medium dense, with pebbles.	No refusal on material

PROJECT:	Proposed Sites Dermacation	TEST PIT	TP 2 DATE	22-Sep-22
SITE:	Elukwatini, Nhlazatshe 1	LOGGED BY:	Mushiana K	Octon Geo
CLIENT:	Ngoti Development Consultants	COORDINATES:	26° 4' 34" S, 30° 45' 2" E	OCTON
CONSULTANT:	Octon Geological Consultants	MACHINE:	TLB	

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2 0.3		Light brown, gravelly sandy, loose, dry, intact with grass roots	NOTES:
0.4 0.5 0.6 0.7		Light red brown, gravelly sand, medium dense, slightly moist, intact	No water table was encountered
0.8 0.9 1.0 1.1 1.2 1.3		Light red brown, gravelly sand, intact, medium dense to coarse with pebbles	No refusal on material

PROJECT:	**Proposed Sites Dermacation**	TEST PIT	TP 3	DATE	**22-Sep-22**
SITE:	**Elukwatini, Nhlazatshe 1**	LOGGED BY:	**Mushiana K**		**Octon Geo**
CLIENT:	**Ngoti Development Consultants**	COORDINATES:	**26° 4' 34" S, 30° 45' 19" E**		OCTON
CONSULTANT:	**Octon Geological Consultants**	MACHINE:	**TLB**		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2 0.3 0.4		Light brown, gravelly sand, Medium Desnse, dry, intact with grass rootlets	NOTES:
0.5 0.6 0.7 0.8		Light Brown, gravelly sand, medium dense, slightly moist, intact	**No water table was encountered**
0.9 1.0 1.1		Light reddish brown, gravelly sand, intact, medium dense with pebbles	No refusal on material

PROJECT:	**Proposed Sites Dermacation**	TEST PIT	TP 4	DATE	**22-Sep-22**
SITE:	**Elukwatini, Nhlazatshe 1**	LOGGED BY:	**Mushiana K**		**Octon Geo**
CLIENT:	**Ngoti Development Consultants**	COORDINATES:	**26° 4' 10" S, 30° 45' 52" E**		OCTON
CONSULTANT:	**Octon Geological Consultants**	MACHINE:	**TLB**		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2 0.3		Light brown, silty sand, loose, dry, intact	NOTES:
0.4 0.5 0.6		Light reddish brown, gravelly sand, medium dense, slightly moist, intact	No water table was encountered
0.7 0.8 1.0 1.1 1.2 1.3 1.4		Light reddish brown, gravelly sand, intact, medium dense, with pebbles	No refusal on material

PROJECT:	**Proposed Sites Dermacation**	TEST PIT	TP 5	DATE	**22-Sep-22**
SITE:	**Elukwatini, Nhlazatshe 1**	LOGGED BY:	**Mushiana K**		**Octon Geo**
CLIENT:	**Ngoti Development Consultants**	COORDINATES:	**26° 3' 57" S, 30° 46' 9" E**		OCTON
CONSULTANT:	**Octon Geological Consultants**	MACHINE:	**TLB**		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2		Light brown, sands gravel, loose, dry, intact with grass roots	NOTES:
0.3 0.4 0.5 0.6		Dark brown, sandy gravel, medium dense, dry,intact	No water table was encountered
0.7 0.8 0.9 1.0		Dark brown, sandy gravel, intact, slighlty miost, medium dense with pebbles	No refusal on material

PROJECT:	**Proposed Sites Dermacation**	TEST PIT	TP 6 DATE	**22-Sep-22**
SITE:	**Elukwatini, Nhlazatshe 1**	LOGGED BY:	**Mushiana K**	**Octon Geo**
CLIENT:	**Ngoti Development Consultants**	COORDINATES:	**26° 3' 46" S, 30° 46' 25" E**	OCTON
CONSULTANT:	**Octon Geological Consultants**	MACHINE:	**TLB**	

Depth (m)	**Legend**	**SOIL PROFILE**	**Sample**
0.1 0.2 0.3 0.4		Light brown, sand, loose, slightly moist, intact with boulders and rootlets.	NOTES:
0.5 0.6 0.7		Dark reddish orange, sandy gravel, medium dense, slightly moist, intact	No water table was encountered
0.8 0.9 1.0 1.1 1.2 1.3		Dark reddish orange, sandy gravel, intact, coarse with pebbles, **residual rock**	No refusal on material

PROJECT:	**Proposed Sites Dermacation**	TEST PIT	TP 7 DATE	**22-Sep-22**
SITE:	**Elukwatini, Nhlazatshe 1**	LOGGED BY:	**Mushiana K**	**Octon Geo**
CLIENT:	**Ngoti Development Consultants**	COORDINATES:	**26° 3' 26" S, 30° 46' 20" E**	OCTON
CONSULTANT:	**Octon Geological Consultants**	MACHINE:	**TLB**	

Depth (m)	**Legend**	**SOIL PROFILE**	**Sample**
0.1 0.2 0.3 0.4		Dark reddish brown, gravelly sand, loose, dry, intact. With roots and boulders.	NOTES:
0.5 0.6 0.7 0.8		Dark reddish orange, gravelly sand, medium dense, slightly moist, intact	No water table was encountered
0.9 1.0 1.1 1.2		Dark reddish orange, gravelly sand, intact, medium dense with boulders.	No refusal on material

PROJECT:	Proposed Sites Dermacation	TEST PIT	TP 8	DATE	22-Sep-22
SITE:	Elukwatini, Nhlazatshe 1	LOGGED BY:	Mushiana K		Octon Geo
CLIENT:	Ngoti Development Consultants	COORDINATES:	26° 3' 23" S, 30° 46' 3" E		OCTON
CONSULTANT:	Octon Geological Consultants	MACHINE:	TLB		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2		Dark brown, sandy, loose, dry, intact	NOTES:
0.3 0.4 0.5 0.6		Dark brown, sandy gravel, medium dense, slightly moist, intact	No water table was encountered
0.7 0.8 0.9 1.0 1.1 1.2		Dark brown, sandy gravel, intact, slightly moist, medium dense with pebbles.	No refusal on material

PROJECT:	Proposed Sites Dermacation	TEST PIT	TP 9	DATE	22-Sep-22
SITE:	Elukwatini, Nhlazatshe 1	LOGGED BY:	Mushiana K		Octon Geo
CLIENT:	Ngoti Development Consultants	COORDINATES:	26° 3' 34" S, 30° 45' 7" E		OCTON
CONSULTANT:	Octon Geological Consultants	MACHINE:	TLB		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2 0.3		Light red brown, sandy silt, loose, dry, intact	NOTES:
0.4 0.5 0.6 0.7		Dark red brown, sandy gravel, medium dense, dry,intact	No water table was encountered
0.8 0.9 1.0 1.1 1.2		Dark red brown, sandy gravel, intact, coarse, with pebbles	No refusal on material

PROJECT:	Proposed Sites Dermacation	TEST PIT	TP 10	DATE	22-Sep-22
SITE:	Elukwatini, Nhlazatshe 1	LOGGED BY:	Mushiana K		Octon Geo
CLIENT:	Ngoti Development Consultants	COORDINATES:	26° 3' 31" S, 30° 45' 51'' E		OCTON
CONSULTANT:	Octon Geological Consultants	MACHINE:	TLB		

Depth (m)	Legend	SOIL PROFILE	Sample
0.1 0.2		Light brown, sand, loose, slightly moist, weathered with grass roots	NOTES:
0.3 0.4 0.5 0.6 0.7		Dark brown, sandy gravel, medium dense, slightly moist, intact	No water table was encountered
0.8 0.9 1.0		Dark brown, sandy gravel, intact, coarse, with boulders, slightly moist	No refusal on material

Proposed Sites Dermacation Elukwatini, Nhlazatshe 1 Ngoti Development Consultants Octon Geological Consultants	TEST PIT LOGGED BY: COORDINATES: MACHINE:	TP 11 Mushiana K 26° 3' 53" S, 30° 45' 33" E TLB	DATE	22-Sep-22 Octon Geo OCTON
Legend	SOIL PROFILE			Sample
	Dark red brown, sandy gravel, loose, dry, intact			NOTES:
	Dark brown, silty sandy gravelly, medium dense, dry,intact			No water table was encountered
	Dark brown, silty sandy gravelly, intact, medium dense, slightly moist			No refusal on material

PROJECT: SITE: CLIENT: CONSULTANT:	Proposed Sites Dermacation Elukwatini, Nhlazatshe 1 Ngoti Development Consultants Octon Geological Consultants	TEST PIT LOGGED BY: COORDINATES: MACHINE:	TP 12 Mushiana K 26° 3' 51" S, 30° 45' 19" E TLB	DATE	22-Sep-22 Octon Geo OCTON
Depth (m)	Legend	SOIL PROFILE			Sample
0.1 0.2 0.3		Dark brown, silty sandy gravel, loose, dry, intact			NOTES:
0.4 0.5 0.6 0.7		Dark brown, silty sandy gravel, slightly moist, medium dense and intact			No water table was encountered
0.8 0.9 1.0		Dark brown, silty sandy gravel, slightly moist, medium dense and intact			No refusal on material

PROJECT: SITE: CLIENT: CONSULTANT:	Proposed Sites Dermacation Elukwatini, Nhlazatshe 1 Ngoti Development Consultants Octon Geological Consultants	TEST PIT LOGGED BY: COORDINATES: MACHINE:	TP 13 Mushiana K 26° 3' 58" S, 30° 45' 15" E TLB	DATE	22-Sep-22 Octon Geo OCTON
Depth (m)	Legend	SOIL PROFILE			Sample
0.1 0.2 0.3 0.4		Dark brown, sand, loose, slightly moist, intact with grass roots and gravel.			NOTES:
0.5 0.6		Dark brown, silty sandy gravel, medium dense, slightly moist, intact			No water table was encountered
0.7 0.8 0.9 1.0		Dark brown, silty sand gravel, intact, slightly moist, medium dense.			NO redusal on material

ROADLAB

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Job Request No.: RC 03757
Client Ref.No.: CE-OCT001-01-0001-22
Date Reported : 2022/10/07

OCTON GELOGICAL CONSULTANTS
389 Green Shank Ave
Unit 53 Khaya Lala
Roodepoort
Attention : Mr. Khano

Project : Nhlazatshe

Full Classification Report SANS 3001 : GR1,GR20,GR30,GR40

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	2475			
HOLE NO./ Km / CHAINAGE	N/A			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2	Test Pit 03 / S3			
LAYER TESTED/SAMPLED	N/A			
SAMPLE DEPTH	N/A			
DATE SAMPLED	2022/09/27			
COLOUR OF SAMPLE	Light Red Brown			
TYPE OF SAMPLE	Gravelly Sand			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm				
	75.0 mm				
	63.0 mm				
	50.0 mm				
	37.5 mm	100			
	28.0 mm	99			
	20.0 mm	97			
	14.0 mm	96			
	5.0 mm	92			
	2.0 mm	86			
	0.425 mm	52			
	0.075 mm	17			
GM %		1.5			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	38			
COARSE FINE SAND	0.425 - 0.250	16			
MEDIUM FINE SAND	0.250 - 0.150	15			
FINE FINE SAND	0.150 - 0.075	10			
SILT CLAY	0.075	20			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	29			
	PLASTICITY INDEX	6			
	LINEAR SHRINKAGE	2.5			
CLASSIFICATION	H.R.B.	A-2-4(0)			
	COLTO	-			
	TRH 14	G/10			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	8.4			
	MDD (kg/m³)	1884			
	COMP MC %	8.1			
SWELL % @	MOD | NRB | PRO	0.14 | 0.18 | 0.21			
C.B.R. SANS GR40	100 %	8			
	98 %	7			
	97 %	6			
	95 %	5			
	93 %	4			
	90 %	3			

STABILISER IN LAB	Neat			
TEST TYPE	Classification			
SAMPLING METHOD	TMH5			
WEATHER WHEN SAMPLED	Sunny			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our schedule of accreditation. (T0824)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM)
The test results reported relate to the samples tested.
Further use of the above information the responsibility or liability of Roadlab.
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Report compiled by : Cornelius Van Der Westhuizen

sanas
Testing Laboratory
Accreditation No. T0824
Prog ver 10.7 (2019/11/07)

W. Potgieter
Technical Signatory

1 of 2

ROADLAB

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Job Request No.: RC 05757
OCTON GELOGICAL CONSULTANTS
309 Green Shark Ave
Unit 63 Khaya Lalo
Roodepoort
Attention : Mr. Khano

Client Ref.No.: OE-OCT001-01-0001-22

Date Reported : 2022/10/07

Project : Nhlazatshe

Full Classification Report SANS 3001 : GR1,GR20,GR30,GR40

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO		2479			
HOLE NO / Km / CHAINAGE		N/A			
ROAD NO / NAME Line 1 ROAD NO / NAME Line 2		Test Pit 08 / 53			
LAYER TESTED/SAMPLED		N/A			
SAMPLE DEPTH		N/A			
DATE SAMPLED		2022/09/27			
COLOUR OF SAMPLE		Dark Red Orange			
TYPE OF SAMPLE		Sandy Gravel			
SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)					
SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	100			
	75.0 mm	84			
	63.0 mm	74			
	50.0 mm	74			
	37.5 mm	69			
	28.0 mm	62			
	20.0 mm	57			
	14.0 mm	56			
	5.0 mm	52			
	2.0 mm	49			
	0.425 mm	40			
	0.075 mm	23			
GM %		1.9			
SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)					
COARSE SAND	2.000 - 0.425	17			
COARSE FINE SAND	0.425 - 0.250	12			
MEDIUM FINE SAND	0.250 - 0.150	14			
FINE FINE SAND	0.150 - 0.075	10			
SILT CLAY	0.075	47			
ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)					
ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	35			
	PLASTICITY INDEX	17			
	LINEAR SHRINKAGE	8.0			
CLASSIFICATION	H.R.B.	A-2-6(1)			
	COLTO	-			
	TRH 14	G8			
CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)					
SANS GR30 MAX. DRY DENSITY	OMC %	13.8			
	MDD (kg/m³)	1853			
	COMP MC %	14.0			
SWELL % @	MOD | NRB | PRO	0.18 | 0.22 | 0.28			
C.B.R. SANS GR40	100 %	14			
	98 %	14			
	97 %	13			
	95 %	13			
	93 %	13			
	90 %	12			
STABILISER IN LAB		Neat			
TEST TYPE		Classification			
SAMPLING METHOD		TMH5			
WEATHER WHEN SAMPLED		Sunny			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our schedule of accreditation. (T0824)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM)
The test results reported relate to the samples tested.
Further use of the above information the responsibility or liability of Roadlab.
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Report compiled by : Cornelius Van Der Westhuizen

sanas Testing Laboratory
Accreditation No. T0824
Prog.ver 10.7 (2019/11/07)

W. Potgieter
Technical Signatory

2 of 2

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ROADLAB

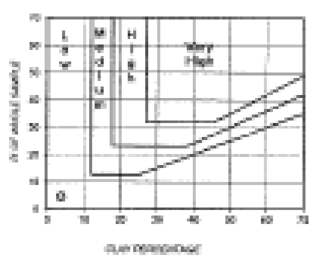
OUR REF : RC 01757
CLIENT : Octon Geological Consultants
PROJECT : Philosophe

DATE RECEIVED : 2022/10/07
POSITION : TP01/S2
LAYER : N/A
SAMPLE No. : 2477
SAMPLE DESCRIPTION : Light Red Brown Gravelly Sand

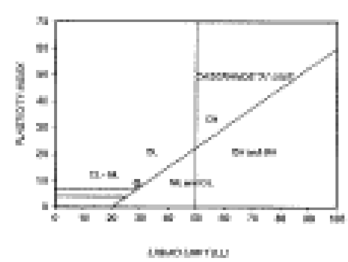
FOUNDATION INDICATOR - (SANS 3001-GR1, SANS 3001-GR10) & (ASTM Method D422)

Weighted PI		4.6
Sieve analysis Cumulative percentage passing (mm)	150.0	100
	75.0	100
	63.0	100
	50.0	100
	37.5	97
	26.5	95
	20.0	93
	14.0	92
	5.00	87
	2.000	80
	0.425	51
	0.250	38
	0.150	29
	0.075	22
	50 µm	10
	5 µm	6
	2 µm	3.9
Soil Mortar Analysis % < 2.00mm	2.000 - 0.425	37
	0.425 - 0.250	16
	0.250 - 0.150	11
	0.150 - 0.075	8
	< 0.075	28
Effective size		0.049
Uniformity Coefficient		18.8
Curvature Coefficient		0.6
Oversize Index		3.1
Shrinkage Product		202.6
Grading Coefficient		12.9
Grading modulus		1.47
Atterberg Limits	Liquid Limit	29
	Plasticity Index	9
	Linear Shrinkage	4.0
	PI < 0.075	-
Unified Soil Classification		SC
U.S. Highway Classification		A-2-4 (0)

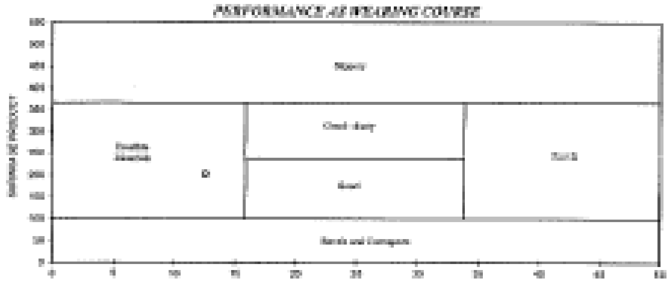
POTENTIAL EXPANSIVENESS



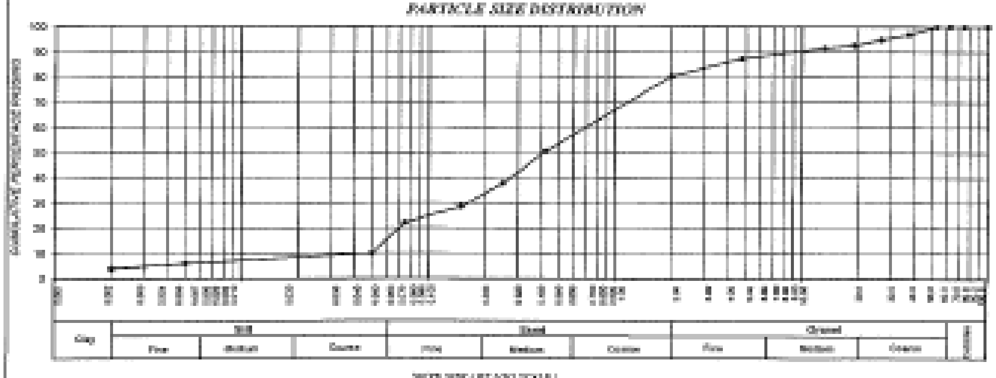
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



PARTICLE SIZE DISTRIBUTION



CLAY (%) (0.001-0.002)	SILT (%) (0.002-0.060)	SAND (%) (0.060-2.00)	GRAVEL (%) (2.00-60.0)
3.9	9.9	66.5	19.7

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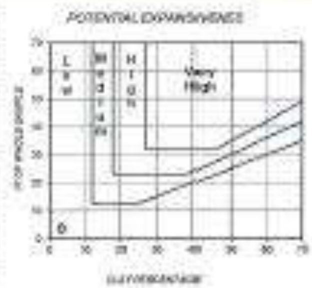
ROADLAB

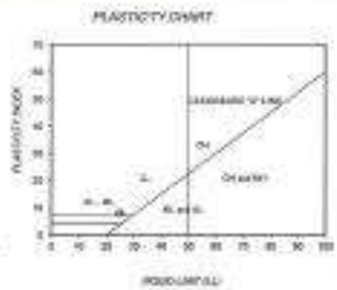
OUR REF.: RC 03757
CLIENT: Octon Geological Consultants
PROJECT: Nhlazatshe

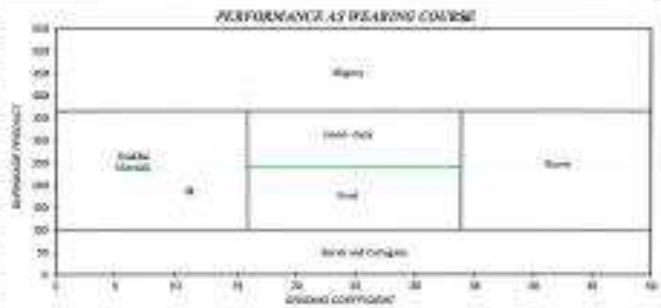
DATE RECEIVED: 2012/10/07
POSITION: TP04/50
LAYER: N/A
SAMPLE No.: 2478
SAMPLE DESCRIPTION: Light Red Brown Silty Gravelly Sand

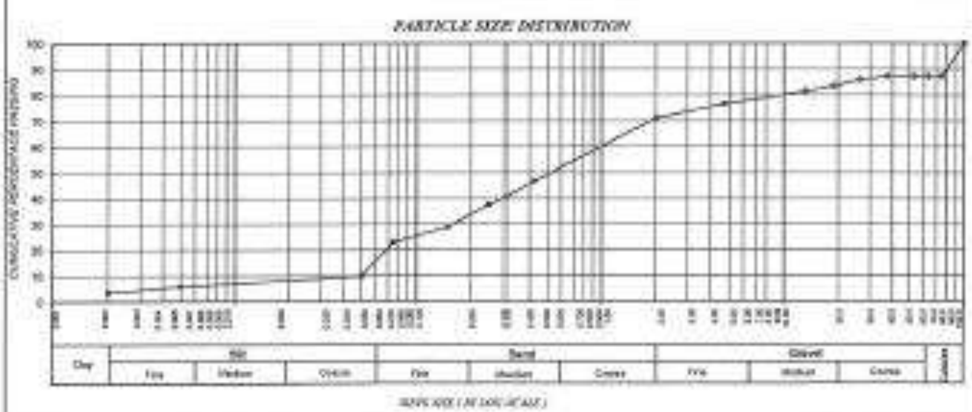
FOUNDATION INDICATOR - (SANS 3001-GR1, SANS 3001-GR10) & (ASTM Method D422)

Weighted PI		3.7
Sieve analysis Cumulative percentage passing (mm)	100.0	100
	75.0	87
	63.0	87
	50.0	87
	37.5	87
	28.0	86
	20.0	84
	14.0	82
	5.00	76
	2.000	71
	0.425	47
	0.250	36
	0.150	29
	0.075	23
	50 µm	10
	5 µm	6
	2 µm	3.5
Soil mortar analysis % < 2.00mm	2.000 - 0.425	34
	0.425 - 0.250	13
	0.250 - 0.150	12
	0.150 - 0.075	9
	< 0.075	32
Effective size		0.058
Uniformity Coefficient		35.6
Curvature Coefficient		0.4
Oversize Index		12.9
Shrinkage Product		206.3
Grading Coefficient		13.2
Grading modulus		1.59
Atterberg Limits	Liquid Limit	23
	Plasticity Index	8
	Linear Shrinkage	4.0
	PI < 0.075	-
Unified Soil Classification		SC
U.S. Highway Classification		A-2-4 (0)









CLAY (%) (0.001-0.002)	SILT (%) (0.002-0.060)	SAND (%) (0.060-2.00)	GRAVEL (%) (2.00-63.0)
3.5	10.6	57.0	28.9

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ROADLAB

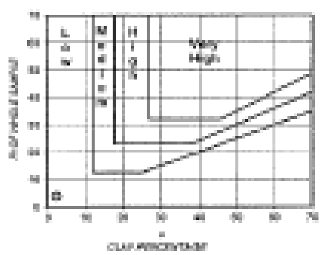
OUR REF: RC 03757
CLIENT: Octon Geological Consultants
PROJECT: Mhlontshe

DATE RECEIVED: 2022/10/07
POSITION: TP12/S3
LAYER: N/A
SAMPLE No.: 2479
SAMPLE DESCRIPTION: Dark Brown Silty Sandy Gravel

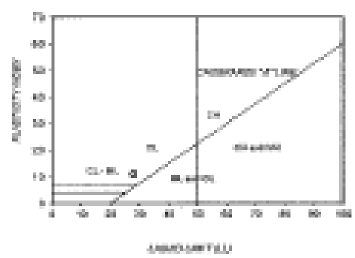
FOUNDATION INDICATOR - (SANS 3001-GR1, SANS 3001-GR10) & (ASTM Method D422)

Weighted PI		3.9
Sieve Analysis Cumulative percentage passing (%)	100.0	100
	75.0	100
	63.0	92
	50.0	92
	37.5	87
	28.0	80
	20.0	71
	14.0	64
	5.00	54
	2.000	49
	0.425	36
	0.250	30
	0.150	26
	0.075	23
	50 µm	8
	5 µm	4
	2 µm	2.4
Soil Mortar Analysis % < 2.00mm	2.000 - 0.425	28
	0.425 - 0.250	12
	0.250 - 0.150	8
	0.150 - 0.075	6
	< 0.075	46
Effective size		0.054
Uniformity Coefficient		192.6
Curvature Coefficient		8.1
Oversize Index		13.5
Shrinkage Product		177.7
Grading Coefficient		16.3
Grading modulus		1.92
Atterberg Limits	Liquid Limit	28
	Plasticity Index	11
	Linear Shrinkage	5.0
	PI < 0.075	-
Unified Soil Classification		SC
U.S. Highway Classification		A-2-6 (0)

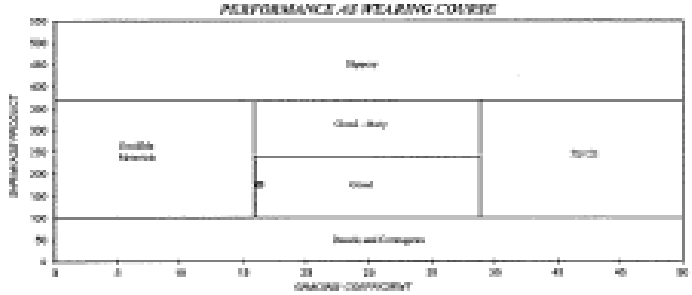
POTENTIAL EXPANSIVENESS



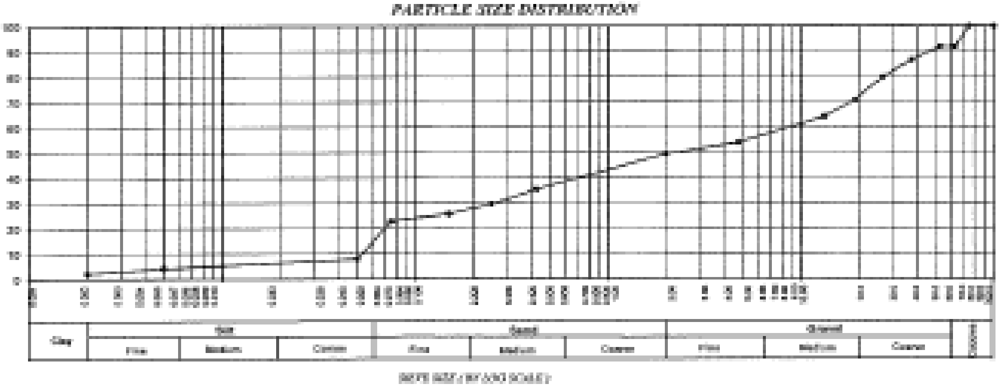
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



PARTICLE SIZE DISTRIBUTION



CLAY (%) (0.002-0.002)	SILT (%) (0.002-0.060)	SAND (%) (0.060-2.00)	GRAVEL (%) (2.00-60.0)
2.4	10.0	37.1	50.5

Roadlab Centurion
121 Ellman Street, Sunderland Ridge
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ROADLAB

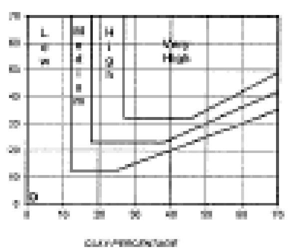
OUR REF: RC 03757
CLIENT: Octan Geological Consultants
PROJECT: Ntlanzakie

DATE RECEIVED: 2022/10/07
POSITION: TP08/S2
LAYER: N/A
SAMPLE No.: 2480
SAMPLE DESCRIPTION: Dark Brown Sandy Gravel

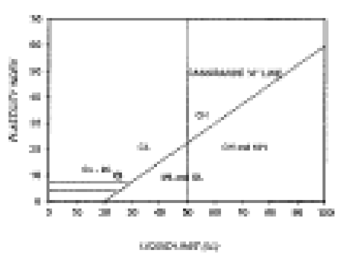
FOUNDATION INDICATOR - (SANS 3001-GR1, SANS 3001-GR10) & (ASTM Method D422)

Weighted PI		2.6
Sieve analysis Cumulative percentage passing (mm)	100.0	100
	75.0	100
	63.0	92
	50.0	85
	37.5	82
	26.5	75
	20.0	64
	14.0	61
	5.00	58
	2.000	44
	0.425	26
	0.250	22
	0.150	19
	0.075	16
	50 µm	6
	5 µm	3
	2 µm	1.8
Soil Mortar Analysis % < 2.00mm	2.000 - 0.425	40
	0.425 - 0.250	10
	0.250 - 0.150	7
	0.150 - 0.075	6
	< 0.075	36
Effective size		0.061
Uniformity Coefficient		226.1
Curvature Coefficient		0.7
Oversize Index		18.4
Shrinkage Product		118.6
Grading Coefficient		15.5
Grading modulus		2.14
Atterberg Limits	Liquid Limit	25
	Plasticity Index	10
	Linear Shrinkage	4.5
	PI < 0.075	-
Unified Soil Classification		SC
U.S. Highway Classification		A-2-4 (0)

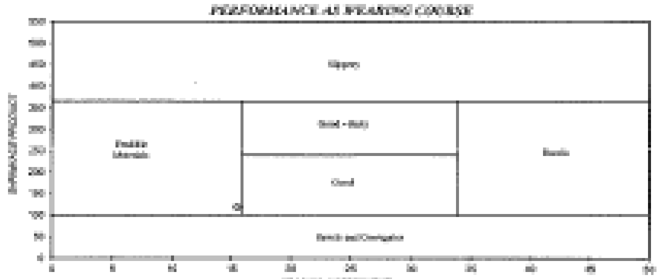
POTENTIAL EXPANSIVENESS



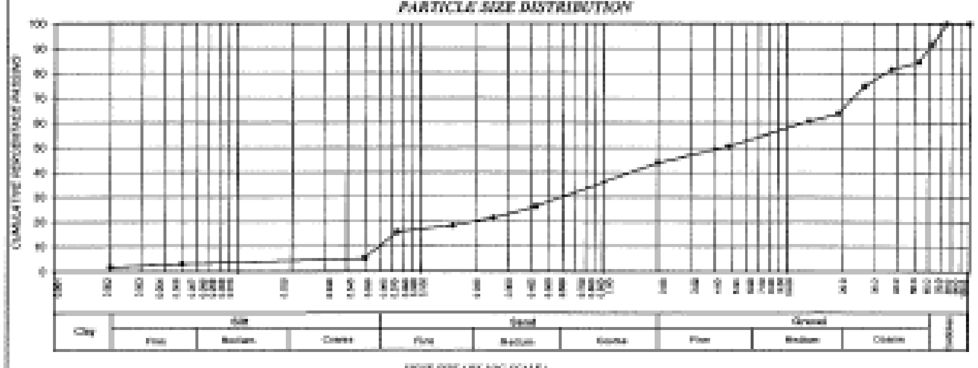
PLASTICITY CHART



PERFORMANCE AS WEARING COURSE



PARTICLE SIZE DISTRIBUTION



CLAY (%) (0.002-0.002)	SILT (%) (0.002-0.060)	SAND (%) (0.060-2.00)	GRAVEL (%) (2.00-60.0)
1.8	4.9	33.6	55.9

Heritage Report

VHUFA HASHU
Heritage Consultancy CC
Sustainable community development is our speciality

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ARCHAEOLOGICAL AND CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED FORMALIZATION OF NHLAZATSHE TOWNSHIP WITHIN THE CHIEF ALBERT LUTHULI LOCAL MUNICIPALITY OF MPUMALANGA PROVINCE.

Compiled for:

Mang Geo-Enviro Services
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September 2022

EXECUTIVE SUMMARY

Item	Description
Proposed development and location	Formalization of Nhlazatshe Township.
Purpose of the study	The purpose of this study is to identify heritage resources within the proposed development area, assess their significance, the impact of the development on the heritage resources and to provide relevant mitigation measures to alleviate impacts to the heritage resources.
Coordinates	S26.065335° E30.759287°
Local Municipality	Chief Albert Luthuli Local Municipality
District Municipality	Gert Sibande District Municipality
Developer	Chief Albert Luthuli Local Municipality
Contact Details	Tel: +27 13 752 5551, Mobile: 083 357 3669, Fax: 086 263 5671 | Email: richard@vhhc.co.za,info@vhhc.co.za, Addresses: 25 Rood Street, Sonheuwel Central, Nelspruit,1200, P.O Box 1856, Nelspruit, 1200
Heritage Consultant	Vhufa Hashu Heritage Consultants
Date of field work	16 and 17 September 2022
Date of Report	September 2022

Vhufa Hashu Heritage Consultants cc has been commissioned by Mang Geo-Enviro Services to conduct the Cultural Heritage Impact Assessment (HIA) study for the proposed formalization of Nhlazatshe Township. The aim of the survey was to investigate the availability of archaeological sites, cultural resources, sites associated with oral histories, graves, cultural landscapes, and any structures of historical significance that may be affected by the proposed project. The proposed study area is located in Nhlazatshe 1 within Chief Albert Luthuli Local Municipality City, Mpumalanga Province.

To begin with, a multi-stepped methodology was used to address the terms of reference. This include a robust desktop study that involve review of the 1972 Convention, the Operational Guidelines of 2013, the ICOMOS (International Council of Monuments and Sites, 2011) guidelines on assessing impact on heritage sites. The IUCN guidelines and standards of best practice were also consulted. Subsequently, a review of the archaeology of the area was carried out using contract archaeology reports, research reports and academic publications. The desktop study was followed by fieldwork carried out by expert archaeologists in conformity with the National Heritage Resources Act (Act 25 of 1999). We are confident that we covered the most sensitive area. Based on an interdisciplinary methodology, that combined ICOMOS methodology with several techniques from various discipline.

South Africa's historical, archaeological and paleontological heritage resources are unique and non-renewable as defined in section 3 of the NHRA. Heritage Resources as defined in section 3 of the NHRA are given "formal" protection in terms of section 27-29 and 31-32 of the NHRA and "general" protection in terms of sections 33,34,35,36 and 37 of the NHRA. Therefore, no damage, destruction or alteration may occur to heritage resources without a permit issued by a relevant heritage authority.

An assessment of impacts on heritage resources of a development was required in terms of section 38(1 and 8) of the NHRA. Where possible, heritage resources should be preserved *in situ* and conserved for future generations. This can be achieved through a monitoring and management plan that may be stipulated in the conditions issued on a development by an authority as per section 38(4)c of the NHRA. Where it is not possible to retain the heritage resources *in situ*, and the heritage resources are not deemed significant, the loss of information can be reduced by recording and mitigation of the heritage resources through a process of excavation (or sampling) as a condition on the development in terms of section 38(4) .d and e, after obtaining a permit from the relevant Heritage Resources Authority (HRA), at the cost of the developer. This allows us to record a part of the history of the place as part of the national inventory. Assessment and mitigation in the early phase of the development may save the developer considerable delays and related costs.

Proposed activities

Proposed formalization of Nhlazatshe 1 within Chief Albert Luthuli Local Municipality, Mpumalanga Province.

Heritage Resources Descriptions and Significance

No heritage/archaeological resources was identified within the proposed formalization of Nhlazatshe 1 Township. The Nhlazatshe 1 grave yard was recoded next to the hill on the western side of the township.

Conclusion

The project may be approved since there are no historical and archaeological sites of significance to be impacted by the proposed project. From a Heritage perspective, the development should be allowed to continue.

Acknowledgements

The authors acknowledge Mang Geo-Enviro Services for their assistance with project information, and the associated project background information as well as responding to technical queries related to the project. Many thanks and appreciation also go to Councilor Nkosi who made our work easy by accompanying us to the site.

ACKNOWLEDGEMENTS OF RECIEPTS

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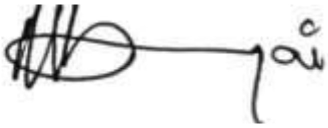
CLIENT CONTACT PERSON: Phakwago M. Kabelo

CLIENT CONTACT NUMBER: (+27) 12 770 4022

HERITAGE CONSULTANT: VHUFAHASHU CONSULTANTS CC



Rudzani Richard Munyai

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1. INTRODUCTION

Mang Geo-Enviro Services was appointed by Chief Albert Luthuli Local Municipality to handle the Environmental Impact Assessment to ensure that the proposed development meets the environmental requirements in line with the National Environmental Management Act 107 of 1998 as amended in 2010. They appointed Vhufahashu heritage Consultants to conduct an Archaeological and Cultural Heritage Impact Assessment study as part of the Environmental Impact Assessment for the proposed project.

In order to comply with the relevant legislations, the Applicant requires information on the heritage resources that occur within or near the proposed project. This enables the applicant to take pro-active measures to limit the adverse effects that the development could have on such heritage resources. Archaeological/ Heritage Impact Assessment (AIA-HIA) are conducted in line with the National Heritage Resources Act of 1999 (Act No. 25 of 1999). The Act protects heritage resources through formal and general protection. The NHRA (Act No. 25 of 1999) provides that certain developmental activities require consents from relevant Heritage Resources Authorities or Agency. The South African Heritage Resources Agency as custodians of the South African Heritage and Monuments sites developed minimum standards for impact assessment processes, in addition to these local standards, the International Council of Monuments and Sites (ICOMOS) published guidelines that specify and guide impact assessment on heritage sites with Outstanding Universal Value. Furthermore, these guidelines and standards have been strengthened by the Burra Charter of 1999 which require a caution approach to the management of sites, it set out the need to understand the significance of heritage places and the significance guide decisions.

The National Heritage Resources Act (NHRA - Act No. 25 of 1999) protects all structures and features older than 60 years (section 34), archaeological sites and material (section 35) and graves and burial sites (section 36). In order to comply with the legislation, the Applicant requires information on the heritage resources, and their significance that occur within the project area. This enables the Applicant to take pro-active measures to limit the adverse effects that the development could have on such cultural and heritage resources.

2. SITE LOCATION AND PROJECT DESCRIPTION

The proposed site is situated 4km western side of Elukwatini and 28km southern side of eManzana town GPS S26.065335° E30.759287°. The site can be accessed through R38 and R541 from Mbombela and Carolina, from Empuluzi the site can be accessed through N17 and R541.

Figure 1: Aerial Photo map.

Figure 2: General view of the Nhlazatshe 1 and the Grave yard.


Figure 3: Close view of the Nhlazatshe 1 properties.

3. ASSESSMENT OF SITES AND FINDS

3.1 Results of the Fieldwork

This section contains the results of the heritage site/find assessment. The phase 1 heritage scoping assessment program as required in terms of section 38 of the National Heritage Resource Act (Act 25 of 1999) done for the proposed project.

No cultural heritage (archaeological or historical) sites, features or objects were found within the proposed formalization Nhlazatshe 1 Township. If any did exist here in the past it would have been destroyed or disturbed through various developments.

3.2 Burial grounds and graves

Only one community grave yard was recorded on the western side of Nhlazatshe 1. It should be noted that burial grounds and gravesites are accorded the highest social significance threshold (see Appendix A). They have both historical and social significance and are considered sacred. Wherever they exist or not, they may not be tempered with or interfered with during any development. It is also important to note that the possibility of encountering human remains during subsurface earth moving works anywhere on the landscape is ever present. Although the possibility of encountering previously unidentified burial sites is low at the development site, should such sites be identified during clearance and earth moving activities, they are still protected by applicable legislations and they should be protected.

3.3 Buildings and structures older than 60 years

Section 34 of the NHRA protects buildings and structures older than 60 years. The field survey did not identify the old structures around the proposed site. As such the proposed development site did not triggers Section 34 of the NHRA.

3.4 Significance of the site and buildings.

Two set of criteria were used to determine the historical and cultural significance of a site. The first set is determined by the National Heritage Resources Act and tends to focus on determining the significance of a site on national or macro geographic level. The second set of criteria is a refinement of those set out in the Act and tends to look at the site in more detail (addressing aspects such as buildings, structures, infrastructural elements, activity areas and planted vegetation). Therefore, the latter is more specific and focus on detail and local cultural significance.

3.5 Public Monuments and Plaques

The study did not record any public monuments and plaques within the proposed site. The proposed development site does not trigger Sections 27, 30 and 37 of NHRA.

4. RELEVANT LEGISLATION

Two sets of legislation are relevant for this study with regards to the protection of heritage resources and graves.

4.1 The National Heritage Resource Act (25 of 1999)

This Act established the South African Heritage Resource Agency (SAHRA) as the prime custodians of the heritage resources and makes provision for the undertaking of heritage resources impact assessment for various categories of development as determined by Section 38. It also provides for the grading of heritage resources (Section 7) and the implementation of a three-tier level of responsibly and functions from heritage resources to be undertaken by the State, Provincial and Local authorities, depending on the grade of heritage resources (Section 8)

In terms of the National Heritage Resource Act 25, (1999) the following is of relevance:

Historical remains

Section 34 (1) No person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the relevant Provincial Heritage Resources Authority.

Archaeological remains

Section 35(3) Any person who discover archaeological or Paleontological object or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resource authority or the nearest local authority or museum, which must immediately notify such heritage resources authority.

Section 35(4) No person may, without a permit issued by the responsible heritage resources authority-

- destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- destroy, damage, excavate, remove from its original position, collect or own any archaeological or paleontological material or object or any meteorite;
- trade in ,sell for private gain, export or attempt to export from republic any category of archaeological or paleontological material or object or any meteorite; or
- bring onto or use at an archaeological or paleontological site any excavation equipment or any equipment which assist with the detection or recovery of metal

or archaeological material or object or such equipment for the recovery of meteorites.

Section 35(5) When the responsible heritage resource authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or paleontological site is underway, and where no application for a permit has been submitted and no heritage resource management procedures in terms of section 38 has been followed, it may

- serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order
- carry out an investigation for the purpose of obtaining information on whether or not an archaeological or paleontological site exists and whether mitigation is necessary;
- if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- recover the cost of such investigation from the owner or occupier of the land on which it is believed an archaeological or paleontological site is located or from the person proposing to undertake the development if no application for a permit is received within two week of the order being served.

Subsection 35(6) the responsible heritage resource authority may, after consultation with the owner of the land on which an archaeological or paleontological site or meteorite is situated; serve a notice on the owner or any other controlling authority, to prevent activities within a specified distance from such site or meteorite.

Burial grounds and graves

Section 36 (3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority:

(i) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(ii) bring onto or use at a burial ground or grave any excavation equipment, or any equipment which assists in detection or recovery of metals.

Subsection 36 (6) Subject to the provision of any person who in the course of development or any other activity discover the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resource authority which must, in co-operation with the South African Police service and in accordance with regulation of the responsible heritage resource authority-

(I) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this act or is of significance to any community; and

if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangement as it deems fit.

Cultural Resource Management

Section **38(1)** Subject to the provisions of subsection (7), (8) and (9), any person who intends to undertake a development*…

- must at the very earliest stages of initiating such development notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

development means any physical intervention, excavation, or action, other than those caused by <u>natural forces</u>, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being, including:

(i) Construction, alteration, demolition, removal or change of use of a place or a structure at a place;

(ii) Any change to the natural or existing condition or topography of land, and

(iii) Any removal or destruction of trees, or removal of vegetation or topsoil;

place means a site, area or region, a building or other structure

structure means any building, works, device or other facility made by people and which is fixed to the ground.

4.2. The Human Tissue Act (65 of 1983)

This act protects graves younger than 60 years, these falls under the jurisdiction of the National Department of Health and the Provincial Health Department. Approval for the exhumation and reburial must be obtained from the relevant provincial MEC as well as relevant Local Authorities.

5. TERMS OF REFERENCE

The terms of reference for the study were to undertake an archaeological impacts assessment on the proposed development and submit a specialist report, which addresses the following:

- Executive summary
- Scope of work undertaken
- Methodology used to obtain supporting information
- Overview of relevant legislation
- Results of all investigations
- Interpretation of information
- Assessment of impact
- Recommendation on effective management measures
- References

6. METHODOLOGY

6.1 Source of information

Most of the information was obtained through the site visit made on the 16 and 17 September 2022; where systematic inspections of the proposed area were covered along linear transects which resulted in the maximum coverage of the entire site. Standard archaeological observation practices were followed; Visual inspection was supplemented by relevant written source, and oral communications with local communities from the surrounding area. In addition, the site was recorded by hand held GPS (Garmin Montana 650) and plotted on 1:50 000 topographical map. Archaeological/historical material and the general condition of the terrain were photographed with a Garmin 650 Camera.

6.2 Assumption and Limitations

It must be pointed out that heritage resources can be found in the unexpected places, it must also be borne in mind that survey may not detect all the heritage resources in a given project area. While some remains may simply be missed during surveys (observation) others may occur below the surface of the earth and may be exposed once constructed commences.

7. ASSESSMENTS CRITERIA

This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. The significance of archaeological and heritage sites were based on the following criteria:

- The unique nature of a site.
- The amount/depth of the archaeological deposit and the range of features (stone walls, activity areas etc).
- The wider historic, archaeological and geographic context of the site.
- The preservation condition and integrity of the site.
- The potential to answer present research questions.

7.1 Site Significance

The site significance classification standards as prescribed in the guideline and endorsed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used as guidelines in determining the site significance for the purpose of this report.

The classification index is represented in the Table below.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.C)	Grade 4C	Low Significance	Destruction

Grading and rating systems of heritage resources

7.2 Impact Rating

VERY HIGH

These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or cultural) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects.

Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.

Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.

HIGH

These impacts will usually result in long term effects on the social and /or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light.

Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.

Example: The change to soil conditions will impact the natural system, and the impact on affected parties (e.g. farmers) would be HIGH.

MODERATE

These impacts will usually result in medium- to long-term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by the public or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are real, but not substantial.

Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.

Example: The provision of a clinic in a rural area would result in a benefit of MODERATE significance.

LOW

These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect.

Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels.

Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people living some distance away.

NO SIGNIFICANCE

There are no primary or secondary effects at all that are important to scientists or the public.

Example: A change to the geology of a certain formation may be regarded as severe from a geological perspective, but is of NO SIGNIFICANCE in the overall context.

7.3 Certainty

DEFINITE: More than 90% sure of a particular fact. Substantial supportive data exist to verify the assessment.

PROBABLE: Over 70% sure of a particular fact, or of the likelihood of an impact occurring.

POSSIBLE: Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.

UNSURE: Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.

7.4 Duration

SHORT TERM : 0 – 5 years

MEDIUM: 6 – 20 years

LONG TERM: more than 20 years

DEMOLISHED: site will be demolished or is already demolished

7.5 Mitigation

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be classified as follows:

- ✓ **A** – No further action necessary
- ✓ **B** – Mapping of the site and controlled sampling required
- ✓ **C** – Preserve site, or extensive data collection and mapping required; and
- ✓ **D** – Preserve site

8. BRIEF SYNTHESIS ON THE ARCHAEOLOGICAL AND HERITAGE.

Existing knowledge indicates the presence of prominent heritage sites within the Mpumalanga (Huffman, 2007; Delius 2007).

8.1. Stone Age sequence (ESA, MSA and LSA)

The Early Stone Age of the area is fairly well understood and stretches from 250 000 years ago. The earliest stone tools are known as the Acheulian industry and are dominated by heavy butchering tools. Inferential evidence suggests that these simple tools were used to chop and butcher meat, de- skin animals and probably to smash bones to obtain marrow (Phillipson, 2005). The presence of cut marks from animal fossil bones dating to this period has led to the conclusion by researchers that human ancestors were scavengers and not hunters (Wadley, 2007; Esterhuysen, 2007). They may have preyed on drowned or crippled animals or shared a kill by other predators, which explains why some ESA sites contain high proportions of bone from large and dangerous game (Wadley, 2007). Some of these remarkable archaeological sites that yielded Early Stone Age tools (Acheulian hand axes) that were dated to nearly 100 000 years ago are scattered throughout Southern Africa (Walker, Chazan & Morris 2013).

The Acheulian industries are characterized by the presence of bifacial hand axes and cleavers. These bifacial tools emerged started around 1.5 million years ago (mya) at places such as Sterkfontein. The Acheulian techno-complex was characterized by a great deal of standardization of tools across widely separated areas from Africa to Eurasia (Sharon, 2009). Evidence presented from Sterkfontein cave in Gauteng, Kathu pan in the Kalahari, Makapansgat in Limpopo as the Swudwala caves in Mpumalanga shows that the first tool making hominids belong to either an early species of the Homo or an immediate ancestor which is yet to be discovered here in South Africa (Esterhuysen, 2007). The Acheulian industries are well represented in the archaeology of the Cradle of Humankind particularly at sites such as Sterkfontein and Kromdraai and Kathu pan (Walker, Chazan & Morris 2013). A large collection of these stone tools are on display at the main entrance of Swudwala caves in Mpumalanga Province.

The Middle Stone Age dating between roughly 250 000 years ago and 25 000 years before present succeeded the Early Stone Age. Comparatively, Middle Stone Age tools are smaller than those of the Early Stone Age period. They are characterized by smaller hand axes, cleavers, and flake and blade industries. The period is marked by the emergence of modern humans and is characterized by the appearance of fairly complex technology, modern human behavior, art, and symbolism (Thompson & Marean, 2008). A variety of MSA tools includes blades, flakes, scraper and pointed tools that may have been hafted onto shafts or handles and used as spear heads. Residue analyses on some of the stone tools indicate that these tools were certainly used as spear heads (Wadley, 2007). The presence of spear heads on some of the MSA assemblages is an indication that these group of people were hunters who targeted middle sized game such as hartebeest, wildebeest and zebra (Wadley, 2007), Some assemblages are show the presence of bone tools such as bone points.

The Late Stone Age (LSA) which stretches from 25 000 years ago to about 2000 years ago is the last phase in the Stone Age sequence. The LSA is characterized by the use of micro lithic tools some of which were found in most sites around the Mpumalanga region. Many of the sites have been seriously damaged by illegal attempts to discover the burial places of legendary gold that Paul Kruger is said to have buried during his flight at the end of the Anglo Boer War. It is not uncommon to find sites where the entire stratigraphy has been completely destroyed (Hampson, Challis, Blundell & De Rosner, 2001).

8.2. Rock art associated with the Late Stone Age and the Iron Age sequence

The province is known owing to the extremely presence of Khoisan people who were also the first permanent inhabitants of the region. San rock art represent unique example of the survival of human cultural endeavor that is part of remarkable religious tradition which is at least 27,500 years old. Rock art is distinctive prehistoric art that occur in various forms namely: Petroglyph (engravings) and rock paintings (Pictographs). The art is fragile including the cultural landscape in which they are situated, once damaged, or destroyed; they can never be repaired or replaced. The art, sites and landscape provide links with important elements to our past which allows us to establish the sense of orientation about our place in time.

The rock art is one of the rare arts done in the San tradition, together with the ethnography, and the history of African communities (Swazi/ Ndebele and the Sotho) in the area provides a valuable commentary by which the indigenous people themselves relates their history and the processes attached to the rock art sites. Historical records relate that people of mixed San and indigenous Swazi descent were living in the wider area as they were engaged in rain making, a practice that was carried on by San people in many parts of southern Africa. The rock paintings tradition is characterized by the earliest tradition of finely detailed images that reflect belief and san cosmology, most of the paintings are in red ochre; survey shows animal figures are more common than any other categories, followed by items such as lines, dots and animal figures etc. This is usually in the South African context where painting of animal and human images pre dominates. As such rock art sites generally have tremendous cultural significance.

Furthermore, the sites were used for traditional and religious ceremonies for the creator of the art as well as the recent African group's descendants. For example The Sudwala cave is currently used by Somqubas descendants as the place where they worship and held traditional beer drinking ceremonies. There are several different traditions that can be correlated with the cosmology of the San hunter gathering, such as that of Iron Age farmers. Early farming community art is different from the San art. The art is characterized by few finger paintings and geometric design in thick red and sometimes white pigment which probably belongs to herder art tradition.

The rock art in some comparatively restricted parts of southern Africa has been intensively studied for many years (Dart 1929; Bleeck 1933; Pager 1971; Vinnicombe 1976; Lewis Williams 1981; Maggs 1967; Halket 1987; Hollman 1993; Eastwood & Blundell, 1999). Within the region rock art images were first recorded in the early 1980s within the Kruger National Park, little is known about rock art sites in the immediate environs of Mbombela or Mpumalanga as a whole. Van riet Lowe (1952) catalogue of rock art sites in South Africa list only 10 in the neighboring Barberton and Nelspruit district (to the south and west of Bongani Reserve) and a mere four in the Kruger National Park.

Recently over 100 sites in and around Bongani Mountains Loge Game Reserves on the southern border of Kruger National Park have been discovered (Hampson, Challis, Blundell & de Rosner, 2001). Records shows that there are several rock art sites recently discovered within concession farm holdings around the Mbombela town (Nelspruit)(Mathoho and Munyai 2016).

Few recorded open sites with agriculturalist engravings occur in a broader region (Maggs, 1995). Sometimes the engravings are characterized by rock engravings of concentric metrics form which represent a stone wall settlement plan. Most of the painted images are extremely faded, despite the fact that granite is comparatively resistant to weathering.
Rock art sites have considerable historical significance as material records of transition between cultural eras. Finally, the sites have great educational value as places where lecturers and students can visit to learn about the history and cultural heritage of the area. Through sites visits and educational tours it helps the province economic growth. Although some research has been conducted in the wider area, there is still potential for archaeological, ethnographic and historical research which can provide additional information to enhance the interpretation of the rock art.

8.2.1. Early Iron Age Sequence

8.2.1.1 Iron Age (EIA, LIA)

Documents suggest that the Iron Age communities moved into southern Africa by c. AD 200, entering the study area either by moving down via coastal plains route of Mozambique or through the Inland. Their movement followed various rivers inland such as the Crocodile, Sabie, Nsikazi, White River and Gutshwa. Being cultivators, they preferred the rich alluvial soils to settle on. These agro pastoralist brought with them variety of domestic grain including sorghum and millet (Maggs &Ward 1984). Maize did not form part of their dietary package since this type of grain was introduced into southern Africa much later, at roughly 1550 AD.

These landscapes, drainage systems and good climatic conditions could have influenced diverse societies including wildlife and farming communities to settle within the region. It is indisputable that the natural environment has played the dominant part; nevertheless it is not deterministic (Katsamudanga, 2007). The introduction of farming communities in southern Africa early in the first millennium AD is characterized by the appearance of distinctive pottery wares (Huffman, 2007), metal working (Friede, 1979), agriculture and sedentism (Maggs, 1980; Phillipson, 2005). Mining and metallurgy were largely limited to the reduction of iron and copper ore for the manufacturing of utilitarian and decorative implements.

The archaeology of Early Iron Age sites within the Mbombela Local Municipality is not well understood because of limited research conducted to date, even when their existence in the region is acknowledged. Research coverage has been previously skewed towards the Lydenburg perhaps this is because of the location of major sites within the Lydenburg. This has left hinterland regions for example, the areas that lie east and west of Mbombela town largely unexplored.

Archaeological investigation by T.M. Evers of the Department of Archaeology, University of Witwatersrand revealed the presence of Early Iron Age site in close proximity to Mbombela Town. The site was accidentally discovered during the construction of a house on holding 119 at Plaston near White River. The site was excavated on February 1976, some of the finds include stratigraphy that consist of grey sand soil underlain by a brown grey sand within which the early Iron age occurrence is stratified (Evers, 1977). A piece of granite with several grooves, two lump of ocher and several ceramic vessels were uncovered.

Ceramic vessels of Plaston site comprised of seventy seven vessels of different shapes, motif and decorations. All the vessels were of homogenous coarse clay matrix. The pottery assemblages of the Plaston site has been assigned to other already recognized in the Eastern Transvaal. The top most one is assemblages which bear very strong resemblances to the Kliengbeil, Lydenburg and Eiland sites. The Lydenburg Heads site dated to the late fifth Century AD (Inskeep, 1971). The full range of Plaston vessel shapes and decoration layout is present here. Many of these sites have been found in the Kruger National Park over the past 20 years (Meyer, 1986). Meyer identified seven different Early Iron age sites ceramic tradition on the eleven excavated sites.

It is generally believed that there are various phases within the Iron Age sequence. The earliest sites most likely range between AD 280 and 450 (Silver Leaves-250-395, Pta 2360, Pta 2459, Pta 914) and are represented by the site of Silver Leaves near Tzaneen (Klapwijk, 1974; Huffman, 2007). The site is generally assumed to be the precursor of Iron Age sites within the Limpopo Province. This first phase was followed by Happy Rest, with sites dating between AD 450 and 750 (Eiland Salt Works-AD390-435, Pta 1524, Pta1608, Pta 1607, Wits 764, Happy Rest-AD430-555, Pta 2421-Klein Africa 415-535, Pta 1168). Happy Rest and Klein Africa are situated in close proximity to the Soutpansberg Mountains (Prinsloo, 1974; Huffman, 2007). The current thinking based on preliminary studies is that Garonga Phase (SK 172 bone 800Pta 3507) mostly ranges between AD 750 and 1000 (Huffman, 2007; Burret 2007). This phase is represented by sites near Mica and Kruger Park (Meyer, 1986; Burret 2007).

All Early Iron age sites were recorded situated in close proximity to water sources (Archeo-info, 2000; Huffman, 2007, Burret, 2007; Mathoho, 2012; unpublished Mphil, thesis). The position of this type of settlement are associated with environmental element that could be interpreted as what the environment offers as opportunities for early farming communities survival (Katsamudanga 2007).

Iron Age occupation of the region seems to have taken place on a significant scale and at least three different phases of occupation have been identified, however the last period of pre-colonial occupation consisted of Sotho and Swazi speaking people that settled on stone-walled sites and caves. At present it is not clear, but, judged on the pottery found; these sites might even date to early historic times. As this was a period of population movement, conflict and change. Considering the time period that they were occupied, they also feature in the early historic period.

8.2.1.2 Stone wall sites associated with the Late Iron Age and historical periods

The region lies within the asserted traditional territories where previous research works was conducted by Mason (1960,) Collet (1982), Maggs (1995), Evers (1975) Esterhysen & Smith (2007). Their research work shed more light in the understanding of the archaeology of the Mpumalanga escarpment. A high density of archaeological settlement sites are known to cover approximately 150 kilometer stretch of land as reflected by an aerial photographic survey .Sites distribution is relatively easy to establish, because they are not covered by *black wattle* or *Eucalyptus* plantations and they can be easily be plotted using air photographs (Mason1968; Evers 1975). With specifics to the earlier archaeological work, particularly those of Evers (1975) and Collett (1982), Maggs (1976) have shown that most of the stone walling sites within the region fit broadly into the well-known phenomenon of stone-built settlements of Black, agriculturist communities which flourished in grassland areas of South Africa within the past 500 years. Other aspects of the material culture are typically Late Iron Age, as is the basic economy, with evidence of cattle and small livestock as well as the African cultigens *Sorghum* and *Vigna* ("cow peas") (Collett, 1982).

The chronology remains imprecise, partly because of the paucity of fieldwork and partly because radiocarbon dating itself becomes of limited value for samples younger than AD 1600. Few available dates do, however, suggest that Marateng flourished within the last four hundred years (Evers & Vogel 1980). The distribution of Marateng settlements is relatively easy to establish as they show up well on air photos, provided they are not blanketed by bush or timber plantations. Both Mason (1968) and Evers (1975) used air photos to plot sites, however their map seems to be the first attempt to show a complete distribution of this settlement type. The result suggests a virtually continuous belt of settlement running from Ohringstad in the north, through Lydenburg and Machadosdorp, to Carolina in the south, a distance of 150 km. From this belt several lines of outliers lead off eastwards down the Komati valley and upper tributaries of the Crocodile, but nowhere reach the Lowveld.

Evers (1975) have identified three basic settlement layout namely: The first and simple consisted of two concentric circles, the inner circle was thought to be the cattle kraal and the space between the circles representing area in which huts were built, the second type was an elaboration of the first in that the inner circle had one or more smaller enclosures attached to it, again huts were built between this complex and the outer ring wall. The third type was an agglomeration of small circles that did not conform to the pattern of the other two. Esterhysen & Smith (2007) maintained that it is not clear whether these different kinds of settlement were occupied by different people at the same time or different periods, but however based on the general density of the stone wall settlement in the region; there must have been a substantial increase in population or movement of people in the area.

Collet (1982) classified these settlements and contended that they comprised of three basic units, namely: homesteads, terraces and livestock enclosure. Some of these stone walling are Koni identified with the extensive Badfontein type of walling found along the Mpumalanga escarpment, more or less contemporary with Melora. Badfontein walling emphasizes the centre/side axis of the Central Cattle Pattern expressed through concentric circles: the inner circle encompassed cattle, the next marked the men's court, and the outer ring the zone of houses.

Rock engravings in the same area depict this settlement layout pattern. The slopes were terraced with lines of stones that ran along the contours, and livestock tracks to the outside of the settlement edged in stones. Oral traditions place Koni (Ndebele) in this escarpment area before the Pedi, and some walled settlements must first date before AD 1650, perhaps as early as AD 1600 which was characterised by the second dispersal. The centre/side layout pattern indicates that they were of Langa origin from northern KwaZulu-Natal. Later, as the associated ceramics show, they became allied to the Pedi. These Badfontein probably chose the escarpment because it is part of a mist belt that would have offered some relief to dry conditions during the Little Ice Age (Huffman, 2007).

Based on such datable phenomena as initiation cycles, other northern and southern groups are thought to have left KwaZulu-Natal between about AD 1630 and 1670. These dates, of course, are tentative. At about the same time, around AD 1700, cool and very dry conditions prevailed throughout the subcontinent. Analysis of climatic data shows that this was the worst time in the Little Ice Age. Dated with remarkable precision, this event is so close to the historical dating that the severe conditions were the most likely reason for the third set of movements. Although the reason may have been the same, there were so many small groups at different times that a co-ordinated movement was unlikely.

Ceramic descriptions of these sites clearly reflect Moloko falling within the range of Sotho-Tswana wares (Collet, 1982; Huffman, 2007). Classification and analysis indicated that this ceramics belongs to Marateng pottery, which is the reminiscent of the Pedi pottery. Ethnography and the Pedi oral history of the region show that these groups of people were called the Koni (Ndebele). As part of this uncoordinated movement, several small groups entered the Pretoria area. These include the well-known Manala and Ndzundza Ndebele who claim Musi as a legendary leader. Significantly, Ndzundza capitals in the Steelpoort area to the northeast, such as KwaMaza have a Moor Park variant of stonewalling: kraals and middens lay down slope of the most important residential zone. Pedi pottery (*Marateng*) in Ndzundza settlements demonstrates interaction with northern neighbours.

Fortunately, the history of many Nguni-derived groups on the plateau today is accessible to oral traditions. Generally, those who live north of the Springbok Flats are known collectively as Northern (Transvaal) Ndebele and those below as Southern (Transvaal) Ndebele. Generally again, many northern groups claim Langa as a legendary leader and many of those to the south claim Musi (Van Warmelo, 1935). If they retained the Nguni language, they are called Ndebele, while those who adopted Sotho-Tswana are Koni (Sotho-Tswana for *Nguni*).

The third set of movements also included various groups that claim Langa as a legendary leader. Most of these Langa people were supposed to have followed the escarpment north through Swaziland before turning west to climb onto the plateau. Thus, there was a different Langa route out of KwaZulu-Natal. The main route most Langa Ndebele took north, through the Swaziland and Mpumalanga low-veld, suggests that the original Langa homeland was in northern KwaZulu-Natal. It is significant that most Nguni groups today who claim Langa ancestry live in that area. The combination of oral history, routes and settlement patterns shows that the division between Langa and Musi is ancient, extending back to at least the middle of the Moor Park phase, and that this division has a geographical expression (Huffman, 2007).

In 1800 communities around the region were living harmoniously, trading and farming it was up to the year 1826 when Mzilikazi Khumalo fled from King Shaka's rule and reaches the region devastating the communities.

8.2.1.3 Early African settlement

Documents suggest that the Lowveld was habituated by Sotho/Tswana speaker. Their villages were associated with stone walls and terraces, land clearings and agriculture. They were cultivators and miners of copper, gold and iron. Towards the end of the 19th Century the Swazis began raiding their livestock and then move northwards into places such as Mbombela either by pushing the early inhabitants or assimilating them into their ranks. By the late 1870s the Swazi settlement extended north of Swaziland border and westwards along the Crocodile River. The lower part of the region remained largely uninhabited due to the presence of tsetse flies. The Swazi movement was possibly necessitated by land shortages resulting from both increases in Swazi human and livestock population. Some historians argued that their movement was mainly based on land restrictions imposed by the king.

Most of the major villages were located along the river valley in close proximity to major stream such as De kaap, Queens, Crocodile, Komati and Lomati Rivers. Their economy was based on subsistence agriculture and livestock herding. The agricultural crops include Maize, beans, cow peas, groundnuts and variety of squash (Packard, 2001).The less privileged African communities were scattered over the flats, in 1877 rinderpest epidemic wipe out both cattle and game in the region. The disease crippled their economy, both production of food stuffs which was supplemented by spoils acquired through periodic raiding activities collapsed. The epidemic greatly reduced the availability of milk which in a soured forms known as *emasi* which was a major component of Swazi diet (Packard, 1984, 2001). The absence of cattle with which to trade for grain forced many Swazi men to seek wage employment; they were forced to work at gold mines at Barberton and then later on the Rand or white owned farms.

8.2.1.4 European settlement

Historical documents suggest that the Mpumalanga region was previously known due to the first hunters and explorers who ventured in to the region from the Cape Colony. At that time, several black tribes occupied the area Mpumalanga region these African cultural groups included Sotho, Swazi and Ndebele.

The great trek was initiated by group of people who wanted to be free, since the British recognized independence of the area north of the Vaal River. The first movement northwards was initiated under the leadership of Louis Trichardt and Hans van Rensburg in 1835. This group left the Cape Colony to cross Orange and Vaal River on their way to the north. They arrived in the region at around April 1836 and set up settlements in various locations. However relation between the two groups (Trichardt and van Rensburg) became tense. They splited and move off in different directions. One of the earliest settlements, in 1836 was in the Soutpansberg, north of Pietersburg. The second Voortrekker movement was acknowledge to have been led by Andries Hendrik Potgieter who arrived in 1848, however other historical sources suggest that Andries Hendrik Potgieter established Ohringstad in 1845. Later in 1848 he led a group that settled on the site Trichardt's group had abandoned, just outside present day Louis Trichardt and established a town Zoutpansbergdorp.

Whites began settling in the region in the middle of the 19th century. This could be associated with the tragic trek of a party of Afrikaner led by Louis Trichardt to Mozambique in 1837.This movement ended in a fewer death of most of the settlers and they had to withdrew to higher lying areas of Mpumalanga. They had tried to settle in Ohringstad valley in 1843 and in 1848 the valley was abandoned and Lydenburg was established. Both areas were fever ridden with malaria and Nagana epidemic. President Burgers sought to end the isolation of the Transvaal by developing relations with non-English colonial powers, and in 1875 began a round of negotiations with Portugal to secure access to the sea via a rail link to Delagoa Bay.

None the less in 1884 alluvial gold was discovered near the present town of Barberton and Whites begin settling in the eastern Lowveld. The subsequent gold rush in 1886 attracted 10000 diggers. Gold mining led to land speculation and expansion of white claim to land in the Lowveld area. Mining created a market for agriculture. The Boers dispensed plots of land to white new comers and most of the land were acquired from the Mswati who gave land to the Boers outside his jurisdiction because he wanted the Boers protection against the Zulus. It was during this time where the Boers began to resort to child labour, using African children captured in raids on villages. Soon a trade in children developed, especially with the Swazi, who wanted to develop a relationship with the Boers.

By 1890s most miner's foodstuffs market had shifted to Witwatersrand but the construction of railway line connecting South Africa and Mozambique created a second wave of agricultural development. The agricultural system of the region was extremely labour intensive. Not all white settlers shared the economic opportunities created by agriculture some were hunters for game and trading in ivory and animal hides with Portuguese. These goods were much in demands in Europe and they could be transported to Mozambique and exported from there.

After the unsuccessful Bloemfontein conference the Transvaal government had realized that War with the British was inevitable. They began to prepare themselves, so did the British. On 8 September the British cabinet decided to send 10 000 men to Natal to strengthen the defense of this British outpost. In retaliation on 27 September President Paul Kruger called up all Boers between the age of 16 and 60 of the Transvaal and persuaded President Steyn of Free State Province to follow the suit. The Boer realized the advantage of striking first, the commandos were therefore ordered to the borders. The commandos of Lydenburg and Carolina were deployed to strengthen to defend the Swaziland borders. Both Boer republics mobilized their artillery units and rallied (Changuion, 2001).

The first Anglo-Boer War broke out from 1880 to 1881. The Anglo Boer war delayed further advancement, Industrial, mining and agricultural until the twentieth century. By 1910 pockets of agriculture had emerged along the River Valley around Nelspruit and Barberton (Packard, 2001). The introduction of DDT and its success in getting rid of Malaria carrying mosquitoes encourage poor white farmers to settle in large numbers, many of them moved to settle in the Lowveld towns and engaged in various forms of commerce or served as skilled laborer. Statistical records show that white population of the Nelspruit town nearly doubled growing from 2,186 to 4.247. From 1951 to 1960 Nelspruit had 11.839 white populations (Packard, 2001).

Most of the historical sensitivity areas is represented by a period associated with the development of farm homestead as well as infrastructure (e.g. roads) many of these farms have been in the ownership of families for generations. As a result they possess a large corpus of information with regarding to the area and its history. A significant numbers of battles and skirmishes took places in the region. There are remains of blockhouses that should be anticipated on the ridges and at river crossings.

9. CONCLUSION AND RECOMMENDATIONS

In conclusion, Phase 1 HIA for the proposed formalization on Nhlazatshe 1 within Chief Albert Luthuli Local Municipality has been conducted successfully. The landscape proves to be fairly uniform and lacking other features that might have focused past activities. The objective of the HIA is to limit primary and secondary impacts on archaeological and cultural heritage in the path of the proposed development and infrastructure footprint. No further studies / Mitigations are recommended given the fact that within the proposed development site and its surrounding there are no archaeological or place of historical significance to be impacted by the proposed project. However, should any chance archaeological or any other physical cultural resources be discovered subsurface, heritage authorities should be informed. From an archaeological and cultural heritage resources perspective, there are no objections to the proposed formalization. We recommend to the South African Heritage Resource Agency to approve the project as planned.

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ADDENDUM 1: Types and ranges as outlined by the National Heritage Resource Act (Act 25 of 1999)

The National Heritage Act (Act No 25 of 1999, Art 3) outlines the following types and ranges of the heritage resources that qualify as part of the national estate, namely:

(a) Places, buildings structures and equipment of cultural significance;
(b) Places to which oral tradition are attached or which are associated with living heritage;
(c) Historical settlement and townscapes
(d) Landscape and natural features of cultural significance;
(e) Geological sites of scientific or cultural importance
(f) Archaeological and paleontological sites
(g) Graves and burial ground including-
    (I) Ancestral graves
    (II) Royal graves and graves of traditional leaders
    (III) Graves of victim of conflict
    (IV) Graves of individuals designated by the minister by notice in the gazette;
    (V) Historical graves and cemeteries; and
    (VI) Other human remains which are not covered by in terms of the Human Tissue Act,1983(Act No 65 of 1983)
(h) sites of significance relating to the history of slavery in South Africa;
(i) movable objects, including-
    (I) object recovered from soil or waters of South Africa, including archaeological and paleontological objects and material, meteorites and rare geological specimens;
    (II) objects to which oral traditions are attached or which are associated with living heritage
    (III) ethnographic art and objects;
    (IV) military objects;
    (V) objects of decorative or fine art;
    (VI) object of scientific or technological interest; and
    (VII) books, records, documents, photographs, positive and negatives, graphic, film or video material or sound recording, excluding those that are public records as defined in section1(xiv) of the National Archives of South Africa Act,1996(Act No 43 of 1996).

The National Heritage Resource Act (Act No 25 of 1999,Art 3)also distinguishes nine criteria for places and objects to qualify as 'part of the national estate if they have cultural significance or other special value… these criteria are the following:

(a) its importance in the community, or pattern of South Africa's history;
(b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
(d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
(e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
(f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons
(h) Its strong or special association with the life or work of a person, group or organization of importance in the history of South Africa
(i) Sites of significance relating to the history of slavery in South Africa.

Civil Engineering Report

FORMALIZATION OF THE NHLAZATSHE 1, INFORMAL SETTLEMENT LOCATED ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172 IT AND EERSTEHOEK 235 IT, MPUMALANGA PROVINCE

BULK ENGINEERING SERVICES REPORT

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Abbreviations

AADD	-	Average Annual Daily Demand
ADWF	-	Average Dry Weather Flow
DWS	-	Department of Water and Sanitation
FAR	-	Floor Area Ratio
IDP	-	Infrastructure Development Plan
kℓ	-	Kilo Litres
kℓ/day	-	Kilo Litres per day
ℓ/s	-	Litres per second
m^3	-	Cubic metre
MAP	-	Mean Annual Precipitation
Mℓ /day	-	Mega litres per day
PSC	-	Project Steering Committee
RWS	-	Regional Water Scheme
SANRAL	-	South African National Roads Authority Limited
StatsSA	-	Statistics South Africa
VIP toilet	-	Ventilated Improved Pit toilet
WC	-	Water Committee

1 INTRODUCTION

Mang Geo (PTY) Ltd appointed Dalimede Projects to prepare the bulk engineering services report for the formalization of the Nhlazatshe 1, informal settlement located on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT, Mpumalanga Province.

This report outlines the engineering services needed for the township, i.e. roads, water, sewer and electricity.

2 LOCALITY

The proposed township is situated 130km south of Mbombela along the R40, R38 and R541 respectively, in Mpumalanga Province, South Africa. The area is administered by Chief Albert Luthuli Local Municipality under Gert Sibande District Municipality. GPS coordinates of site are 26° 3'55.66"S 30°45'44.04"E. The locality map is shown on the figures below.

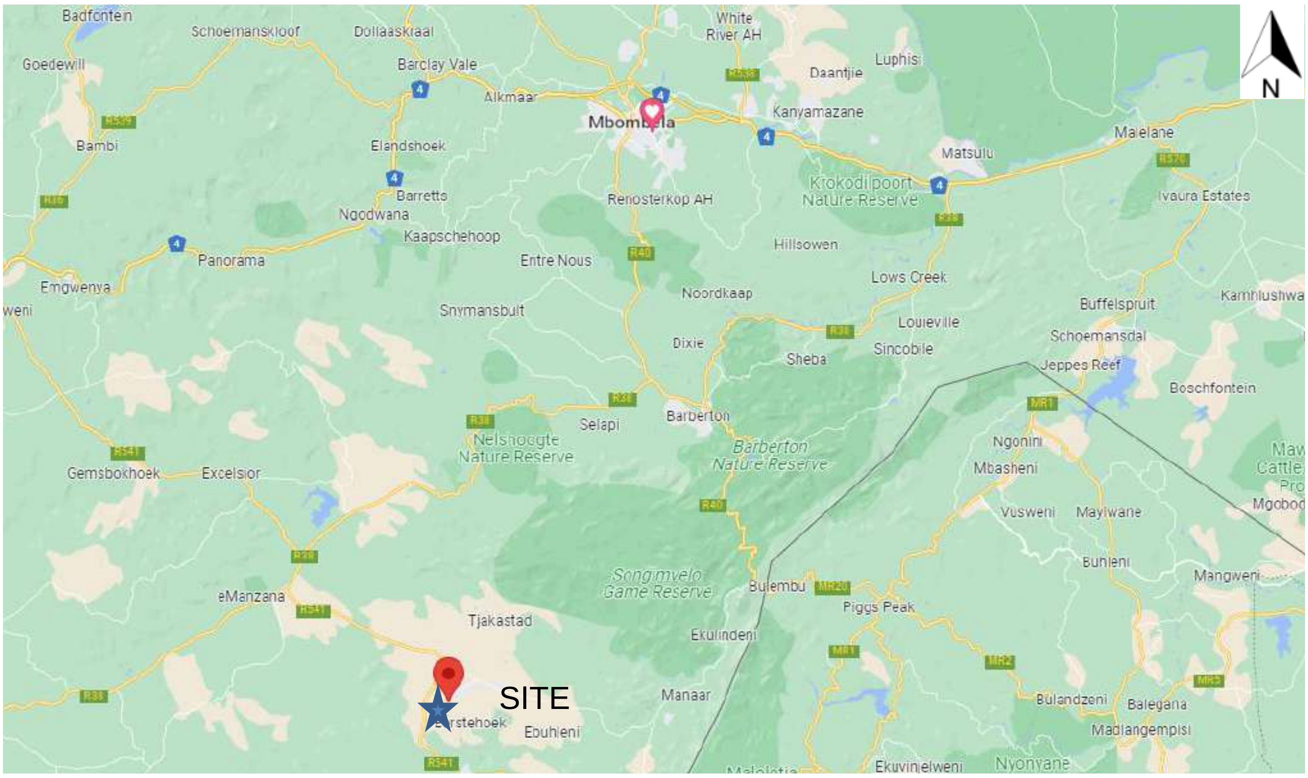


Figure 1 Locality map

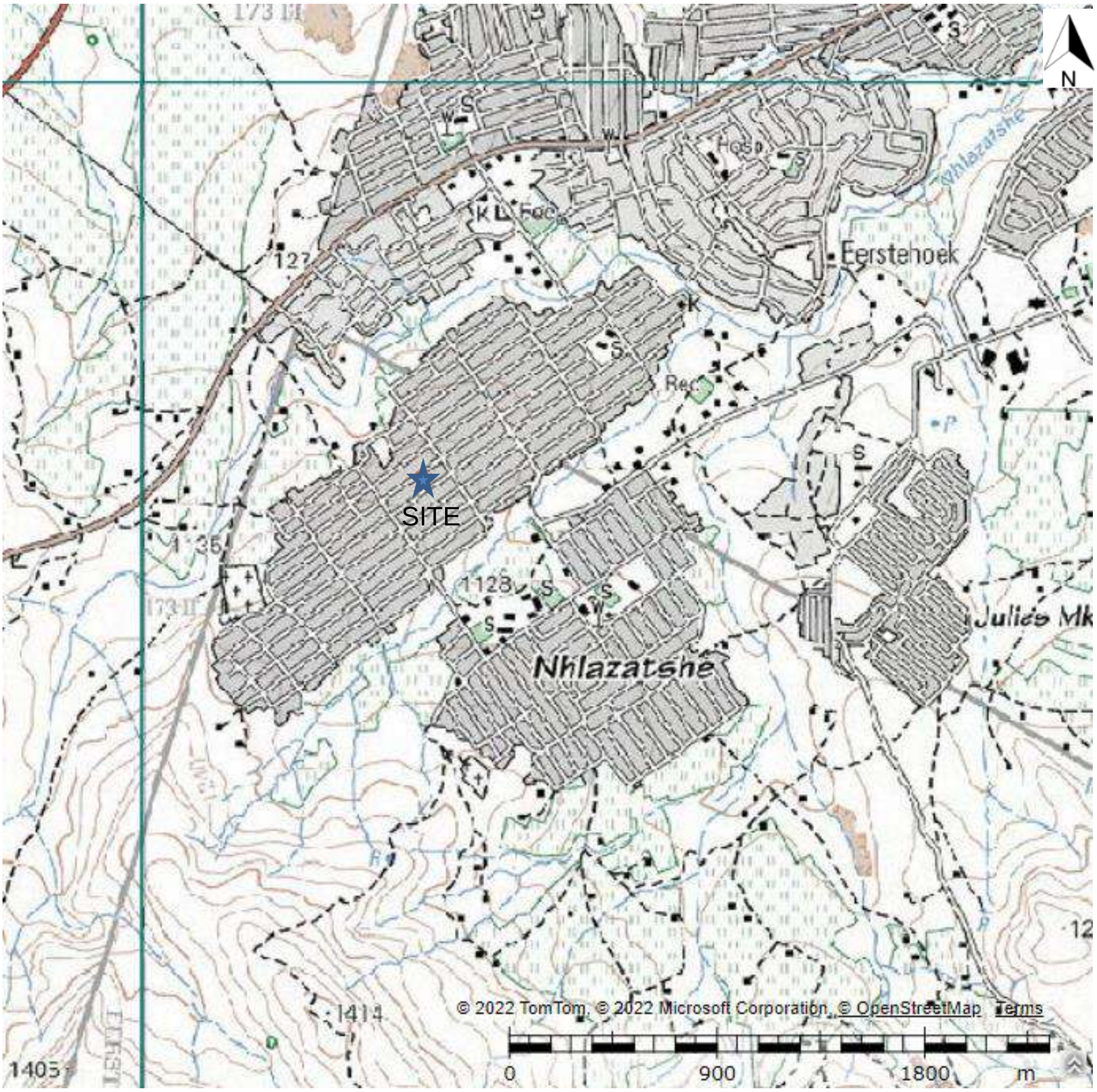


Figure 2 Locality

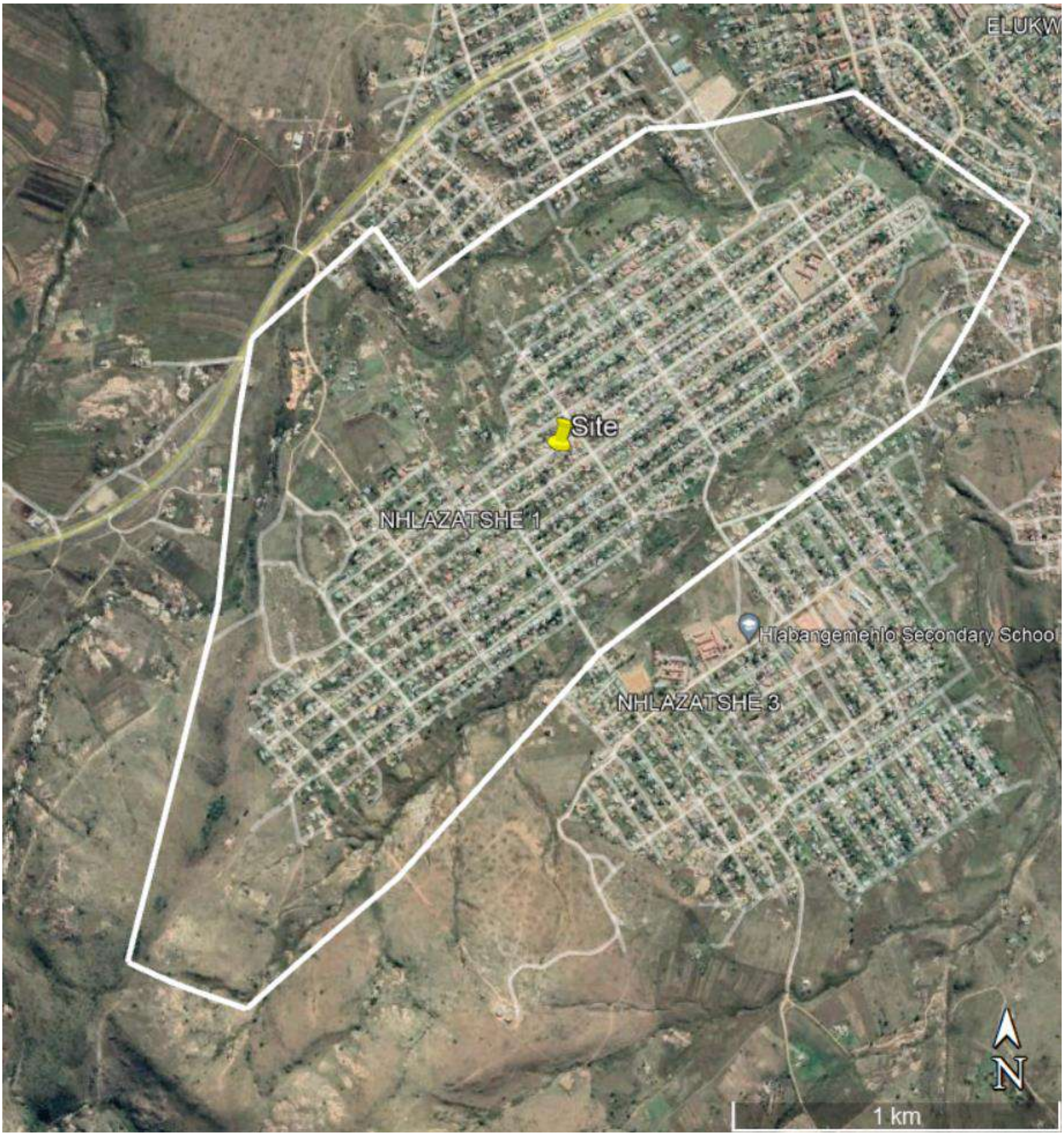


Figure 3 Locality plan

3 TOWN PLANNING

The site land use will be for residential purposes.

The site is to be developed for land uses shown in the table below.

Table 1 Land use

LAND USE					
ZONING	LAND USE		NO. OF STANDS	AREA Ha.	% OF AREA
RESIDENTIAL 1	RESIDENTIAL		1522	124.302095	65
BUSINESS 1	BUSINESS		10	0.611804	0
EDUCATIONAL	SCHOOL		1	1.99183972	1
INSTITUTIONAL	PLACE OF WORSHIP		5	18.0194003	9
PUBLIC OPEN SPACE	PARK		14	20.0635855	10
MUNICIPAL	CEMETERY		1	7.6040	4
STREETS	*	*	*	27.3517	14
TOTAL	*		1553	192,3405	100

The land use layout is shown in the figure below.

Figure 4 Spatial Development Plan

4 TOPOGRAPHY AND ACCESS

The site topography is generally flat to hilly.

Figure 5 Site view

Figure 6 Site view

Figure 7 Site view

The proposed development can be accessed from the through the main route option, described below.

- R541 through to D2807_020+ access road, to Church Street.

The R541 road is bituminous top surfaced. The local internal streets have block paving, gravel road and bituminous top surfaced roads.

See the figures below.

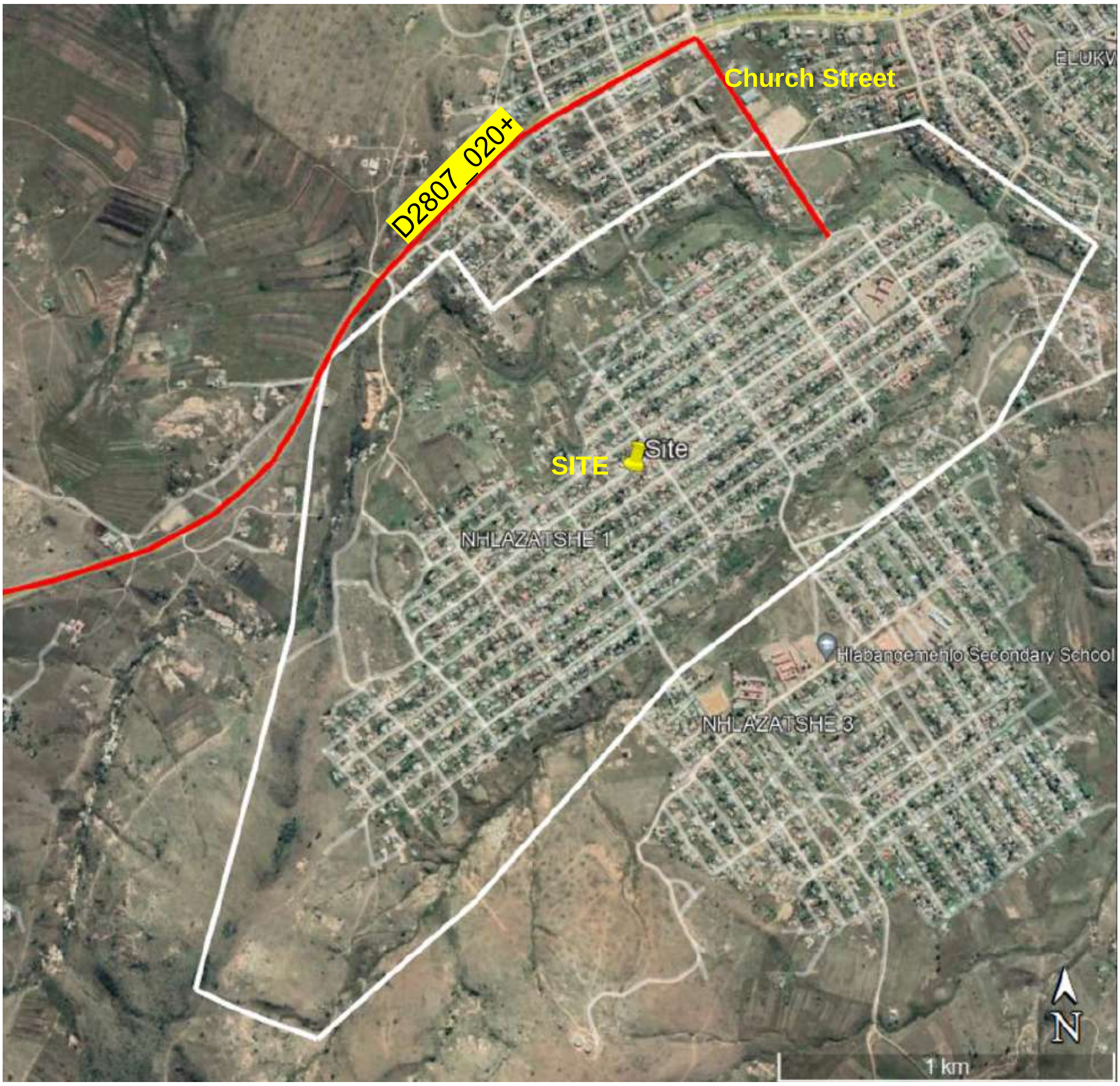


Figure 8 Site access

Figure 9 Internal Street

The access road has existing potholes and edge breaks.

	
Typical gravel road, Nhlazatshe, Mpumalanga	Typical block paving road, Nhlazatshe

Figure 10 Typical block paving and gravel Internal Street, Nhlazatshe, Mpumalanga.

See figure below:


Figure 11 Access road condition

5 WATER SERVICE

The project site has existing municipal infrastructure for water, electricity, access roads and stormwater. The existing bulk water infrastructure is shown on the figure below.

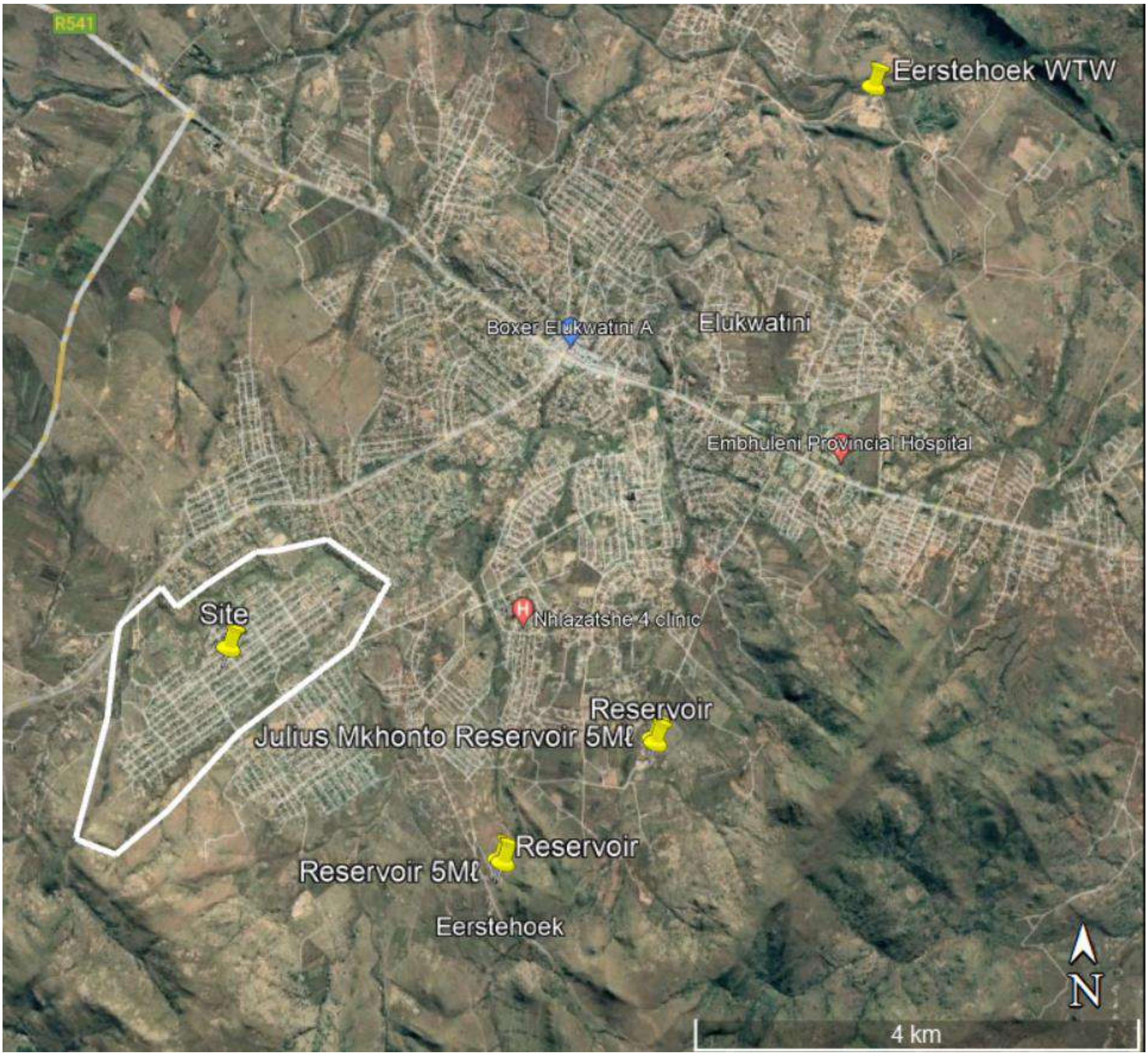


Figure 12 Existing water bulk infrastructure

5.1 Water source

The site is within the Eerstehoek Water Scheme (MP_30103).

In Nhlazatshe township, water is sourced from Nkomazi River and Nkomazana river.

Table 2 Abstraction Point

Description	Locality:
	Nhlazatshe
Water Source	Nkomazi and Nkomazana / Eerstehoek river
Raw Water Bulk line	200mm diameter uPVC

Raw water is then conveyed to the following water treatment works (WTW):

Eerstehoek WTW, GPS 26° 1'11.52"S 30°49'9.52"E, with a design capacity of 8Mℓ/day, and is currently being upgraded to 16Mℓ/day.

Table 3 WTW details

Description	Locality:
	Eerstehoek WTW
Water Treatment Works Capacity	8Mℓ/day

	
Water tank refill station, Eerstehoek WTW	WTW upgrading
	
Pump station (Tjakastad, Mooiplaas, Nhlazatshe)	Pump station (Elukwatini)

Figure 13 Eerstehoek WTW

Bulk meter water supply records could not be obtained as bulk meters are not working.

5.2 Bulk Water Pipeline

From Nkomazi River and Nkomazana / Theespruit river raw water is pumped through the following bulk lines to the Eerstehoek WTW:

- 355mm diameter AC pipeline inlet.
- 200mm diameter AC pipeline.
- 400mm diameter pipeline.
- 355mm diameter pipeline.

At the Eerstehoek WTW, water is pumped through a:

- 355 mm diameter AC pipeline to booster pump station (Not working).
- 300mm diameter steel pipeline to booster pump station.

See the figure below with water bulk line in blue colour.

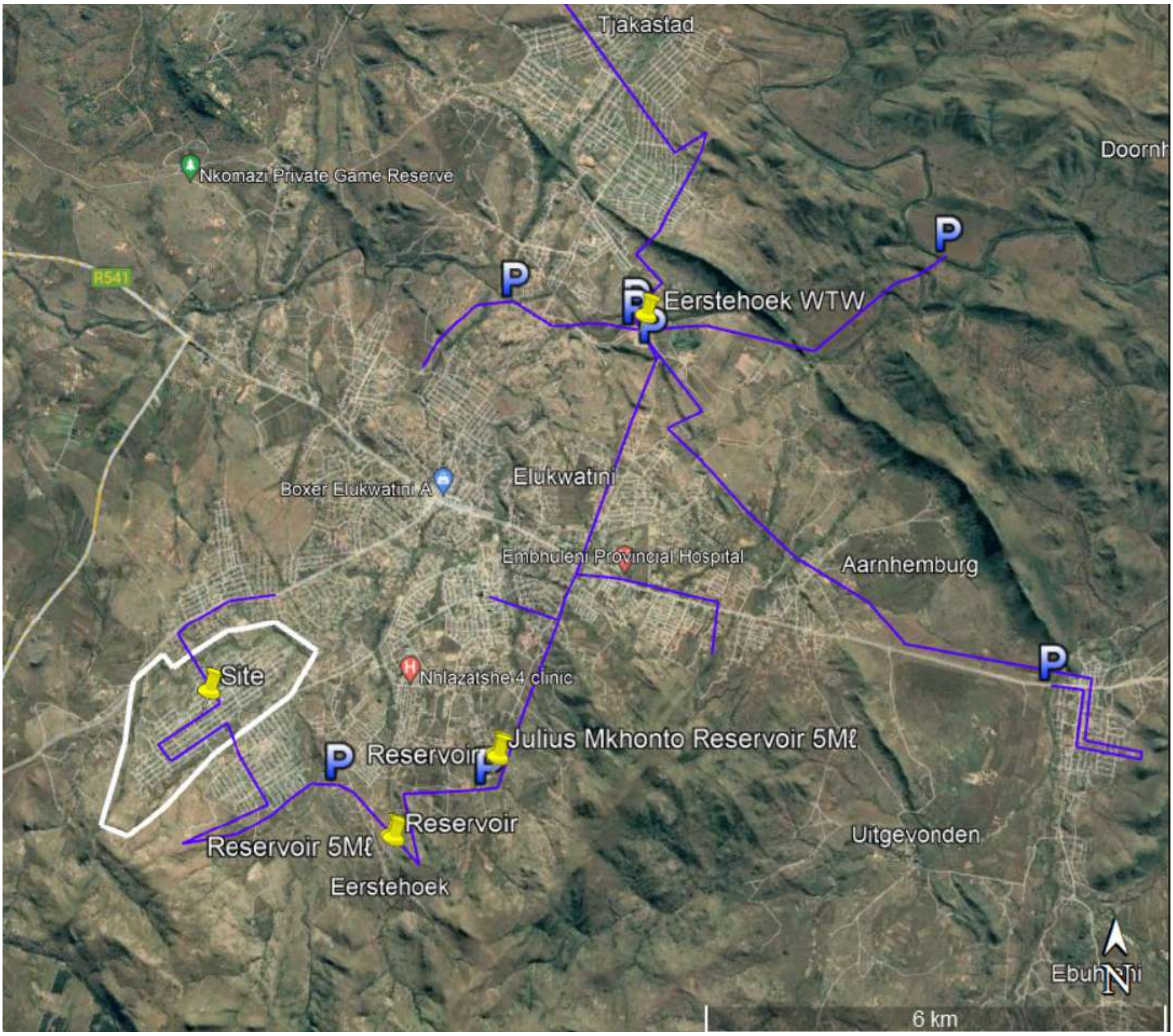


Figure 14 Water bulk lines

5.3 Storage Reservoirs / Tanks

There are four reservoirs in Nhlazatshe, viz;

- Two x 5Mℓ reservoirs in Julius Mkhonto. One reservoir serves the booster pump and the other serves the Nhlazatshe Ext. 1,2,3,4A and 4C. GPS coordinates 26° 4'23.07"S 30°48'0.27"E.
- Two reservoirs in Ward 16. 1 x 2Mℓ and 1 x 1.5Mℓ. Both reservoirs service the areas of higher elevation in Nhlazatshe that the reservoirs in Julius Mkhonto cannot.

The reservoirs are shown in the figure below.

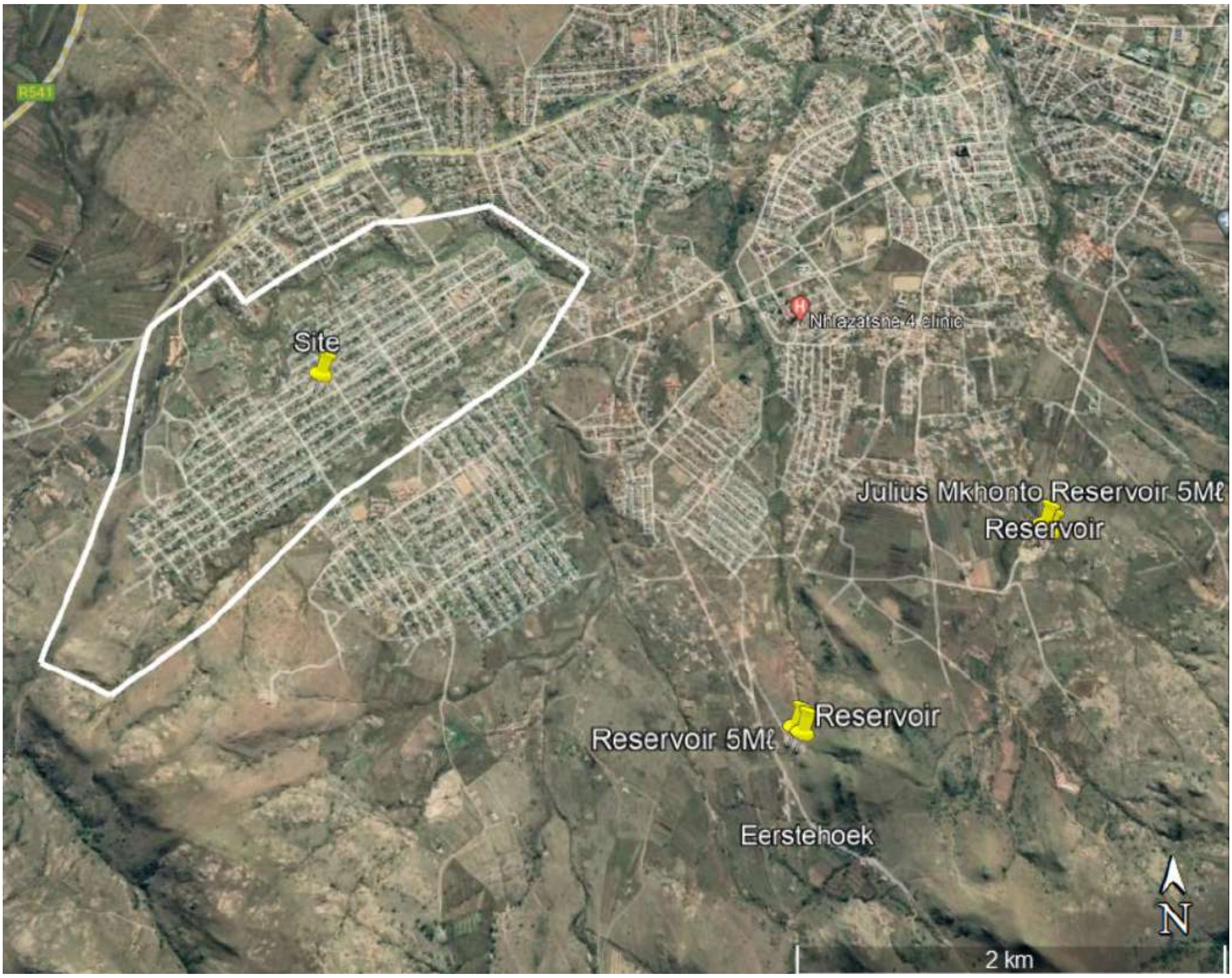


Figure 15 Water storage

5Mℓ reservoir, Julius Mkhonto, Mpumalanga.

2Mℓ reservoir, Ward 16, Nhlazatshe, Mpumalanga.

1.5Mℓ reservoir, Ward 16 Nhlazatshe, Mpumalanga

Figure 16 Water storages, Nhlazatshe, Mpumalanga

5.4 Water Reticulation

The proposed site has an existing water reticulation to yard connection standard.

Figure 17 Water meter and JoJo tank at typical homestead

5.5 Water design criteria

The water design criterion to be used is listed in the table below. The design guidelines were adopted from the CSIR document titled:

The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, Version 1.1.

Table 4 The water design criteria

Item	Design element	Criteria
i.	Average Annual Daily Demand (AADD), for Residential 1	0.6kℓ/c/day
ii.	Group / cluster housing, Medium density	0.5kℓ/unit/day
iii.	Business / commercial, FAR = 0.4	0.65kℓ/100m^2
iv.	Park	12kℓ/hectare
v.	Municipal, FAR = 0.4	0.6kℓ/100m^2
vi.	Institutional, FAR = 0.4	0.6kℓ/100m^2
vii.	Educational, FAR = 0.4	0.6kℓ/100m^2
viii.	Industrial, FAR = 0.4	0.4kℓ/100m^2
ix.	Taxi Rank	0.3kℓ/100m^2
x.	School, crèche, educational buildings	60 ℓ/student
xi.	Hospital, building according to Floor Area Ratio (FAR)	1.2 kℓ/100m^2
xii.	Church buildings	0.3 kℓ/100m^2
xiii.	Church grounds	1.2 kℓ/Ha
xiv.	School, crèche, educational buildings	60 ℓ/student
xv.	School, crèche, educational grounds	12 kℓ/Ha
xvi.	Institutional, FAR = 0.4	0.6 kℓ/100m^2
xvii.	Sport grounds / Recreational	40 kℓ/Ha
xviii.	Residential stands; High density, small sized, with 20 to 12 units/Ha	11 kℓ/Ha/day
xix.	Flats, High density	0.35 kℓ/unit/day
xx.	Stadium: Buildings only	1.5 kℓ/1000seats
xxi.	Stadium: Grounds only	12 kℓ/Ha/day
xxii.	Hotels	0.2 kℓ/person
xxiii.	Golf estate - excluding golf course water requirements. Stand size less than 2670m^2.	3kℓ/stand/day
xxiv.	Garage or filling station	0.8kℓ/100m^2
xxv.	Frail care centres and hospitals, Building according to FAR	1.2kℓ/100m^2
xxvi.	Gross Average Annual Daily Demand (GAADD)	Allow 10% losses
xxvii.	Daily Instantaneous Peak Factor (DIPF)	1.5
xxviii.	Design Peak Flow Rate (DPFR) for domestic flows.	25ℓ/s
xxix.	Maximum static head	90m
xxx.	Minimum residual head under conditions of domestic peak flow	10m
xxxi.	Maximum linear flow velocity under conditions of domestic peak flow	3m/s
xxxii.	Pipe type	uPVC
xxxiii.	Minimum pipe class	9
xxxiv.	Fire flow at any one hydrant under the conditions of domestic peak flows (one hydrant at a time)	15 ℓ/s
xxxv.	Minimum residual head (fire plus domestic peak flow)	25m
xxxvi.	Maximum linear flow velocity under conditions of fire-fighting	3m/s
xxxvii.	DWS storage reservoirs sizing criteria: 48 Hrs x AADD Pumped from One Source 36 Hrs x AADD Pumped from Multiple Sources 24 Hrs x AADD Gravity Source	

The following adoptions were also made:

- Residential 2 land use type has 44 Dwelling Units / Hectare
- Residential 3 land use type has 65 Dwelling Units / Hectare

5.6 Water demands

The estimated water demand for the proposed development is shown in table below. As per the table below, the water demand calculations indicate that the proposed township will require 1 550.1kℓ/d AADD and 1 705.1kℓ/d Gross Average Annual Daily Demand.

Table 5 Water demand

Land Use	No. of Erven	Area (Ha)	Area (m^2)	No. of Units	Floor Area Ratio, FAR	Unit flow	Unit of measure	Water Demand	
Residential 1 (Residential)	1522	124.302095	1243021	1522		0.6	kℓ/erf/day	913.2	kℓ/d
Business 1 (Business)	10	0.611804	6118		0.4	0.65	kℓ/100m²	15.9	kℓ/d
Educational (School)	1	1.99183972	19918.4	100		0.060	kℓ/student	6.0	kℓ/d
Institutional (Place of Worship)	5	18.0194003	180194		0.4	0.600	kℓ/100m2	432.5	kℓ/d
P.O.S (Park)	14	20.0636	200635.9						
Municipal (Cemetery)	1	7.6040	76040		0.4	0.600	kℓ/100m2	182.5	kℓ/d
Street		192.3405	1923405						
Totals	1553	364.93	3649332.2						
Sub-total Average Annual Daily Demand (AADD)								1550.1	kℓ/d
Gross Average Annual Daily Demand (GAADD) (added 10%)								1705.1	kℓ/d
Gross Average Annual Daily Demand (GAADD) (added 10%)								19.7	ℓ/s
Multiply by a peak factor (Summer Peak Factor)						1.5	peak factor	2557.6	kℓ/d
Multiply by a peak factor (Summer Peak Factor)						1.5	peak factor	29.6	ℓ/s

The Fire flows are shown in the table below.

Table 6 Fire flow demands

Fire category: **Moderate risk 1: Industrial, business, high rise flats ≥ four storeys**	**Quantity**	**Unit**
Total fire flow	50	ℓ/s
Duration of design fire flow	4	Hours
Minimum Flow at one hydrant (ℓ/s)	25	ℓ/s
Moderate risk 2: Cluster & low-income housing, high-rise flats ≤ three storeys		
Total fire flow	25	ℓ/s
Duration of design fire flow	2	Hours
Minimum Flow at one hydrant (ℓ/s)	25	ℓ/s
Fire category: **Low risk: Single residential housing**		
Total fire flow	15	ℓ/s
Duration of design fire flow	1	Hours
Minimum Flow at one hydrant (ℓ/s)	15	ℓ/s

5.7 Bulk water capacity

The proposed water demand AADD is 1 550.1kℓ/d.

The Nhlazatshe reservoirs have a capacity of 5Mℓ + 1.5Mℓ + 2 Mℓ =8Mℓ and receives water from a pumped source.

Therefore, Nhlazatshe required storage = AADD x 2 = 1550.1kℓ/d x 2 = 3 .1Mℓ

Nhlazatshe proposed development required storage (3.1Mℓ) is **less** than Existing reservoirs capacity of 8Mℓ.

Hence the existing Nhlazatshe reservoir capacity is adequate.

The capacity of the existing 300mm bulk line pumping water to Nhlazatshe is shown in the table below.

Table 7 Pipeline existing capacity

BULKLINE	**INTERNAL DIAMETER**	**MAX CAPACITY (At V=1.2m/s)**		**WATER SUPPLY**	
DIAMETER	**(mm)**	**Flow Q (ℓ/s)**	**Flow Q (m^3/s)**	**Supply (m^3/d)**	**Supply (Mℓ/d)**
300mm	277.0	72.32	0.072	6 248.0	6.248

The proposed site’s peak water demand of 29.6ℓ/s is less than the capacity of the existing 300mm diameter pipeline with a capacity of 72.32ℓ/s.

Therefore, the existing 300mm diameter bulk pipeline for Nhlazatshe is adequate.

Eerstehoek WTW is meant to have a capacity of 13.5Mℓ / day but is currently only treating 8Mℓ / day.

Eerstehoek Water meter readings not available, because water meters currently do not work.

Eerstehoek WTW pumps treated water for 13 hours a day.

Eerstehoek WTW supplies the following villages: Mooiplaas, Tjakastad and Nhlazatshe.

Nhlazatshe reservoirs are supplied twice a week and has a water allocation of 12Mℓ / week.

Nhlazatshe experiences regular water shortages.

Locals then store water by JoJo tank or ration water use through out the week.

5.8 Water infrastructure proposed

- WTW is being upgraded from 8Mℓ to 16Mℓ capacity reservoir.

5.8.1 Ground water source

In order to augment the water supply to site, a groundwater borehole will need to be divined, drilled and tested. The borehole should be aimed at matching the water demand of the development as shown in Table 5 Water demand.

6 SEWER SERVICE

6.1 Existing wastewater treatment works

There are no existing bulk wastewater treatment works infrastructure servicing Nhlazatshe 1 village.

There is an existing Elukwatini WWTW situated next to the Eerstehoek WTW that is under construction. The Elukwatini WWTW, once complete, will have a capacity of 16Mℓ/d. GPS coordinates: 26° 1'18.74"S 30°49'33.80"E.

Figure 18 Existing Sewer ponds under refurbishment / upgrade.

6.2 Sewer reticulation

There is no existing sewer reticulation in Nhlazatshe 1 village. Domestic wet or dry sanitation is utilised in the village. This is the form of pit toilets and septic tanks.

Figure 19 Existing pit toilet at typical homestead

6.3 Sewer flows

The design guidelines were adopted from the CSIR document titled:

The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, Version 1.1.

Table 8 Sewer design flow of proposed development

Land Use	No. of Erven	Area (Ha)	Water Demand		Sewer Return	Sewer Flow	
Residential 1 (Residential)	1522	124.30	913.2	kℓ/d	85%	776.2	kℓ/d
Business 1 (Business)	10	0.61	15.9	kℓ/d	85%	13.5	kℓ/d
Educational (School)	1	1.99	6.0	kℓ/d	85%	5.1	kℓ/d
Institutional (Place of Worship)	5	18.02	432.5	kℓ/d	85%	367.6	kℓ/d
P.O.S (Park)	14	20.06					
Municipal (Cemetery)	1	7.60	182.5	kℓ/d	85%	155.1	kℓ/d
Street		192.34					
Totals	1553	364.93	1550.1				
Sub-total Sewer ADWF						**1317.6**	**kℓ/d**
15% Extraneous flow						197.6	kℓ/d
Gross Sewer						1515.2	kℓ/d
Gross Sewer Flow						17.5	ℓ/s
Peak Factor						2.5	
Peak Sewer Flow						43.8	ℓ/s

The proposed development will have an estimated sewer ADWF of 1317.6kℓ/d and a gross sewer flow of 1515.2kℓ/d.

6.4 Wastewater bulk capacity

The proposed site has a gross sewer flow of 1.318Mℓ/d.

The estimated peak sewer flow from the proposed Nhlazatshe 1 is 43.8 ℓ/s.

The municipality has commenced on the upgrade of the Elukwatini WWTW. The WWTW capacity is planned be upgraded to 16 Mℓ/d by the municipality.

6.5 Sewer proposed

The proposed sewer infrastructure is as follows:

- A 12km long sewer main outfall gravitating to the proposed 16Mℓ/day WWTW.

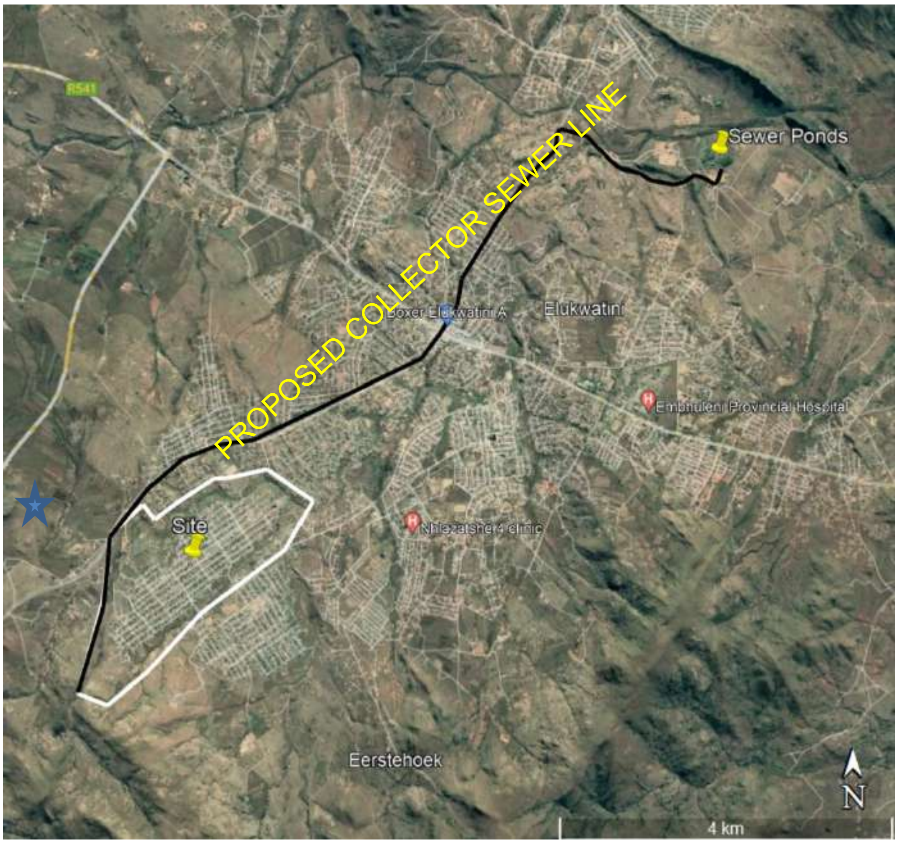


Figure 20 Sewer outfall proposed (black line)

The proposed 12 000m long sewer outfall is shown in the figure above.

7 ELECTRICITY

There is existing electricity supply infrastructure on site.

Figure 21 Electrical lines onsite

8 TOWNSHIP ROADS

There is an existing functioning road network that can be used to access the proposed development.

The road infrastructure to internally service the development will be the standards of the Red Book, TMH, TRH books and the local municipality.

8.1 Classification of roads

Table 9 Classification of roads

Description	Class no.	Function	Reserve width	Roadway width
Access Road	5d	Access from existing bounding road	15m	7.4m
Internal Service Road	5f	Internal Road	13	6m
Internal Service Road	5f	Internal Road	10	6m

8.2 Geometric Design Standards

Table 10 Class 5d – Access Road

Design speed	60km/h
Minimum centre line radii	50m
Minimum gradient	0.5%
Favoured maximum gradient	10%
Maximum grade/grade length	12.5% over 70m
Maximum K-value : Crest	16
: Sag	16

Table 11 Class 5f – Internal roads

Design speed	**30km/h**
Minimum centre line radii	30m
Minimum gradient	0.5%
Favoured maximum gradient	12%
Maximum grade/grade length	16% over 50m
Maximum K-value : Crest	6
: Sag	8

8.3 Pavement Design

The proposed pavement designs are based on anticipated traffic volumes and ground conditions, a detailed pavement design will require a geotechnical centreline investigation report.

The table below shows the proposed pavement design for the development.

Table 12 Proposed pavement design

Design	**Description**
Pavement	30mm Premix Asphalt / 80mm concrete block paving
Base	150mm Thick natural gravel stabilised with Cement to create C4 material compacted to 97% of Mod AASHTO
Subbase	150mm Thick natural gravel G7 material compacted to 97% of Mod AASHTO
Upper Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Lower Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Roadbed & Fill (where required)	150mm Thick layers compacted to 90% of Mod AASHTO Density. Minimum CBR= 3 at 90% of Mod AASHTO Density- G9

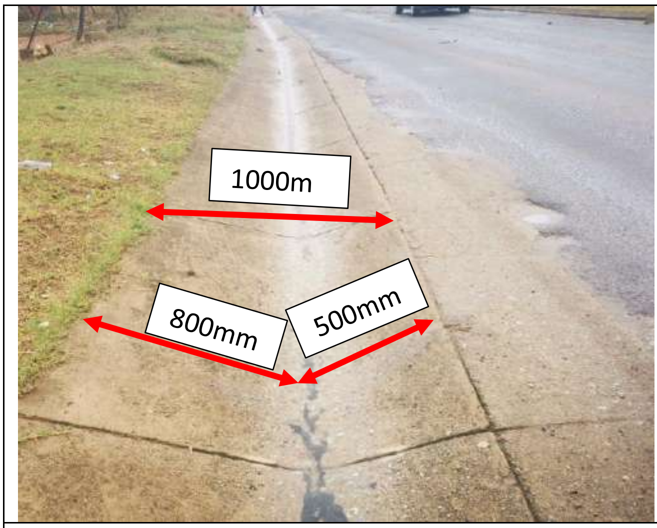
9 STORMWATER DRAINAGE

Stormwater generated onsite can be channelled to follows the natural slope of the ground, to the lowest point. It is envisioned to use Sustainable Urban Drainage Systems (SuDS) to manage stormwater runoff from the site. A stormwater management plan will need to be submitted to the municipality before construction starts. Extraneous stormwater from above the site will be accommodated over the site.

9.1 Stormwater systems

Stormwater runoff onsite is handled through an existing internal stormwater system that is provided to drain the site in a safe and efficient way. The stormwater is discharged into the adjacent river and streams.

See figure below:



Typical stormwater chanel.

450mm diameter stormwater culvert.

Figure 22 Electrical lines onsite

9.2 Hydrology

The hydrological data used in the design of the stormwater drainage system is shown in the table below.

Table 13 Hydrological data

Hydrological Data	
a) Flood return period	1: 2 years for storm water pipe system. 1: 5 years for the combined stormwater pipe and road systems
b) Average yearly rainfall	1000mm
c) Minimum time of concentration and run	As per Local Municipality Guidelines
d) Design Method	Rational method

9.3 Design Standards

The table below lists the standards to be used in the design of the stormwater drainage system:

Table 14 Stormwater design standard

Design Element	**Specification**
a) Minimum pipe size	600 concretes
b) Minimum pipe gradient	0.67%
c) Storm water details	Local Municipal Standard Details

10 SOLID WASTE

A regional landfill situated nearest the site is to be used to dispose solid waste. The local municipality is responsible for connecting and disposing the solid waste. If the municipality is not able to provide this service, then a private company will need to be appointed by the development owners for the service.

A refuse area with bins will be done onsite and solid waste will be disposed of at the municipal dump site as per the municipal health bylaws.

The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, Version 1.1.

The solid waste generation range from 0.6 kg per capita per day in the poor areas, to 1.29 kg per capita per day.

The rate of 0.6kg/c/d was adopted for the township. Solid waste will be generated by the development.

Population estimate = 1522 residential units x 4 people per unit = 6 088 people

- Solid waste = 0.6kg/per person/day or (0.6kgx365 days)
- Waste generated per day = 0.6x 6 088 = 1423kg = 3.653 tonne
- Waste generated per annum = 3.653x365 = 1333 tonne

11 CONCLUSION

The proposed development will contribute towards improving the service delivery of the area and general livelihood of the residents.

FORMALIZATION OF THE NHLAZATSHE 1, INFORMAL SETTLEMENT LOCATED ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172 IT AND EERSTEHOEK 235 IT, MPUMALANGA PROVINCE

BULK ENGINEERING SERVICES REPORT:

CIVIL SERVICES REPORT

Compiled by	W. KASILEMBO B. Tech Civil	Kasilembo Signature	29/09/2022 Date
Reviewed by	L. MTHUNZI BSc Hons Eng, Pr Tech Eng ECSA	Signature	29/09/2022 Date

ANNEXURES

ANNEXURE 1 Layout Plan

Electrical Report

FORMALIZATION OF THE NHLAZATSHE 1, INFORMAL SETTLEMENT LOCATED ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172 IT AND EERSTEHOEK 235 IT, MPUMALANGA PROVINCE

ELECTRICAL SERVICES REPORT

September 2022, Rev0

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1. Executive Summary

The proposed formalization of Nhlazathe 1 is situated on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT. The area is administered by Chief Albert Luthuli Local Municipality under Gert Sibande District Municipality in Mpumalanga Province. The proposed development township consists of 1553 stands. All the stands are electrified. There is an existing medium voltage feeder lines that are supplying the area.

The medium voltage line is Mink Conductor. The proposed township development is connected from medium voltage on 11KV. The proposed township development is connecting electricity from Goliath feeder medium voltage line on 11KV. The feeder line is fed from Eerstehoek Substation and the capacity is 132/11KV. There is existing medium voltage aluminum conductor steel reinforced passing through the development and is utilized to supply the development. The site is supplied from existing overhead medium voltage line to the drop out fuse link and distributes cable overhead and connected to the electrical meter. The area is situated within the electricity licensed area and supply by Eskom. It is recommended that the township development is connected according to Eskom Distribution Standard.

2. Introduction

This report outlines the design philosophy of the electrical medium voltage and low voltage installation for the proposed area. The proposed formalization of Nhlazathe 1 is situated on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT. The installation is designed to ensure that the installation is complying with the South African national safety standard while meeting the objective of the development.

Table 1 Demographic information

ITEM	DESCRIPTION	COMMENTS
1.	**DEMOGRAPHIC INFORMATION**	
Town Layout	Number of stands	1553
	Stand Density	Medium -10.3 hectare
	Town layout	Relatively Structured
	Classification of layout	Medium Density
Existing Infrastructure	Type of Road	Gravel
	Existence of Telephone Services	Yes
	Existence of Water Services	Yes
	Water reticulation	Yes
	Sewage infrastructure	None
	Others: Clinic	1
	Schools	1
	Churches	5
	Businesses	10
Site Conditions	Soil type	Red turf
	Climate	Temp: -5 to 33^{o}C
	Population	Estimated 2600 people

ITEM	DESCRIPTION	COMMENTS
2	NETWORK INFORMATION	
2.1	Substation Source	Eerstehoek Substation
2.2	Substation MV transformer capacity	132/11KV
2.3	Feeder Name	Goliath 11KV
2.4	MV CONDUCTOR TYRE AND SIZE	MINK

3. Development Proposal (Locality)

The proposed township is situated 130km south of Mbombela along the R40, R38 and R541 respectively, in Mpumalanga Province, South Africa. The area is administered by Chief Albert Luthuli Local Municipality under Gert Sibande District Municipality. GPS coordinates of site are 26° 3'55.66"S 30°45'44.04"E.

The locality map is shown on the figures below.

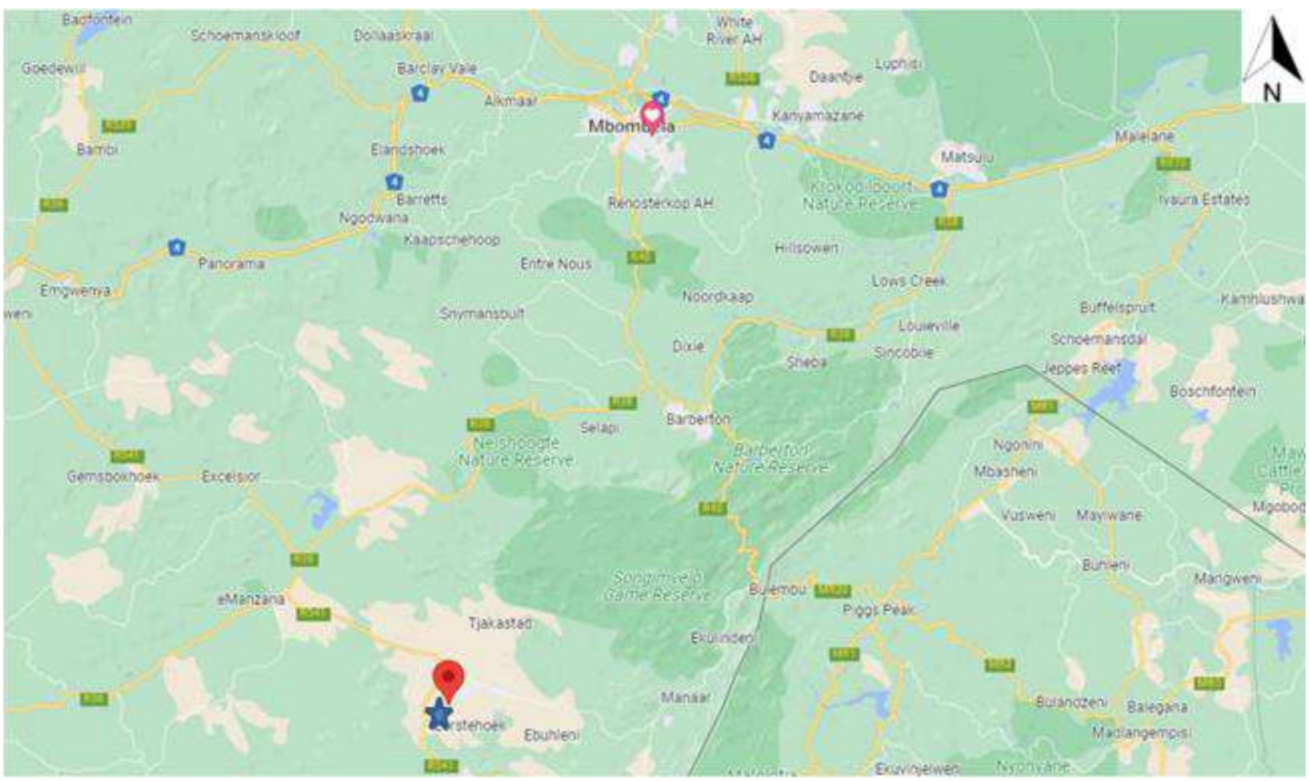

Figure 1 Locality

4. Distribution Network Model

4.1 MV Reticulation

There is an existing medium voltage feeder lines that are supplying the area. The medium voltage line is Mink Conductor. The proposed township development is connected from medium voltage on 11KV. The proposed township development is connecting electricity from Goliath feeder medium voltage line on 11KV. The feeder line is fed from Eerstehoek Substation and the capacity is 132/11KV. There is existing medium voltage aluminum conductor steel reinforced passing through the development and is utilized to supply the development. The site is supplied from existing overhead medium voltage line to the drop out fuse link and distributes cable overhead and connected to the electrical meter. There is existing electrical infrastructure around the area.

5. Distribution Model

The objective of this task is to develop an adequate network model representing the entire area up to the main feeder level. The main feeder is defined as the main feeder supply from substation.

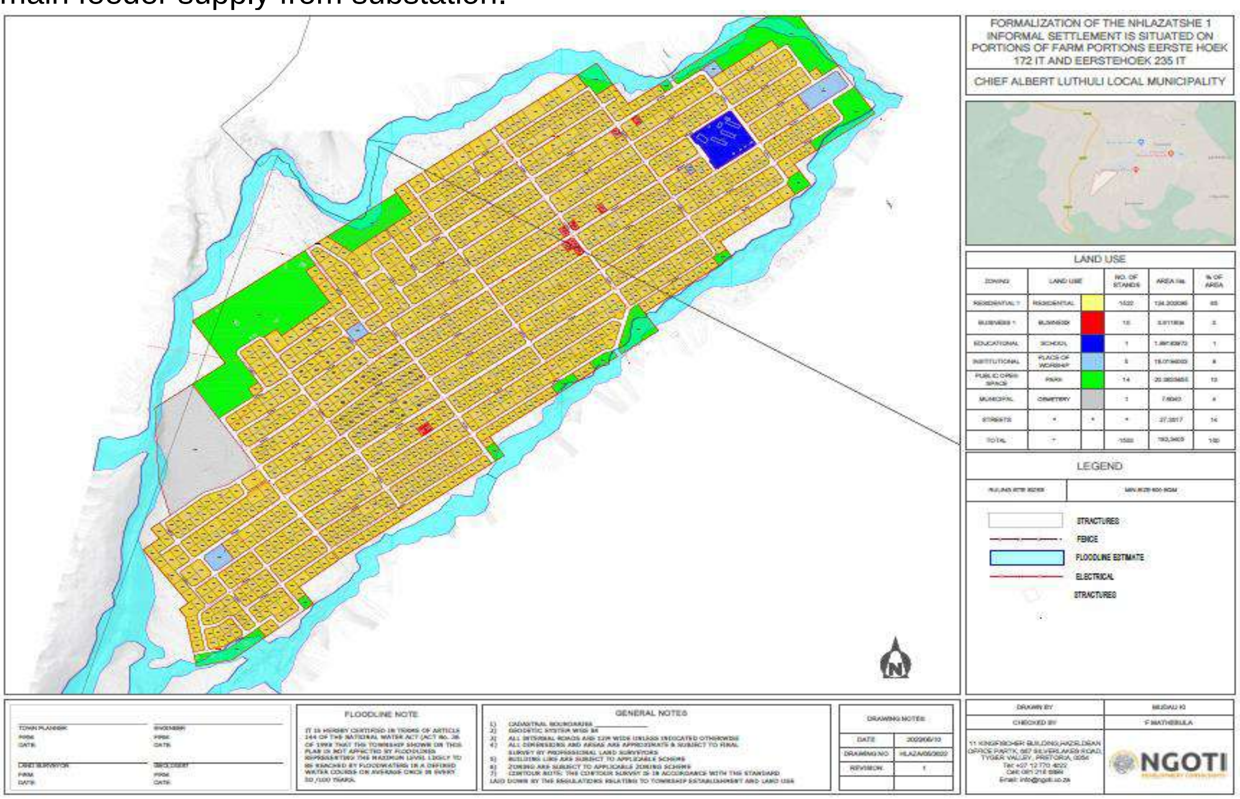

Figure 2 Proposed township development

6. Supply Authority (Licensed)

The area is situated within the electricity licensed area and supply by Eskom.

7. Existing Infrastructure.

There is existing medium voltage aluminum conductor steel reinforced passing through the development and is utilized to supply the development. The power supply authority is Eskom. There are existing electrical infrastructures that are supplying the area.

Existing Medium voltage

Existing Transformer

Existing feeder line

Existing low voltage line

Figure 3: Existing Infrastructure

8. Reticulation Design

8.1 Method of Supply

MV feeder is constructed within the Informal Settlement and they are connected to the distribution transformer. There is an existing MV feeder lines that are supplying the area.
This is to determine the most cost-effective supply arrangement that is used and provide details of required in feed points. The following is included regarding to bulk supply:

- The planning capacity and bulk infrastructure.
- The quality of supply.
- Metering arrangement.
- Protection arrangement.
- The loss profile due to load.

8.2 Design Parameter

The Developer shall erect the MV and LV overhead line reticulation systems in accordance with Eskom's Electrification Standards (Wood Structures).
The internal MV distribution systems shall comprise of "Hare "aluminum conductor steel reinforced configuration on 11m or 9m wooden poles and shall be built to 22kV specifications.

The LV distribution systems shall comprise an aerial bundled conductor (ABC) system, of the supporting core type mounted overhead on either 7 or 9 meter wooden poles. LV distributor spurs shall extend within a radius of approximately 500m from transformer positions depending on individual voltage drop requirements. LV distributor spurs shall share pole structures with the MV system where these follow parallel routes providing clearance of LV can be achieved.

Transformers shall be of the pole mounted type suitably rated to serve anticipated individual LV distributor loads and shall be of the SABS 780 type. All materials supplied by the Developer shall conform to Eskom's Buyer's Guide (Part 9 of DT Standard).

8.3 Existing Load Demand.

Table 2 Existing Load

Land Use	No. of Erven	Area (Ha)	No. of Stands	VA / stand	Total
Residential 1	1522	124.302095	1522	1.2	1826.4
Business 1	10	0.611804	10	1.2	12
Education (School)	1	1.99183972	1	1.2	1.2
Institutional (Place of safety)	5	18.0194003	5	1.2	6
Public open space(Park)	14	20.0635855	14	1.2	16.8
Municipal (Cementery)	1	1	7.6040	1.2	1.2
			Total Load Demand		**1863.6**

Total Existing Load is 1863.6KVA

The following design parameter is set:

- Medium voltage (Final Design)
  - ADMD 1.2kVA/stand
  - Spare capacity on feeder 0.5kVA/stand
  - Supply voltage 11kV-3 phase
  - Supply regulation(bulk) 100%(assumed)

  The projected load for the final phase (at 1.2kVA per stand) is 1863.6kVA. The transformer installed capacity is suitable for and can deliver an ADMD of 1.2kVA per stand.

- Low voltage (Final Design)
  - ADMD 1.2kVA/stand
  - Supply voltage 415/240 volt
  - Regulation +- 10%ase
  - Service connection(max) 20Amp

CART Parameters:

Table 3 Design Parameter

ADMD	Alpha	Beta
Initial	0.47	8.91
Final	0.73	7.48

8.4 Summary of Predictions for each year

Table 4 Prediction for each year

Year	Energy [kWh]	IADMD [kVA]		beta	Circuit
1	150.70	0.69	0.47	8.91	20.00
2	160.63	0.73	0.49	8.75	20.00
3	170.57	0.76	0.50	8.61	20.00
4	180.50	0.80	0.52	8.49	20.00
5	190.44	0.84	0.54	8.36	20.00
6	200.38	0.88	0.56	8.24	20.00
7	210.31	0.92	0.58	8.14	20.00
8	220.25	0.96	0.60	8.05	20.00
9	230.18	0.99	0.62	7.95	20.00
10	241.78	1.04	0.64	7.85	20.00
11	251.71	1.08	0.66	7.77	20.00
12	261.65	1.12	0.68	7.69	20.00
13	271.58	1.16	0.70	7 62	20.00
14	281.52	1.20	0 72	7,55	20.00
15	291.46	1.23	0.73	7.48	20.00

8.5 MV Design

The existing and proposed medium-voltage network is best described in terms of both geographic layout and electrical connection layout. The performance of the network is quantified by MV load flow studies, based on the loads described in the load forecast.

Medium Voltage supply consists of three phase mink conductor. The conductor shall be mounted on 9m wood poles and shall run street-front. A 780 pole mounted transformer shall be used to supply the stands. The transformer must not be loaded more than 108%.

All MV structures shall be constructed in accordance with Eskom Medium Voltage Distribution Standard and specifications.

The MV overhead feeder system shall comply with the requirements of ESKOM’s Distribution Technology, Electrification Standards and Guidelines as and where applicable for an urban concrete pole reticulation system.

a) Conductor

Type	:	Aluminium conductor steel reinforced.
Code Name	:	Hare/Fox-see Bill of Quantities/drawings
Mass	:	85kg/km / 149kg/km
Ultimate tensile strength	:	7 900 / 13 200 Newton
Max working tension	:	@ -5oC + wind 5 240 / 8760 Newton.
Mounting	:	See structure codes on drawings.

The maximum working tension may be exceeded only during the construction stages when the conductors are to be “over-tensioned” to 1.05 x MWT for a period of not less than 8 hours nor longer than 24 hours after which the tension is to be reduced to a figure not to exceed the stated maximum working tension of the conductor concerned.

b) Poles

Pole type	-	Wood
Pole lengths	-	7m for LV distributor 9m for LV road crossing, 11m for MV Line
Planting depth	-	1.5, 1.8 and 2m respectively
Pole marker	-	painted - black on yellow background.

c) Stays

Type	-	Fiber glass for MV and Porcelain of LV
Rods	-	M20 - 2000 long
Base plate	-	380 x 380 x 6 galvanized
Stay wire	-	7/4mm, 1100 MPA - galvanized
Planting depth	-	2m

d) Flying Stays

Flying stays shall be installed in the positions indicated on the drawings by the structure codes. Anchor poles shall be as specified for the line structures and of sufficient length to ensure the required ground clearance. Overhead stay wire shall be 7/4.00mm as specified for stays.

e) Struts

Struts shall be installed in the positions indicated on the drawings by the structure codes. Strut poles shall be as specified for the line structures. Line structure poles shall be fitted with suitable ground anchors at all strut positions.

Struts shall be fitted with barbed wire anti climbing devices.

f) Insulators, Line Clamps and Other Line Components, Pole Dressing Hardware etc.

All in accordance with Eskom's Distribution Reticulation Technology, Electrification Standards and Guidelines with particular reference to the detailed material take off sheets provided for the various line structures.

g) Sags and Tensions

The Developer shall provide suitable dynamometer sighting rods or other approved apparatus necessary for proper checking of the work. Dynamometers shall be calibrated in kg or kN.

h) Surge Arrestors

Surge arrestors shall be of the metal oxide outdoor hermetically sealed, vertical base mounted type, rated at 11kV, 10kA impulse current.

i) Sectionalizers

Dropout fuses shall be provided for each transformer zone.

8.5.1 Pole Mounted Transformers

Transformers shall generally comply with the following details:

Situation	:	Outdoors
Mounting	:	Suitable for single pole structure (Transformer outline)
Type	:	SABS 780
kVA rating	:	100/50 (as indicated on drawings)
No load voltage ratio	:	11000/415/231 volt
Vector group	:	Dyn 11
Parallel operation	:	Not required
MV & LV connections	:	External bushings with suitable insulated connections.

The transformers shall have connected on the MV side through the use of links or fuses.

8.6 LV Design

The low voltage feeders shall be three phase 4 core aerial bundle conductor with bare neutral and shall be 70 and 35mm². The LV network is to be constructed in mid-block layout on 7m wood poles. The feeders shall be fused at the transformer pole**.** All LV structures shall be constructed in accordance with Eskom Low Voltage Distribution Standard and specifications.

8.7 Service connection

The majority of customers are expected to purchase a 20 Amp supply. Service connections are to be made with a 10mm² concentric cables from a 4-way and 8-way distribution pole top boxes. The service connection shall be a concentric cable in accordance with SCSSCAAC7. For a 60A supply a 10mm² concentric cables shall be used. The concentric cable used on all new services shall be installed without joints from the pole-top distribution box into the standard passive unit base, which is mounted in the customer's premises.

Where the concentric cable enters the dwelling, suitable protection shall be applied around the cable to prevent damage to the insulation. The concentric cable shall form a "drip loop" before the attachment or entry point on the customer's wall as illustrated in drawings D-DT-0360 and D-DT-0361. The concentric cable entry point into the SPU shall be watertight.

The SPU consists of a standard dispenser socket (ED base) attached to a standard 110 mm x 110 mm socket outlet box as illustrated in D-DT-0347. The SPU shall be installed in every customer’s home regardless of the type of supply required. For customers with a 60A supply the standard 110mm X 110mm socket outlet box shall be removed from the SPU. The SPU shall comply with SCSSCAAJ1.

The SPU integrates the incoming service cable with the metering, protection and household distribution. It provides the separation of the earth and neutral for the customer's installation. The wiring between the standard dispenser terminals and the socket outlet box is part of the customer’s installation. The wiring shall be done with a separate earth and neutral wire.

The SPU shall be mounted at a position that is suitable for the customer and away from sources of heat and moisture. Refer to 7.9 in SABS 0142 for the positioning of distribution boards. On brick walls, a 6mm diameter "easy-drive" with screw (D-DT-3149) will be used to mount the SPU. In all other cases, a threaded rod with washers shall be used. A non-metallic cable gland (D-DT-3070) will be provided at the service cable entry point to the standard passive unit.
All services shall be in accordance with Eskom Distribution Services Standard and specifications.

9. **Material and Equipment Specification.**

The Developer will erect the MV and LV overhead line reticulation systems in accordance with Eskom's Electrification Standards (Wood Structures). The internal MV distribution systems shall comprise of "Mink "aluminum conductor steel reinforced configuration on 12m,11m or 9m wooden poles and shall be built to 11kV specifications.

The LV distribution systems shall comprise an aerial bundled conductor (ABC) system, of the supporting core type mounted overhead on either 7 or 9 meter wooden poles. LV distributor spurs shall extend within a radius of approximately 500m from transformer positions depending on individual voltage drop requirements. LV distributor spurs shall share pole structures with the MV system where these follow parallel routes providing clearance of LV can be achieved.

Transformers shall be of the pole mounted type suitably rated to serve anticipated individual LV distributor loads and shall be of the SABS 780 type. All materials supplied by the Developer shall conform to Eskom's Buyer's Guide (Part 9 of DT Standard).

10. **Earthing and Lightning Protection System**

In accordance with Eskom Distribution Standard Part 2, with particular reference to:

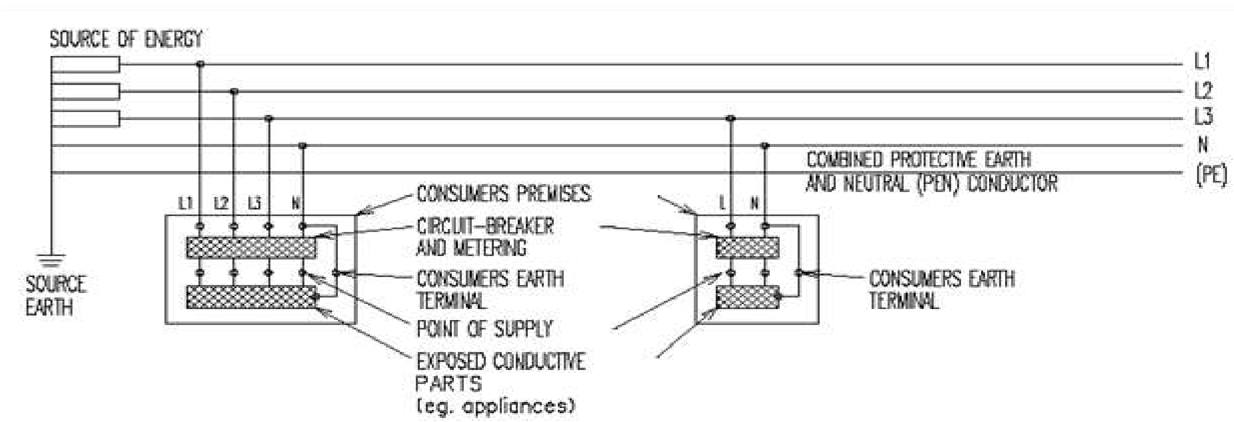

Figure 4 Consumer schematic

Results of soil resistivity survey at 2 points.

Min Cu area : 16mm² stranded

12mm² solid

- Low Voltage

  11 kV systems : 70 Ohms

- Medium Voltage

  11kV system : 30 Ohms

11. Recommendation

The proposed development township consists of 1553 stands. All the stands are electrified. There is an existing medium voltage feeder lines that are supplying the area.The medium voltage line is Mink Conductor. The proposed township development is connected from medium voltage on 11KV. The proposed township development is connecting electricity from Goliath feeder medium voltage line on 11KV.

The feeder line is fed from Eerstehoek Substation and the capacity is 132/11KV. There is existing medium voltage aluminum conductor steel reinforced passing through the development and is utilized to supply the development. The site is supplied from existing overhead medium voltage line to the drop out fuse link and distributes cable underground and connected to the electrical meter. The area is situated within the electricity licensed area and supply by Eskom. It is recommended that the township development is connected according to Eskom Distribution Standard.

Floodline Report

FORMALIZATION OF THE NHLAZATSHE 1, INFORMAL SETTLEMENT LOCATED ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172 IT AND EERSTEHOEK 235 IT, MPUMALANGA PROVINCE

1:100 RETURN PERIOD FLOODLINE DETERMINATION REPORT

October 2022, Rev0

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1.0 INTRODUCTION

1.1 Study Request

The report study is to undertake floodline assessment relating to the formalization of the Nhlazatshe 1, informal settlement located on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT, Mpumalanga Province.

1.2 Locality

The proposed township is situated 130km south of Mbombela along the R40, R38 and R541 respectively, in Mpumalanga Province, South Africa. The area is administered by Chief Albert Luthuli Local Municipality under Gert Sibande District Municipality. GPS coordinates of site are 26° 3'55.66"S 30°45'44.04"E. The locality map is shown on the figures below.

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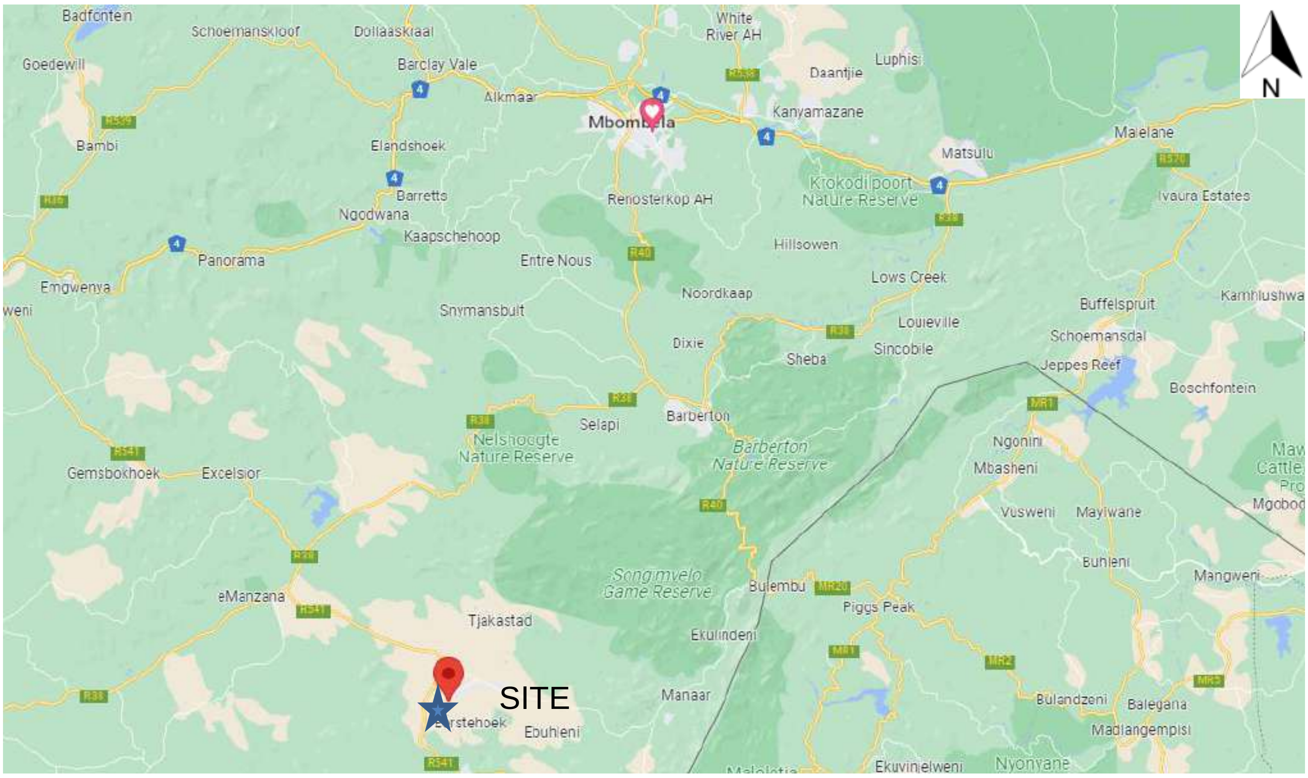


Figure 1 Location of development site

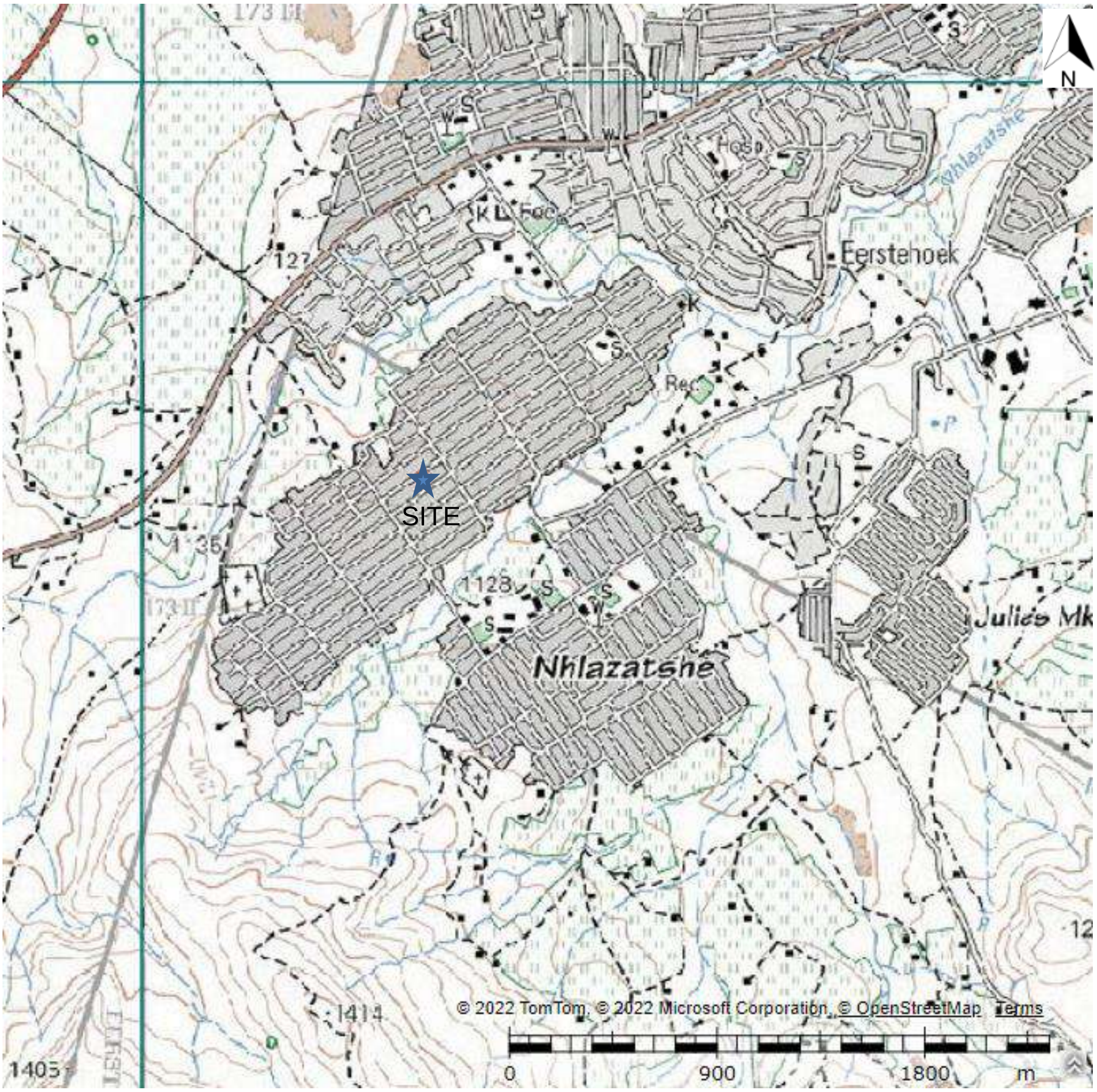


Figure 2 Project site

1.3 Background

A flood line analysis must be conducted along the stream / river traversing or in proximity of the site of proposed development.

See the figures below for the streams in catchment area in proximity to the site.

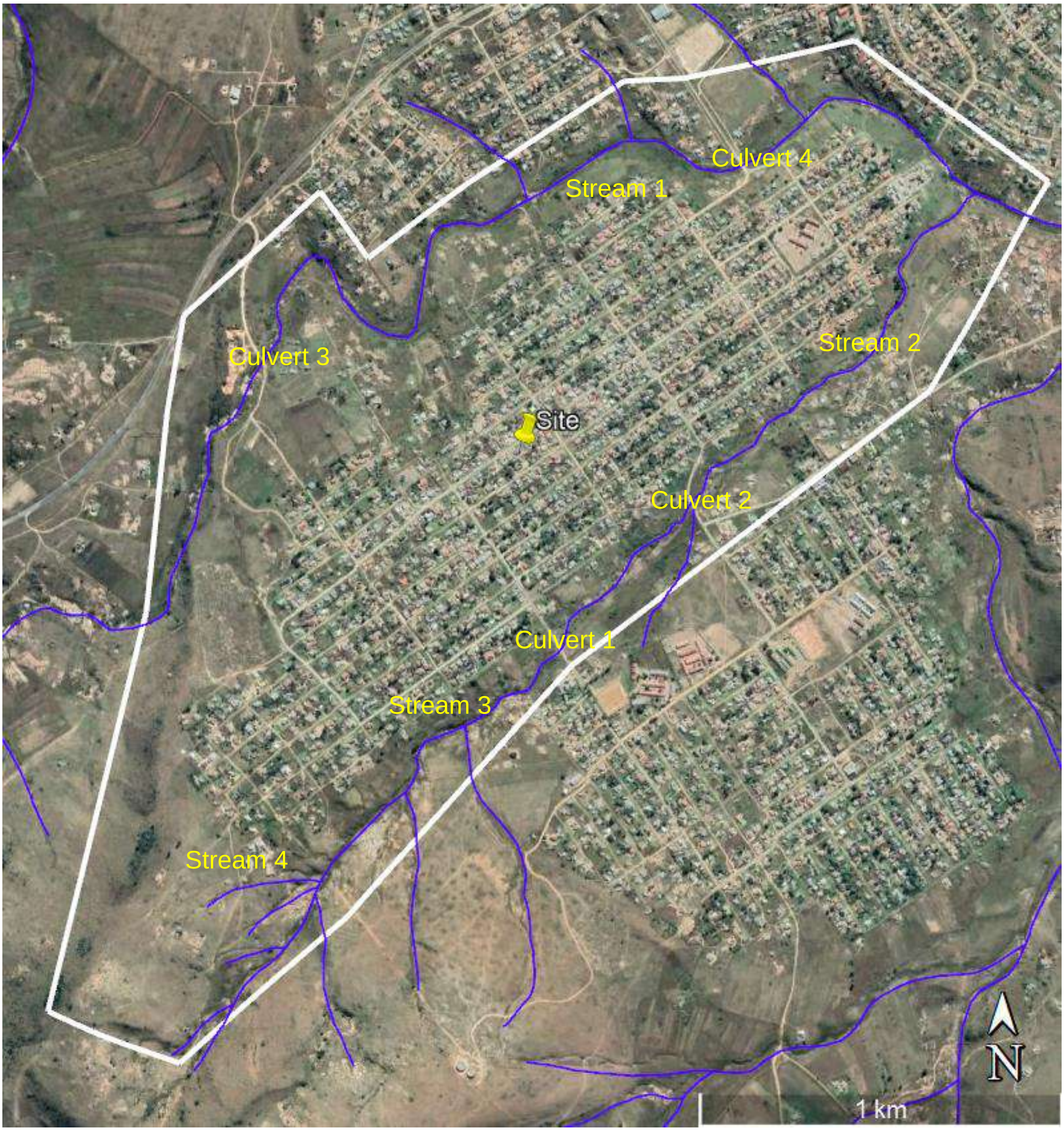


Figure 3 Streams (blue line)

Figure 4 Stream 3, culvert 1, barrels 5No. 1200mm high x 1200mm wide

Figure 5 Stream 3, upstream of culvert 1

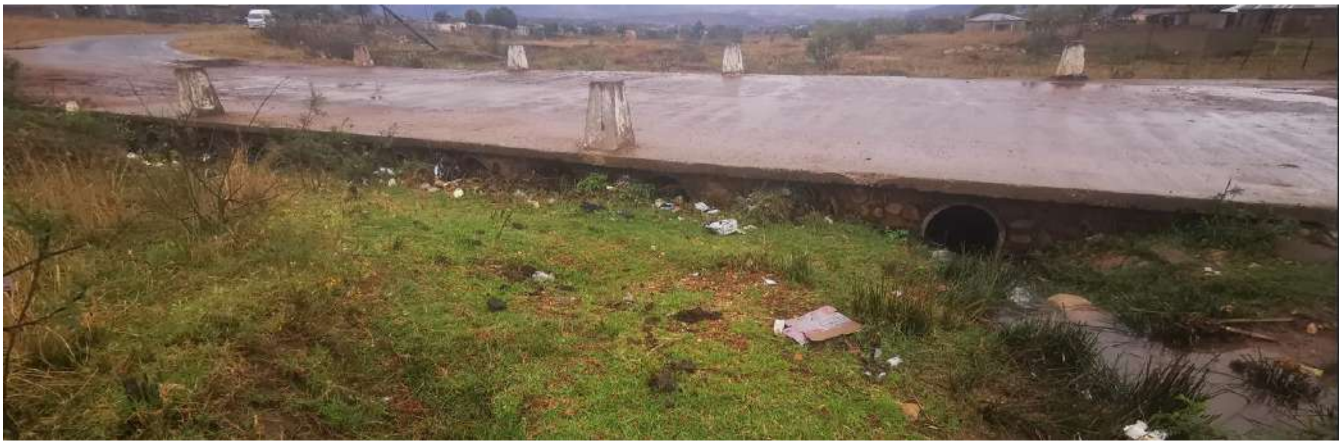


Figure 6 Stream 2, culvert 2, barrels 10No. 600mm pipe culvert, blocked

Figure 7 Stream 2, downstream of culvert 2

Figure 8 Stream 1, culvert 3, barrels 5No. 1200mm high x 1200mm wide

Figure 9 Stream 1 culvert 3 approach erosion

Culvert 3 needs urgent repair works.


Figure 10 Stream 1, culvert 4, barrels 9No. 1200mm high x 1200mm wide


Figure 11 Stream 1, upstream of culvert 4


Figure 12 Stream 1, further downstream next to St Johns church

1.4 Methodology

1.4.1 general

The study consists of 2 major components:

- a flood analysis to determine the flood peak flow and,
- a surface water profile analysis to determine the flood line.

The magnitude of a flood is dependent on many factors, such as catchment size, slope and rainfall intensity. There are several different methods for determining floods and in general, different methods arrive at different estimates of the peak flow rate. The accepted approach is therefore to use several methods and then make a judgment call as to which method is the most applicable to the catchment under consideration. For this study, the Rational, Alternative Rational, Standard Design Flood (SDF) methods were used to determine the peak flow rate for the 1:100 return flood.

The reason for choosing these methods was because they are applicable to the catchment and to show the variance in the flood line between the method that produced the highest flood peak and the method that produced the lowest flood peak. Hence a flood line has been produced to take cognisance of the uncertainty related to estimating floods and flood lines.

The area of the catchment in which the adjacent stream is located was determined using GIS software as were additional properties applicable to the catchment, such as the length of the watercourse and the centroid of the catchment. The flood peak flows provide the flow used in the flood line analysis using the *HEC-RAS* software.

Other input required for *HEC-RAS* is channel geometry and roughness parameters. Channel cross-sections were taken at points along the river / stream course, within the area that contour lines were provided. The stream reaches that were analysed are in a natural state.

1.4.2 Flood Modelling Methodology

Flood peaks for the catchments selected for flood modelling were estimated by the following methods using the Utility Programs for Drainage (UPD) software, 2007 with the methods detailed in SANRAL, 2013:

- Rational Method (RM).
- Alternative Rational Method (ARM).
- Standard Design Flood (SDF).

1.4.2.1 Rational Method

This method is based on the conservation of mass and is applicable for catchment areas below 15 km^2. Aerial and time distributions of rainfall in this method are assumed to be uniform throughout the catchment. Flood peaks and empirical hydrographs can be determined by this method.

Where: The peak flow is obtained from the following relationship:

$$Q = \frac{CIA}{3.6}$$

Where: Q = peak flow (m^3 /s)
C = runoff coefficient (dimensionless)
I = average rainfall intensity over the catchment (mm/hour)
A = effective runoff area of the catchment (km^2)
3.6 = conversion factor

1.4.2.2 Alternative Rational Method

This method is based on the rational method with the point precipitation being adjusted using the Design Rainfall Estimation Methodology developed by Smithers and Schulze (2003) to consider local South African conditions.
Design rainfall values for the study area were extracted from the database of six closest to site South African Weather Service stations, using the Design Rainfall Utility developed by Smithers and Schulze (2000).

Table 1 Design Rainfall Values for the site

Duration		**Return Period (Years) Design Rainfall Depth (mm)**						
		1:2	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**	**1:200**
5	m	8.8	12.3	14.9	17.8	21.9	25.4	29.2
10	m	12.7	17.7	21.5	25.5	31.4	36.5	42
15	m	15.7	21.8	26.5	31.5	38.9	45.1	52
30	m	20.2	28	34	40.5	49.9	57.9	66.7
45	m	23.3	32.4	39.4	46.8	57.7	67	77.2
1	h	25.9	36	43.7	52	64	74.3	85.6
1.5	h	30	41.6	50.6	60.1	74.1	86	99
2	h	33.2	46.2	56.1	66.7	82.2	95.3	109.9
4	h	39.9	55.5	67.4	80.2	98.8	114.6	132
6	h	44.5	61.8	75.1	89.3	110	127.6	147
8	h	48	66.7	81	96.3	118.7	137.7	158.7
10	h	50.9	70.8	86	102.2	126	146.1	168.4
12	h	53.5	74.3	90.2	107.3	132.2	153.4	176.7
16	h	57.7	80.2	97.4	115.8	142.7	165.5	190.7
20	h	61.2	85.1	103.3	122.8	151.4	175.6	202.3
24	h	64.2	89.3	108.4	128.9	158.9	184.3	212.4
1	d	55.7	77.4	94	111.7	137.7	159.7	184
2	d	68.8	95.7	116.2	138.1	170.2	197.4	227.5
3	d	77.9	108.3	131.5	156.3	192.7	223.5	257.5
4	d	84.8	117.8	143.1	170.1	209.7	243.2	280.2
5	d	90.5	125.8	152.8	181.6	223.9	259.7	299.2
6	d	95.5	132.7	161.2	191.6	236.2	273.9	315.6
7	d	99.9	138.9	168.6	200.5	247.1	286.6	330.2

2.0 PROPOSED DEVELOPMENT

2.1 Flood Analysis

To make the analysis possible, properties of the catchments that influence the runoff relating to the 1:100 return flood event need to be determined. These properties are described in the following sections.

2.1.1 Catchment Properties

The catchment topography is composed of mainly flat areas, to hilly. The topographic elevation ranges from 1059m to 1306m above sea level. The landscape soils are mostly with slow infiltration rates with restricted permeability (Schulze, 2010). The soils are classified to be semi permeable and with a moderately hugh runoff potential.

The Mean Annual Precipitation (MAP) of the catchment was determined from weather stations gridded from in the vicinity of the site. The MAP for the catchment is estimated to be 933mm.

Table 2 Rainfall data

Station Name	**SAWS**	**Distance**	**Record**	**Latitude**		**Longitude**		**MAP**
	Number	(km)	(Years)	(°)	(')	(°)	(')	(mm)
THE BROOK	0481310_W	9	60	26	9	30	41	904
HARTBEESKOP (POL)	0481731_W	21.7	53	26	10	30	55	926
BADPLAAS (POL)	0518088_W	23.1	88	25	57	30	34	885
BUSBY	0481167_W	24.5	89	26	16	30	36	904
STEYNSDORP	0481848_W	27.9	32	26	9	30	59	816
JESSIEVALE (BOS)	0481014_W	28.5	92	26	14	30	31	933

Table 3 MAP Data (mm)

	Return Period						
Duration	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**	**1:200**
1 day	56	77	94	112	138	160	184
2 day	69	96	116	138	170	197	228
3 day	78	108	132	156	193	224	258
7 day	100	139	169	201	247	287	330

The climate is characterised by hot and rainy summers for a long period as well as cold and dry winters over a short period.

2.1.2 Catchment Delineation

There were four catchments that were delineated.
The catchment area is within the Inkomati Water Management Area.

Catchment in the table below was delineated to cover the stream nearest to the project boundary and was utilised to determine the flood peaks for 1:100 return extreme events. The catchment information is listed in the table below.

Table 4 Catchment area

Catchment Site	Catchment area (km^2)	Remark	Quaternary catchment
C1	20.982	Rural / Urban	X12F
C2	2.469	Rural / Urban	X12F
C3	1.892	Rural / Urban	X12F
C4	0.095	Rural	X12F

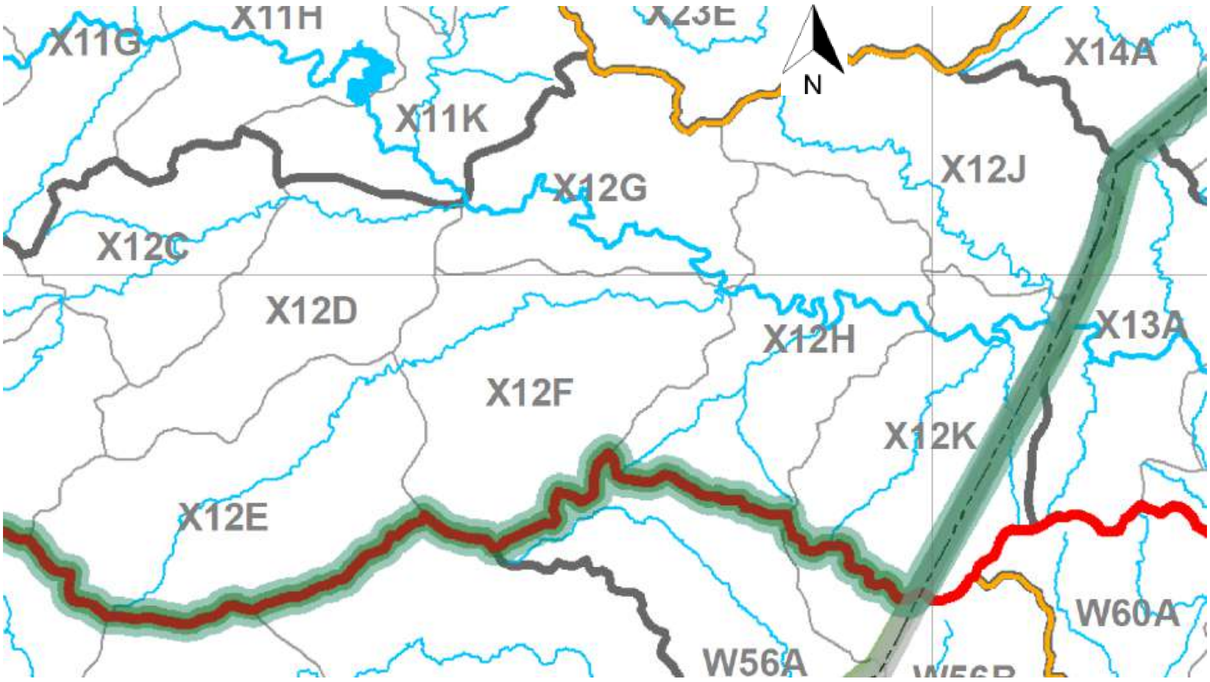


Figure 13 Quaternary catchments

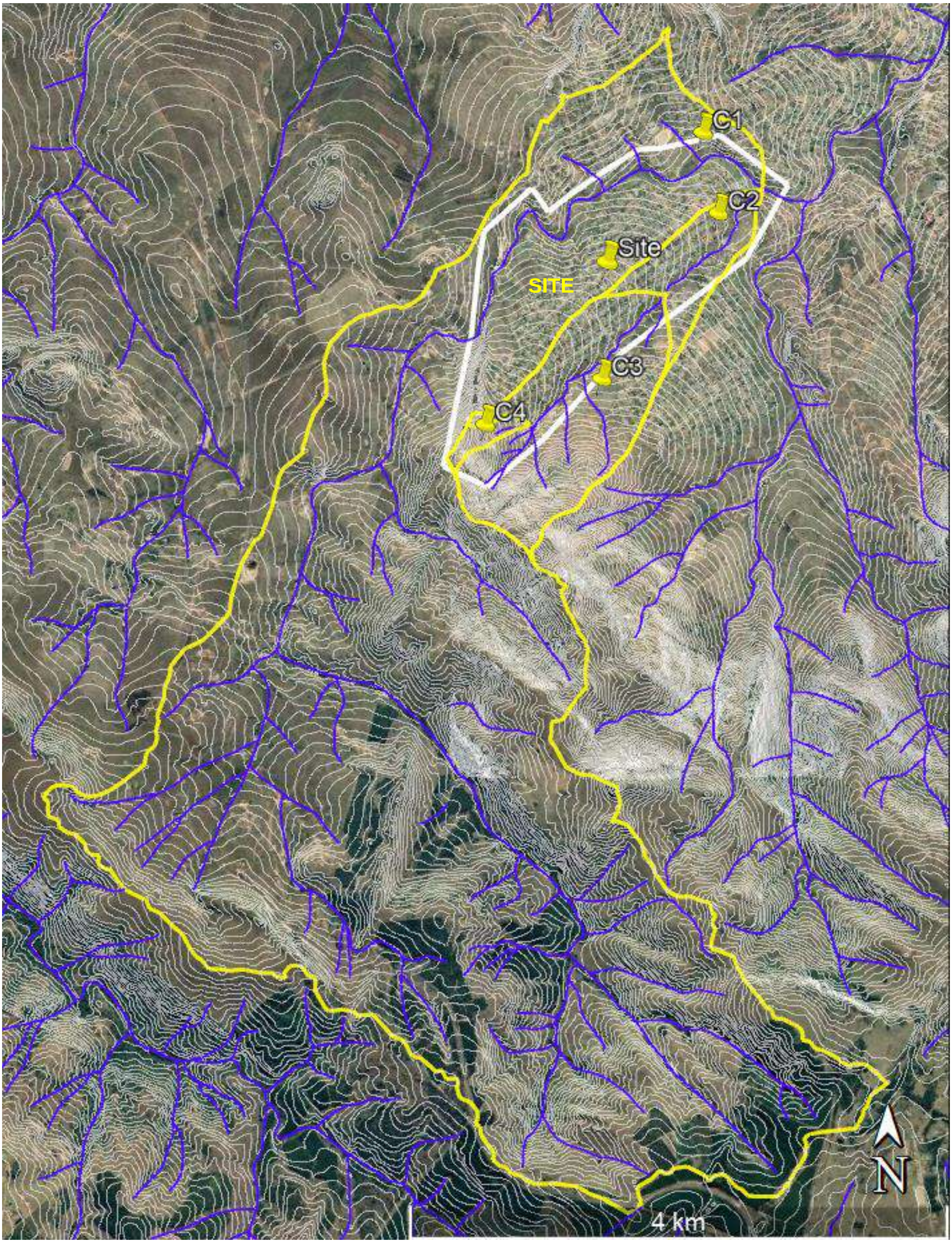


Figure 14 Catchments delineation (yellow line boundary)

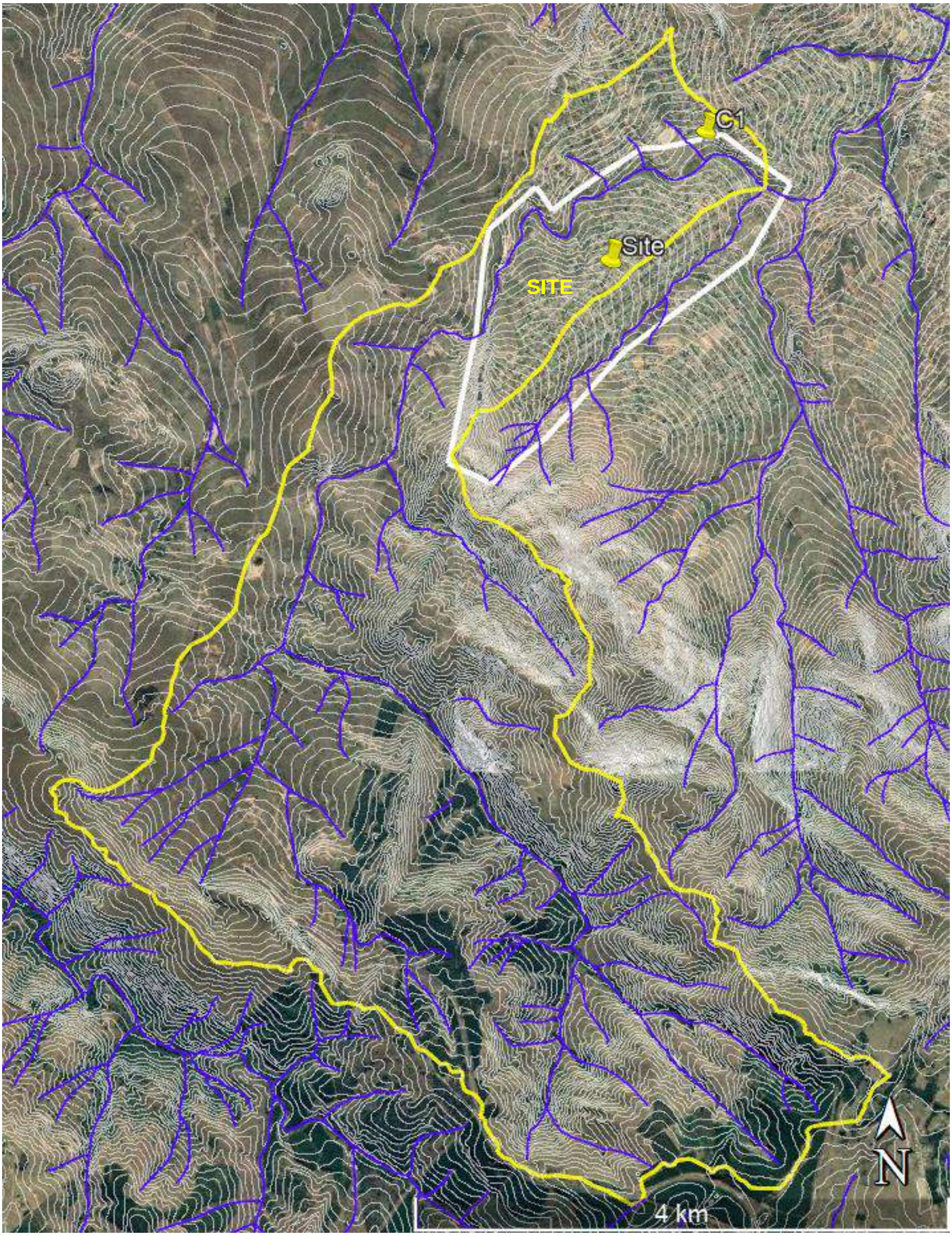


Figure 15 Catchment C1 (yellow line boundary)

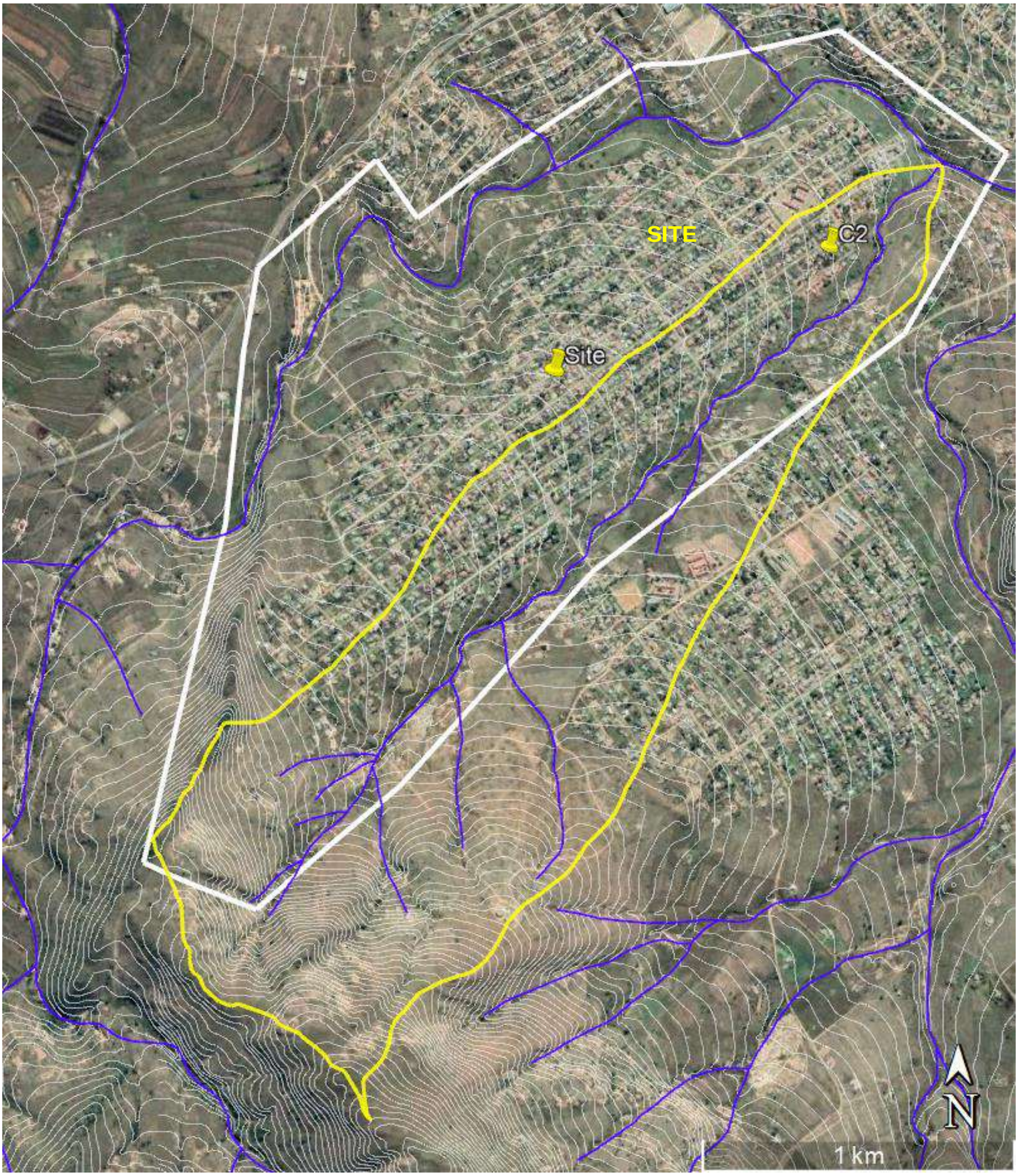


Figure 16 Catchment C2 (yellow line boundary)

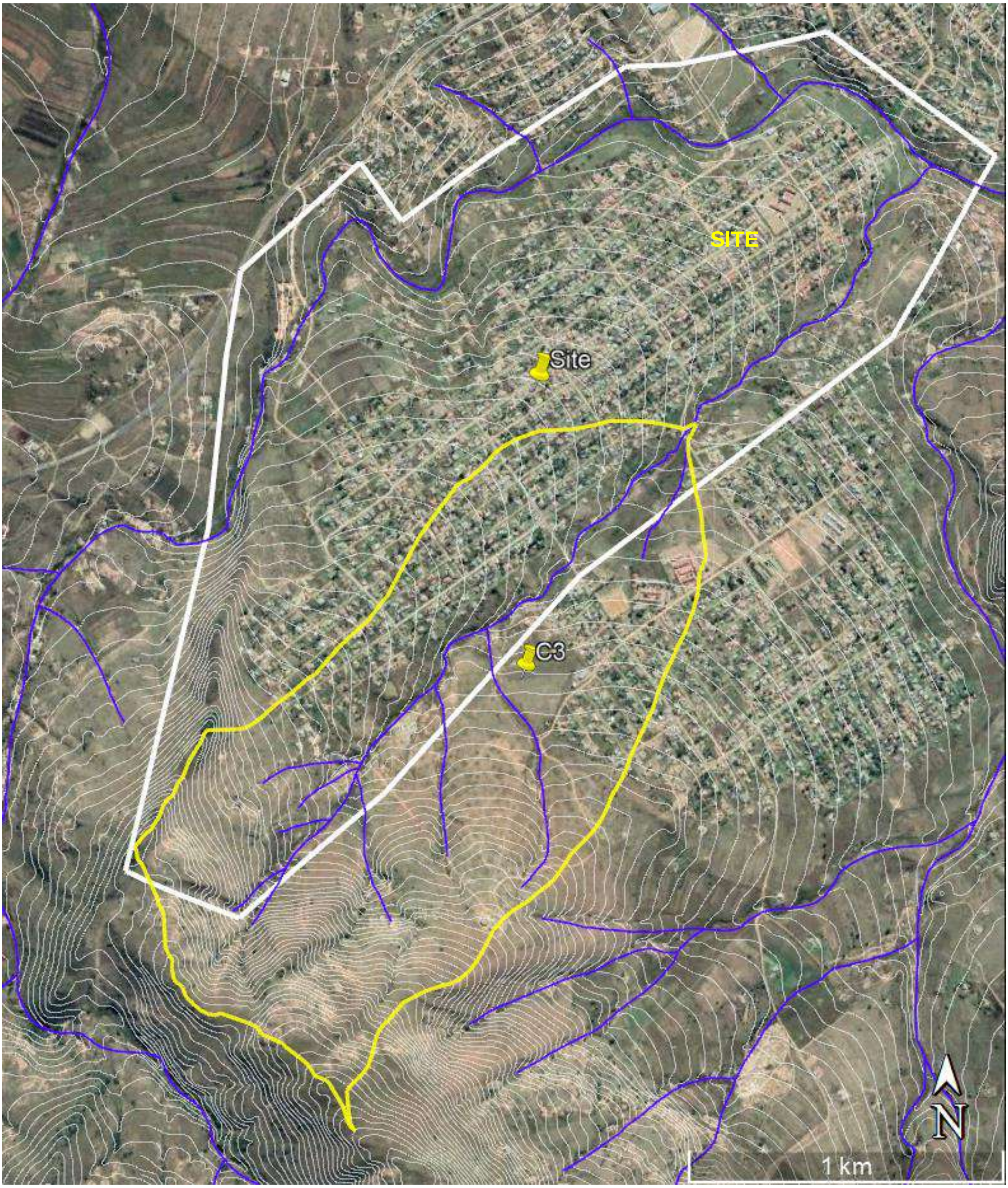


Figure 17 Catchment C3 (yellow line boundary)

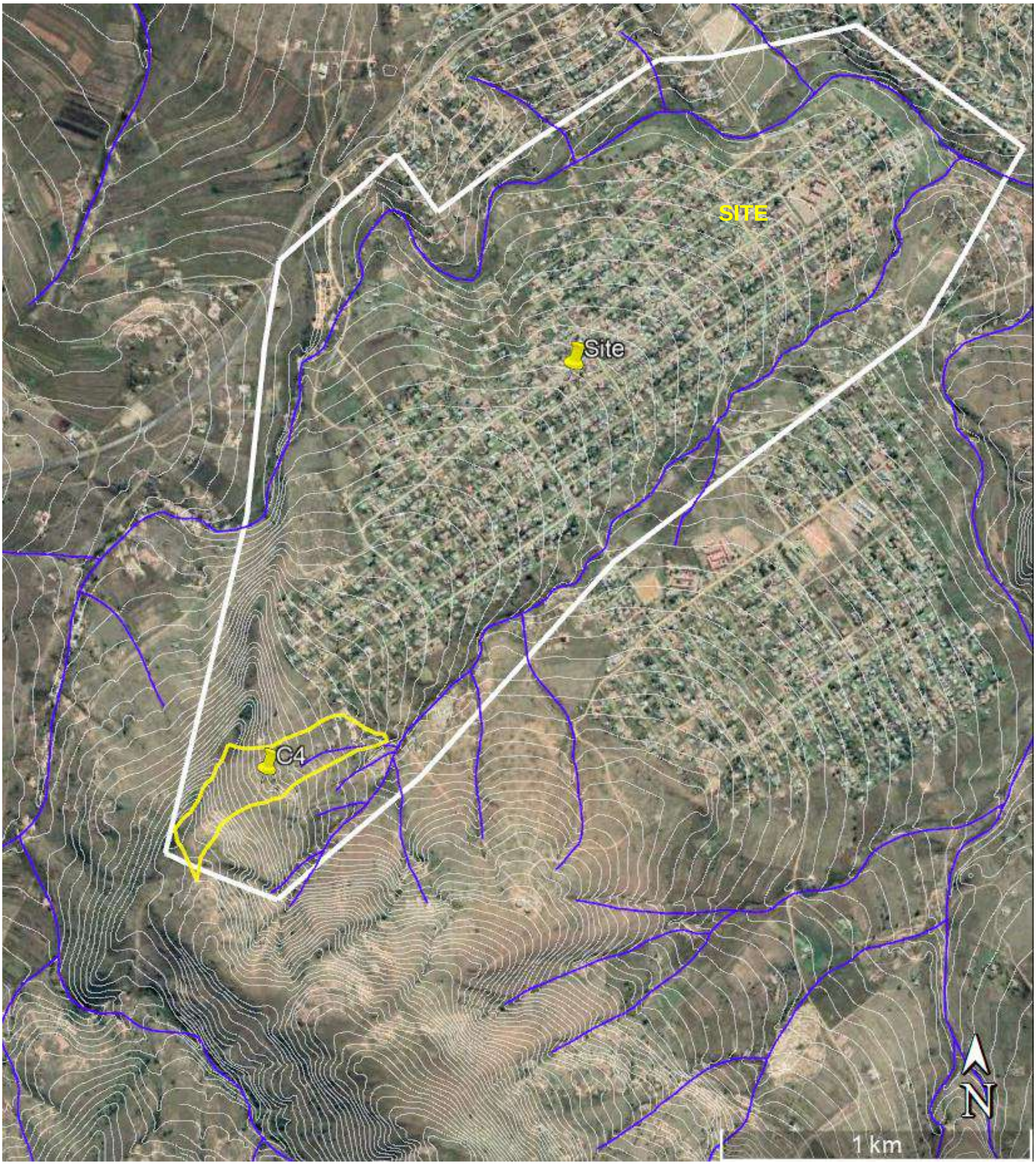


Figure 18 Catchment C4 (yellow line boundary)

Table 5 Catchment Characteristic

Characteristic	Rural Distribution	Urban Distribution	Lakes Distribution	Total
Catchment	%	%	%	(%)
C1	100%	9%	0%	100.0%
C2	100%	35%	0%	100.0%
C3	100%	28%	0%	100.0%
C4	100%	0%	0%	100.0%

Table 6 Rural area - Surface slope

Rural area - Surface slope	Lakes and pans (<3%) Distribution	Flat area (3 to 10%) Distribution	Hilly (10 to 30%) Distribution	Steep areas (>30%) Distribution	Total
Catchment	(%)	(%)	(%)	(%)	(%)
C1	2%	17%	54%	27%	100.0%
C2	1%	52%	36%	11%	100.0%
C3	1%	41%	44%	14%	100.0%
C4	2%	7%	72%	19%	100.0%

Table 7 Rural area – Permeability

Rural area - Permeability	Very permeable Distribution	Permeable Distribution	Semi-permeable Distribution	Impermeable Distribution	Total
Catchment	(%)	(%)	(%)	(%)	(%)
C1	0%	39%	61%	0%	100.0%
C2	0%	90%	10%	0%	100.0%
C3	0%	85%	15%	0%	100.0%
C4	0%	65%	35%	0%	100.0%

Table 8 Rural area - Vegetation

Rural area - Vegetation	Thick bush & forests Distribution	Light bush & cultivated land Distribution	Grasslands Distribution	Bare Distribution	Total
Catchment					(%)
C1	6%	7%	75%	12%	100.0%
C2	0%	4%	88%	8%	100.0%
C3	0%	5%	88%	7%	100.0%
C4	0%	3%	91%	6%	100.0%

Table 9 Run-off factors

Catchment	Run-off factor			
	Rural (C_R)	Urban (C_U)	Lakes (C_L)	Combined (C)
C1	0.607	0.613	0	**0.607**
C2	0.523	0.613	0	**0.554**
C3	0.539	0.613	0	**0.560**
C4	0.595	0	0	**0.595**

Table 10 Hydrological input data

Catchment	Catchment Area (km^2)	Longest water course (km)	Height difference 1085 method (m)	Days thunder was heard (No.)	Area Dolomite (%)	Mean Annual Precipitation (mm)	SDF Basin no. (No.)
C1	20.982	13.246	388.2	40	0	933	29
C2	2.469	3.656	191.9	40	0	933	29
C3	1.892	2.525	178.5	40	0	933	29
C4	0.095	0.829	122.7	40	0	933	29

Table 11 Catchment characteristics

Catchment Site	Catchment area (km^2)	Longest water course, L (km)	Height difference along 10-85 slope (m)	Average slope S_{av} (m/m)	Time of concentration, Tc (hours)	% Slope	MAP (mm)	Run-off factor C
C1	20.982	13.246	388.2	0.03907352	1.689806309	3.91%	933	0.607
C2	2.469	3.656	191.9	0.06997500	0.501083607	7.00%	933	0.554
C3	1.892	2.525	178.5	0.09426538	0.336022158	9.43%	933	0.56
C4	0.095	0.829	122.7	0.19740615	0.10719862	19.74%	933	0.595

Flood magnitudes

The flood magnitudes from the 1:2 return up to 1:100 return floods are presented in the Tables below.

Table 12 Estimated stormwater flow (m^3/s)

	Rational method						**Alternative rational method**					
Return	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**
Catchment												
C1	76.98	110.02	145.69	187.47	251.86	319.55	46.47	83.01	114.62	149.07	195.97	236.56
C2	21.50	30.29	39.61	50.45	67.54	85.50	13.31	23.27	31.50	40.23	52.01	61.83
C3	20.30	28.75	37.79	48.38	65.06	82.72	13.00	22.85	31.09	39.89	51.81	61.84
C4	1.54	2.24	3.01	3.94	5.40	6.99	1.10	1.99	2.76	3.61	4.77	5.79

Table 13 Estimated stormwater flow (m^3/s)

	Standard design flood method					
Return	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**
Catchment						
C1	12.86	39.96	64.78	92.68	134.06	168.66
C2	3.69	11.44	18.55	26.54	38.40	48.30
C3	3.65	11.33	18.37	26.29	38.02	47.84
C4	0.32	1.00	1.62	2.32	3.35	4.22

The applications and limitation of flood calculation methods are shown in the table below.

Table 14 Applications and limitation of flood calculation methods

Method	Recommended maximum area (km^2)	Return period of floods that could be determined
Statistical method	No limitation (larger areas)	1:2 to 1:200
Rational method	Usually less than $15km^2$	1:2 to 1:200
Unit Hydrograph method	$15km^2$ to $5,000km^2$	1:2 to 1:100
Standard Design Flood method	No limitation	1:2 to 1:200
SCS-SA method	Less than $30km^2$	1:2 to 1:100
Empirical methods	No limitation (larger areas)	1:10 to 1:100

Flood magnitudes for the 1:100-year floods

The Rational, Alternative Rational (AR), and Standard Design Flood (SDF) methods were used to select the flood peak.

The flow results were similar, therefore, the method with the highest magnitude of the peak flow was used for the 1:100 return flood for a sub-catchment.

The selected maximum peak flow is shown in the table below.

Table 15 Catchment generated estimated 1:100 peak flow

C1	Catchment, estimated 100year peak flow =	319.55	m^3/s
C2	Catchment, estimated 100year peak flow =	85.50	m^3/s
C3	Catchment, estimated 100year peak flow =	82.72	m^3/s
C4	Catchment, estimated 100year peak flow =	6.99	m^3/s

The estimated 1:100 stream flow is listed in the table below.

Table 16 Stream 1:100 return peak flow estimates

Stream - Reach	Flow (m^3/s)
Stream 1	319.55
Stream 2	85.50
Stream 3	82.72
Stream 4	6.99
Stream 5	405.05

2.2 Flood line Modelling

The HEC-RAS model was used to determine the flood line during the event of a flood for any return period, and in this case the 1:100-year floods were modelled.

2.2.1 Cross section profile

Cross sectional data was generated using GIS and CAD software, as well as the contour lines that were obtained from the 5m contour lines that were obtained from the National Geo-Spatial Information (NGI) and contour survey from Client appointed surveyor; Messers Top Group Geomatics. Sections shown in Annexure 5 were used to approximate the geometry for the river.

2.2.2 Flood profiles

Annexure 4 shows the longitudinal profile for the 1:100 return peak flow.

3.0 CONCLUSION

The determination of the 1:100 return period floodlines was undertaken for the site of the proposed development. The results of this determination provide an indication as to the extent of the areas that will be inundated by the 1:100 return design flood.

It is recommended that a buffer zone of 20m should be provided between the 1:100 flood line and any proposed development.

The lateral extent of the 1:100 return flood line is shown in Annexure 2. These flood lines have also been provided as Gauss Conform WGS84 LO31 coordinated CAD dwg softcopy files.

4.0 REFERENCES

- Smithers J.C. and Schulze R.E. (2002): Drainage rainfall and flood estimation in South Africa, WRC project KS/1060.

- The South African National Roads Agency Limited (2013): Drainage manual, 6th Edition.

ANNEXURE 1: FLOODLINE CERTIFICATE

Branch Offices
Polokwane, Limpopo

DALIMEDE PROJECTS (PTY) LTD
No. 11 Pierre street,
IT Park RentCo Building, Office 6,
Bendor, Polokwane, South Africa, 0699
Tel: 015 291 0775, Cell: 079 368 8414,
E-mail: admin@dalimede.com

Reg. No: 2014 / 233383 / 07

FLOOD LINE CERTIFICATE

Dalimede Projects (PTY) LTD was appointed by Mang GeoEnviro Services to undertake floodline assessment relating to the formalization of the Nhlazatshe 1, informal settlement located on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT, Mpumalanga Province.

This will entail to delineate the 1:100 return flood line.

Site: *Nhlazatshe 1, Elukwatini, Mpumalanga Province*

Township Name: *Nhlazatshe 1*

Co-ordinates: *26° 3'55.66"S 30°45'44.04"E*

Municipality: *Chief Albert Luthuli Local Municipality under Gert Sibande District Municipality*

In terms of section 114 of the National Water Act, Act 36 of 1998 the above-mentioned property is affected by flood water within the 1:100 period from the stream / river as indicated in the floodline report. Development must be done outside of the floodline.

It is recommended that a buffer zone of 20m should be provided between the 1:100 flood line and any proposed development.

Thus, done and signed in ……Polokwane…… on this day……10 October 2022……

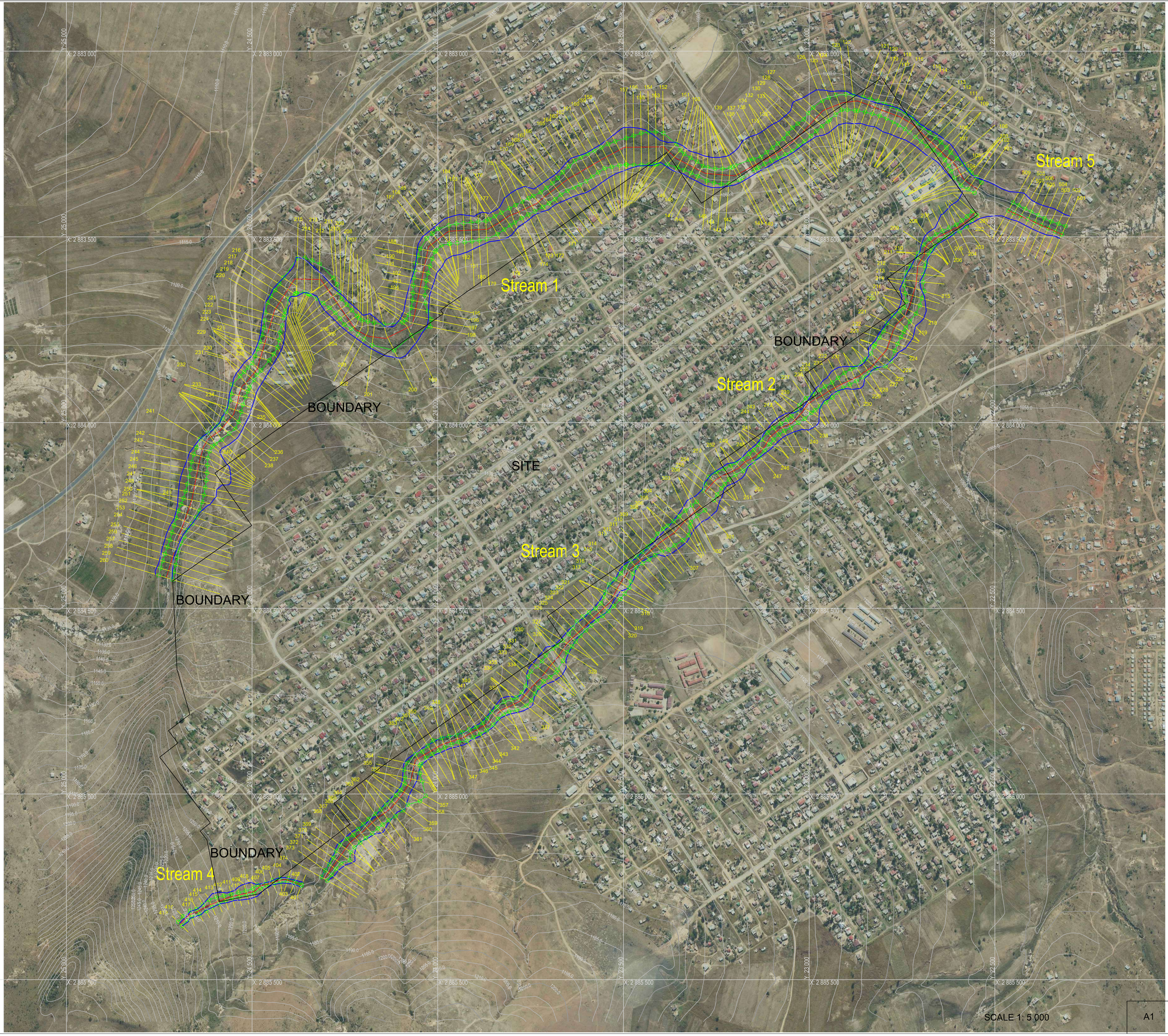
Signature: ……………………..................

Engineer: Litmos Mthunzi

Pr Tech Eng

Pr no.: ECSA 201770075

ANNEXURE 2: FLOODLINE DELINEATION



A1

KEY

FLOODLINE

CROSS SECTION

STREAM / RIVER

REVISIONS

REV	DATE	SIGN	DESCRIPTION
0	../../...	....	....

CLIENT

mang GEOENVIRO SERVICES

Mang GeoEnviro Services
Block 9, Unit 2 Boardwalk Office Park,
6 Enos Road, Faerie Glen,
Pretoria, 0004
Tel: 012 770 4022
Cell: +27 72 573 2390
Email: fnmathebula@gmail.com / info@manggeoenviro.co.za

CONSULTANT

DALIMEDE PROJECTS (PTY) LTD

Dalimede Projects (PTY) LTD
No. 11 Pierre street, IT Park RentCo Building, Office 6,
Bendor, Polokwane, South Africa, 0699

Tel: 015 291 0775, Cell: 079 368 8414,
E-mail: admin@dalimede.com
GPS; Lat: -23.894692 Long: 29.479758

DRAWING STATUS

FOR INFORMATION

PROJECT TITLE

Proposed formalization of the Nhlazatshe 1, informal settlement located on portions of farm portions Eerstehoek 172 IT and Eerstehoek 235 IT, Mpumalanga Province.

PROJECT LOCATION

The proposed township is situated 130km south of Mbombela along the R40, R38 and R541 respectively, in Mpumalanga Province, South Africa. GPS coordinates of site are 26° 3'55.66"S 30°45'44.04"E.

DRAWING DESCRIPTION

FLOODLINE DELINEATION 1:100 RETURN PERIOD

SCALE	DATE	DESIGNED	DRAWN	CHECKED
As Shown	Oct 2022	LM	AK	CM

DRAWING No.	REVISION
NHLAZATSHE1/FL/01	A

ANNEXURE 3: HEC-RAS PROGRAMME MODELLING RESULTS

HEC-RAS Plan: Current mode River: StteamC1 Reach: 1 Profile: 1:100yr

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)	
1	260	1:100yr	319.55	1123.37	1126.33	1126.33	1127.22	0.014924	4.23	79.88	47.84	0.96
1	259	1:100yr	319.55	1122.44	1125.58	1125.58	1126.60	0.014917	4.49	73.19	38.66	0.97
1	258	1:100yr	319.55	1121.52	1124.96	1124.96	1126.07	0.015000	4.69	69.57	33.34	0.98
1	257	1:100yr	319.55	1120.59	1124.43	1124.43	1125.52	0.014326	4.68	72.45	36.73	0.96
1	256	1:100yr	319.55	1119.99	1123.63	1123.49	1124.63	0.011999	4.48	75.63	35.73	0.88
1	255	1:100yr	319.55	1119.98	1123.37	1123.30	1124.38	0.012496	4.55	76.16	37.49	0.90
1	254	1:100yr	319.55	1119.97	1123.10	1123.10	1124.11	0.013948	4.54	75.35	39.90	0.95
1	253	1:100yr	319.55	1119.95	1122.79	1122.79	1123.74	0.015463	4.32	75.51	42.90	0.98
1	252	1:100yr	319.55	1119.94	1122.51	1122.50	1123.37	0.016483	4.11	77.86	45.68	0.99
1	251	1:100yr	319.55	1119.93	1122.46		1123.03	0.010156	3.37	95.32	54.08	0.79
1	250	1:100yr	319.55	1119.92	1122.34		1122.83	0.008057	3.11	104.85	60.69	0.71
1	249	1:100yr	319.55	1119.90	1122.33		1122.65	0.004785	2.60	139.33	83.92	0.56
1	248	1:100yr	319.55	1119.89	1122.26		1122.55	0.004471	2.52	149.57	95.04	0.54
1	247	1:100yr	319.55	1119.88	1122.10		1122.45	0.005642	2.73	138.38	91.88	0.60
1	246	1:100yr	319.55	1119.86	1121.65	1121.65	1122.25	0.013987	3.62	105.73	111.00	0.91
1	245	1:100yr	319.55	1118.47	1120.76	1120.76	1121.26	0.013422	3.46	120.96	123.37	0.88
1	244	1:100yr	319.55	1116.92	1119.77	1119.77	1120.44	0.012087	3.89	104.92	86.00	0.87
1	243	1:100yr	319.55	1115.34	1118.83	1118.83	1119.46	0.010910	3.85	110.76	91.60	0.83
1	242	1:100yr	319.55	1113.10	1116.86	1116.86	1117.44	0.011852	3.66	113.44	99.22	0.84
1	241	1:100yr	319.55	1110.72	1113.98	1113.98	1114.88	0.013756	4.32	82.44	49.79	0.93
1	240	1:100yr	319.55	1109.99	1112.39	1112.39	1113.35	0.014414	4.44	78.50	45.09	0.96
1	239	1:100yr	319.55	1109.98	1112.19	1112.07	1112.93	0.012222	3.95	90.28	53.79	0.88
1	238	1:100yr	319.55	1109.84	1111.85	1111.85	1112.65	0.015346	4.12	87.37	58.62	0.97
1	237	1:100yr	319.55	1109.12	1111.07	1111.07	1111.83	0.015816	3.96	87.71	61.39	0.97
1	236	1:100yr	319.55	1108.40	1110.44	1110.44	1111.20	0.015265	3.95	88.60	62.33	0.96
1	235	1:100yr	319.55	1107.68	1109.90	1109.90	1110.67	0.015262	4.06	89.24	62.40	0.96
1	234	1:100yr	319.55	1107.00	1109.37	1109.37	1110.15	0.016332	4.15	87.67	60.18	0.99
1	233	1:100yr	319.55	1106.29	1108.88	1108.88	1109.61	0.015676	4.03	91.54	63.54	0.97
1	232	1:100yr	319.55	1105.66	1108.39	1108.39	1109.11	0.015617	3.96	91.71	64.89	0.97
1	231	1:100yr	319.55	1105.04	1107.60	1107.60	1108.36	0.013721	3.98	91.33	67.35	0.92
1	230	1:100yr	319.55	1104.20	1106.89	1106.89	1107.68	0.013534	4.12	89.95	63.09	0.93
1	229	1:100yr	319.55	1103.54	1106.34	1106.34	1107.16	0.012695	4.20	90.46	62.87	0.91
1	228.5		Culvert									
1	228	1:100yr	319.55	1102.85	1105.71	1105.71	1106.55	0.012430	4.23	89.56	61.71	0.90
1	227	1:100yr	319.55	1101.77	1104.52	1104.52	1105.35	0.014239	4.08	84.30	56.77	0.94
1	226	1:100yr	319.55	1100.91	1103.69	1103.69	1104.48	0.015606	3.98	84.55	58.51	0.97
1	225	1:100yr	319.55	1100.06	1102.57	1102.57	1103.32	0.015941	3.87	86.31	62.05	0.97
1	224	1:100yr	319.55	1099.40	1101.86	1101.86	1102.62	0.015696	3.90	85.71	62.61	0.97
1	223	1:100yr	319.55	1098.75	1101.35	1101.35	1102.11	0.014671	3.90	88.37	67.46	0.94
1	222	1:100yr	319.55	1098.11	1100.79	1100.79	1101.54	0.015016	3.86	87.25	66.88	0.95
1	221	1:100yr	319.55	1097.46	1100.20	1100.20	1100.96	0.016341	3.86	84.52	62.07	0.98
1	220	1:100yr	319.55	1096.97	1099.69	1099.69	1100.42	0.017049	3.79	85.37	62.76	0.99
1	219	1:100yr	319.55	1096.26	1098.95	1098.95	1099.68	0.016783	3.78	86.01	61.07	0.98
1	218	1:100yr	319.55	1095.60	1098.32	1098.32	1099.08	0.014805	3.96	87.92	64.04	0.95
1	217	1:100yr	319.55	1095.00	1097.35	1097.35	1098.08	0.016152	3.84	88.31	65.88	0.97
1	216	1:100yr	319.55	1094.82	1096.78	1096.78	1097.48	0.016956	3.72	87.96	66.83	0.98
1	215	1:100yr	319.55	1094.61	1096.16	1096.16	1096.65	0.019022	3.16	105.31	110.63	0.99
1	214	1:100yr	319.55	1093.57	1095.07	1095.07	1095.65	0.019381	3.37	94.89	83.00	1.01
1	213	1:100yr	319.55	1092.54	1094.64		1095.03	0.007993	2.78	114.78	68.57	0.69
1	212	1:100yr	319.55	1091.66	1094.56		1094.89	0.005005	2.51	127.10	62.15	0.56
1	211	1:100yr	319.55	1091.26	1094.25		1094.74	0.008161	3.10	103.06	52.98	0.71
1	210	1:100yr	319.55	1090.55	1093.61	1093.61	1094.48	0.016956	4.13	77.31	44.67	1.00
1	209	1:100yr	319.55	1090.00	1093.40		1093.81	0.005715	2.84	114.34	56.86	0.61
1	208	1:100yr	319.55	1089.98	1093.34		1093.70	0.003931	2.73	127.97	61.87	0.52
1	207	1:100yr	319.55	1089.97	1093.17		1093.61	0.005125	3.01	117.81	59.67	0.59
1	206	1:100yr	319.55	1089.95	1092.96		1093.48	0.006962	3.27	106.72	60.28	0.68
1	205	1:100yr	319.55	1089.94	1092.79		1093.33	0.007659	3.33	104.02	61.65	0.71
1	204	1:100yr	319.55	1089.92	1092.37	1092.29	1093.12	0.013048	3.96	89.45	58.07	0.90
1	203	1:100yr	319.55	1089.91	1092.03	1092.03	1092.82	0.015345	4.07	86.34	60.07	0.97
1	202	1:100yr	319.55	1089.89	1091.72	1091.62	1092.33	0.012877	3.56	97.78	71.59	0.88
1	201	1:100yr	319.55	1089.88	1091.39	1091.39	1092.03	0.016787	3.60	94.79	80.04	0.97
1	200	1:100yr	319.55	1088.02	1090.00	1090.00	1090.56	0.015785	3.39	102.26	95.00	0.93
1	199	1:100yr	319.55	1085.27	1087.76	1087.76	1088.49	0.014803	3.91	90.66	68.11	0.95
1	198	1:100yr	319.55	1084.55	1087.33	1087.33	1088.01	0.016418	3.69	90.50	68.61	0.97
1	197	1:100yr	319.55	1083.96	1086.90	1086.90	1087.61	0.016825	3.84	89.07	63.73	0.99
1	196	1:100yr	319.55	1083.37	1086.41	1086.41	1087.15	0.016556	3.97	88.03	59.69	0.99
1	195	1:100yr	319.55	1082.78	1085.84	1085.84	1086.68	0.014734	4.24	85.02	56.34	0.96
1	194	1:100yr	319.55	1082.19	1085.27	1085.27	1086.14	0.013497	4.27	83.52	53.63	0.93
1	193	1:100yr	319.55	1081.60	1084.69	1084.69	1085.57	0.013216	4.24	83.68	54.37	0.92
1	192	1:100yr	319.55	1081.01	1084.09	1084.09	1084.96	0.013938	4.23	84.28	55.42	0.94
1	191	1:100yr	319.55	1080.42	1083.47	1083.47	1084.27	0.014443	4.12	87.55	57.11	0.95
1	190	1:100yr	319.55	1080.00	1082.66	1082.57	1083.37	0.012444	3.89	92.57	59.18	0.88
1	189	1:100yr	319.55	1079.99	1082.55		1083.11	0.009063	3.46	106.10	66.90	0.76
1	188	1:100yr	319.55	1079.98	1082.59		1082.91	0.004661	2.74	143.11	85.16	0.56
1	187	1:100yr	319.55	1079.97	1082.48		1082.83	0.005014	2.79	139.33	85.48	0.58
1	186	1:100yr	319.55	1079.96	1082.26		1082.70	0.007288	3.15	122.71	80.70	0.69
1	185	1:100yr	319.55	1079.95	1082.25		1082.54	0.004491	2.51	148.54	89.52	0.54
1	184	1:100yr	319.55	1079.94	1082.20		1082.45	0.003962	2.38	162.81	98.98	0.51
1	183	1:100yr	319.55	1079.93	1082.13		1082.36	0.003872	2.31	167.36	102.94	0.50
1	182	1:100yr	319.55	1079.92	1081.97		1082.27	0.005378	2.59	147.59	97.93	0.58
1	181	1:100yr	319.55	1079.37	1081.42	1081.42	1082.06	0.015250	3.69	97.70	81.45	0.94
1	180	1:100yr	319.55	1078.69	1081.05	1081.05	1081.74	0.014819	3.75	92.77	75.48	0.94
1	179	1:100yr	319.55	1078.01	1080.44	1080.44	1081.16	0.015279	3.82	90.47	71.20	0.95

HEC-RAS Plan: Current mode   River: StteamC1   Reach: 1   Profile: 1:100yr (Continued)

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)	
1	178	1:100yr	319.55	1077.43	1079.99	1079.99	1080.71	0.014261	3.82	91.41	72.07	0.93
1	177	1:100yr	319.55	1076.84	1079.39	1079.39	1080.11	0.013959	3.86	92.80	72.12	0.92
1	176	1:100yr	319.55	1076.24	1078.81	1078.81	1079.54	0.013732	3.90	92.85	70.97	0.92
1	175	1:100yr	319.55	1075.64	1078.21	1078.21	1078.89	0.013286	3.83	99.21	81.98	0.90
1	174	1:100yr	319.55	1075.04	1077.35	1077.35	1078.05	0.014728	3.95	96.68	76.93	0.95
1	173	1:100yr	319.55	1073.71	1076.28	1076.28	1077.00	0.014445	3.97	94.29	72.68	0.94
1	172	1:100yr	319.55	1072.36	1075.02	1075.02	1075.78	0.015306	4.05	89.51	64.15	0.97
1	171	1:100yr	319.55	1071.15	1073.84	1073.84	1074.60	0.013782	3.98	90.48	66.33	0.92
1	170	1:100yr	319.55	1070.00	1072.66	1072.38	1073.26	0.008834	3.55	101.76	61.73	0.76
1	169	1:100yr	319.55	1069.99	1072.51		1073.08	0.008136	3.43	104.87	63.86	0.73
1	168	1:100yr	319.55	1069.99	1072.33	1072.08	1072.91	0.008804	3.50	105.54	67.32	0.76
1	167	1:100yr	319.55	1069.99	1072.07	1071.94	1072.70	0.011213	3.62	98.91	68.87	0.84
1	166	1:100yr	319.55	1069.98	1072.00		1072.46	0.008406	3.09	114.86	78.35	0.72
1	165	1:100yr	319.55	1069.98	1071.93		1072.28	0.006364	2.70	132.30	88.71	0.63
1	164	1:100yr	319.55	1069.97	1071.85		1072.14	0.005602	2.50	144.27	97.05	0.59
1	163	1:100yr	319.55	1069.95	1071.34	1071.33	1071.93	0.018187	3.55	98.97	87.63	1.00
1	162	1:100yr	319.55	1069.40	1070.93	1070.93	1071.55	0.019061	3.67	96.15	82.19	1.02
1	161	1:100yr	319.55	1068.84	1070.65	1070.53	1071.18	0.014387	3.40	105.26	84.27	0.90
1	160	1:100yr	319.55	1068.31	1070.23	1070.22	1070.85	0.017205	3.60	96.02	81.64	0.98
1	159	1:100yr	319.55	1067.76	1069.90	1069.90	1070.51	0.016720	3.51	96.87	87.60	0.96
1	158	1:100yr	319.55	1067.26	1069.45	1069.45	1070.05	0.017629	3.48	96.00	86.05	0.98
1	157	1:100yr	319.55	1067.11	1069.13	1069.13	1069.69	0.016131	3.36	101.35	99.77	0.94
1	156	1:100yr	319.55	1066.63	1068.63	1068.63	1069.20	0.017646	3.34	98.51	94.91	0.97
1	155	1:100yr	319.55	1066.15	1068.16	1068.16	1068.73	0.018781	3.35	96.37	89.57	1.00
1	154	1:100yr	319.55	1065.67	1067.83	1067.76	1068.34	0.016568	3.16	101.21	87.95	0.94
1	153	1:100yr	319.55	1065.19	1067.35	1067.35	1067.98	0.018126	3.52	91.05	73.60	0.99
1	152	1:100yr	319.55	1064.44	1066.60	1066.60	1067.29	0.017957	3.68	86.86	63.05	1.00
1	151	1:100yr	319.55	1063.84	1066.13	1066.13	1066.81	0.017845	3.64	87.93	66.44	1.00
1	150	1:100yr	319.55	1063.03	1065.36	1065.36	1066.09	0.016319	3.82	87.74	66.04	0.98
1	149	1:100yr	319.55	1062.29	1064.72	1064.72	1065.50	0.014363	4.00	87.47	61.22	0.94
1	148	1:100yr	319.55	1061.50	1064.07	1064.07	1064.90	0.013900	4.13	85.25	56.77	0.94
1	147	1:100yr	319.55	1060.71	1063.49	1063.49	1064.27	0.013305	4.11	90.89	63.91	0.92
1	146	1:100yr	319.55	1060.00	1062.53	1062.34	1063.17	0.009641	3.79	103.43	65.87	0.80
1	145	1:100yr	319.55	1060.00	1062.53		1062.96	0.005899	3.08	125.49	73.87	0.63
1	144	1:100yr	319.55	1059.99	1062.26	1062.01	1062.80	0.008858	3.44	110.23	74.14	0.76
1	143	1:100yr	319.55	1059.99	1061.99	1061.89	1062.59	0.012478	3.65	104.00	79.57	0.87
1	142	1:100yr	319.55	1059.72	1061.82	1061.62	1062.33	0.010369	3.40	112.16	82.83	0.80
1	141	1:100yr	319.55	1059.14	1061.36	1061.36	1062.09	0.014055	3.94	93.27	71.54	0.93
1	140	1:100yr	319.55	1058.88	1061.16	1061.16	1061.90	0.013590	3.99	93.09	69.57	0.92
1	139.5		Culvert									
1	139	1:100yr	319.55	1057.74	1060.18	1060.18	1060.90	0.013407	4.12	99.43	77.52	0.92
1	138	1:100yr	319.55	1057.42	1059.96	1059.96	1060.62	0.012202	4.08	108.57	86.79	0.89
1	137	1:100yr	319.55	1056.85	1059.38	1059.38	1060.03	0.013839	4.27	108.06	84.76	0.94
1	136	1:100yr	319.55	1056.28	1058.76	1058.76	1059.44	0.015387	4.23	101.77	79.53	0.98
1	135	1:100yr	319.55	1055.71	1058.20	1058.20	1058.87	0.015193	4.07	101.07	80.08	0.96
1	134	1:100yr	319.55	1055.14	1057.97		1058.44	0.008362	3.32	120.16	82.46	0.73
1	133	1:100yr	319.55	1055.00	1057.88		1058.26	0.006342	2.95	132.02	86.25	0.64
1	132	1:100yr	319.55	1054.99	1057.55	1057.37	1058.09	0.010563	3.43	107.94	79.02	0.81
1	131	1:100yr	319.55	1054.99	1057.40		1057.87	0.008960	3.19	114.81	83.58	0.74
1	130	1:100yr	319.55	1054.99	1057.17	1056.97	1057.68	0.009844	3.30	110.65	82.83	0.78
1	129	1:100yr	319.55	1054.98	1057.03		1057.48	0.008866	3.17	120.89	92.29	0.74
1	128	1:100yr	319.55	1054.98	1057.07		1057.29	0.004253	2.33	173.66	120.78	0.52
1	127	1:100yr	319.55	1054.97	1056.95		1057.20	0.004772	2.40	162.27	111.06	0.55
1	126	1:100yr	319.55	1054.95	1056.76		1057.07	0.006798	2.69	142.36	104.86	0.64
1	125	1:100yr	319.55	1054.62	1056.24	1056.24	1056.85	0.015648	3.67	102.63	90.42	0.95
1	124	1:100yr	319.55	1053.82	1055.61	1055.61	1056.27	0.017476	3.90	96.76	80.03	1.01
1	123	1:100yr	319.55	1053.04	1055.09	1055.09	1055.79	0.018587	3.99	92.55	70.66	1.03
1	122	1:100yr	319.55	1052.34	1054.84		1055.32	0.009651	3.37	112.59	69.80	0.77
1	121	1:100yr	319.55	1051.84	1054.30	1054.30	1055.08	0.015463	4.24	89.54	58.90	0.98
1	120	1:100yr	319.55	1051.18	1053.88	1053.88	1054.69	0.014407	4.31	89.36	57.17	0.95
1	119	1:100yr	319.55	1050.51	1053.41	1053.41	1054.20	0.014159	4.26	90.93	59.63	0.94
1	118	1:100yr	319.55	1050.00	1052.73		1053.34	0.009309	3.66	103.13	61.11	0.78
1	117	1:100yr	319.55	1049.99	1052.72		1053.13	0.005954	3.07	124.95	69.05	0.63
1	116	1:100yr	319.55	1049.99	1052.60		1053.02	0.005726	3.05	125.77	70.80	0.62
1	115	1:100yr	319.55	1049.99	1052.17	1052.04	1052.84	0.011452	3.82	97.61	63.73	0.85
1	114	1:100yr	319.55	1049.59	1052.02	1051.77	1052.61	0.009431	3.60	104.32	64.90	0.78
1	113	1:100yr	319.55	1048.98	1051.50	1051.50	1052.36	0.014105	4.23	85.18	55.05	0.94
1	112	1:100yr	319.55	1048.40	1051.16	1051.16	1052.04	0.013095	4.25	83.46	55.39	0.92
1	111	1:100yr	319.55	1047.81	1050.76	1050.76	1051.68	0.013379	4.29	80.54	52.25	0.93
1	110	1:100yr	319.55	1047.23	1050.33	1050.33	1051.20	0.012979	4.24	85.03	58.23	0.91
1	109	1:100yr	319.55	1046.65	1049.76	1049.76	1050.62	0.013660	4.32	86.45	56.08	0.94
1	108	1:100yr	319.55	1046.07	1049.18	1049.18	1050.05	0.014189	4.44	86.54	55.16	0.96
1	107	1:100yr	319.55	1045.49	1048.66	1048.66	1049.54	0.012710	4.47	88.06	54.72	0.92
1	106	1:100yr	319.55	1044.84	1048.10	1048.10	1049.04	0.013541	4.40	80.70	48.40	0.94
1	105	1:100yr	319.55	1043.71	1047.06	1047.06	1047.98	0.015243	4.27	77.23	44.79	0.97
1	104	1:100yr	319.55	1042.56	1045.97	1045.97	1046.88	0.015690	4.25	76.73	44.53	0.98
1	103	1:100yr	319.55	1041.60	1044.91	1044.91	1045.87	0.015472	4.35	74.99	41.82	0.98
1	102	1:100yr	319.55	1040.49	1043.93	1043.93	1044.85	0.014886	4.33	79.01	45.43	0.97
1	101	1:100yr	319.55	1040.00	1044.22		1044.47	0.002272	2.35	163.41	68.50	0.41

HEC-RAS Plan: Current mode River: StreamC2 Reach: 2 Profile: 1:100yr

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)	
2	256	1:100yr	85.50	1094.61	1095.67	1095.67	1096.04	0.020280	2.71	32.68	48.64	0.97
2	255	1:100yr	85.50	1093.32	1094.43	1094.43	1094.78	0.021099	2.65	33.37	50.82	0.98
2	254	1:100yr	85.50	1091.83	1093.01	1093.01	1093.38	0.020824	2.70	32.57	47.67	0.98
2	253	1:100yr	85.50	1090.29	1091.65	1091.65	1092.05	0.022053	2.79	30.64	39.56	1.01
2	252	1:100yr	85.50	1089.99	1091.52		1091.75	0.007665	2.19	42.47	46.80	0.64
2	251	1:100yr	85.50	1089.86	1091.10	1091.10	1091.50	0.019481	2.94	32.66	44.44	0.98
2	250	1:100yr	85.50	1088.73	1090.35	1090.35	1090.82	0.019338	3.06	28.40	32.56	0.98
2	249	1:100yr	85.50	1087.69	1089.42	1089.42	1089.99	0.019800	3.35	25.55	22.71	1.01
2	248	1:100yr	85.50	1086.64	1088.53	1088.53	1089.11	0.016835	3.41	26.40	25.07	0.95
2	247	1:100yr	85.50	1085.64	1087.73	1087.73	1088.28	0.017852	3.34	27.24	25.99	0.97
2	246	1:100yr	85.50	1084.56	1086.28	1086.28	1086.81	0.018147	3.22	27.25	28.57	0.97
2	245	1:100yr	85.50	1083.38	1085.04	1085.04	1085.50	0.018882	3.10	29.77	35.46	0.98
2	244	1:100yr	85.50	1082.25	1083.90	1083.90	1084.37	0.017757	3.07	29.53	34.97	0.95
2	243	1:100yr	85.50	1081.05	1082.72	1082.72	1083.16	0.016011	3.04	31.93	40.77	0.91
2	242	1:100yr	85.50	1080.00	1081.64		1081.92	0.007856	2.45	42.26	45.82	0.66
2	241	1:100yr	85.50	1079.99	1081.41	1081.27	1081.73	0.010740	2.63	38.58	45.86	0.76
2	240	1:100yr	85.50	1079.20	1081.04	1081.04	1081.45	0.017049	2.96	33.52	48.52	0.93
2	239	1:100yr	85.50	1078.08	1080.02	1080.02	1080.38	0.015130	2.86	37.07	50.56	0.88
2	238	1:100yr	85.50	1076.88	1078.45	1078.45	1078.80	0.019970	2.96	35.96	49.94	0.98
2	237	1:100yr	85.50	1075.95	1077.55	1077.55	1077.94	0.019007	2.86	32.85	43.47	0.96
2	236	1:100yr	85.50	1074.90	1076.24	1076.24	1076.65	0.021062	2.85	30.20	38.66	1.00
2	235	1:100yr	85.50	1074.03	1075.36	1075.36	1075.80	0.018811	3.00	30.39	36.09	0.96
2	234	1:100yr	85.50	1073.15	1074.57	1074.57	1075.03	0.017682	3.06	30.14	35.80	0.94
2	233	1:100yr	85.50	1072.30	1073.76	1073.76	1074.23	0.017426	3.12	30.25	35.80	0.94
2	232	1:100yr	85.50	1071.43	1072.98	1072.98	1073.39	0.017639	2.88	32.50	44.68	0.93
2	231	1:100yr	85.50	1070.56	1071.99	1071.99	1072.35	0.018578	2.74	34.28	52.20	0.94
2	230	1:100yr	85.50	1069.51	1070.93	1070.93	1071.28	0.026484	2.79	33.93	53.89	1.08
2	229	1:100yr	85.50	1068.20	1070.21	1070.21	1070.65	0.021094	2.95	28.97	33.58	1.00
2	228	1:100yr	85.50	1066.80	1068.78	1068.78	1069.35	0.019943	3.34	25.63	22.71	1.00
2	227	1:100yr	85.50	1065.45	1067.50	1067.50	1067.98	0.020667	3.08	27.78	28.88	1.00
2	226	1:100yr	85.50	1064.51	1065.42	1065.42	1065.75	0.023063	2.55	33.61	52.52	1.00
2	225	1:100yr	85.50	1063.86	1064.78	1064.78	1065.06	0.021833	2.37	37.59	70.94	0.97
2	224	1:100yr	85.50	1063.24	1064.22	1064.22	1064.53	0.022638	2.47	35.31	59.41	0.99
2	223	1:100yr	85.50	1062.58	1063.60	1063.60	1063.92	0.022333	2.51	34.97	61.38	0.99
2	222	1:100yr	85.50	1061.92	1062.99	1062.99	1063.28	0.020107	2.43	37.72	70.05	0.94
2	221	1:100yr	85.50	1061.32	1062.41	1062.41	1062.72	0.020870	2.51	36.12	61.57	0.96
2	220	1:100yr	85.50	1060.73	1061.86	1061.86	1062.21	0.020910	2.62	33.89	52.47	0.97
2	219	1:100yr	85.50	1060.07	1061.50		1061.73	0.009887	2.15	43.08	53.87	0.70
2	218	1:100yr	85.50	1059.97	1061.46		1061.58	0.003582	1.60	61.54	65.31	0.44
2	217	1:100yr	85.50	1059.94	1061.26		1061.47	0.007986	2.05	45.27	56.82	0.64
2	216	1:100yr	85.50	1059.91	1060.93	1060.89	1061.23	0.017877	2.44	35.99	54.92	0.90
2	215	1:100yr	85.50	1059.00	1060.49	1060.49	1060.84	0.021258	2.64	33.20	49.23	0.98
2	214	1:100yr	85.50	1057.78	1059.36	1059.36	1059.81	0.021332	2.95	28.95	33.18	1.01
2	213	1:100yr	85.50	1056.34	1057.97	1057.97	1058.38	0.021939	2.84	30.11	37.42	1.01
2	212	1:100yr	85.50	1054.92	1056.41	1056.41	1056.84	0.021236	2.91	29.43	35.19	1.00
2	211	1:100yr	85.50	1053.82	1055.49	1055.49	1055.99	0.020385	3.11	27.54	28.74	1.00
2	210	1:100yr	85.50	1052.80	1054.44	1054.44	1054.98	0.019068	3.26	26.62	25.42	0.99
2	209	1:100yr	85.50	1051.95	1053.78	1053.78	1054.27	0.019883	3.11	27.61	29.69	0.99
2	208	1:100yr	85.50	1051.07	1052.79	1052.79	1053.25	0.017588	3.12	30.26	34.76	0.95
2	207	1:100yr	85.50	1050.02	1051.69	1051.69	1052.17	0.017305	3.27	30.98	35.35	0.96
2	206	1:100yr	85.50	1049.99	1051.46		1051.82	0.010438	2.84	36.31	36.69	0.77
2	205	1:100yr	85.50	1049.99	1051.21	1051.21	1051.57	0.015499	2.97	39.58	60.33	0.90
2	204	1:100yr	85.50	1048.77	1049.87	1049.87	1050.17	0.032673	2.91	35.98	58.48	1.18
2	203	1:100yr	85.50	1048.00	1048.85	1048.85	1049.17	0.037651	2.43	34.27	54.47	1.19
2	202	1:100yr	85.50	1047.43	1047.98	1047.98	1048.26	0.034640	2.06	36.31	62.77	1.11
2	201	1:100yr	85.50	1045.81	1046.51	1046.51	1046.80	0.035172	2.82	36.87	68.48	1.21

HEC-RAS Plan: Current mode River: StreamC5 Reach: 5 Profile: 1:100yr

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)	
5	509	1:100yr	405.05	1039.99	1043.55		1044.09	0.005217	3.64	150.41	71.73	0.63
5	508	1:100yr	405.05	1039.99	1043.50		1043.99	0.005088	3.57	156.48	74.55	0.62
5	507	1:100yr	405.05	1039.69	1042.85	1042.85	1043.80	0.011841	4.81	111.70	63.15	0.92
5	506	1:100yr	405.05	1039.12	1042.55	1042.55	1043.51	0.011471	4.84	111.30	62.03	0.90
5	505	1:100yr	405.05	1038.55	1042.15	1042.15	1043.11	0.010990	4.83	112.84	63.53	0.88
5	504	1:100yr	405.05	1037.98	1041.60	1041.60	1042.54	0.010739	4.85	116.42	66.20	0.88
5	503	1:100yr	405.05	1037.42	1041.02	1041.02	1041.95	0.011851	4.88	115.84	67.50	0.92
5	502	1:100yr	405.05	1036.85	1040.37	1040.37	1041.37	0.014087	4.99	106.44	61.07	0.98
5	501	1:100yr	405.05	1036.29	1039.77	1039.77	1040.76	0.015730	4.93	101.65	56.16	1.02

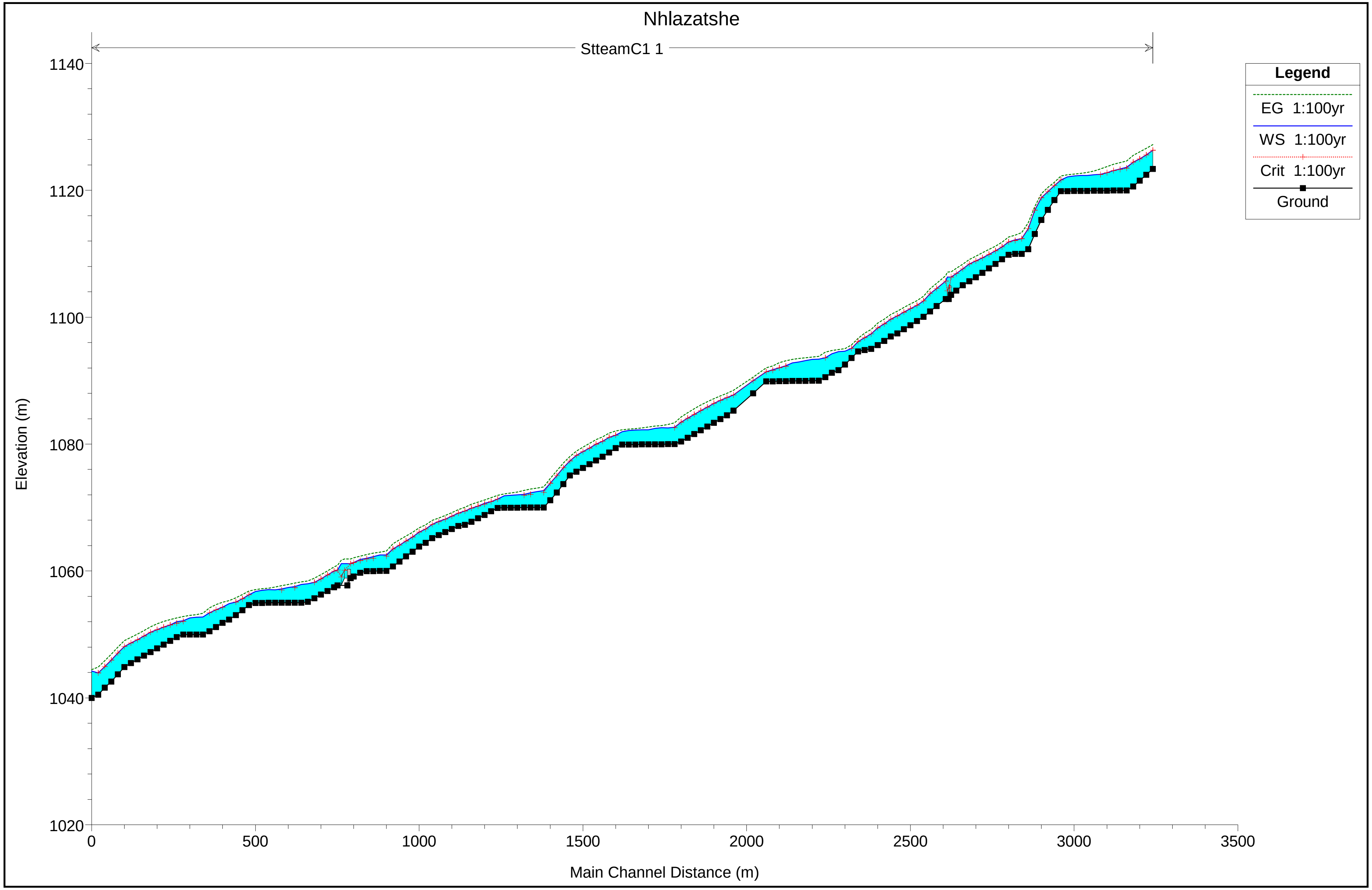
HEC-RAS Plan: Current mode River: StreamC3 Reach: 3 Profile: 1:100yr

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)	
3	374	1:100yr	82.72	1160.07	1162.52	1162.52	1163.18	0.018002	3.60	23.48	18.90	0.98
3	373	1:100yr	82.72	1159.97	1161.74		1162.12	0.010043	2.81	31.83	25.75	0.75
3	372	1:100yr	82.72	1159.95	1161.62	1161.30	1161.92	0.007726	2.50	35.39	29.70	0.66
3	371	1:100yr	82.72	1159.92	1161.19	1161.19	1161.68	0.018561	3.12	27.69	31.01	0.97
3	370	1:100yr	82.72	1159.89	1161.22		1161.33	0.003746	1.53	57.54	57.07	0.45
3	369	1:100yr	82.72	1159.86	1160.79	1160.79	1161.16	0.019624	2.76	32.42	47.05	0.96
3	368	1:100yr	82.72	1158.17	1159.42	1159.42	1159.87	0.020188	2.96	28.31	32.91	0.99
3	367	1:100yr	82.72	1156.38	1157.97	1157.97	1158.46	0.017967	3.15	27.88	29.92	0.96
3	366	1:100yr	82.72	1154.76	1156.64	1156.64	1157.08	0.021305	2.94	28.22	33.42	1.01
3	365	1:100yr	82.72	1153.69	1155.53	1155.53	1155.99	0.020710	3.01	27.53	30.76	1.00
3	364	1:100yr	82.72	1152.63	1154.42	1154.42	1154.84	0.017652	2.91	30.92	41.58	0.94
3	363	1:100yr	82.72	1151.61	1153.38	1153.38	1153.79	0.018075	2.91	30.73	40.33	0.94
3	362	1:100yr	82.72	1150.55	1152.11	1152.11	1152.54	0.021074	2.89	28.93	36.17	1.00
3	361	1:100yr	82.72	1149.46	1150.80	1150.80	1151.25	0.020522	2.97	28.06	32.66	1.00
3	360	1:100yr	82.72	1148.40	1150.22	1150.22	1150.60	0.022152	2.75	30.18	40.22	1.00
3	359	1:100yr	82.72	1147.34	1149.15	1149.15	1149.56	0.021557	2.85	29.24	36.55	1.00
3	358	1:100yr	82.72	1146.31	1148.02	1148.02	1148.52	0.019805	3.16	26.47	27.24	0.99
3	357	1:100yr	82.72	1145.25	1147.16	1147.16	1147.65	0.019071	3.11	27.23	29.25	0.98
3	356	1:100yr	82.72	1144.99	1146.74		1147.15	0.013646	2.86	29.46	27.50	0.85
3	355	1:100yr	82.72	1144.99	1146.50		1146.86	0.014145	2.67	30.94	30.13	0.84
3	354	1:100yr	82.72	1144.78	1146.07	1146.07	1146.51	0.021486	2.92	28.29	33.36	1.01
3	353	1:100yr	82.72	1143.65	1145.29	1145.29	1145.77	0.019778	3.07	27.24	29.32	0.99
3	352	1:100yr	82.72	1142.75	1144.45	1144.45	1144.98	0.017192	3.28	26.71	27.24	0.95
3	351	1:100yr	82.72	1141.86	1143.63	1143.63	1144.15	0.019727	3.19	26.16	26.63	1.00
3	350	1:100yr	82.72	1140.96	1142.83	1142.83	1143.33	0.019024	3.13	26.96	28.66	0.98
3	349	1:100yr	82.72	1140.08	1141.79	1141.79	1142.25	0.018744	3.05	28.37	31.93	0.97
3	348	1:100yr	82.72	1138.25	1140.30	1140.30	1140.86	0.017200	3.39	26.19	24.73	0.96
3	347	1:100yr	82.72	1136.34	1138.55	1138.55	1139.07	0.017008	3.32	27.73	27.04	0.95
3	346	1:100yr	82.72	1134.57	1135.90	1135.90	1136.41	0.019271	3.20	26.27	26.39	0.99
3	345	1:100yr	82.72	1133.23	1134.68	1134.68	1135.20	0.018451	3.21	26.67	27.78	0.97
3	344	1:100yr	82.72	1131.88	1133.52	1133.52	1134.06	0.017588	3.28	26.20	26.68	0.96
3	343	1:100yr	82.72	1130.53	1132.41	1132.41	1132.95	0.019734	3.26	25.42	24.59	1.00
3	342	1:100yr	82.72	1130.00	1131.91		1132.19	0.007102	2.35	36.10	29.47	0.63
3	341	1:100yr	82.72	1129.99	1131.53	1131.45	1131.97	0.015973	2.95	28.27	27.21	0.90
3	340	1:100yr	82.72	1129.99	1131.51		1131.72	0.005507	2.07	42.78	37.38	0.56
3	339	1:100yr	82.72	1129.98	1131.37		1131.59	0.007346	2.16	41.22	41.41	0.63
3	338	1:100yr	82.72	1129.96	1130.95	1130.95	1131.36	0.018643	2.86	31.31	42.75	0.95
3	337	1:100yr	82.72	1128.96	1130.33	1130.33	1130.74	0.019721	2.89	30.19	38.40	0.97
3	336	1:100yr	82.72	1127.44	1128.89	1128.89	1129.35	0.019964	3.02	27.88	32.87	0.99
3	335	1:100yr	82.72	1125.92	1127.58	1127.58	1128.10	0.019911	3.18	26.09	26.14	1.00
3	334	1:100yr	82.72	1125.00	1127.06		1127.17	0.002689	1.43	59.11	46.48	0.39
3	333	1:100yr	82.72	1125.00	1127.07		1127.12	0.000893	1.00	88.15	57.66	0.23
3	332	1:100yr	82.72	1125.00	1127.07		1127.10	0.000548	0.82	112.60	71.38	0.19
3	331	1:100yr	82.72	1125.00	1127.07		1127.09	0.000434	0.75	124.78	76.05	0.17
3	330	1:100yr	82.72	1125.00	1127.06	1126.68	1127.09	0.000439	0.74	126.19	79.35	0.17
3	329.5		Culvert									
3	329	1:100yr	82.72	1122.89	1125.16	1125.16	1126.27	0.015070	4.66	17.74	67.06	1.00
3	328	1:100yr	82.72	1119.95	1121.51	1121.51	1121.96	0.020954	2.96	27.94	32.18	1.00
3	327	1:100yr	82.72	1119.35	1120.86	1120.85	1121.32	0.018941	3.04	28.26	31.08	0.97
3	326	1:100yr	82.72	1118.74	1120.43	1120.43	1120.93	0.018736	3.19	27.07	28.14	0.97
3	325	1:100yr	82.72	1118.15	1119.86	1119.86	1120.39	0.020726	3.23	25.60	24.39	1.01
3	324	1:100yr	82.72	1117.55	1119.33	1119.33	1119.88	0.020181	3.28	25.18	22.95	1.00
3	323	1:100yr	82.72	1116.96	1118.83	1118.83	1119.38	0.020115	3.29	25.15	22.87	1.00
3	322	1:100yr	82.72	1116.37	1118.33	1118.33	1118.91	0.019813	3.36	24.60	21.39	1.00
3	321	1:100yr	82.72	1115.77	1117.87	1117.87	1118.40	0.018622	3.25	25.96	25.03	0.97
3	320	1:100yr	82.72	1115.18	1117.12	1117.12	1117.60	0.019427	3.09	27.33	29.94	0.98
3	319	1:100yr	82.72	1114.18	1115.91	1115.91	1116.40	0.019928	3.09	27.09	29.97	0.99
3	318	1:100yr	82.72	1113.19	1115.09	1115.09	1115.62	0.020142	3.21	25.78	24.68	1.00
3	317	1:100yr	82.72	1111.98	1113.96	1113.96	1114.45	0.020566	3.09	26.77	27.61	1.00
3	316	1:100yr	82.72	1110.80	1112.66	1112.66	1113.06	0.021634	2.81	29.42	36.59	1.00
3	315	1:100yr	82.72	1110.00	1111.60		1111.87	0.009990	2.34	35.98	36.32	0.72
3	314	1:100yr	82.72	1109.35	1111.14	1111.14	1111.59	0.018493	3.00	29.21	36.10	0.96
3	313	1:100yr	82.72	1107.41	1109.59	1109.59	1110.24	0.019553	3.57	23.15	17.98	1.01
3	312	1:100yr	82.72	1105.55	1108.23	1108.23	1108.93	0.019409	3.70	22.33	16.07	1.00
3	311	1:100yr	82.72	1104.58	1106.77	1106.77	1107.40	0.019587	3.50	23.62	19.21	1.01
3	310	1:100yr	82.72	1104.00	1106.01	1106.01	1106.54	0.020143	3.22	25.69	24.50	1.00
3	309	1:100yr	82.72	1103.41	1105.27	1105.27	1105.66	0.018261	2.81	31.92	44.14	0.94
3	308	1:100yr	82.72	1102.82	1104.62	1104.62	1104.99	0.021290	2.70	31.28	46.68	0.99
3	307	1:100yr	82.72	1102.23	1103.94	1103.94	1104.29	0.021900	2.64	31.68	47.53	0.99
3	306	1:100yr	82.72	1101.68	1103.22	1103.22	1103.56	0.022572	2.56	32.37	50.33	1.00
3	305	1:100yr	82.72	1101.09	1102.54	1102.54	1102.87	0.024052	2.55	32.47	51.28	1.02
3	304	1:100yr	82.72	1100.50	1101.85	1101.85	1102.19	0.020521	2.64	32.93	50.70	0.97
3	303	1:100yr	82.72	1099.99	1101.44	1101.26	1101.67	0.009245	2.20	42.19	56.44	0.69
3	302.5		Culvert									
3	302	1:100yr	82.72	1098.43	1100.28	1100.28	1101.00	0.017416	3.77	21.91	50.72	0.99
3	301	1:100yr	82.72	1097.08	1098.58	1098.58	1098.93	0.018668	2.73	34.90	55.71	0.94

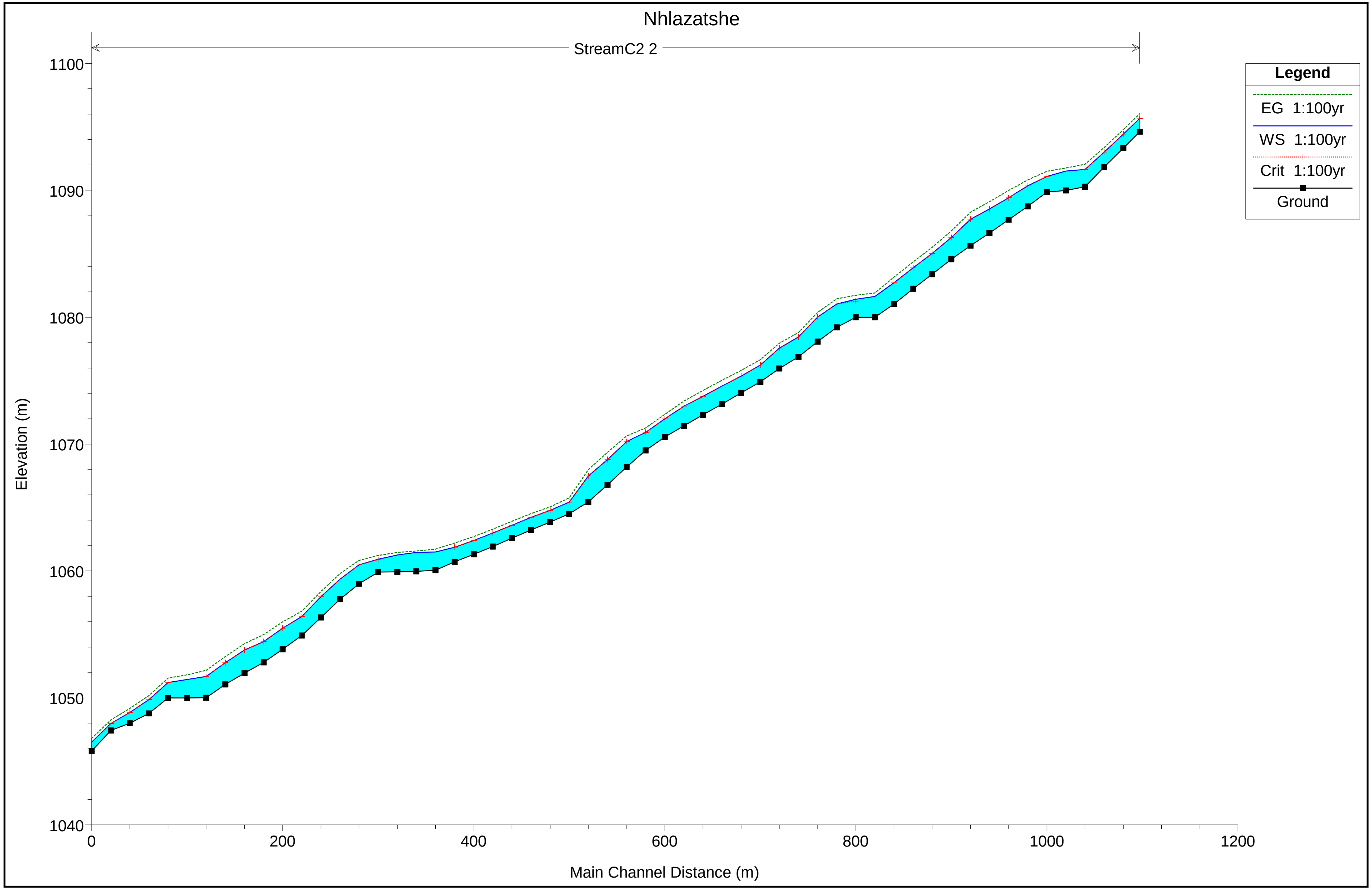
HEC-RAS Plan: Current mode River: StreamC4 Reach: 4 Profile: 1:100yr

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)	
4	419	1:100yr	6.99	1223.16	1223.57	1223.57	1223.69	0.025470	1.58	4.96	21.76	0.93
4	418	1:100yr	6.99	1219.92	1220.50	1220.50	1220.66	0.029227	1.76	3.98	13.42	1.00
4	417	1:100yr	6.99	1216.02	1216.53	1216.53	1216.67	0.027875	1.66	4.49	17.82	0.97
4	416	1:100yr	6.99	1212.82	1213.21	1213.21	1213.33	0.030168	1.58	4.61	20.07	0.99
4	415	1:100yr	6.99	1209.96	1210.44	1210.44	1210.59	0.030200	1.75	4.00	13.13	1.01
4	414	1:100yr	6.99	1207.37	1207.89	1207.89	1207.97	0.035724	1.42	5.67	32.06	1.02
4	413	1:100yr	6.99	1204.73	1205.05	1205.05	1205.15	0.031356	1.53	5.34	26.92	0.99
4	412	1:100yr	6.99	1202.57	1202.97	1202.97	1203.09	0.024100	1.55	4.88	25.94	0.90
4	411	1:100yr	6.99	1200.47	1200.97	1200.97	1201.12	0.027025	1.77	4.21	14.57	0.97
4	410	1:100yr	6.99	1198.01	1198.66	1198.66	1198.81	0.024919	1.76	4.26	16.26	0.94
4	409	1:100yr	6.99	1195.44	1195.82	1195.82	1195.91	0.027934	1.53	6.22	35.10	0.95
4	408	1:100yr	6.99	1192.91	1193.21	1193.21	1193.30	0.043824	1.51	5.25	27.13	1.12
4	407	1:100yr	6.99	1190.69	1191.11	1191.11	1191.23	0.033039	1.69	4.88	20.49	1.04
4	406	1:100yr	6.99	1187.12	1187.95	1187.95	1188.21	0.026963	2.24	3.12	6.19	1.01
4	405	1:100yr	6.99	1183.09	1183.73	1183.73	1183.93	0.028263	1.96	3.58	9.48	1.01
4	404	1:100yr	6.99	1179.98	1180.47	1180.47	1180.66	0.026462	1.91	3.76	10.70	0.98
4	403	1:100yr	6.99	1177.78	1178.95	1178.95	1179.26	0.027779	2.43	2.87	4.84	1.01
4	402	1:100yr	6.99	1174.52	1175.16	1175.16	1175.38	0.021896	2.14	3.69	9.26	0.94
4	401	1:100yr	6.99	1169.98	1170.51	1170.51	1170.73	0.031890	2.31	3.55	8.92	1.10

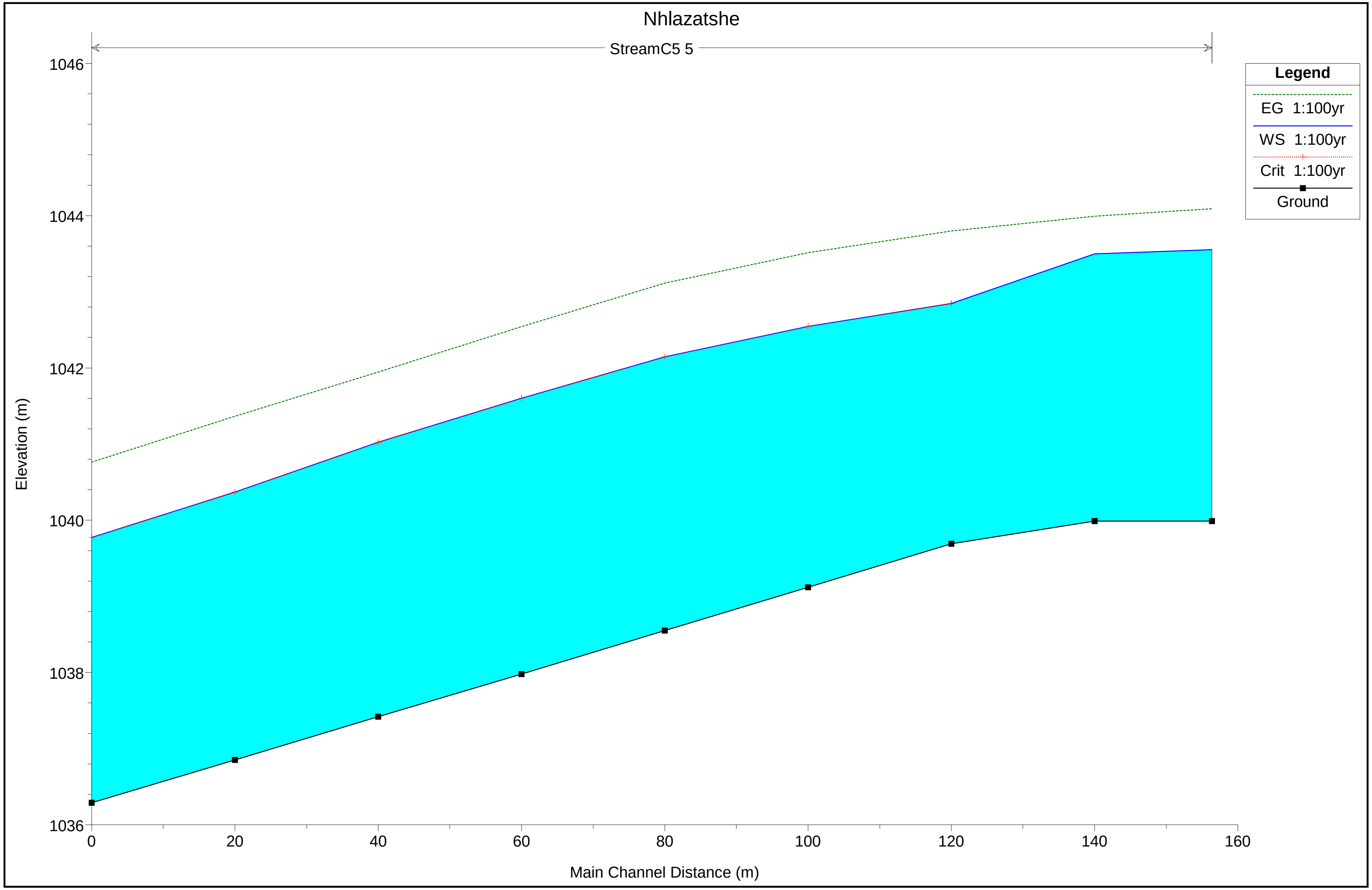
ANNEXURE 4: LONGITUDINAL FLOW PROFILE FOR THE FLOOD PEAK



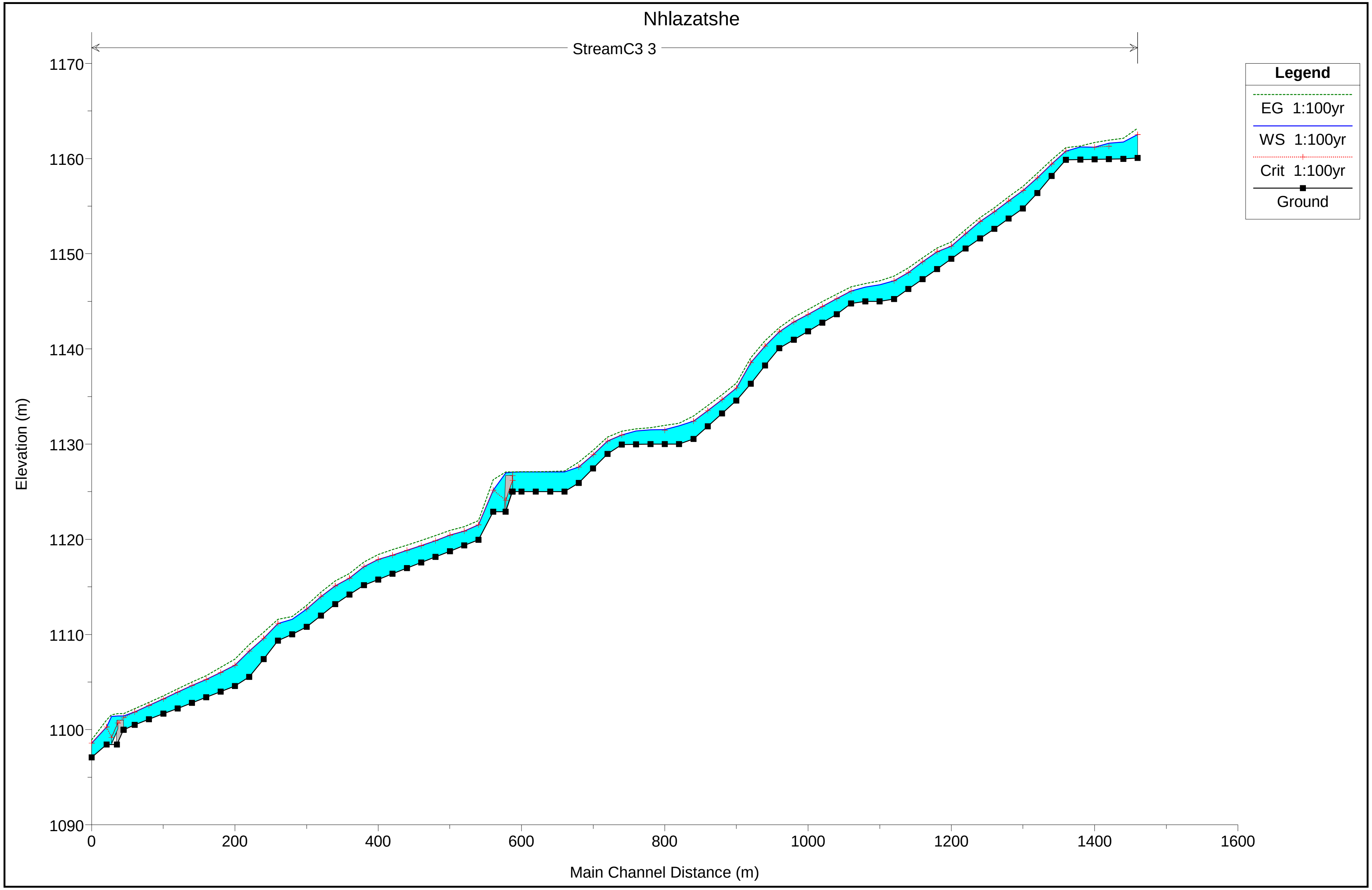
Nhlazatshe
SteamC1 1
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1140
1120
1100
1080
1060
1040
1020
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (m)

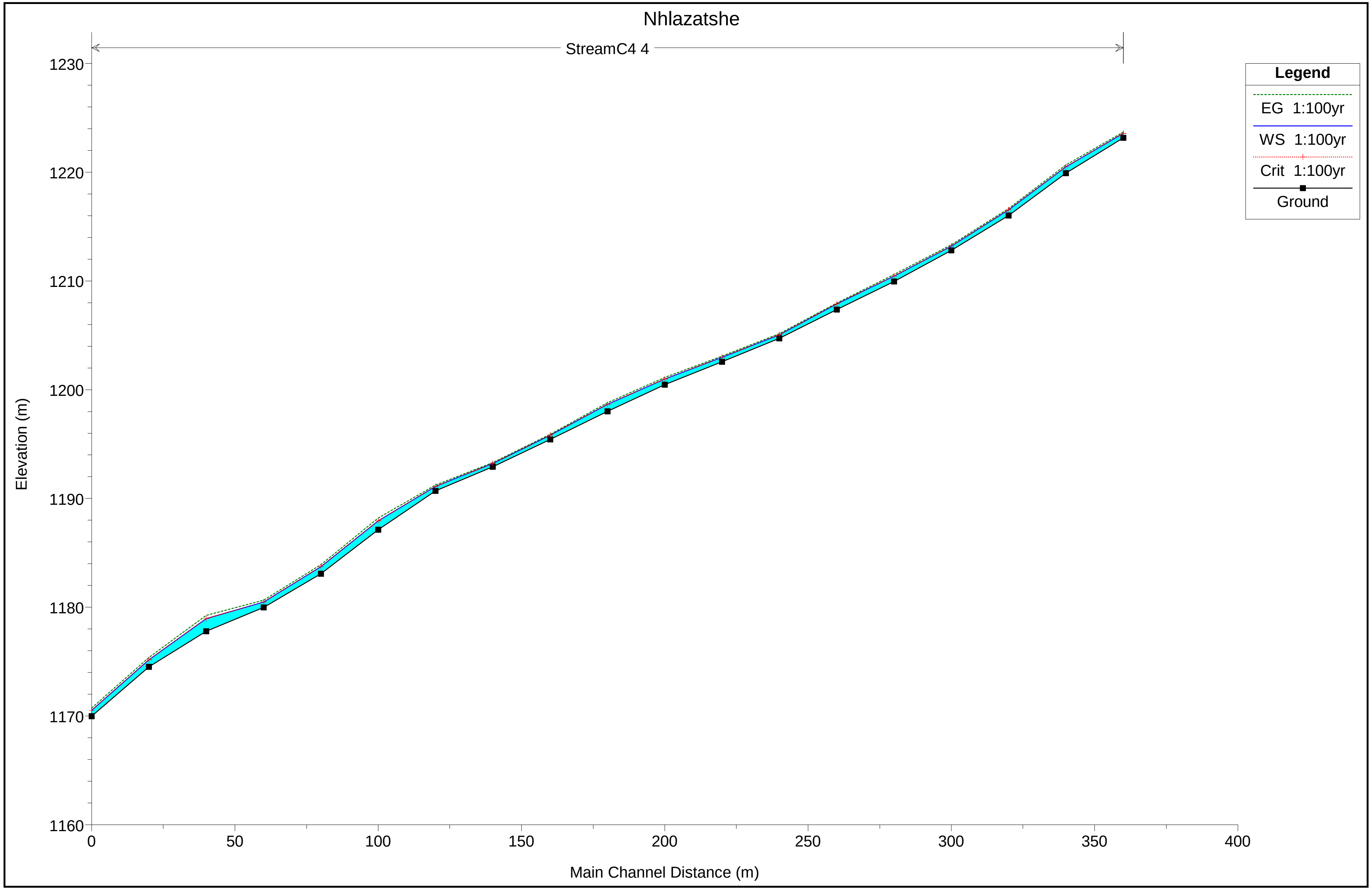


Nhlazatshe
StreamC2 2
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1040
1050
1060
1070
1080
1090
1100
0
200
400
600
800
1000
1200
Main Channel Distance (m)



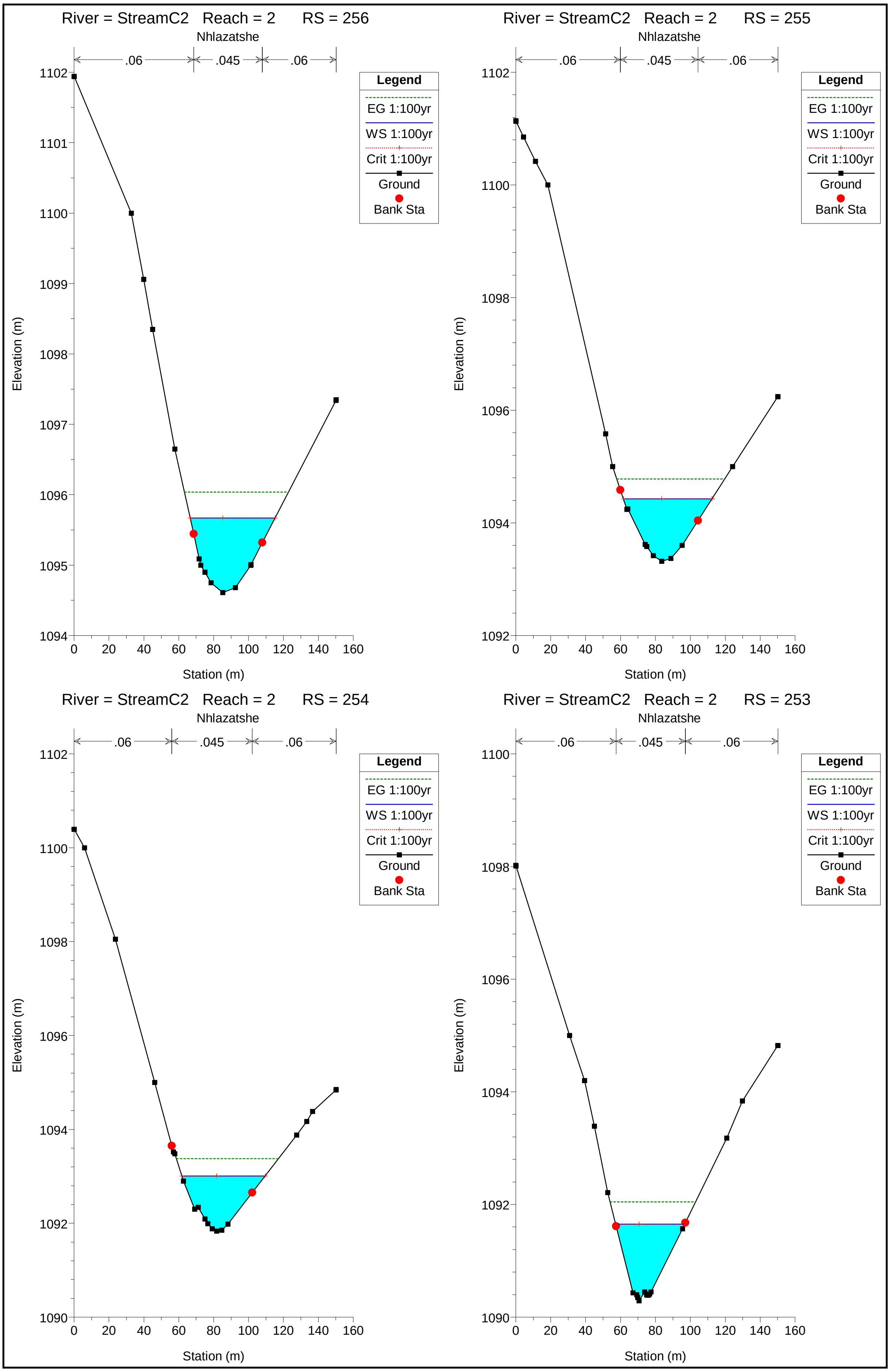
Nhlazatshe
StreamC5 5
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1036
1038
1040
1042
1044
1046
0
20
40
60
80
100
120
140
160
Main Channel Distance (m)

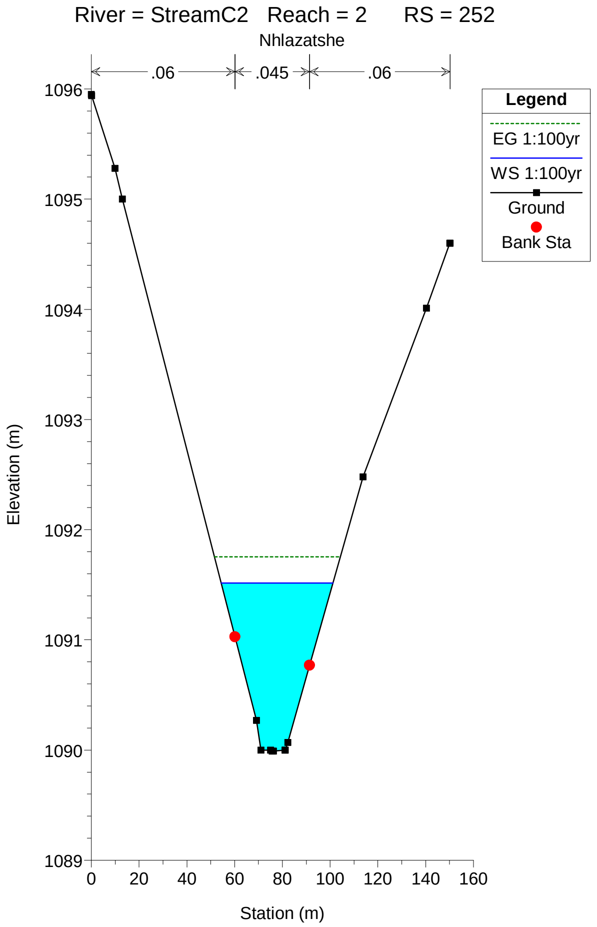

Nhlazatshe
StreamC3 3
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1170
1160
1150
1140
1130
1120
1110
1100
1090
0
200
400
600
800
1000
1200
1400
1600
Main Channel Distance (m)

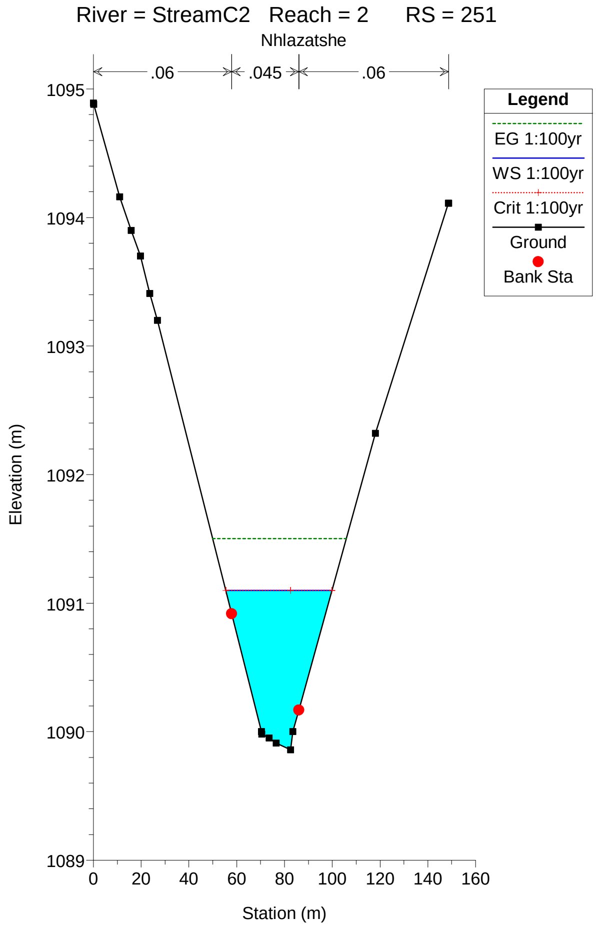


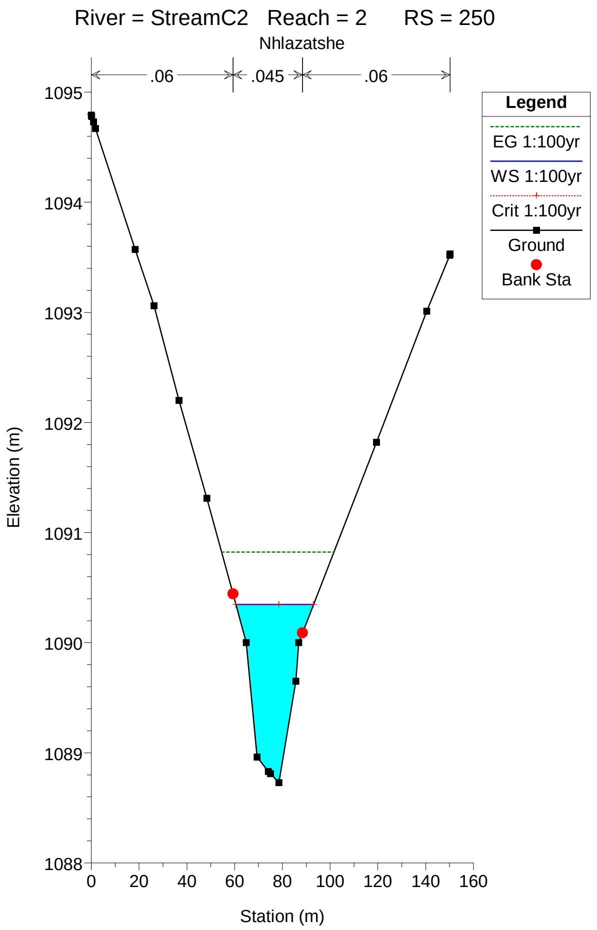
Nhlazatshe
StreamC4 4
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1160
1170
1180
1190
1200
1210
1220
1230
0
50
100
150
200
250
300
350
400
Main Channel Distance (m)

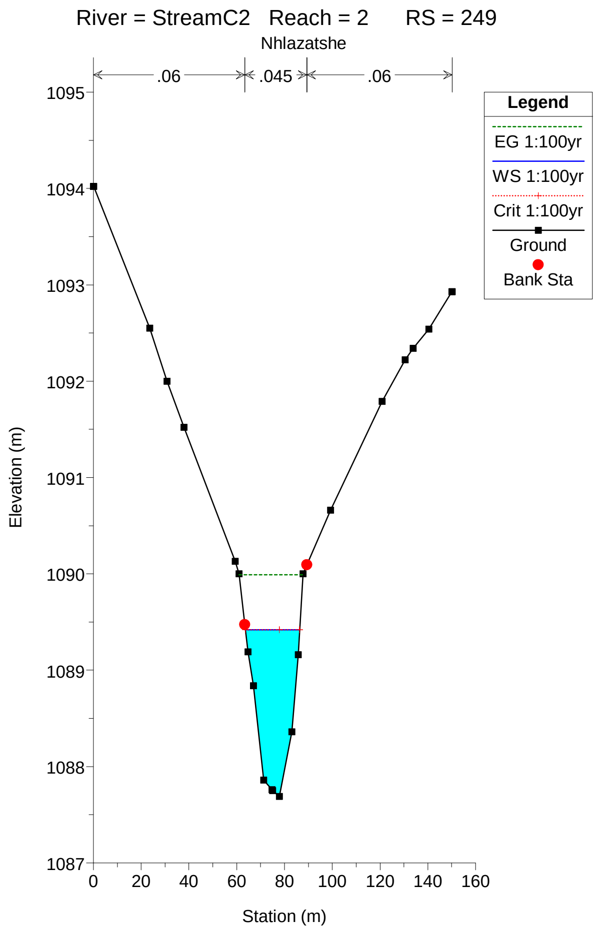
ANNEXURE 5: FLOW CROSS SECTIONS FOR THE FLOOD PEAK

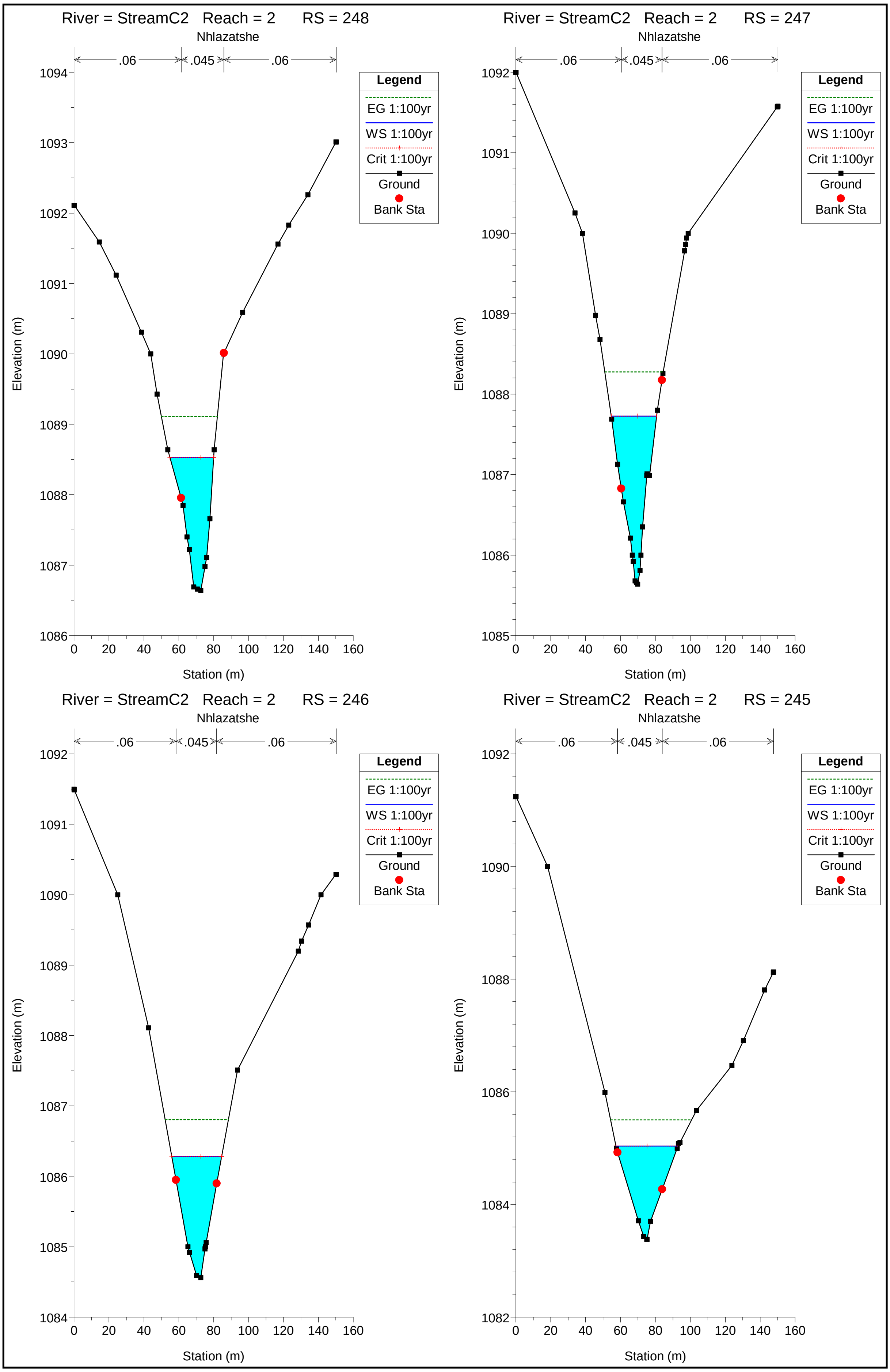

River = StreamC2 Reach = 2 RS = 256
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1094
1095
1096
1097
1098
1099
1100
1101
1102
0 20 40 60 80 100 120 140 160
Station (m)
River = StreamC2 Reach = 2 RS = 255
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1092
1094
1096
1098
1100
1102
0 20 40 60 80 100 120 140 160
Station (m)
River = StreamC2 Reach = 2 RS = 254
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1090
1092
1094
1096
1098
1100
1102
0 20 40 60 80 100 120 140 160
Station (m)
River = StreamC2 Reach = 2 RS = 253
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1090
1092
1094
1096
1098
1100
0 20 40 60 80 100 120 140 160
Station (m)

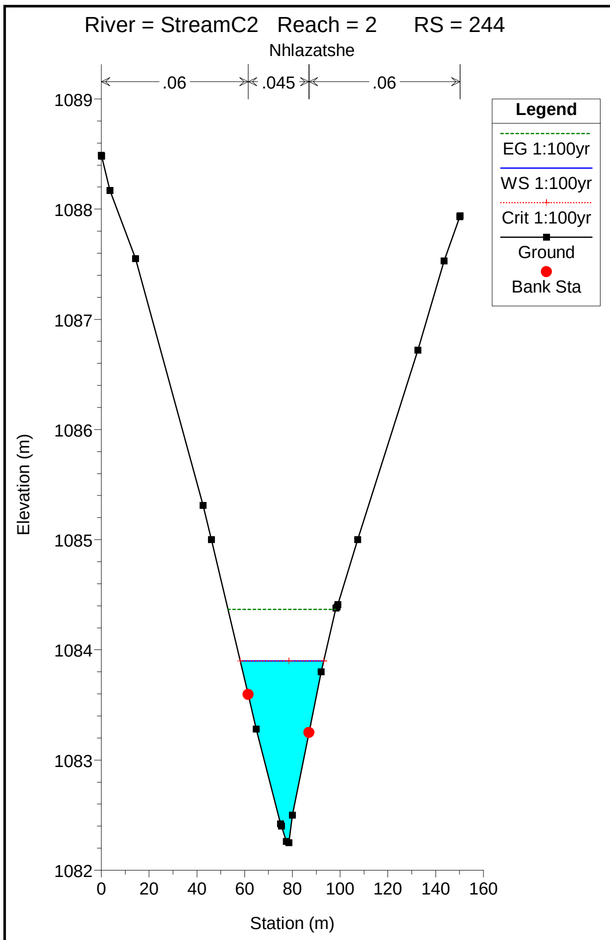

River = StreamC2 Reach = 2 RS = 252
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

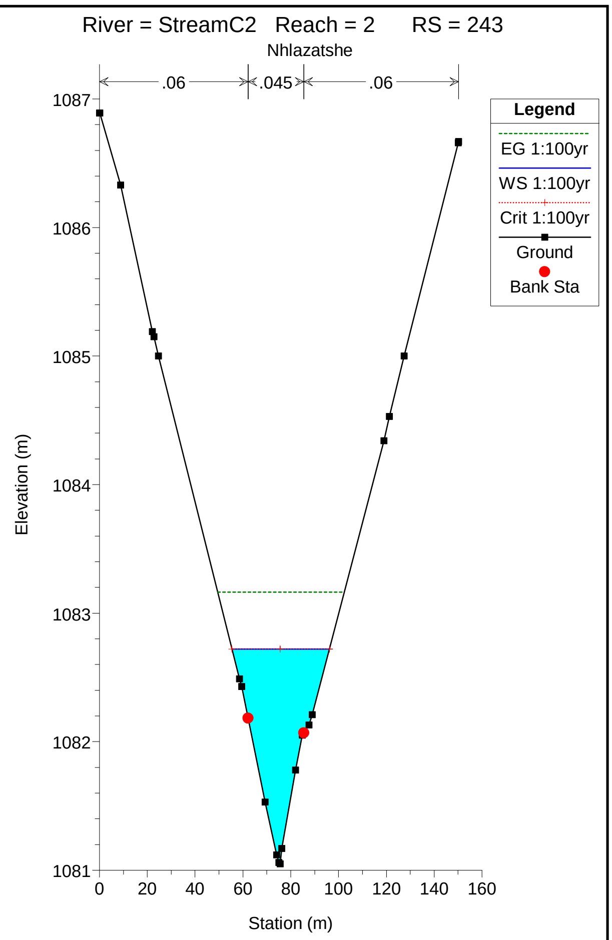

River = StreamC2 Reach = 2 RS = 251
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

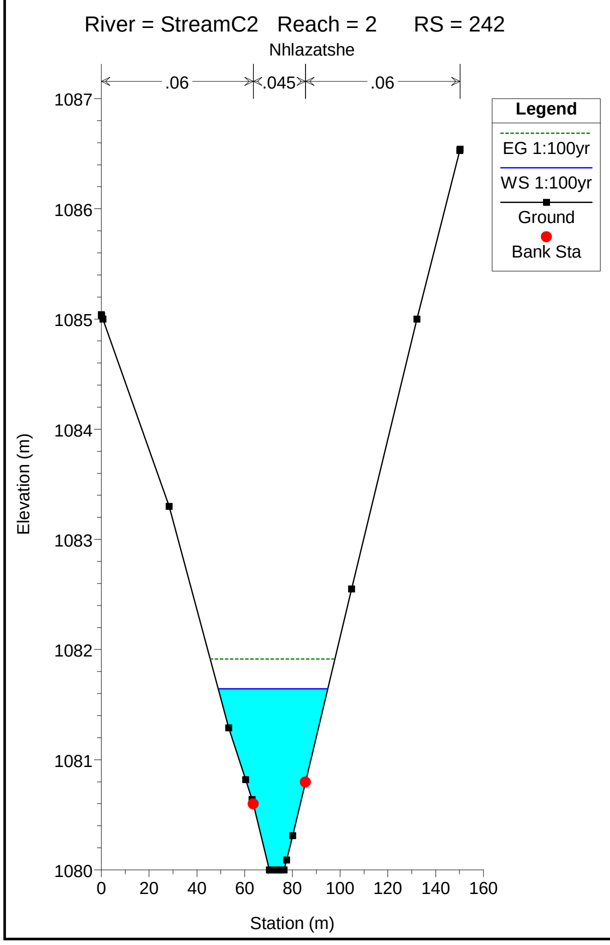

River = StreamC2 Reach = 2 RS = 250
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

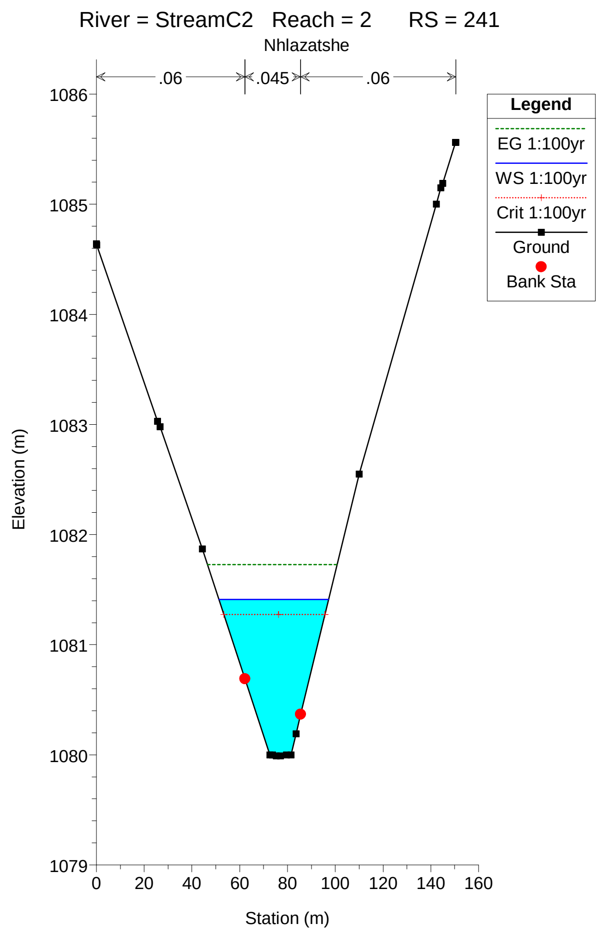

River = StreamC2 Reach = 2 RS = 249
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

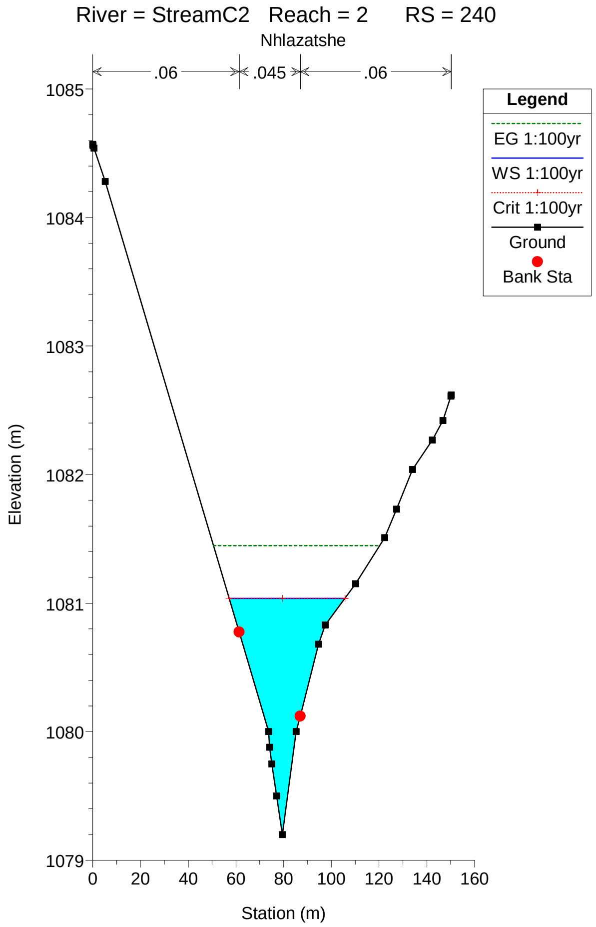

River = StreamC2 Reach = 2 RS = 248
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC2 Reach = 2 RS = 247
Nhlazatshe
River = StreamC2 Reach = 2 RS = 246
Nhlazatshe
River = StreamC2 Reach = 2 RS = 245
Nhlazatshe

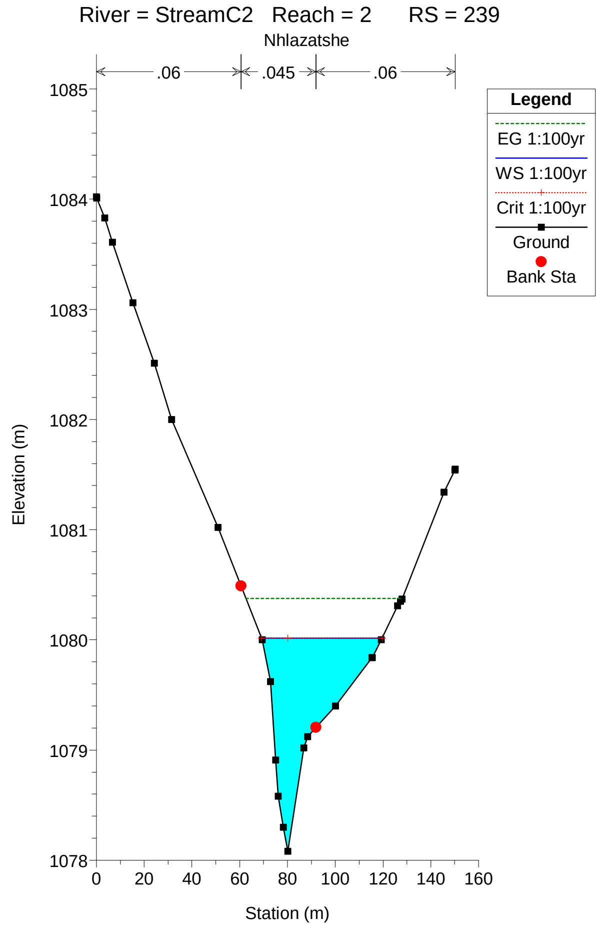

River = StreamC2 Reach = 2 RS = 244
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1082 1083 1084 1085 1086 1087 1088 1089
Station (m)
0 20 40 60 80 100 120 140 160

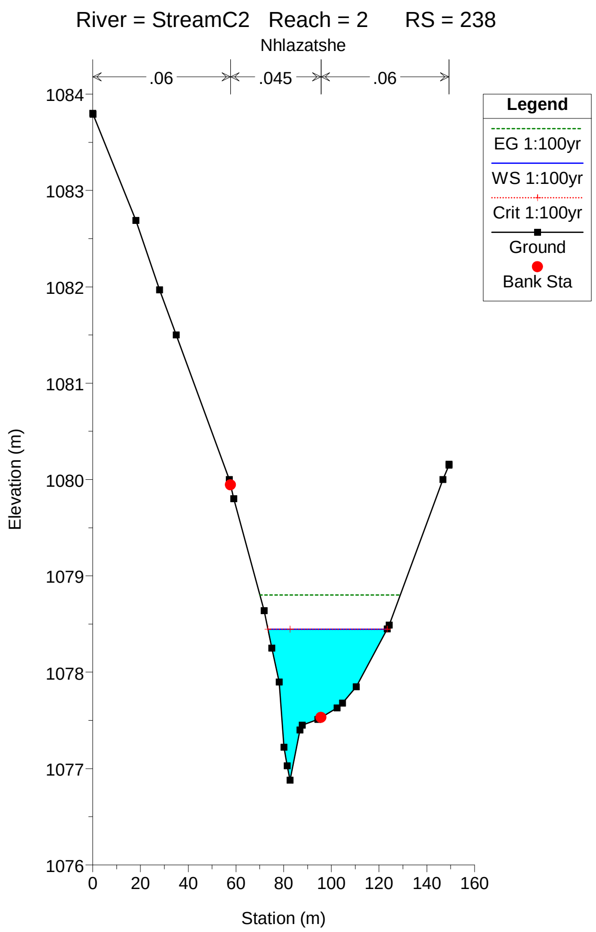

River = StreamC2 Reach = 2 RS = 243
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1081 1082 1083 1084 1085 1086 1087
Station (m)
0 20 40 60 80 100 120 140 160

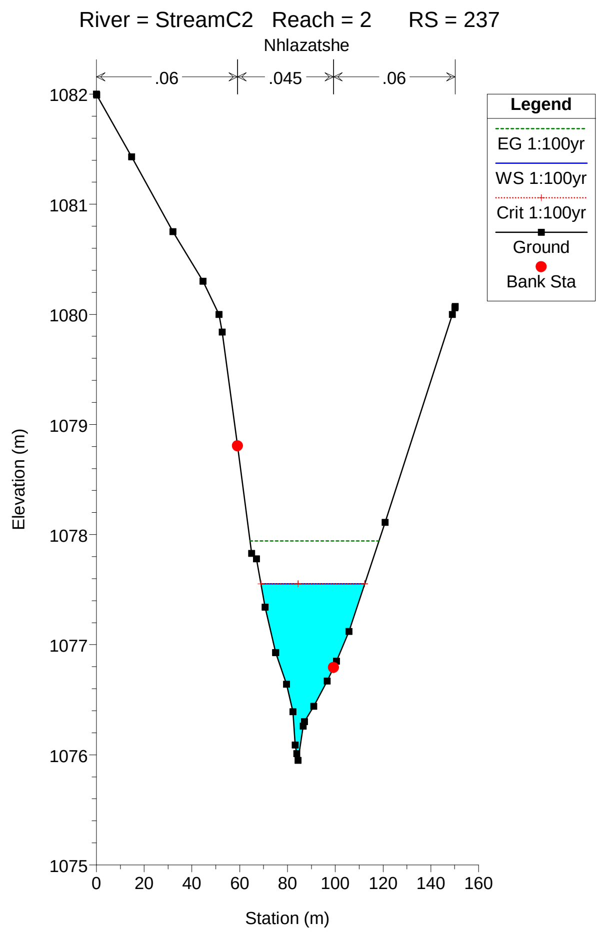

River = StreamC2 Reach = 2 RS = 242
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1080 1081 1082 1083 1084 1085 1086 1087
Station (m)
0 20 40 60 80 100 120 140 160

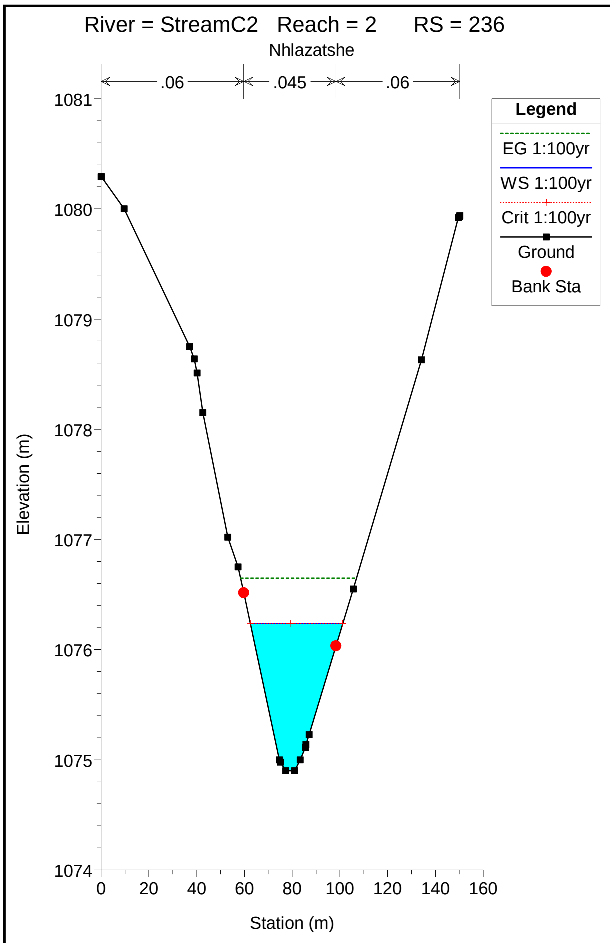

River = StreamC2 Reach = 2 RS = 241
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1079 1080 1081 1082 1083 1084 1085 1086
Station (m)
0 20 40 60 80 100 120 140 160

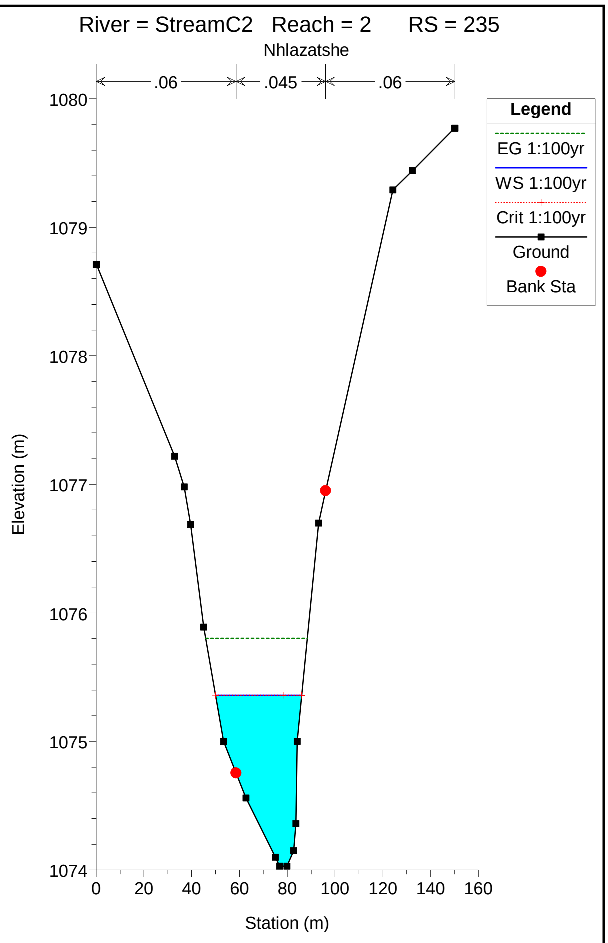

River = StreamC2 Reach = 2 RS = 240
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1085
1084
1083
1082
1081
1080
1079
0 20 40 60 80 100 120 140 160
Station (m)

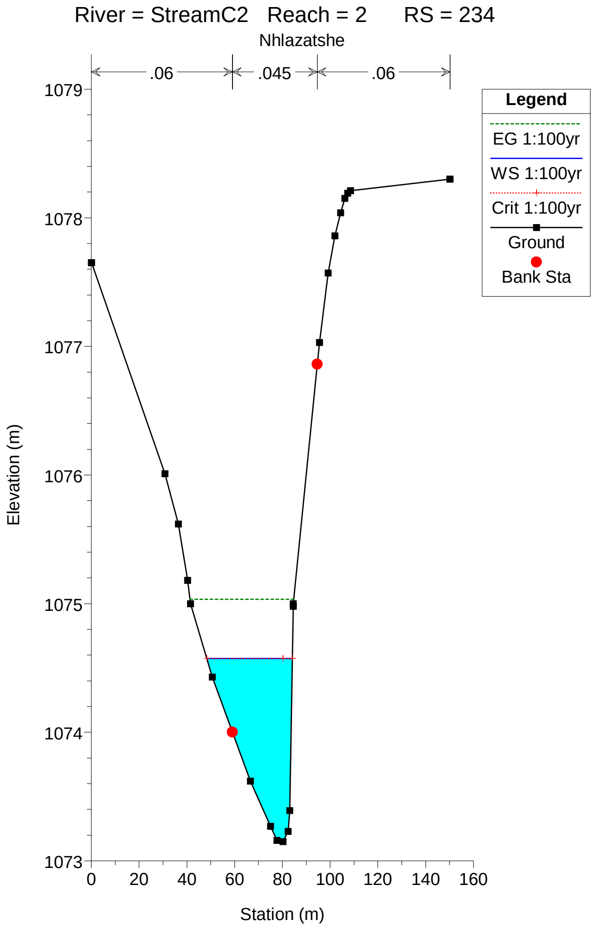

River = StreamC2 Reach = 2 RS = 239
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1085
1084
1083
1082
1081
1080
1079
1078
0 20 40 60 80 100 120 140 160
Station (m)

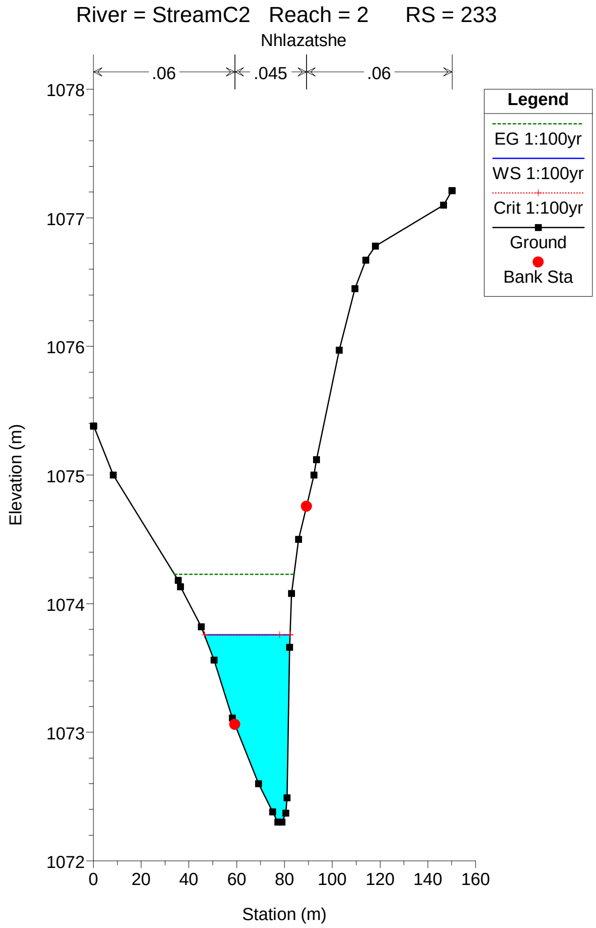

River = StreamC2 Reach = 2 RS = 238
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1084
1083
1082
1081
1080
1079
1078
1077
1076
0 20 40 60 80 100 120 140 160
Station (m)


River = StreamC2 Reach = 2 RS = 237
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1082
1081
1080
1079
1078
1077
1076
1075
0 20 40 60 80 100 120 140 160
Station (m)


River = StreamC2 Reach = 2 RS = 236
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1074
1075
1076
1077
1078
1079
1080
1081
0 20 40 60 80 100 120 140 160
Station (m)

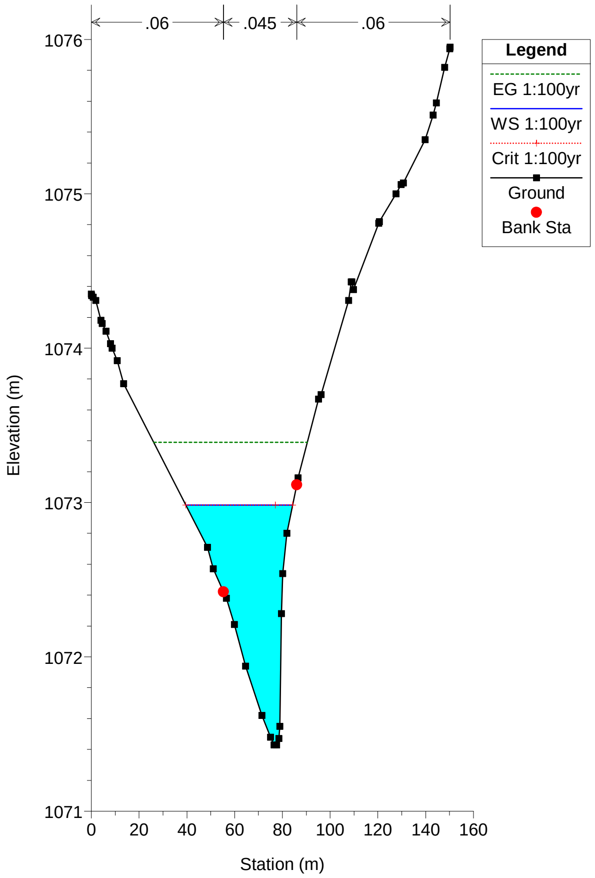

River = StreamC2 Reach = 2 RS = 235
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1074
1075
1076
1077
1078
1079
1080
0 20 40 60 80 100 120 140 160
Station (m)


River = StreamC2 Reach = 2 RS = 234
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1073
1074
1075
1076
1077
1078
1079
0 20 40 60 80 100 120 140 160
Station (m)


River = StreamC2 Reach = 2 RS = 233
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1072
1073
1074
1075
1076
1077
1078
0 20 40 60 80 100 120 140 160
Station (m)

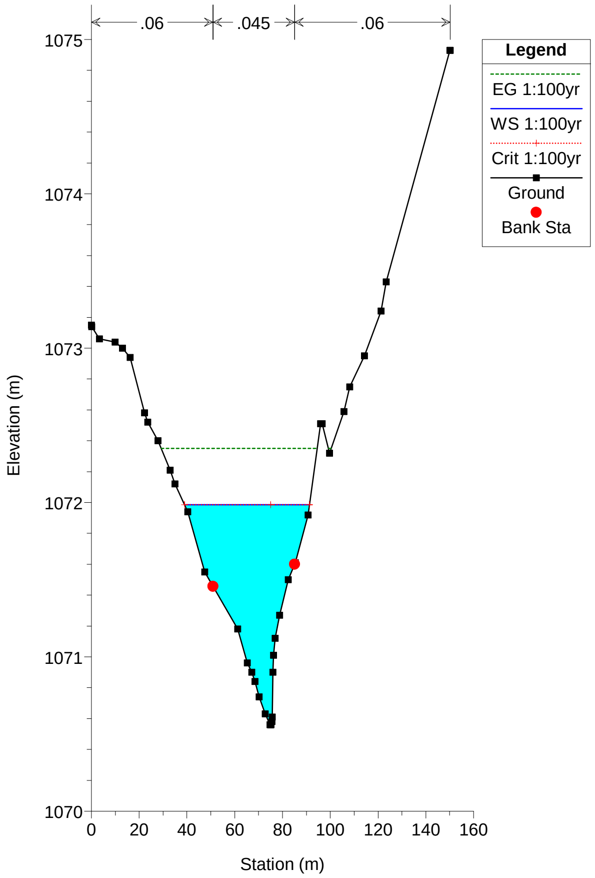
River = StreamC2 Reach = 2 RS = 232

Nhlazatshe



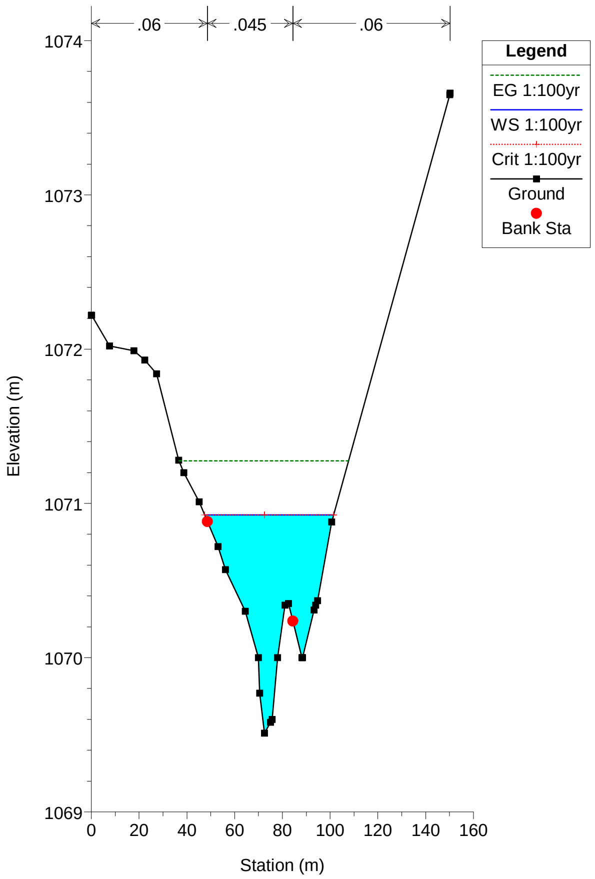
River = StreamC2 Reach = 2 RS = 231

Nhlazatshe



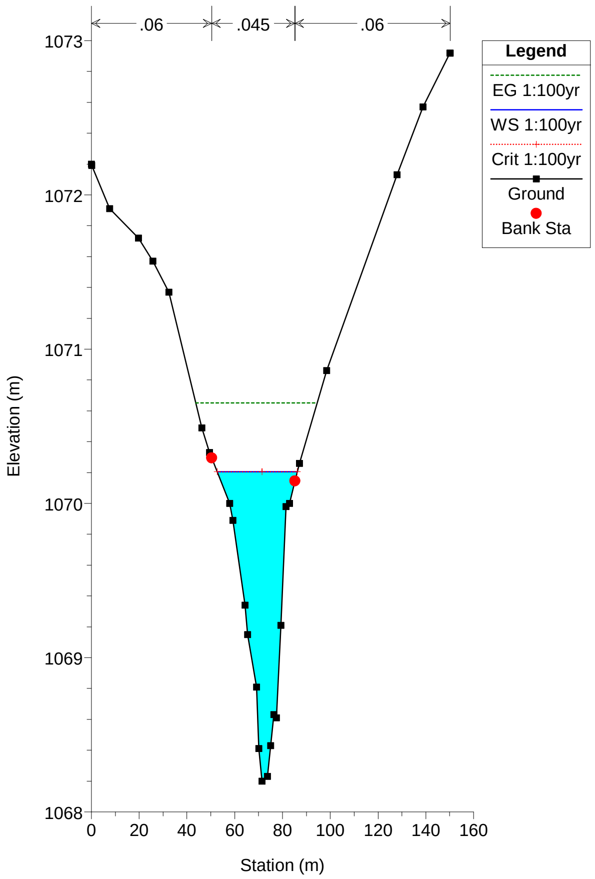
River = StreamC2 Reach = 2 RS = 230

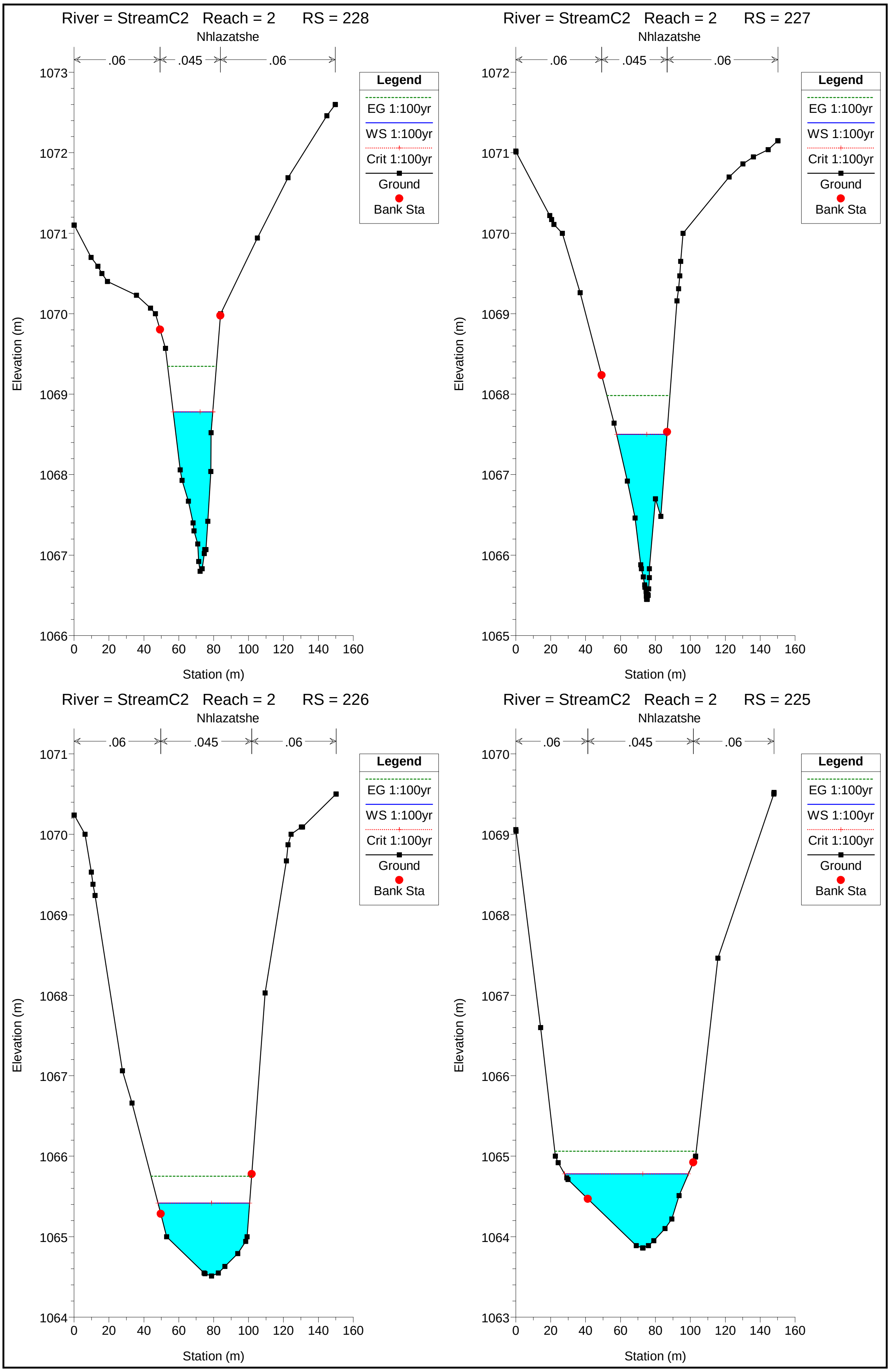
Nhlazatshe

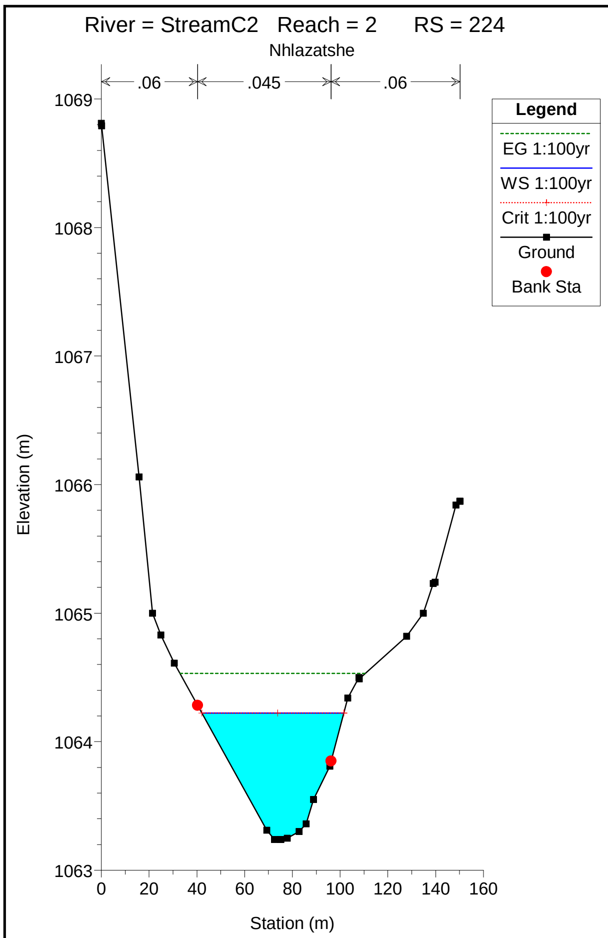


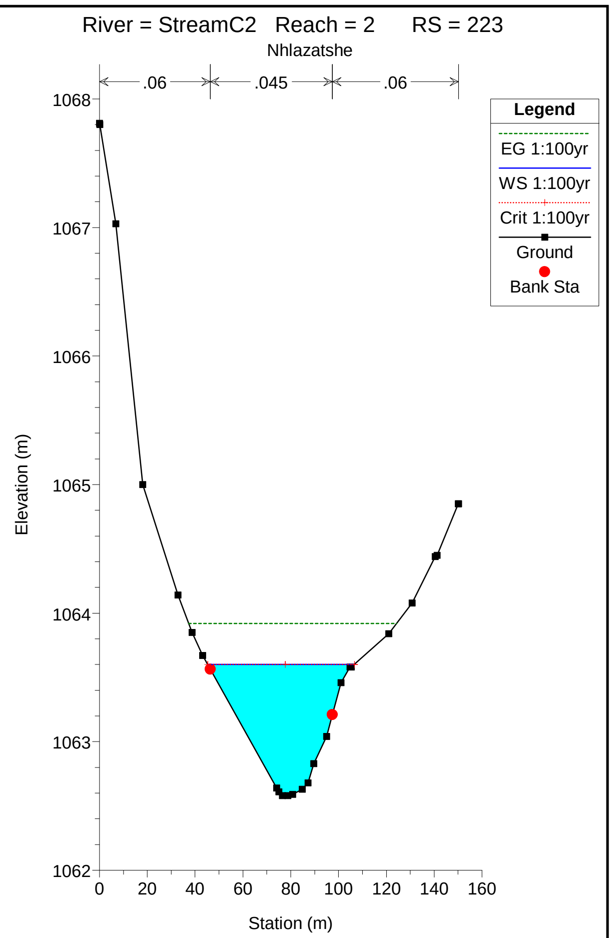
River = StreamC2 Reach = 2 RS = 229

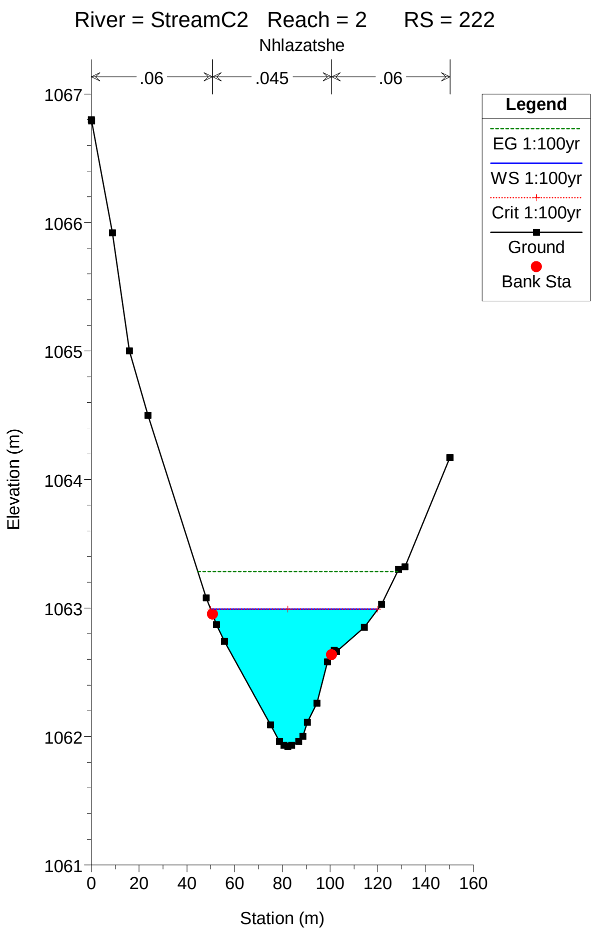
Nhlazatshe

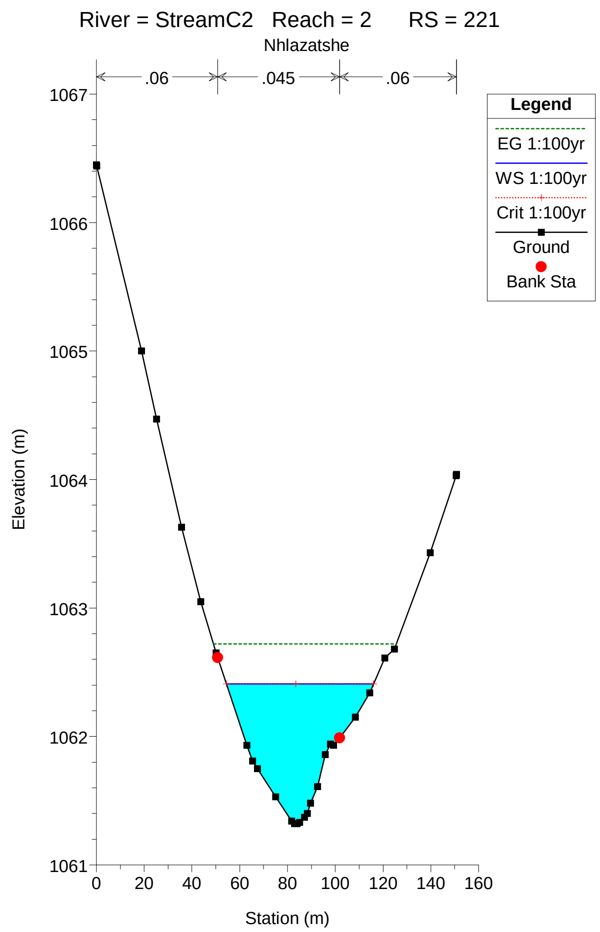


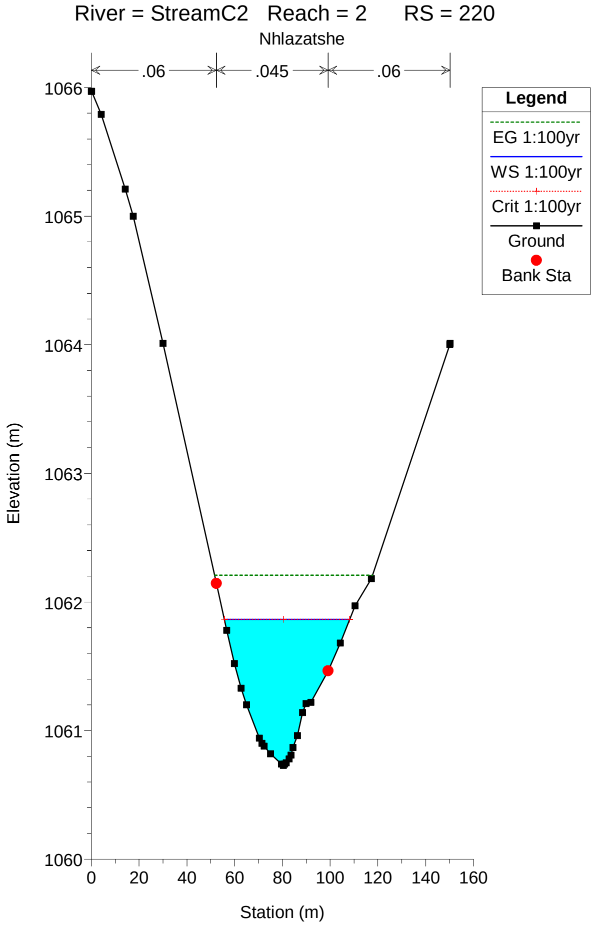

River = StreamC2 Reach = 2 RS = 228
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC2 Reach = 2 RS = 227
Nhlazatshe
River = StreamC2 Reach = 2 RS = 226
Nhlazatshe
River = StreamC2 Reach = 2 RS = 225
Nhlazatshe

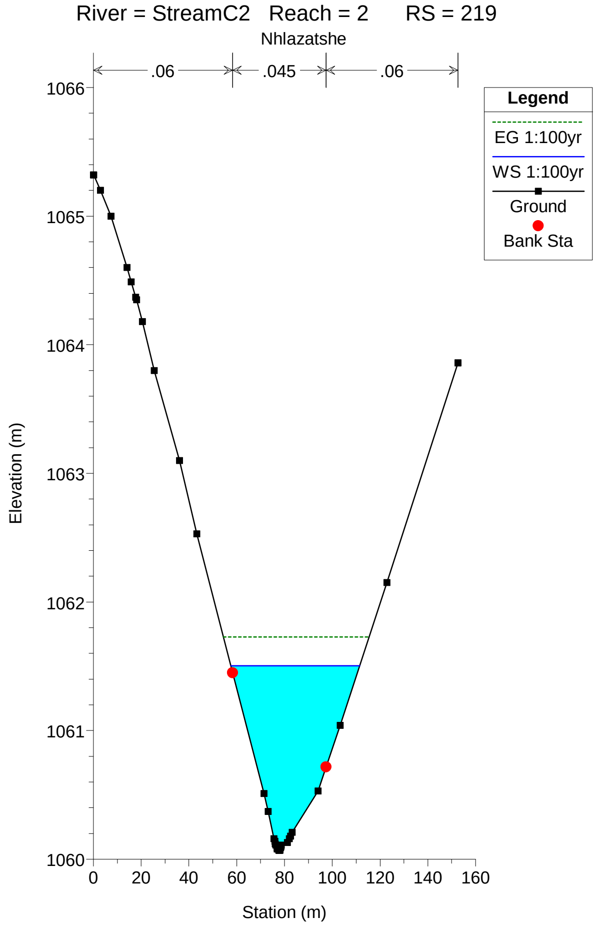

River = StreamC2 Reach = 2 RS = 224
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1063 1064 1065 1066 1067 1068 1069
Station (m)
0 20 40 60 80 100 120 140 160

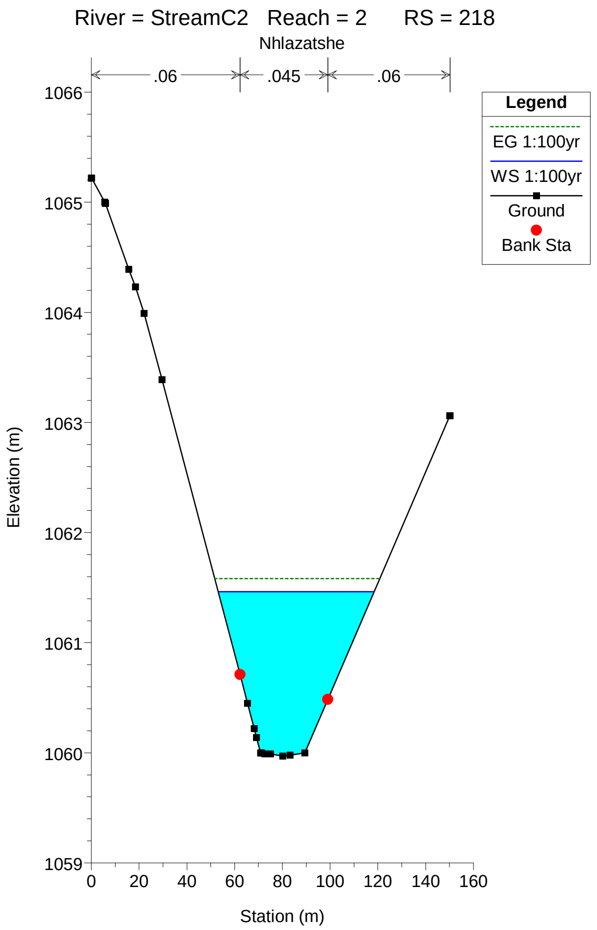

River = StreamC2 Reach = 2 RS = 223
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1062 1063 1064 1065 1066 1067 1068
Station (m)
0 20 40 60 80 100 120 140 160

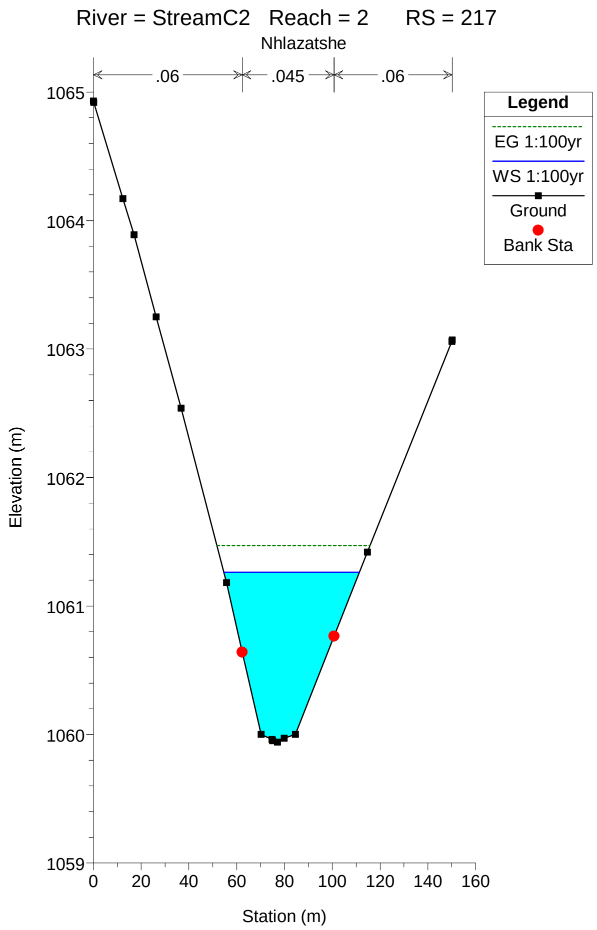

River = StreamC2 Reach = 2 RS = 222
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1061 1062 1063 1064 1065 1066 1067
Station (m)
0 20 40 60 80 100 120 140 160

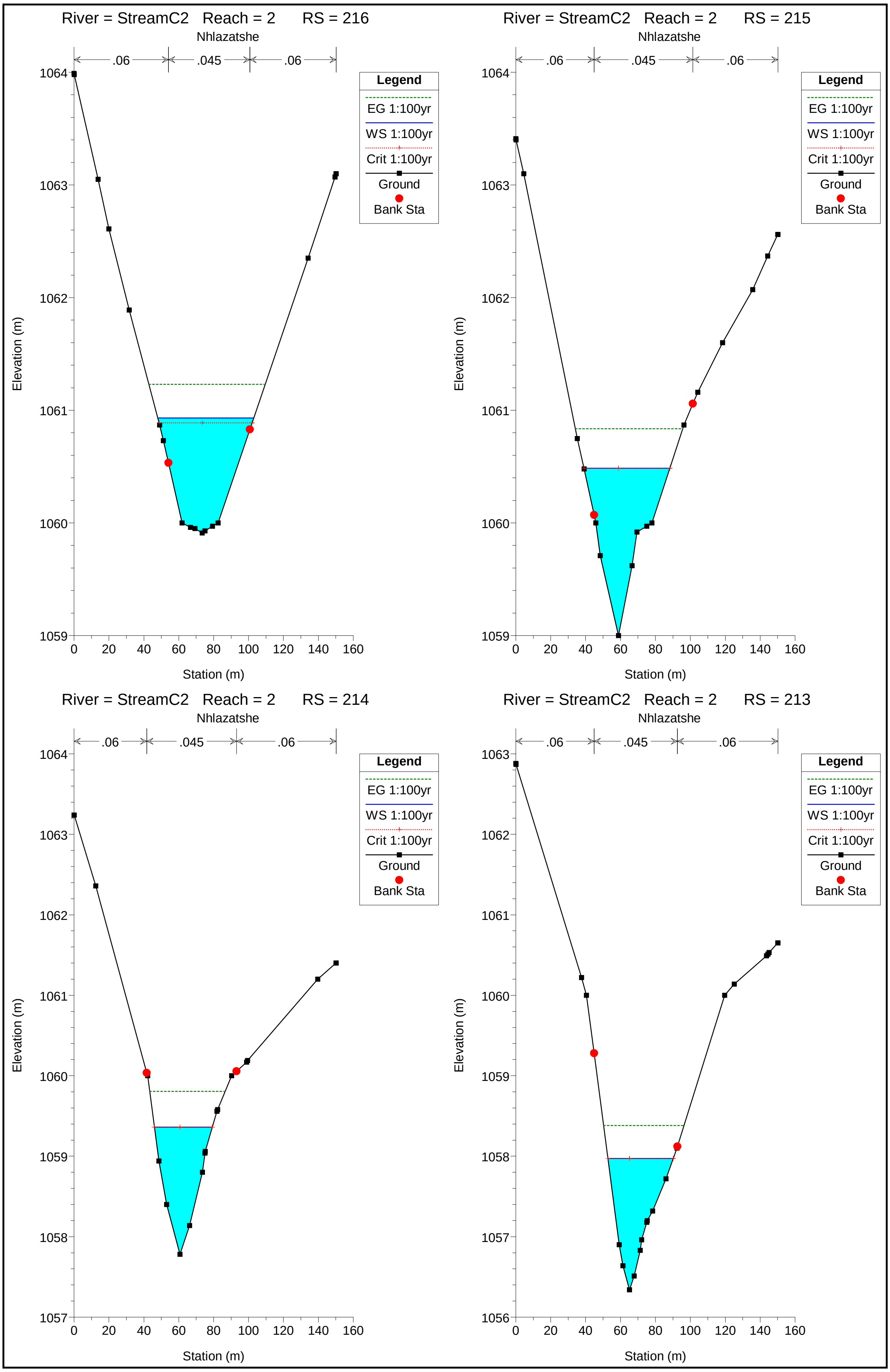

River = StreamC2 Reach = 2 RS = 221
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1061 1062 1063 1064 1065 1066 1067
Station (m)
0 20 40 60 80 100 120 140 160

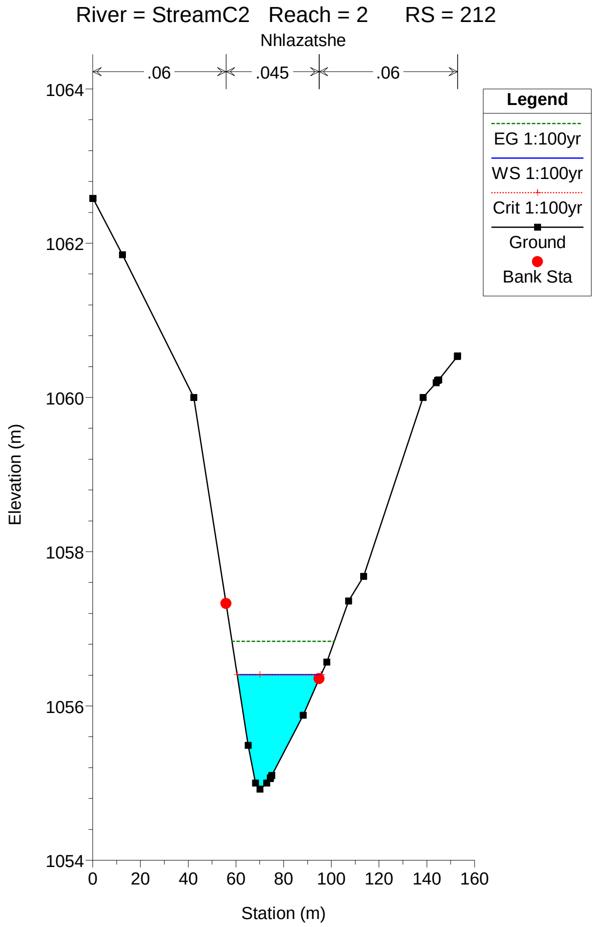

River = StreamC2 Reach = 2 RS = 220
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1060 1061 1062 1063 1064 1065 1066
Station (m)
0 20 40 60 80 100 120 140 160

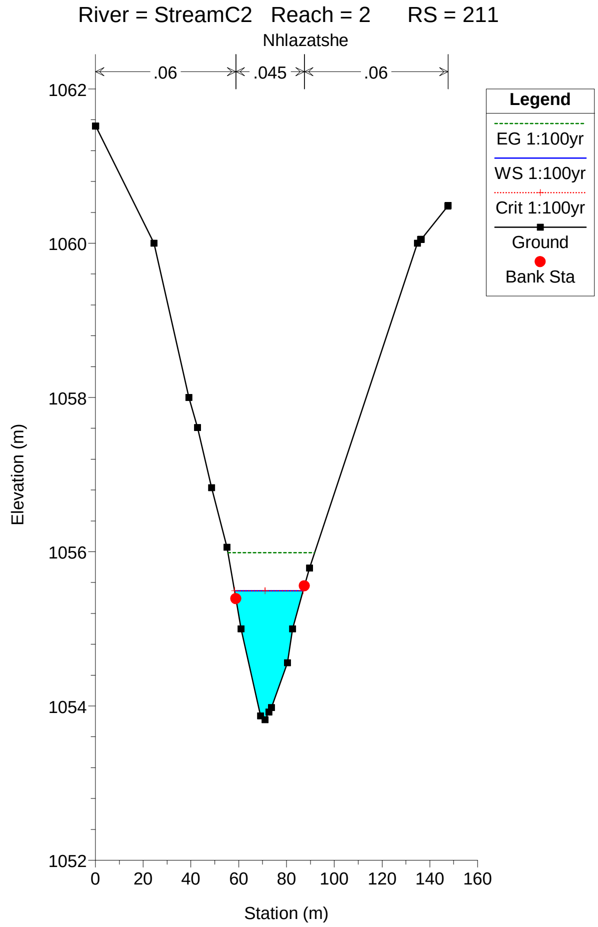

River = StreamC2 Reach = 2 RS = 219
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1060 1061 1062 1063 1064 1065 1066
Station (m)
0 20 40 60 80 100 120 140 160

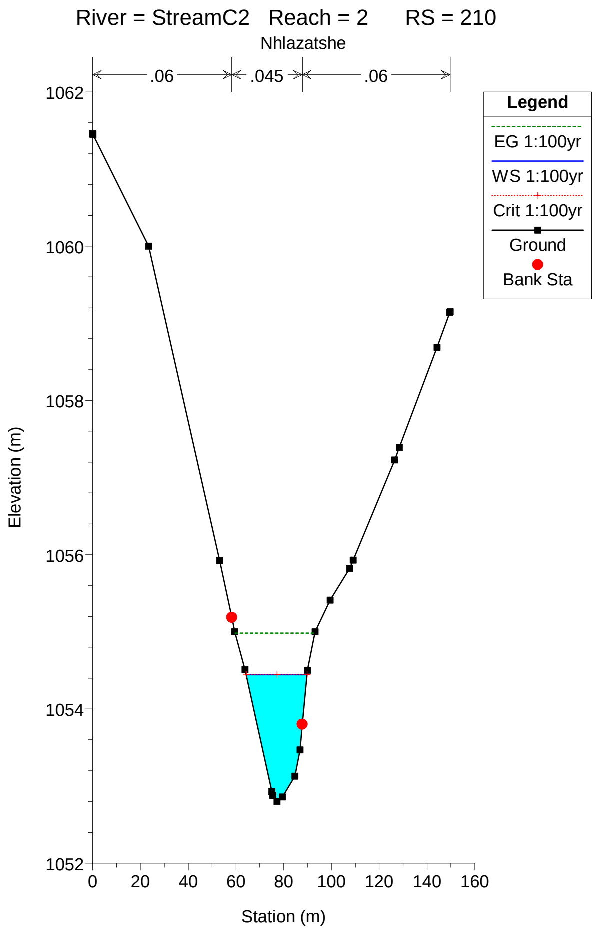

River = StreamC2 Reach = 2 RS = 218
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1059 1060 1061 1062 1063 1064 1065 1066
Station (m)
0 20 40 60 80 100 120 140 160

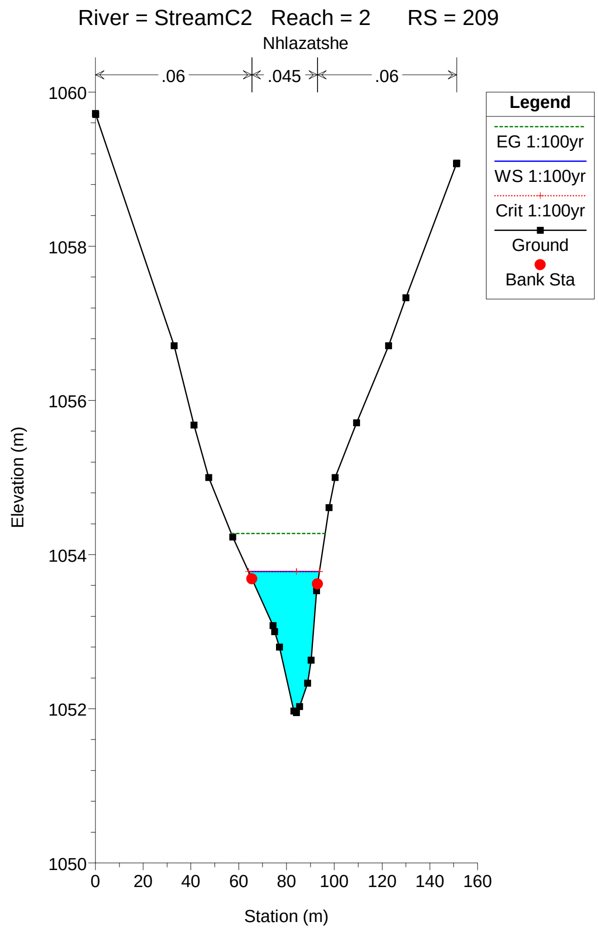

River = StreamC2 Reach = 2 RS = 217
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1059 1060 1061 1062 1063 1064 1065
Station (m)
0 20 40 60 80 100 120 140 160

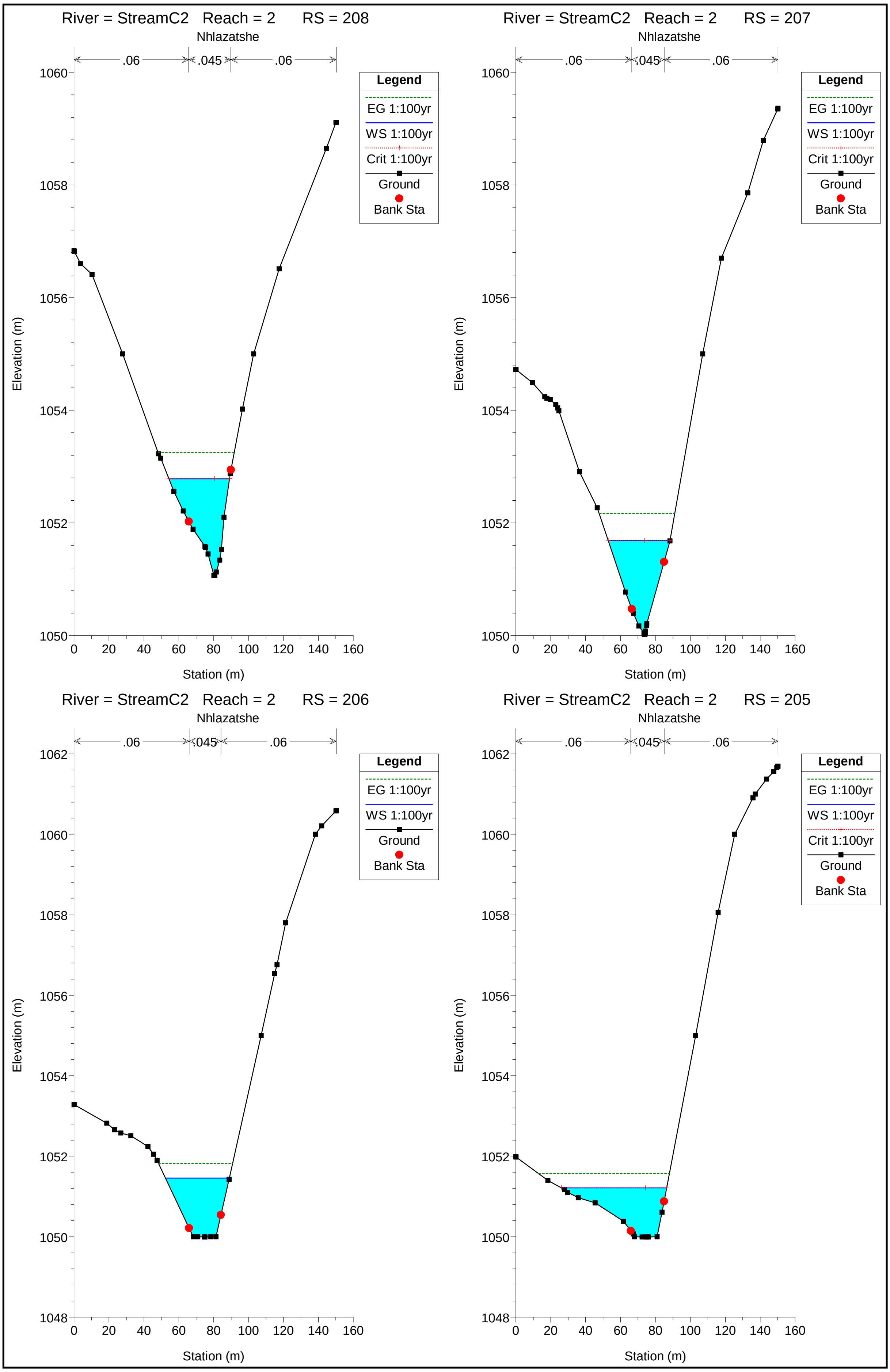

River = StreamC2 Reach = 2 RS = 216
Nhlazatshe
River = StreamC2 Reach = 2 RS = 215
Nhlazatshe
River = StreamC2 Reach = 2 RS = 214
Nhlazatshe
River = StreamC2 Reach = 2 RS = 213
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

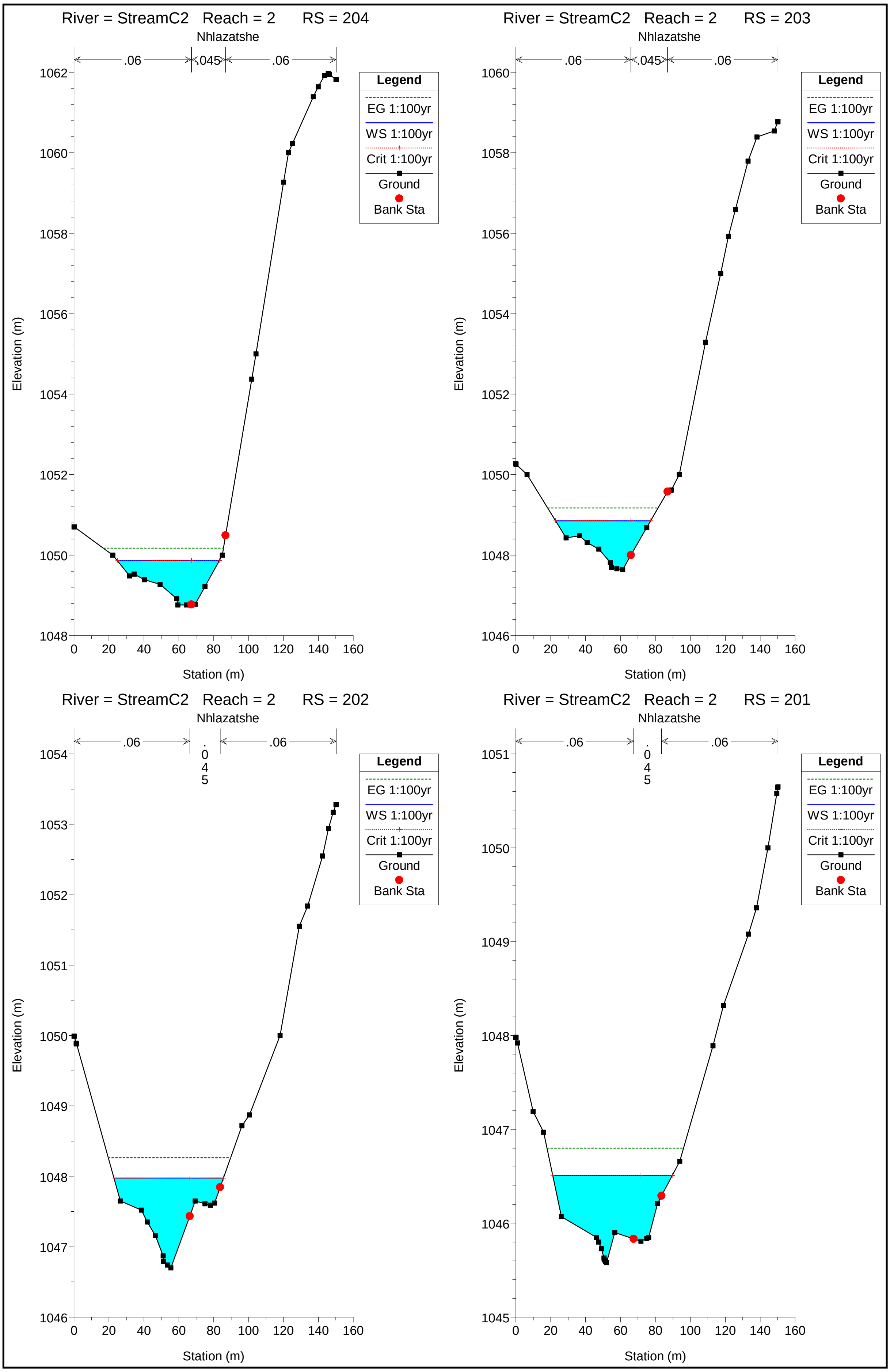

River = StreamC2 Reach = 2 RS = 212
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
0
20
40
60
80
100
120
140
160
Station (m)

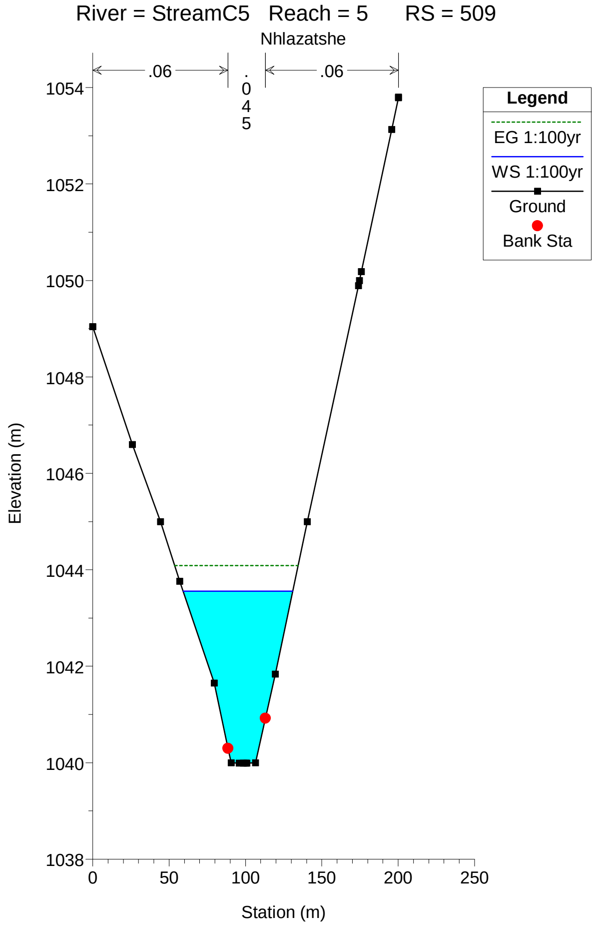

River = StreamC2 Reach = 2 RS = 211
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1052
1054
1056
1058
1060
1062
0
20
40
60
80
100
120
140
160
Station (m)

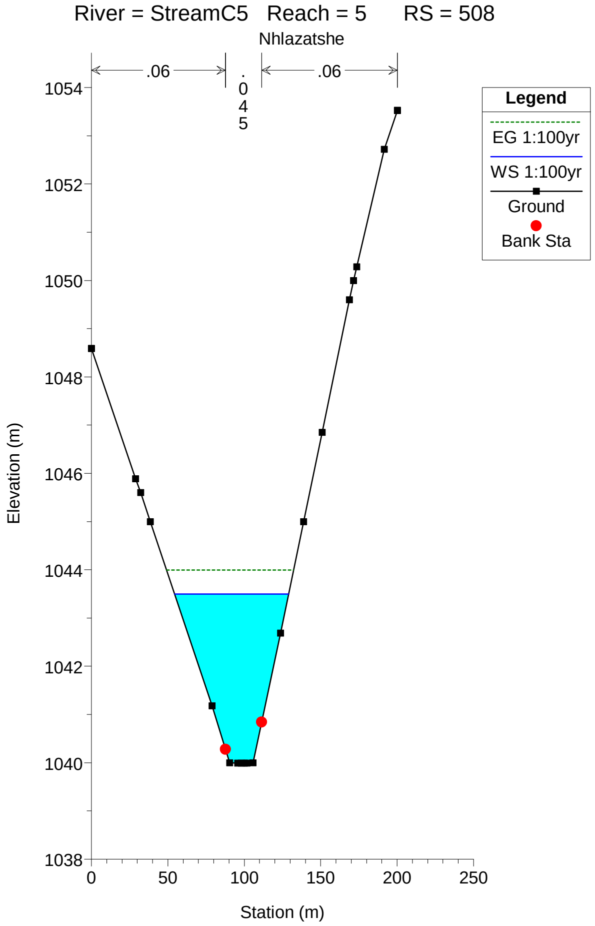

River = StreamC2 Reach = 2 RS = 210
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1052
1054
1056
1058
1060
1062
0
20
40
60
80
100
120
140
160
Station (m)

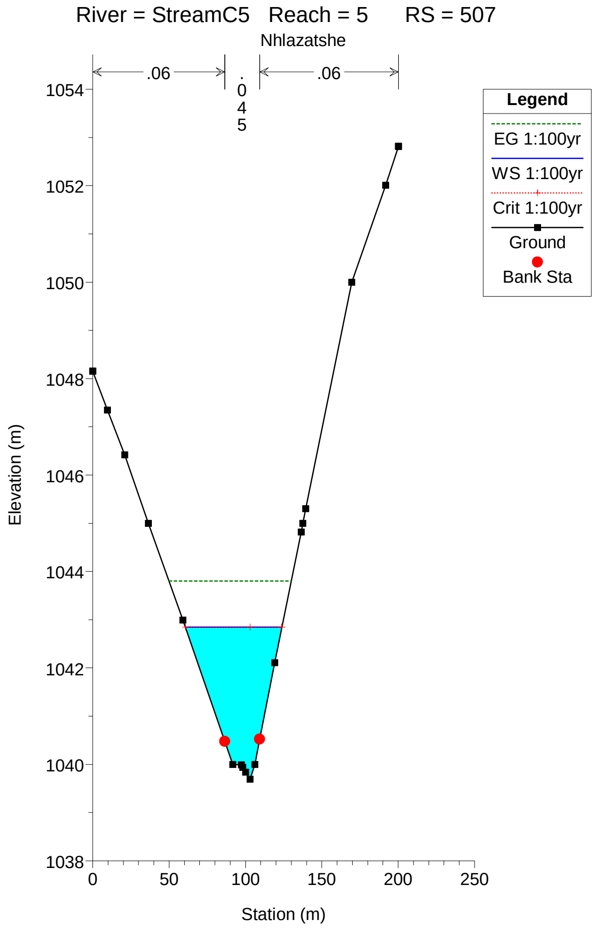

River = StreamC2 Reach = 2 RS = 209
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1050
1052
1054
1056
1058
1060
0
20
40
60
80
100
120
140
160
Station (m)

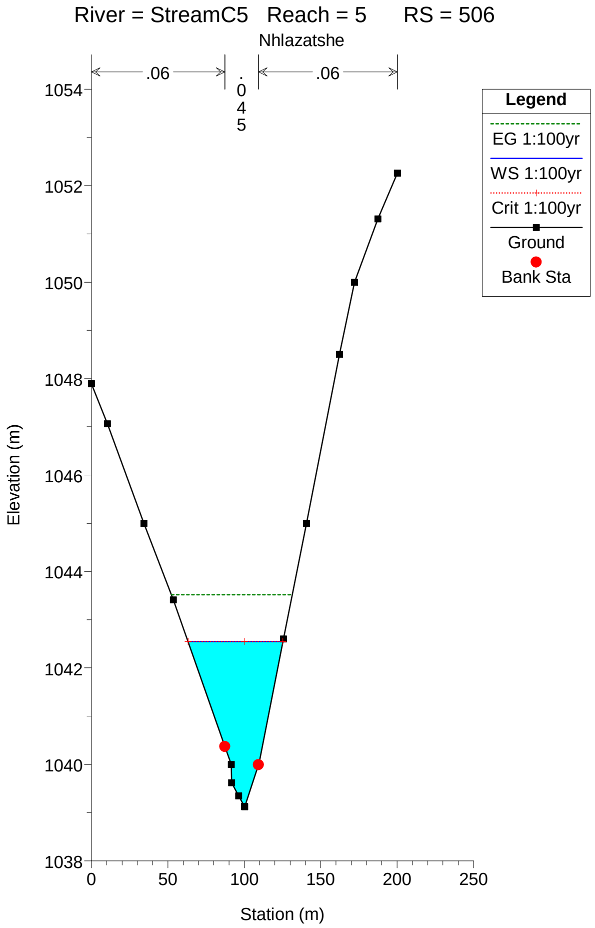

River = StreamC2 Reach = 2 RS = 208
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC2 Reach = 2 RS = 207
Nhlazatshe
River = StreamC2 Reach = 2 RS = 206
Nhlazatshe
River = StreamC2 Reach = 2 RS = 205
Nhlazatshe

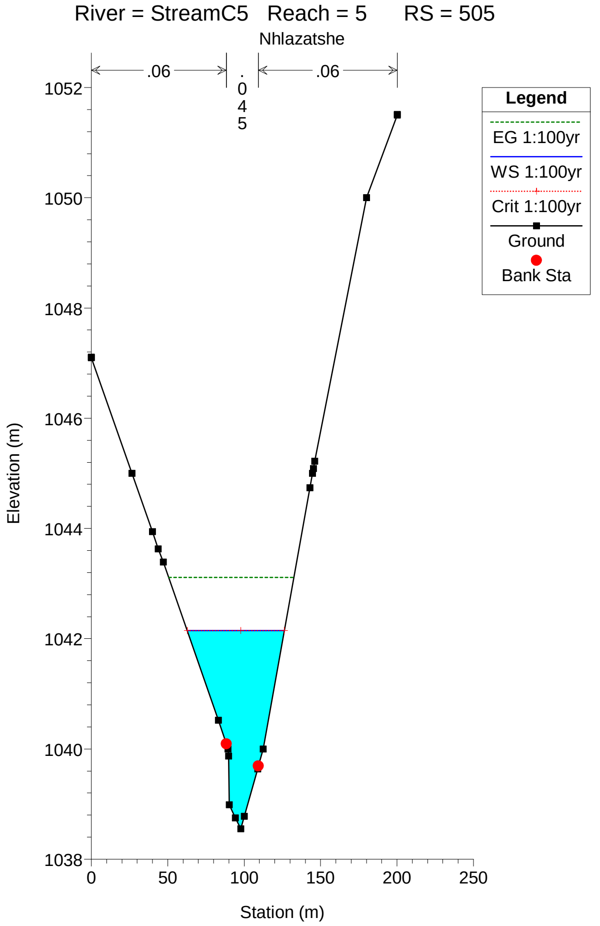

River = StreamC2 Reach = 2 RS = 204
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1048
1050
1052
1054
1056
1058
1060
1062
Station (m)
0
20
40
60
80
100
120
140
160
River = StreamC2 Reach = 2 RS = 203
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1046
1048
1050
1052
1054
1056
1058
1060
Station (m)
0
20
40
60
80
100
120
140
160
River = StreamC2 Reach = 2 RS = 202
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1046
1047
1048
1049
1050
1051
1052
1053
1054
Station (m)
0
20
40
60
80
100
120
140
160
River = StreamC2 Reach = 2 RS = 201
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1045
1046
1047
1048
1049
1050
1051
Station (m)
0
20
40
60
80
100
120
140
160

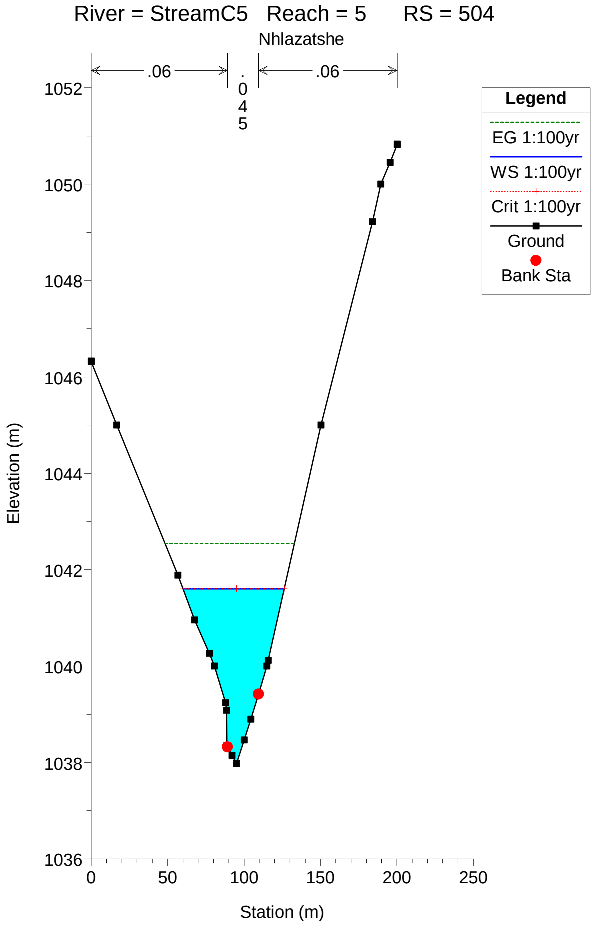

River = StreamC5 Reach = 5 RS = 509
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1038
1040
1042
1044
1046
1048
1050
1052
1054
0
50
100
150
200
250
Station (m)

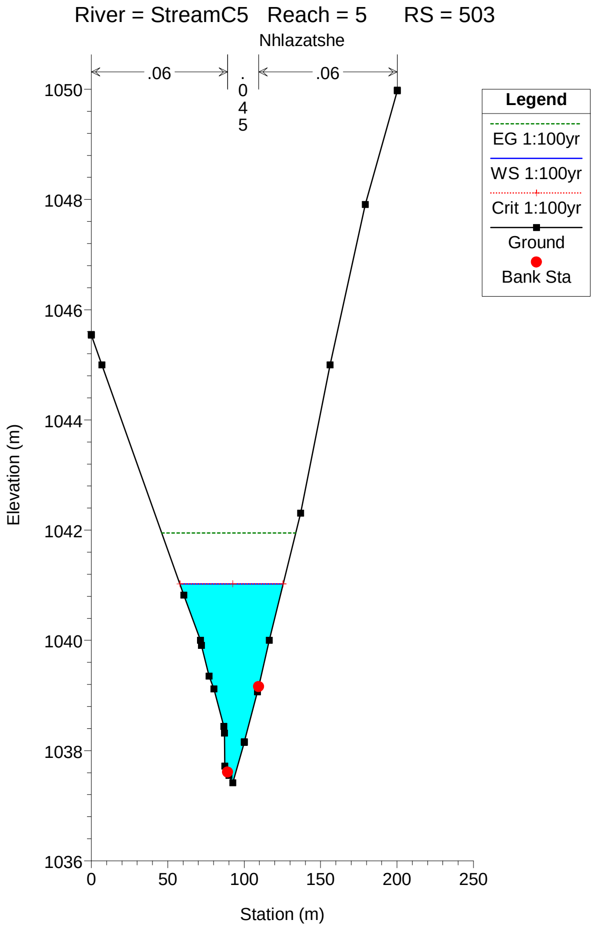

River = StreamC5 Reach = 5 RS = 508
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1038
1040
1042
1044
1046
1048
1050
1052
1054
0
50
100
150
200
250
Station (m)

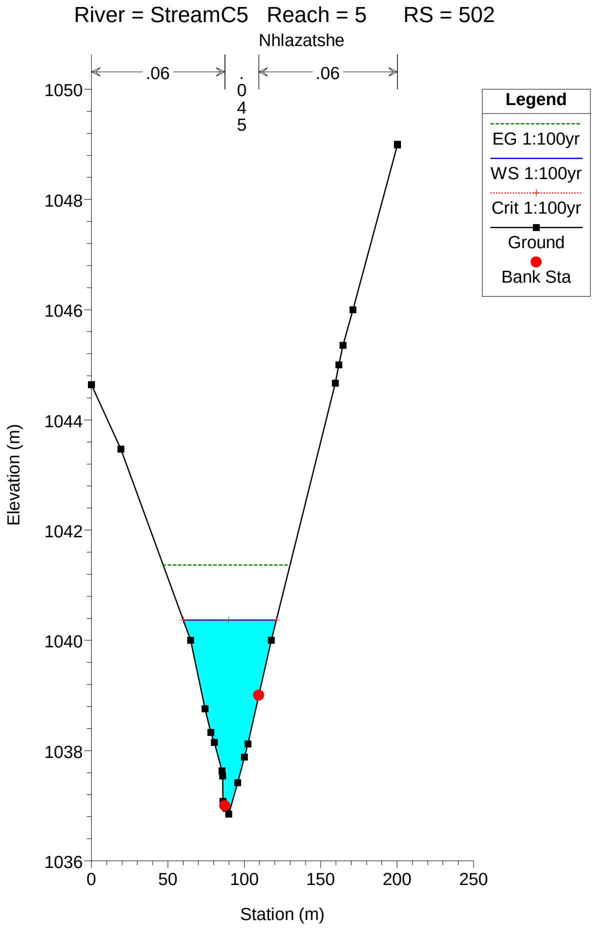

River = StreamC5 Reach = 5 RS = 507
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1038
1040
1042
1044
1046
1048
1050
1052
1054
0
50
100
150
200
250
Station (m)

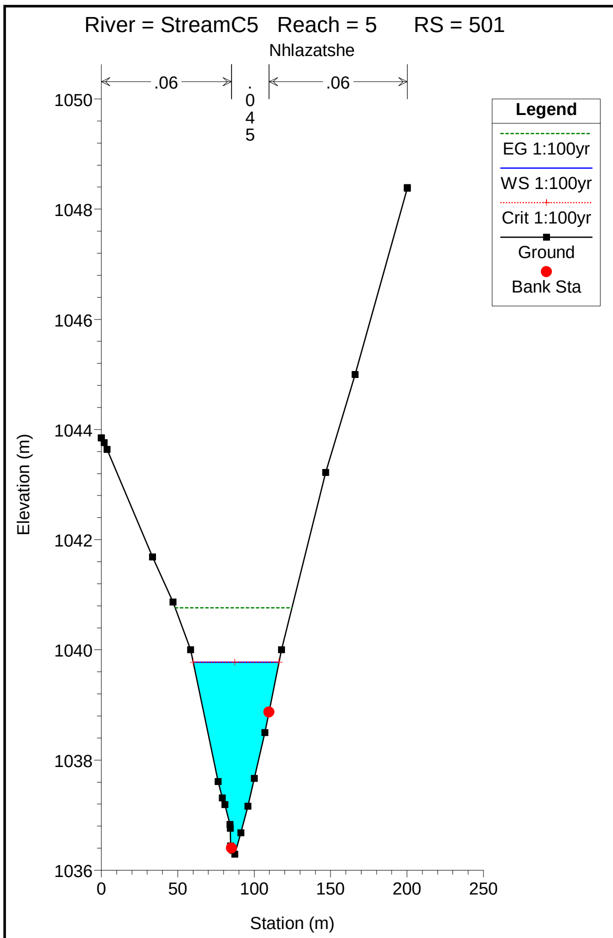

River = StreamC5 Reach = 5 RS = 506
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1038
1040
1042
1044
1046
1048
1050
1052
1054
0
50
100
150
200
250
Station (m)

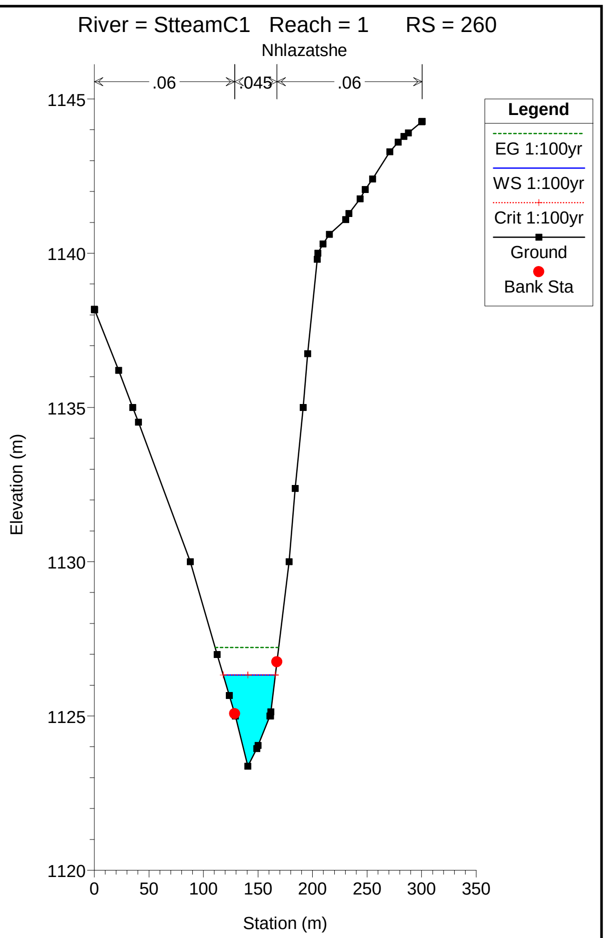

River = StreamC5 Reach = 5 RS = 505
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1038
1040
1042
1044
1046
1048
1050
1052
Station (m)
0
50
100
150
200
250

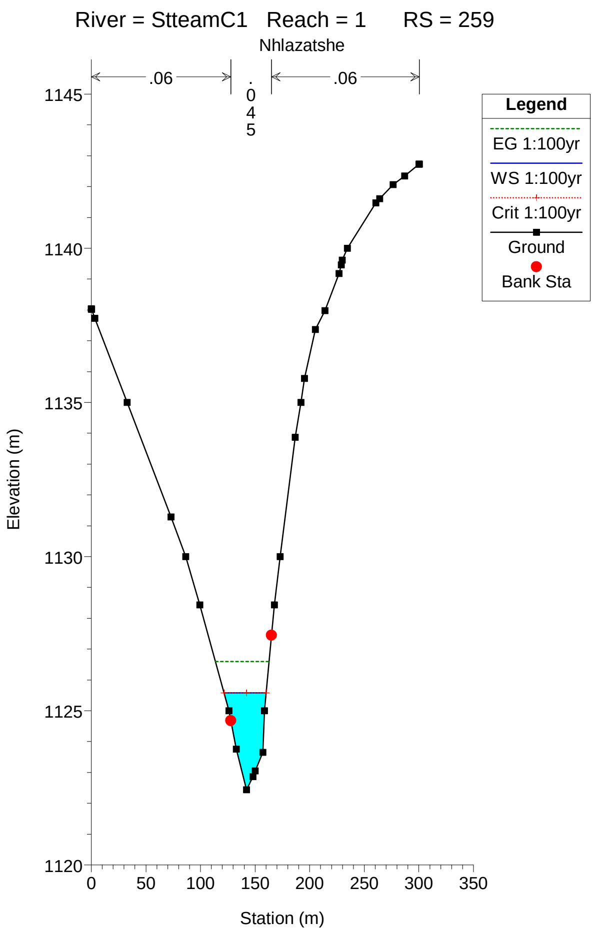

River = StreamC5 Reach = 5 RS = 504
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1036
1038
1040
1042
1044
1046
1048
1050
1052
Station (m)
0
50
100
150
200
250

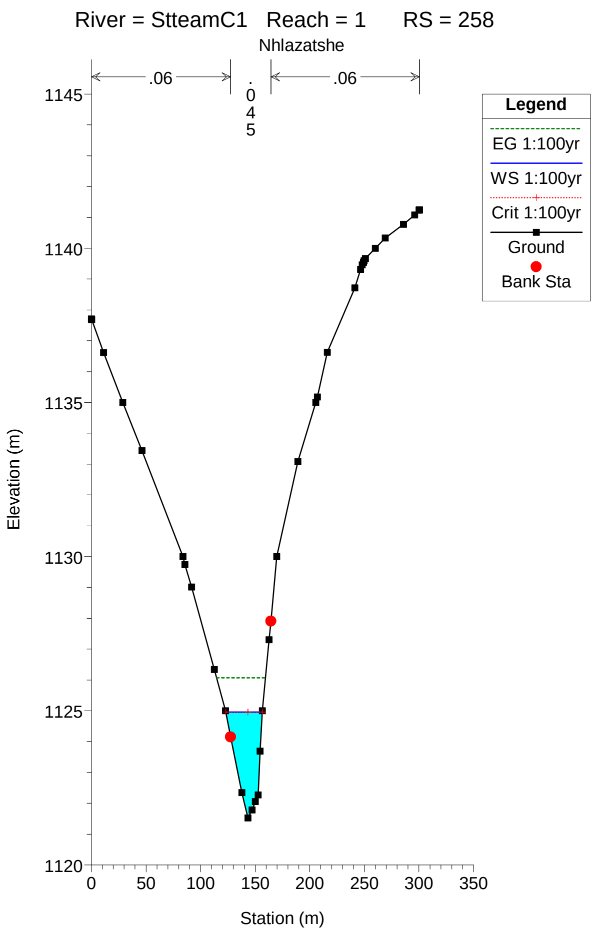

River = StreamC5 Reach = 5 RS = 503
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1036
1038
1040
1042
1044
1046
1048
1050
Station (m)
0
50
100
150
200
250

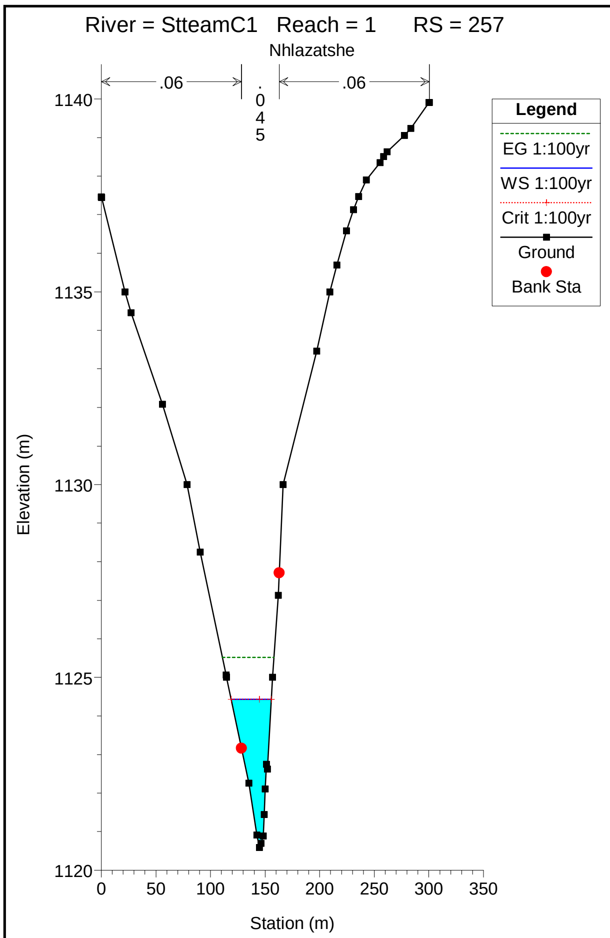

River = StreamC5 Reach = 5 RS = 502
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1036
1038
1040
1042
1044
1046
1048
1050
Station (m)
0
50
100
150
200
250

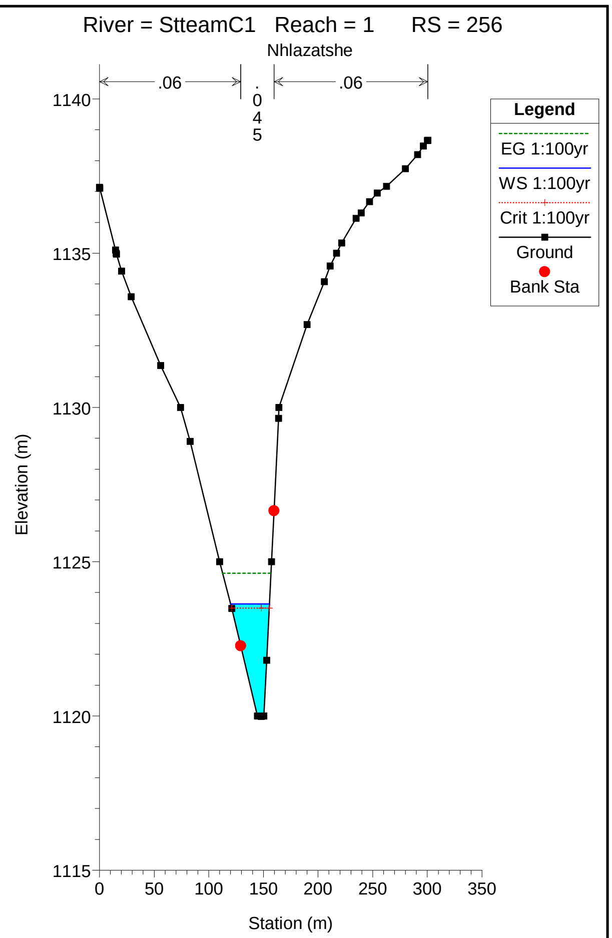

River = StreamC5 Reach = 5 RS = 501
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1036
1038
1040
1042
1044
1046
1048
1050
0
50
100
150
200
250

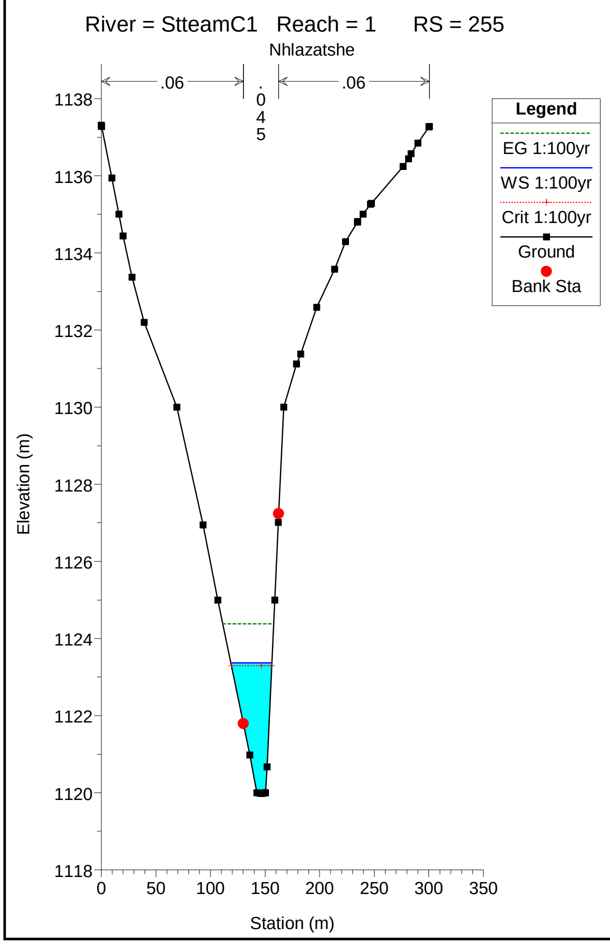

River = StteamC1 Reach = 1 RS = 260
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1120
1125
1130
1135
1140
1145
0
50
100
150
200
250
300
350

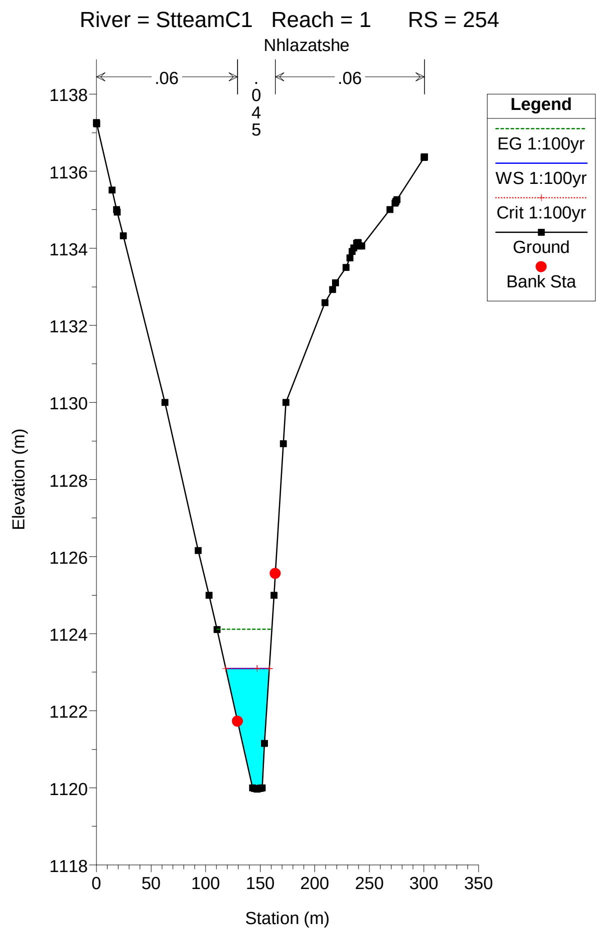

River = StteamC1 Reach = 1 RS = 259
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1120
1125
1130
1135
1140
1145
0
50
100
150
200
250
300
350

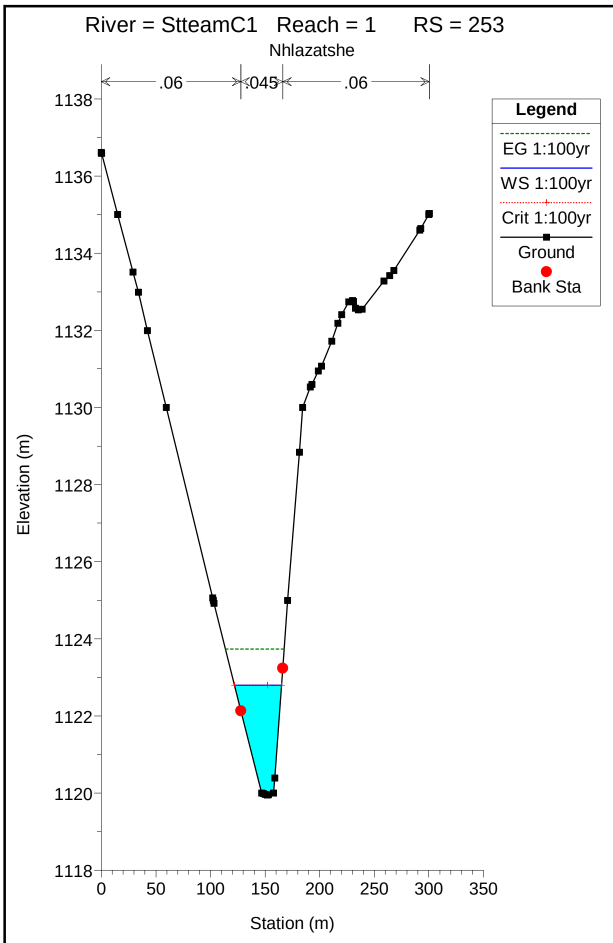

River = StteamC1 Reach = 1 RS = 258
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1120
1125
1130
1135
1140
1145
0
50
100
150
200
250
300
350

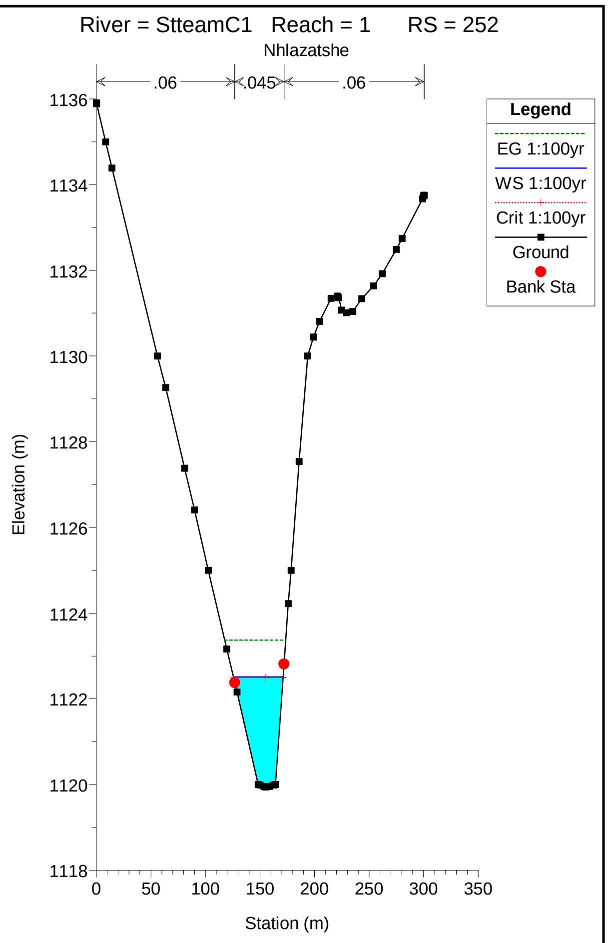

River = SteamC1 Reach = 1 RS = 257
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1120
1125
1130
1135
1140
0
50
100
150
200
250
300
350

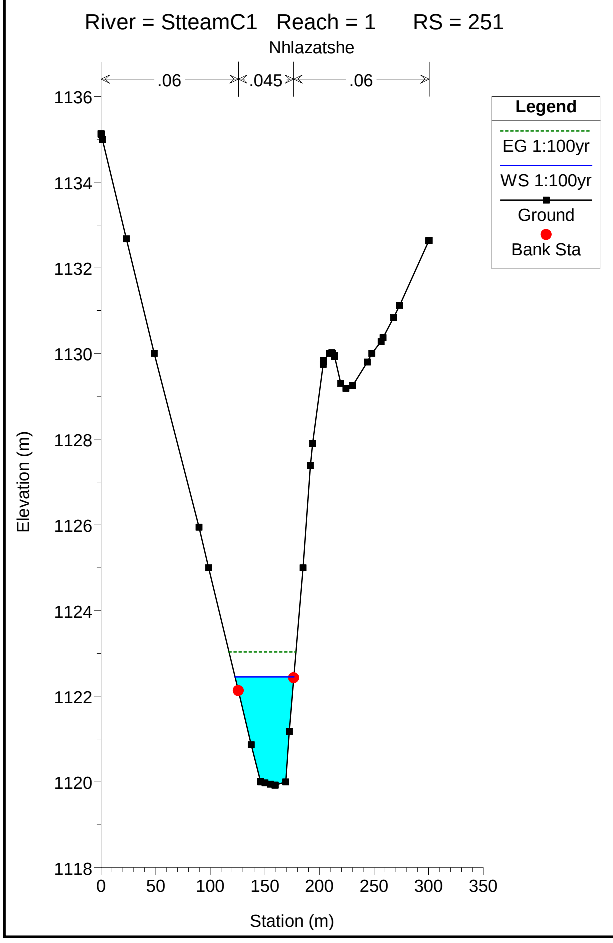

River = SteamC1 Reach = 1 RS = 256
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1115
1120
1125
1130
1135
1140
0
50
100
150
200
250
300
350

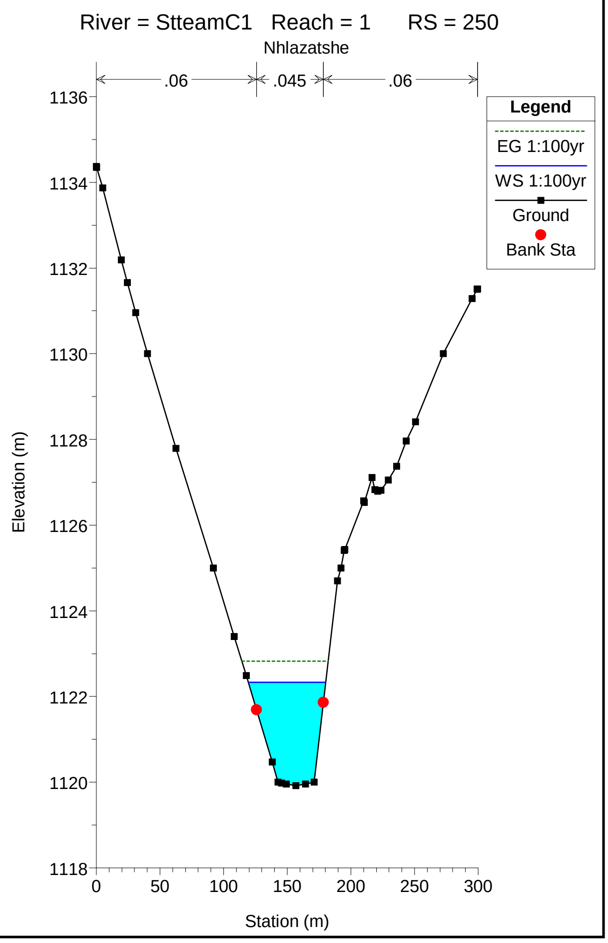

River = SteamC1 Reach = 1 RS = 255
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
1138
0
50
100
150
200
250
300
350

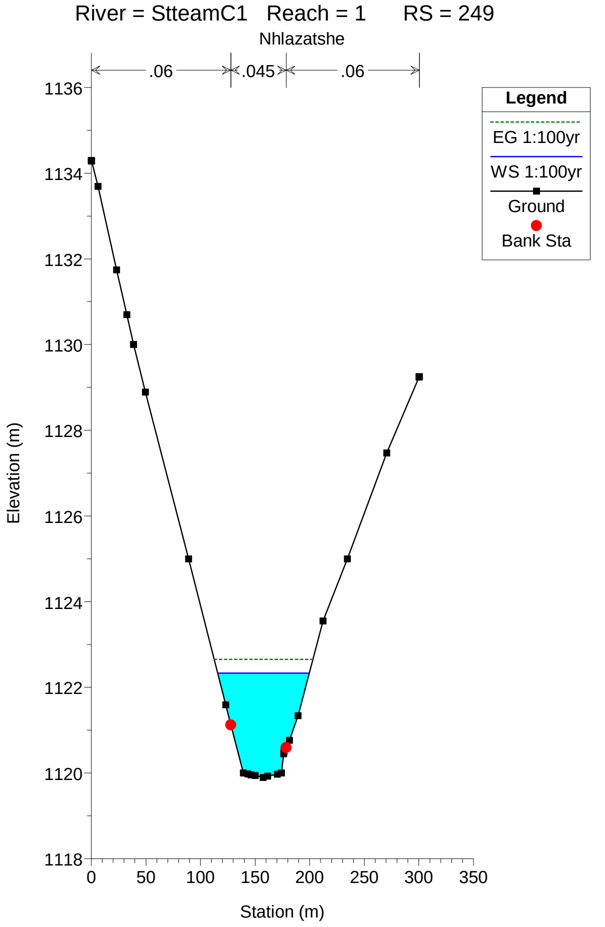

River = SteamC1 Reach = 1 RS = 254
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
1138
0
50
100
150
200
250
300
350

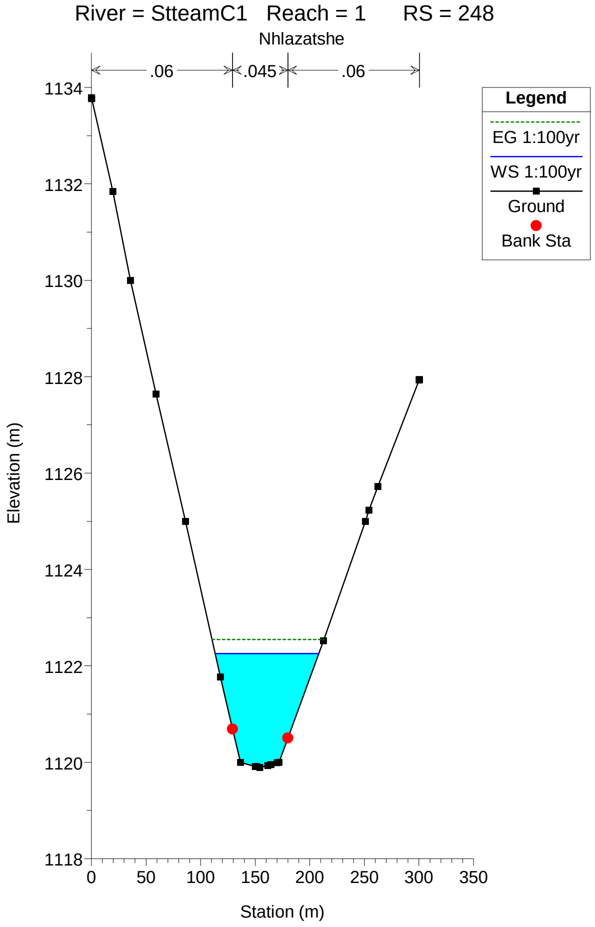

River = StteamC1 Reach = 1 RS = 253
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
1138
0
50
100
150
200
250
300
350

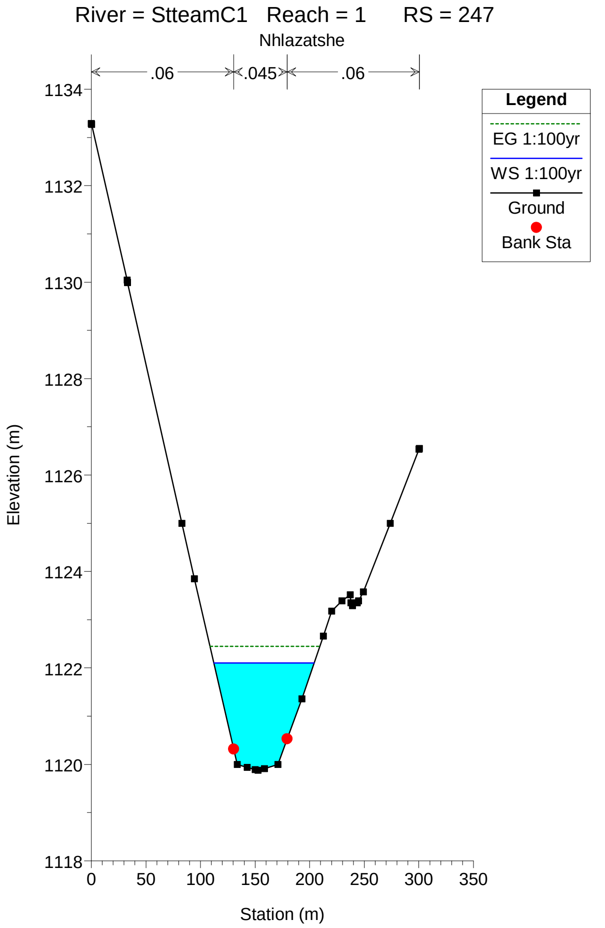

River = StteamC1 Reach = 1 RS = 252
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
0
50
100
150
200
250
300
350

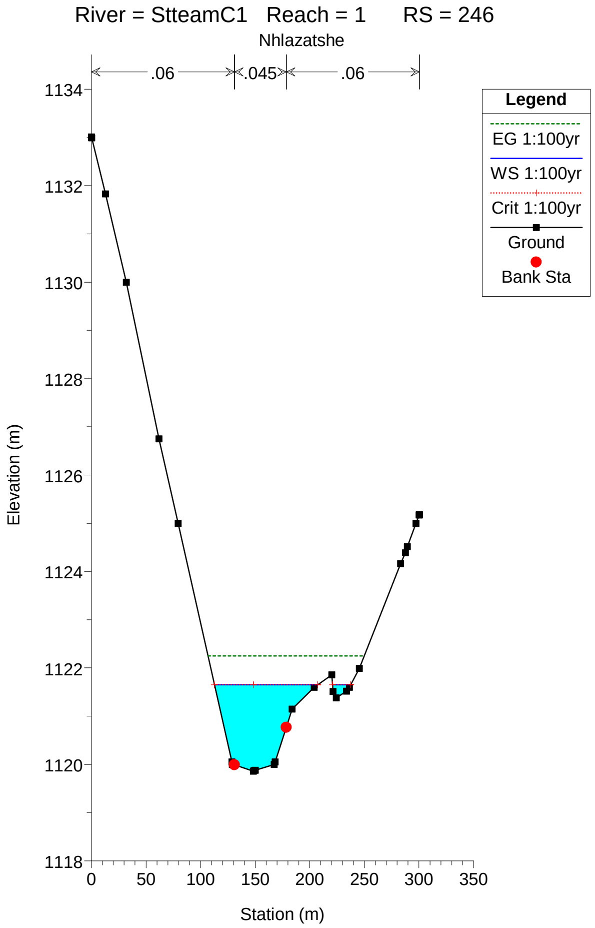

River = StteamC1 Reach = 1 RS = 251
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
0
50
100
150
200
250
300
350

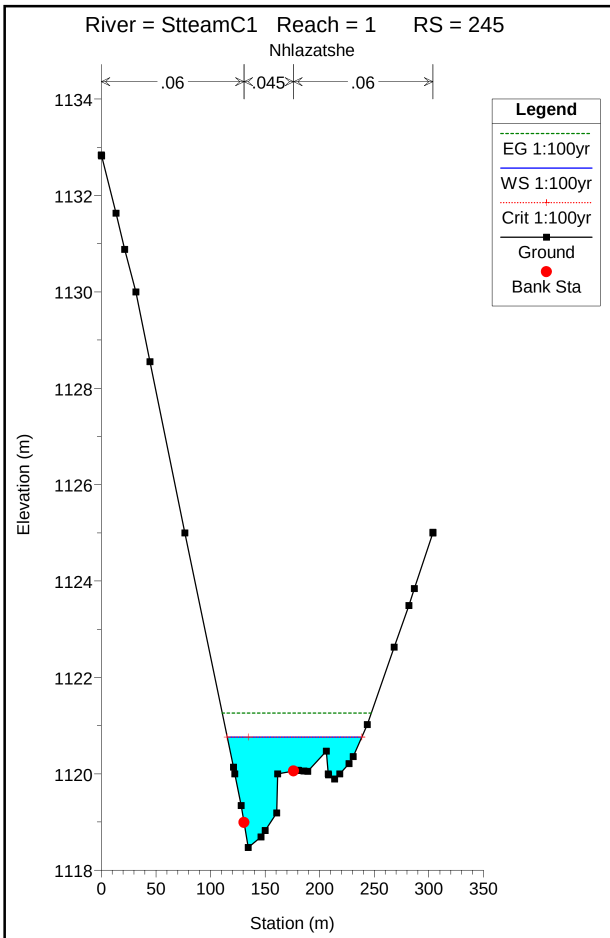

River = StteamC1 Reach = 1 RS = 250
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1118
1120
1122
1124
1126
1128
1130
1132
1134
1136
0
50
100
150
200
250
300

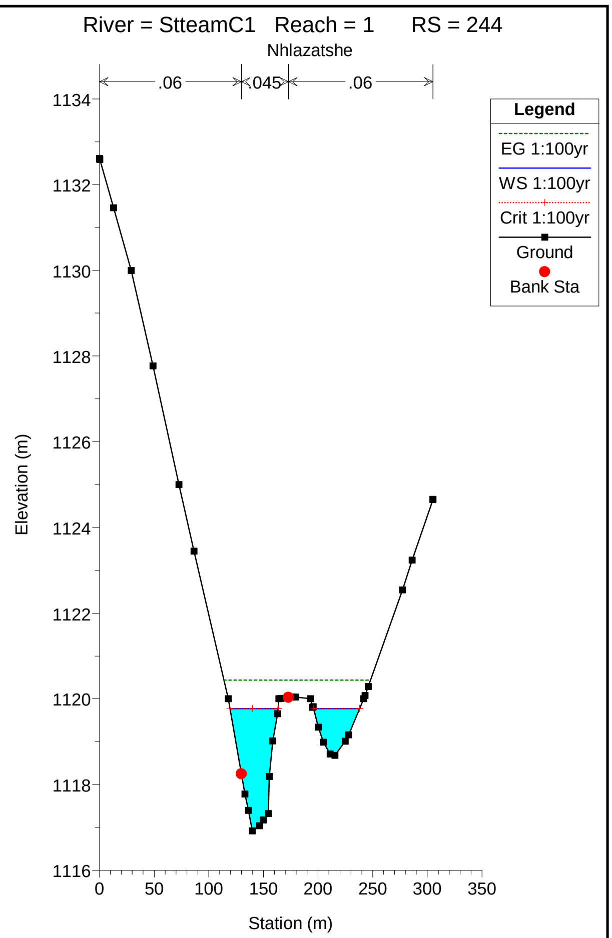

River = SteamC1 Reach = 1 RS = 249
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

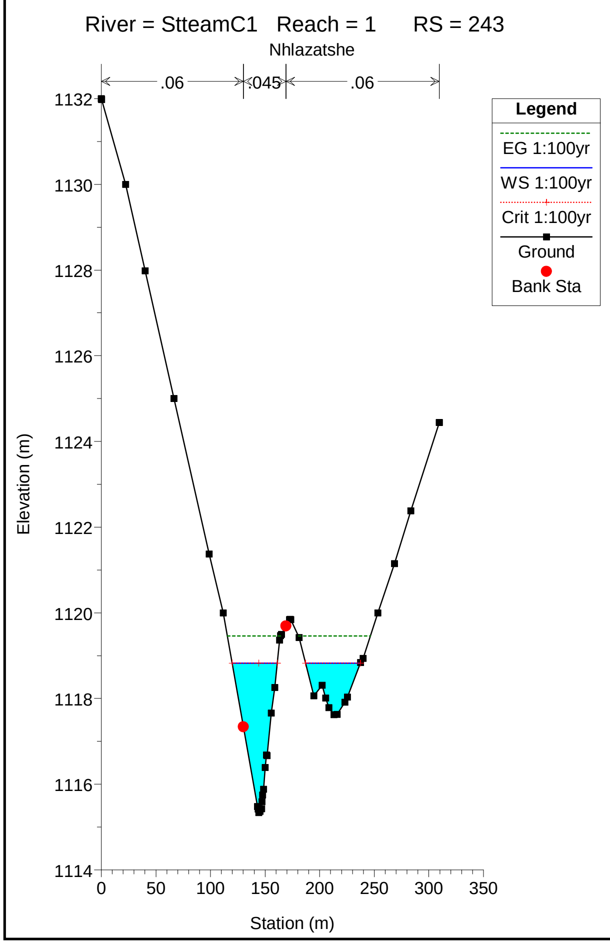

River = SteamC1 Reach = 1 RS = 248
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

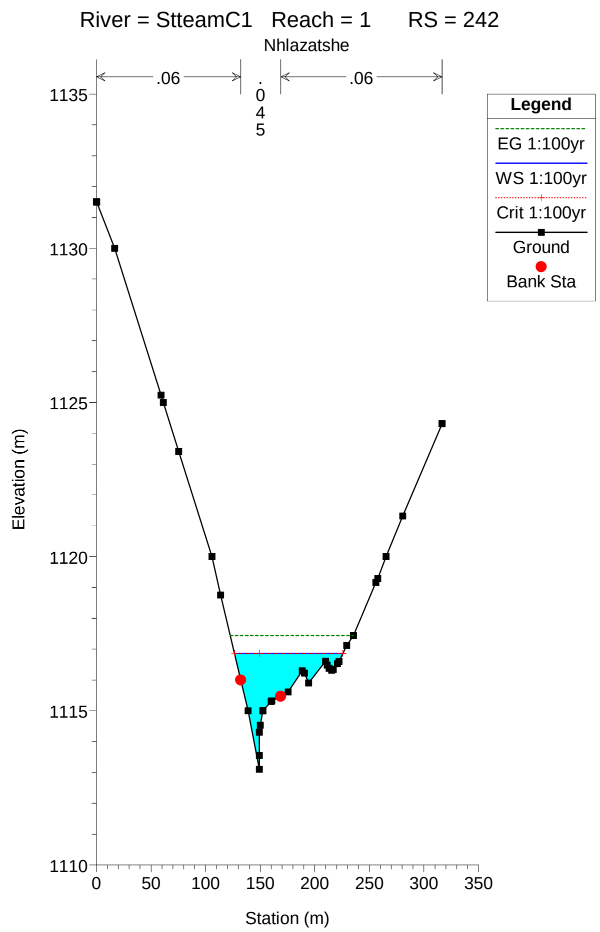

River = SteamC1 Reach = 1 RS = 247
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

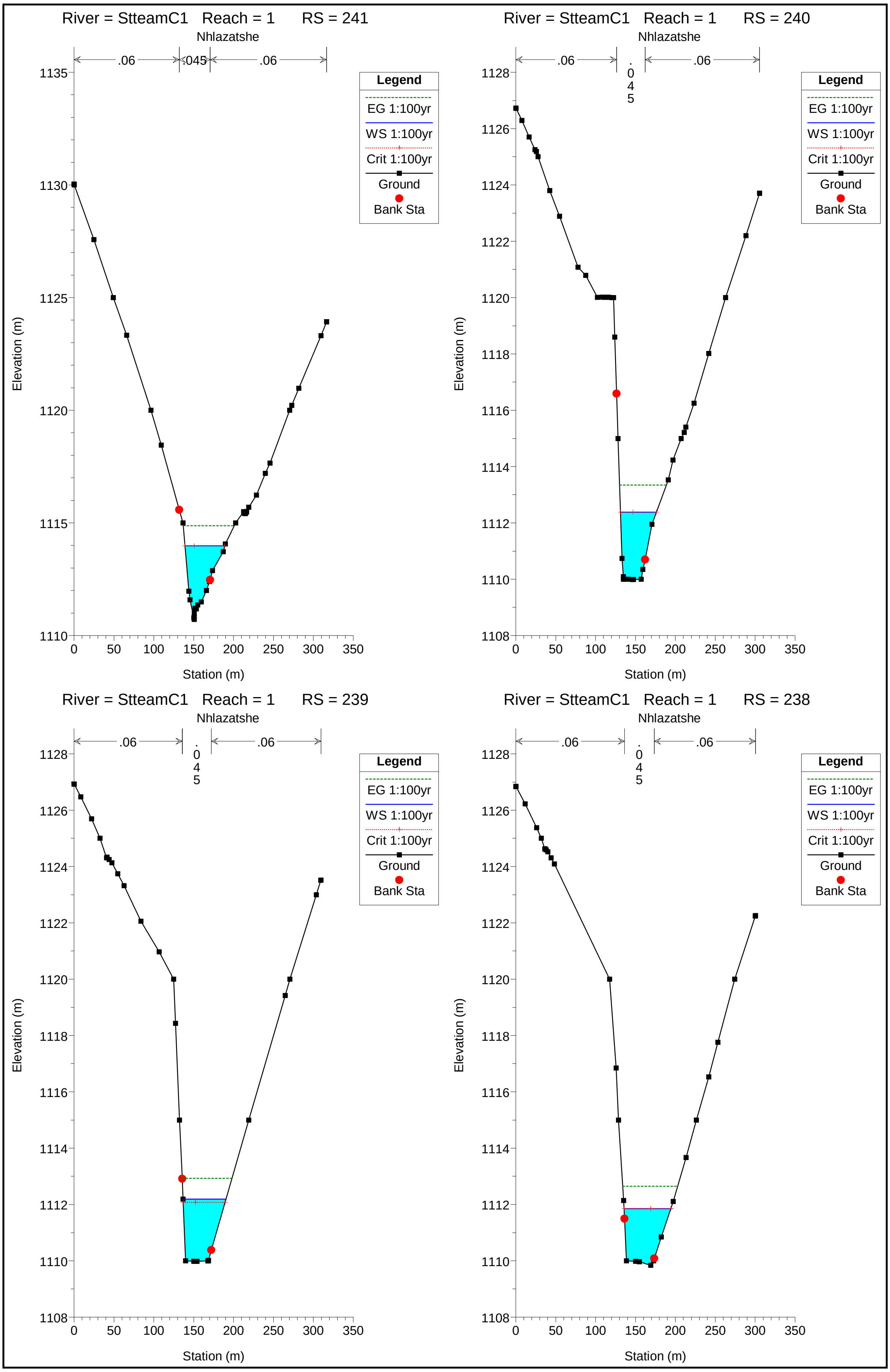

River = SteamC1 Reach = 1 RS = 246
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = StteamC1 Reach = 1 RS = 245
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1134
1132
1130
1128
1126
1124
1122
1120
1118
0
50
100
150
200
250
300
350
Station (m)

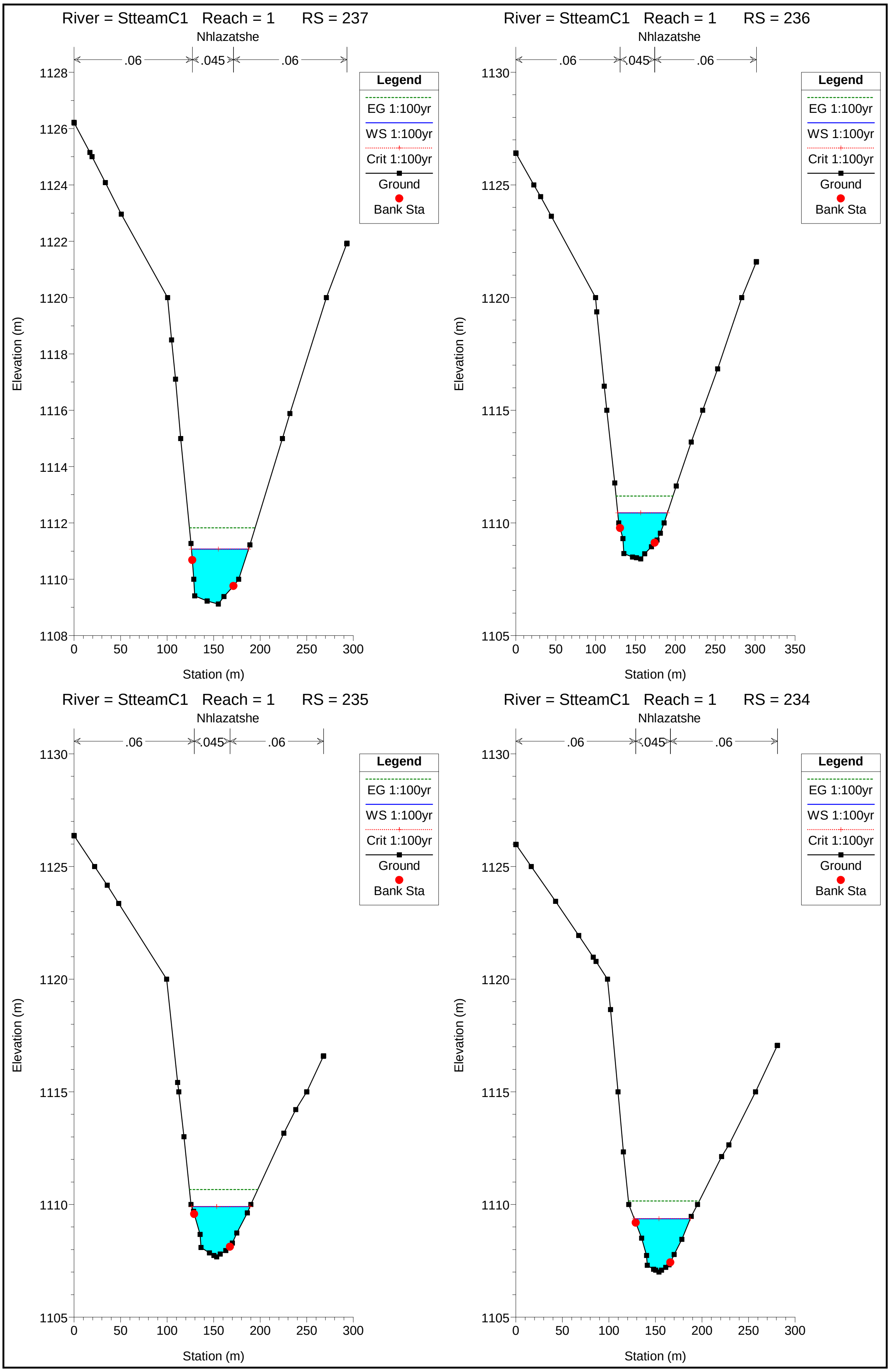

River = StteamC1 Reach = 1 RS = 244
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1134
1132
1130
1128
1126
1124
1122
1120
1118
1116
0
50
100
150
200
250
300
350
Station (m)

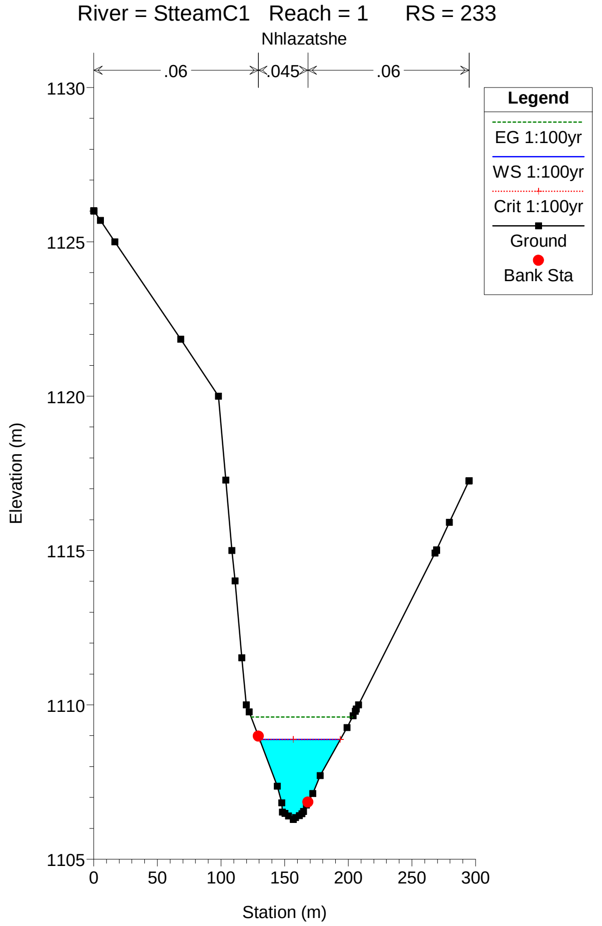

River = StteamC1 Reach = 1 RS = 243
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1132
1130
1128
1126
1124
1122
1120
1118
1116
1114
0
50
100
150
200
250
300
350
Station (m)

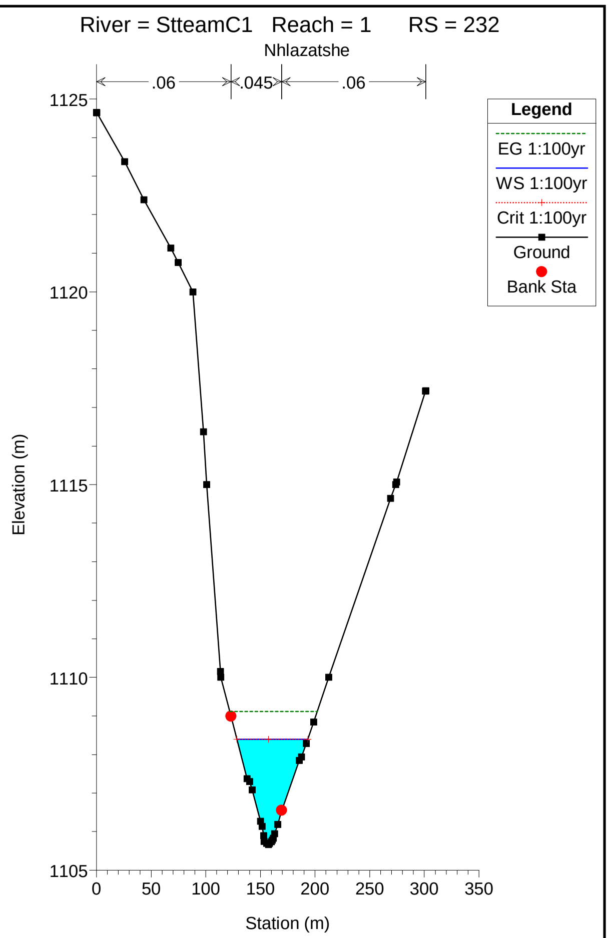

River = StteamC1 Reach = 1 RS = 242
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1135
1130
1125
1120
1115
1110
0
50
100
150
200
250
300
350
Station (m)

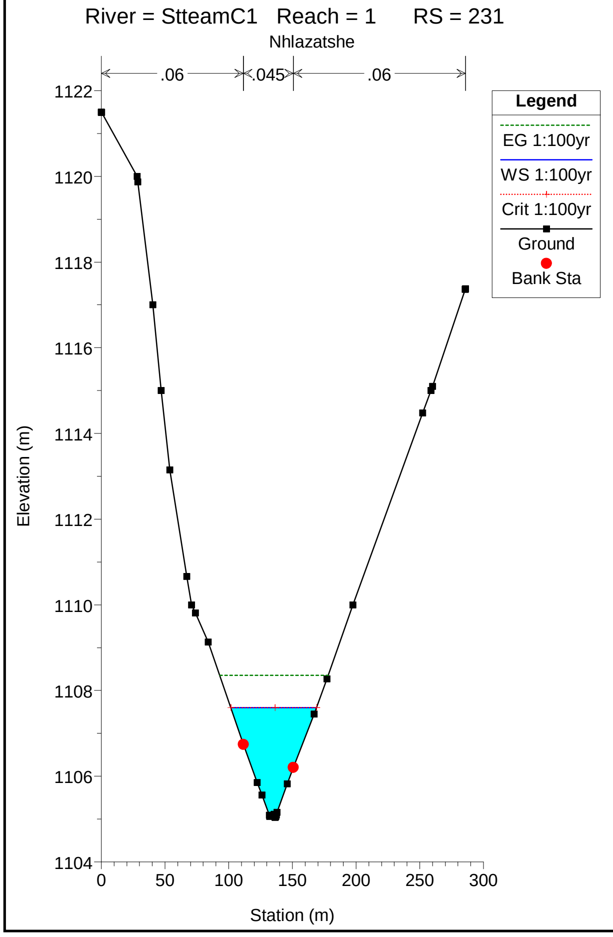


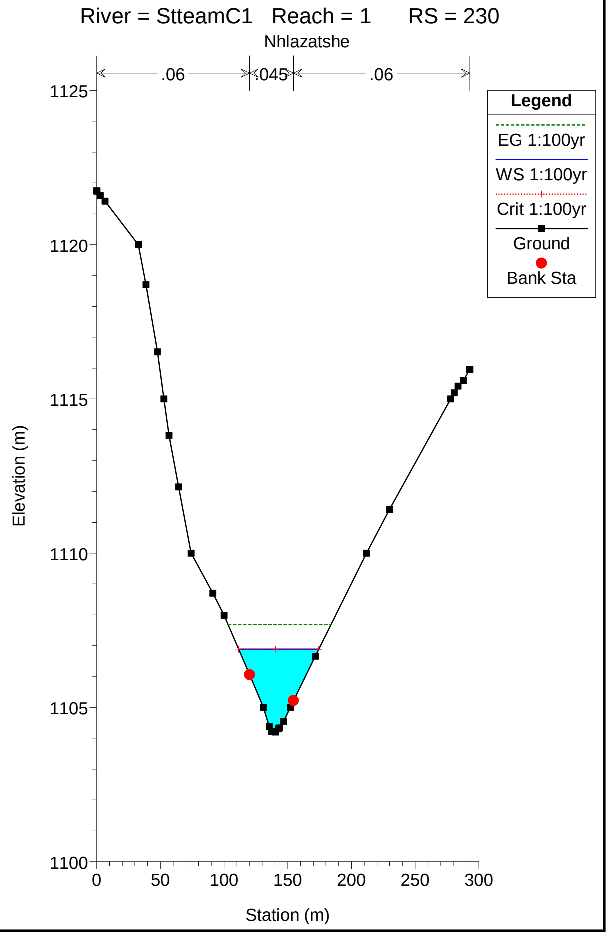
River = StteamC1 Reach = 1 RS = 241
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 240
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 239
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 238
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

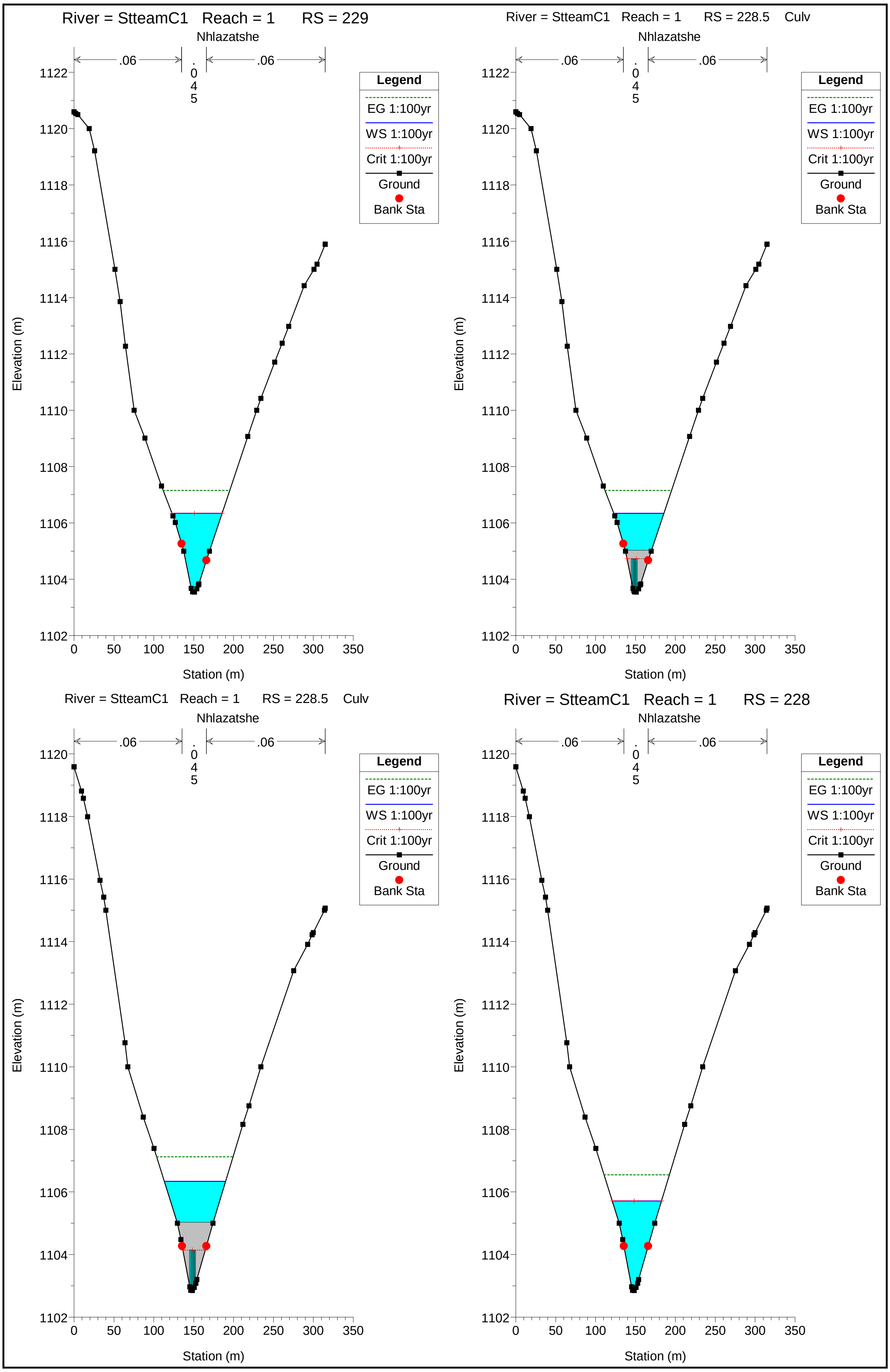

River = StteamC1 Reach = 1 RS = 237
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1108
1110
1112
1114
1116
1118
1120
1122
1124
1126
1128
Station (m)
0
50
100
150
200
250
300
River = StteamC1 Reach = 1 RS = 236
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1105
1110
1115
1120
1125
1130
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 235
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1105
1110
1115
1120
1125
1130
Station (m)
0
50
100
150
200
250
300
River = StteamC1 Reach = 1 RS = 234
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1105
1110
1115
1120
1125
1130
Station (m)
0
50
100
150
200
250
300


River = StteamC1 Reach = 1 RS = 233
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1130
1125
1120
1115
1110
1105
0
50
100
150
200
250
300
Station (m)

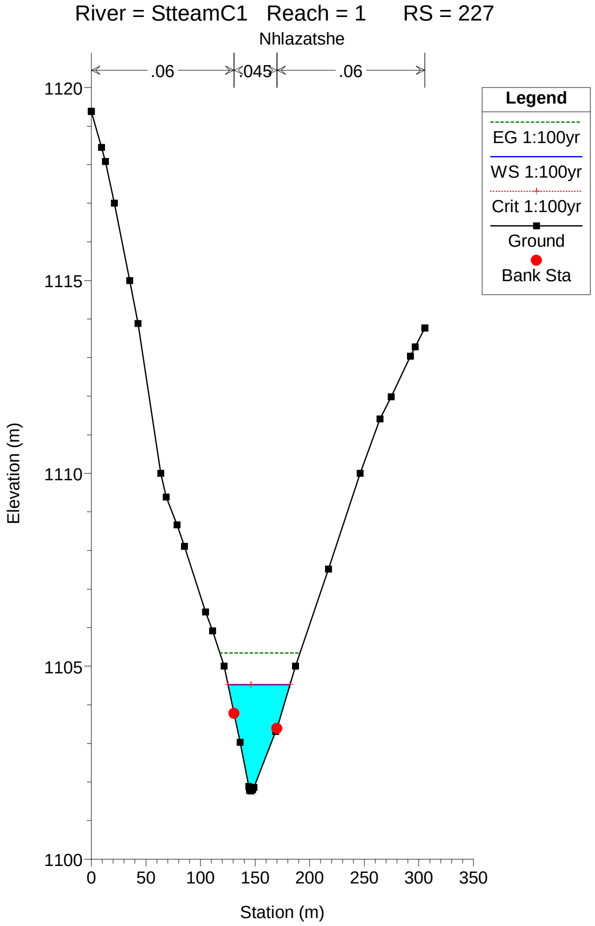

River = StteamC1 Reach = 1 RS = 232
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1125
1120
1115
1110
1105
0
50
100
150
200
250
300
350
Station (m)


River = StteamC1 Reach = 1 RS = 231
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1122
1120
1118
1116
1114
1112
1110
1108
1106
1104
0
50
100
150
200
250
300
Station (m)

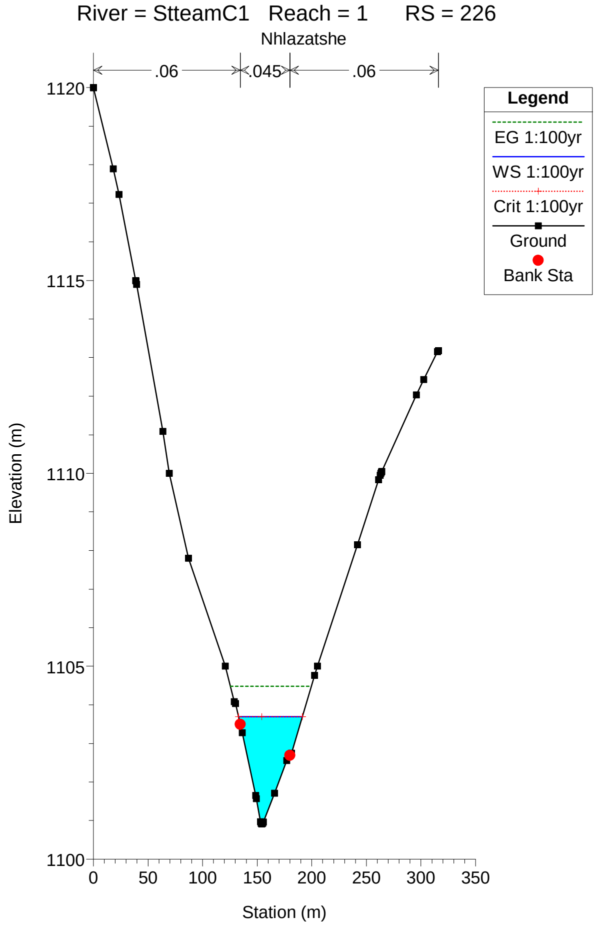

River = StteamC1 Reach = 1 RS = 230
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1125
1120
1115
1110
1105
1100
0
50
100
150
200
250
300
Station (m)



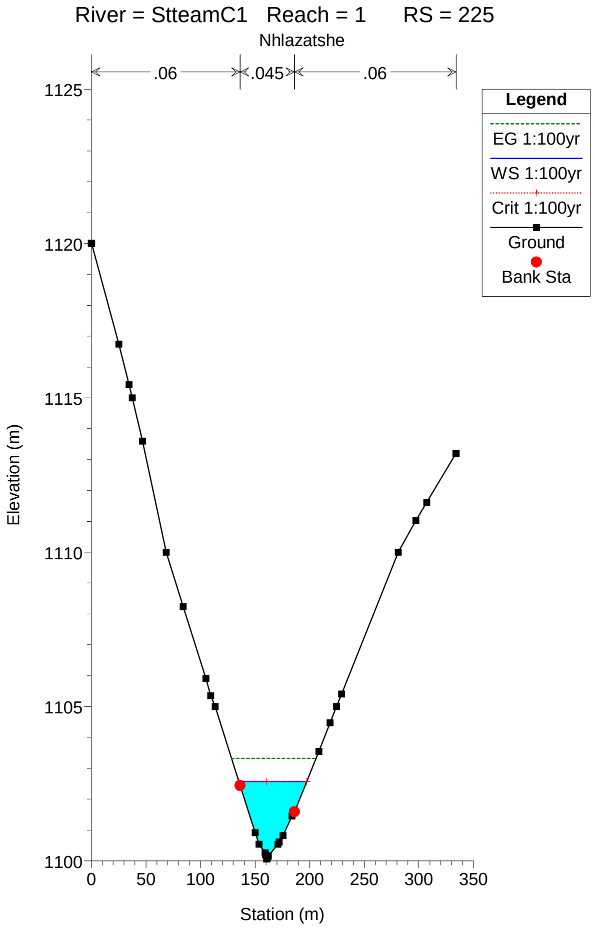
River = StteamC1 Reach = 1 RS = 229
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 228.5 Culv
Nhlazatshe
River = StteamC1 Reach = 1 RS = 228.5 Culv
Nhlazatshe
River = StteamC1 Reach = 1 RS = 228
Nhlazatshe



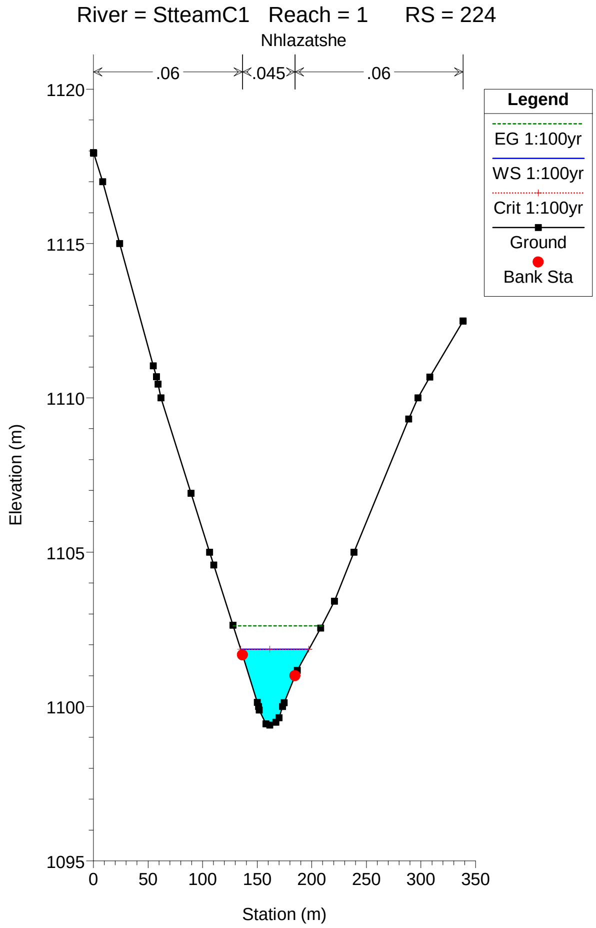
River = SteamC1 Reach = 1 RS = 227
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)



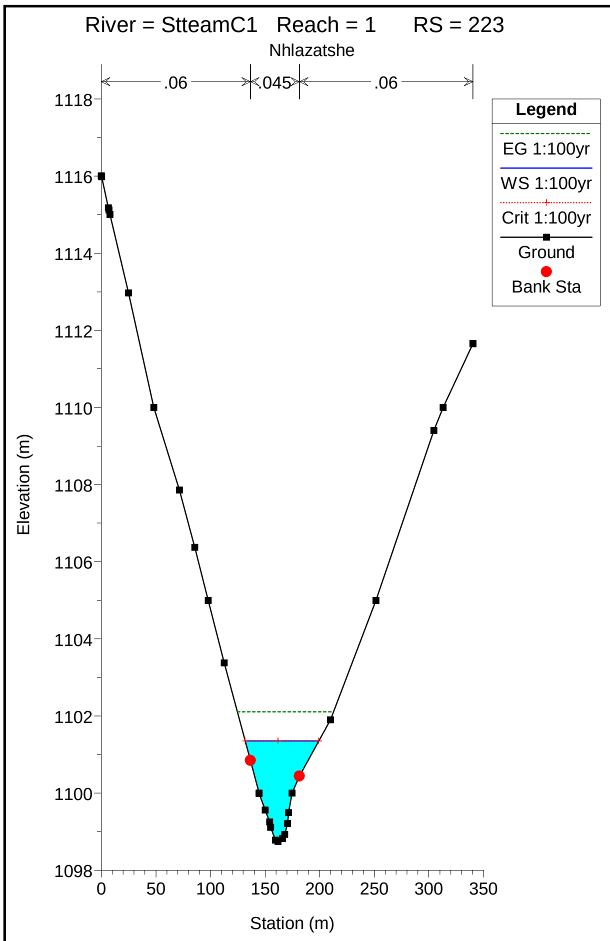
River = SteamC1 Reach = 1 RS = 226
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

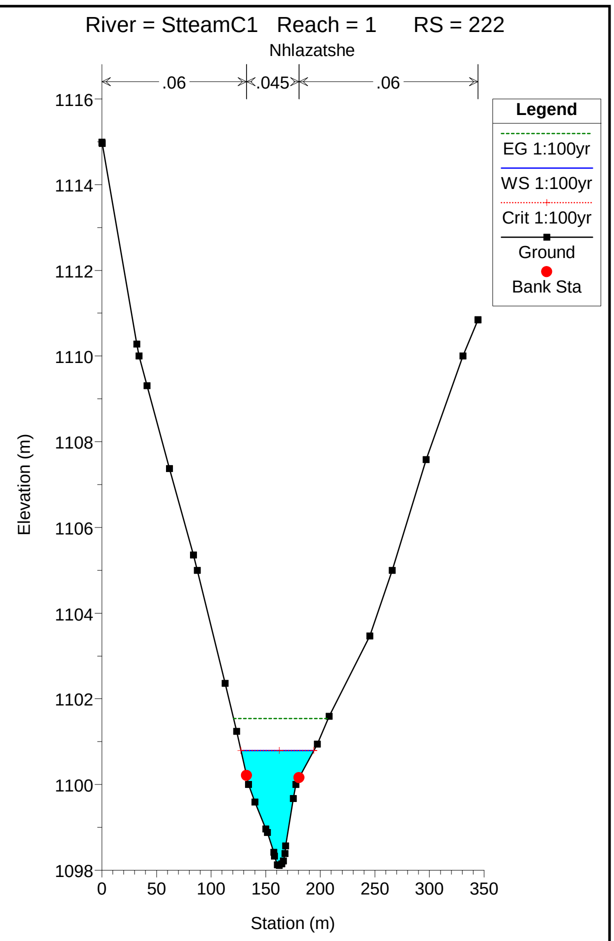


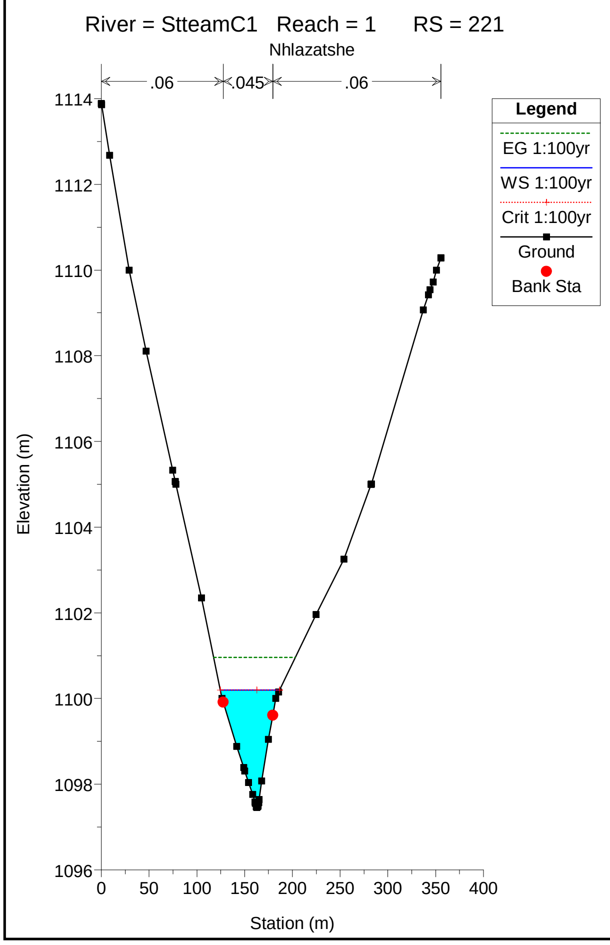
River = SteamC1 Reach = 1 RS = 225
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

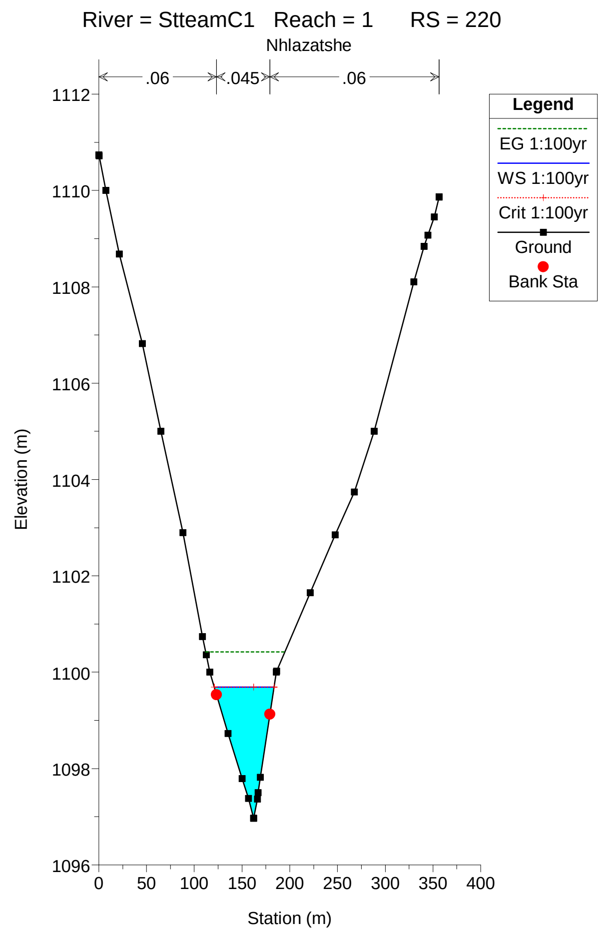


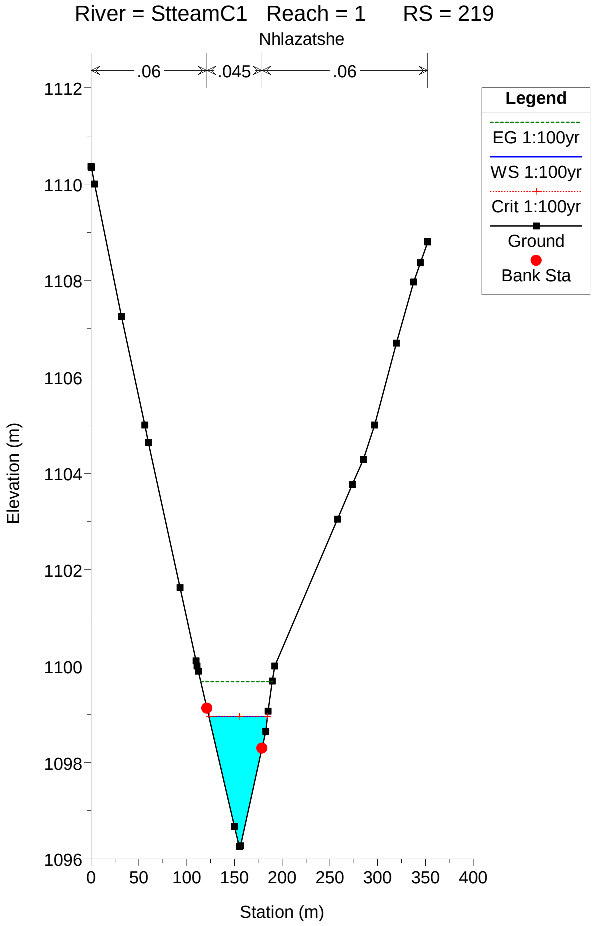
River = SteamC1 Reach = 1 RS = 224
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

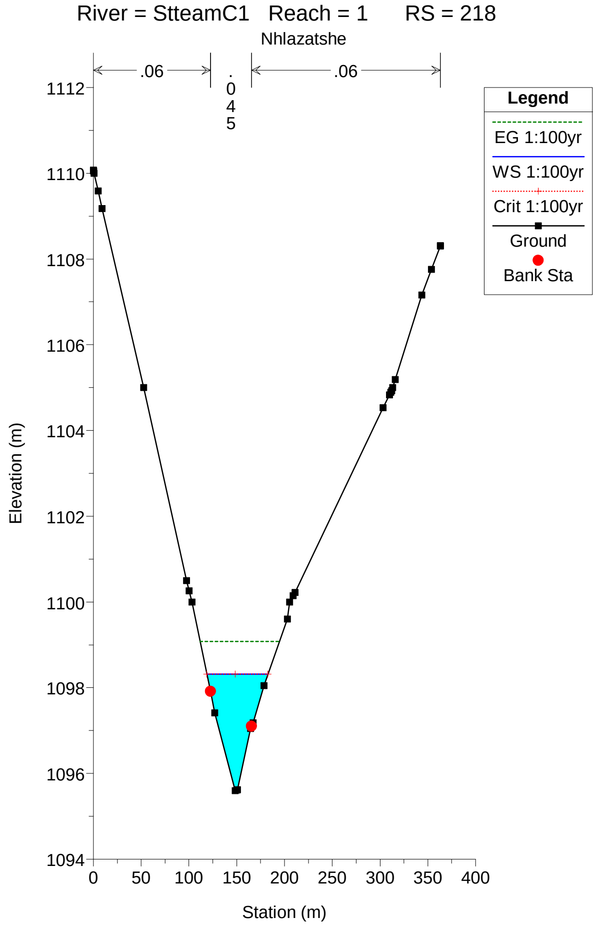

River = StteamC1 Reach = 1 RS = 223
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1118
1116
1114
1112
1110
1108
1106
1104
1102
1100
1098
0
50
100
150
200
250
300
350
Station (m)

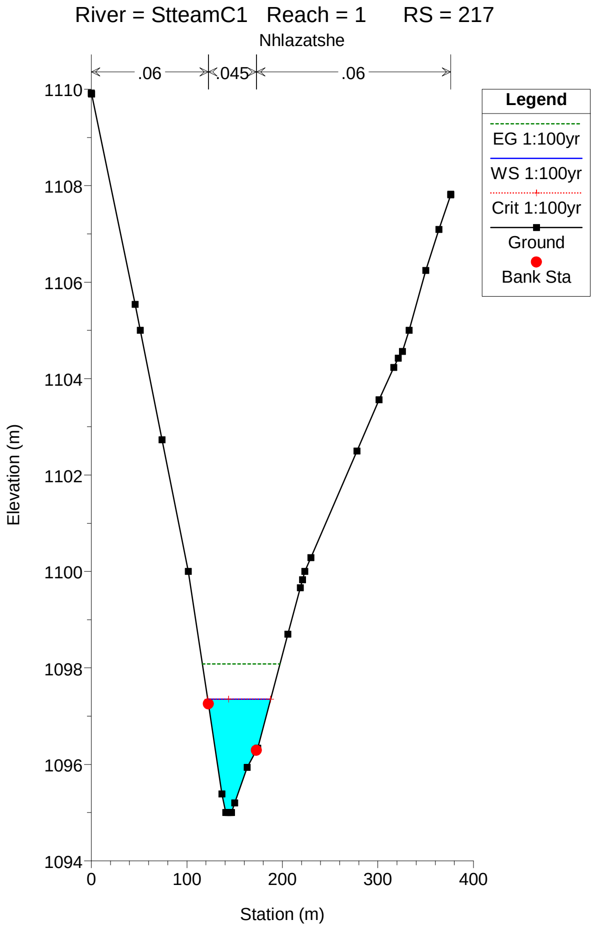

River = StteamC1 Reach = 1 RS = 222
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1116
1114
1112
1110
1108
1106
1104
1102
1100
1098
0
50
100
150
200
250
300
350
Station (m)

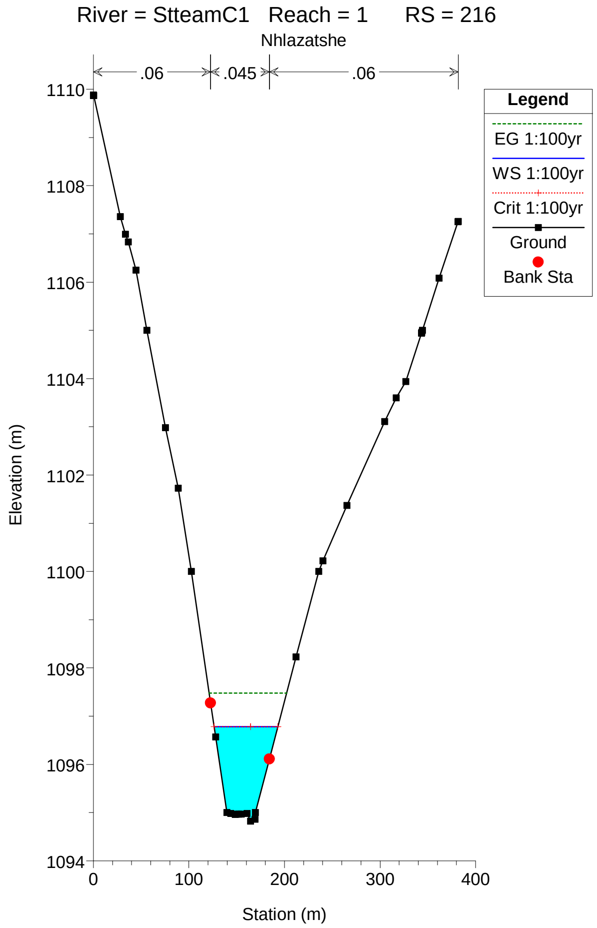

River = StteamC1 Reach = 1 RS = 221
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1114
1112
1110
1108
1106
1104
1102
1100
1098
1096
0
50
100
150
200
250
300
350
400
Station (m)

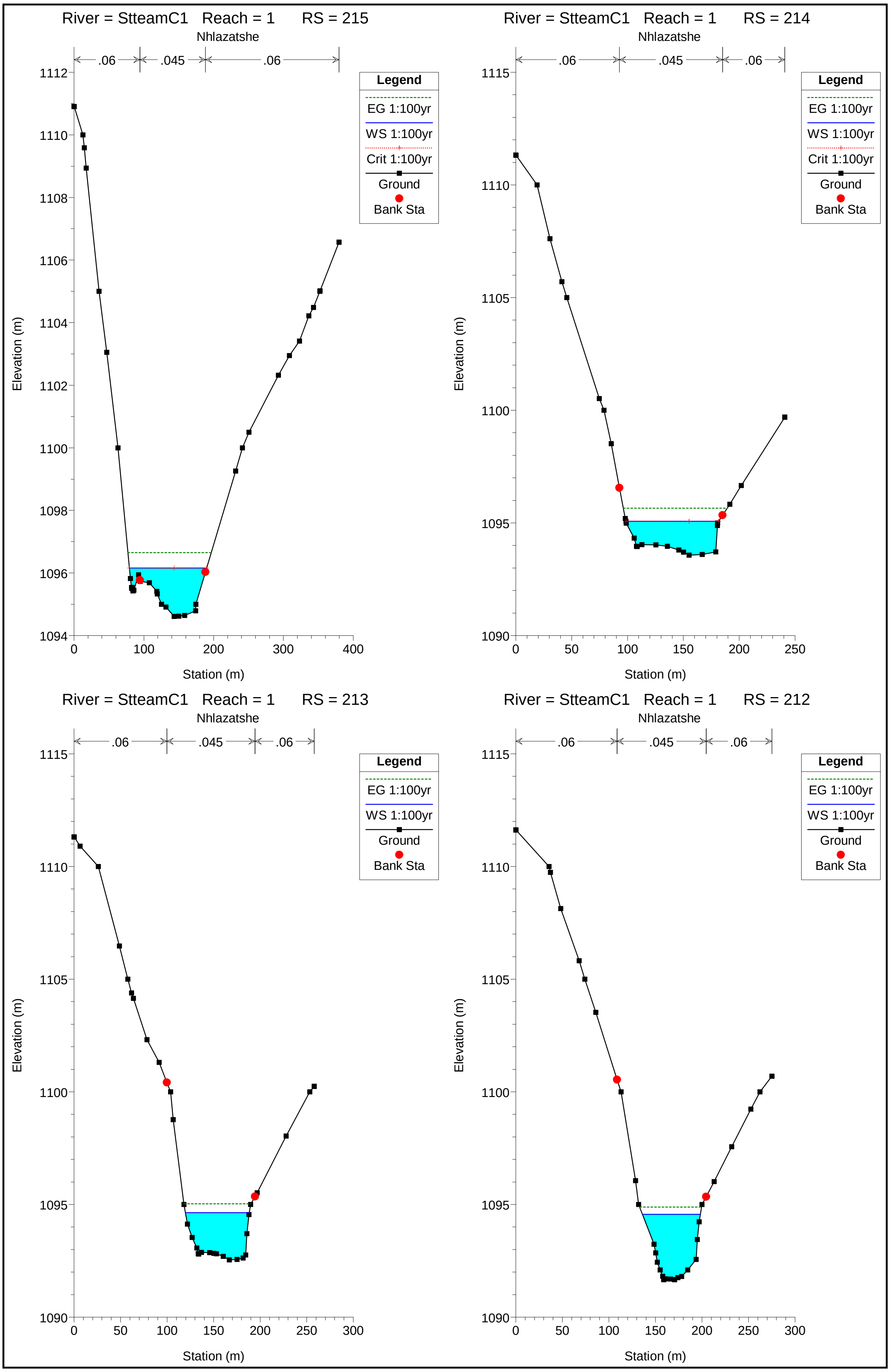

River = StteamC1 Reach = 1 RS = 220
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1112
1110
1108
1106
1104
1102
1100
1098
1096
0
50
100
150
200
250
300
350
400
Station (m)

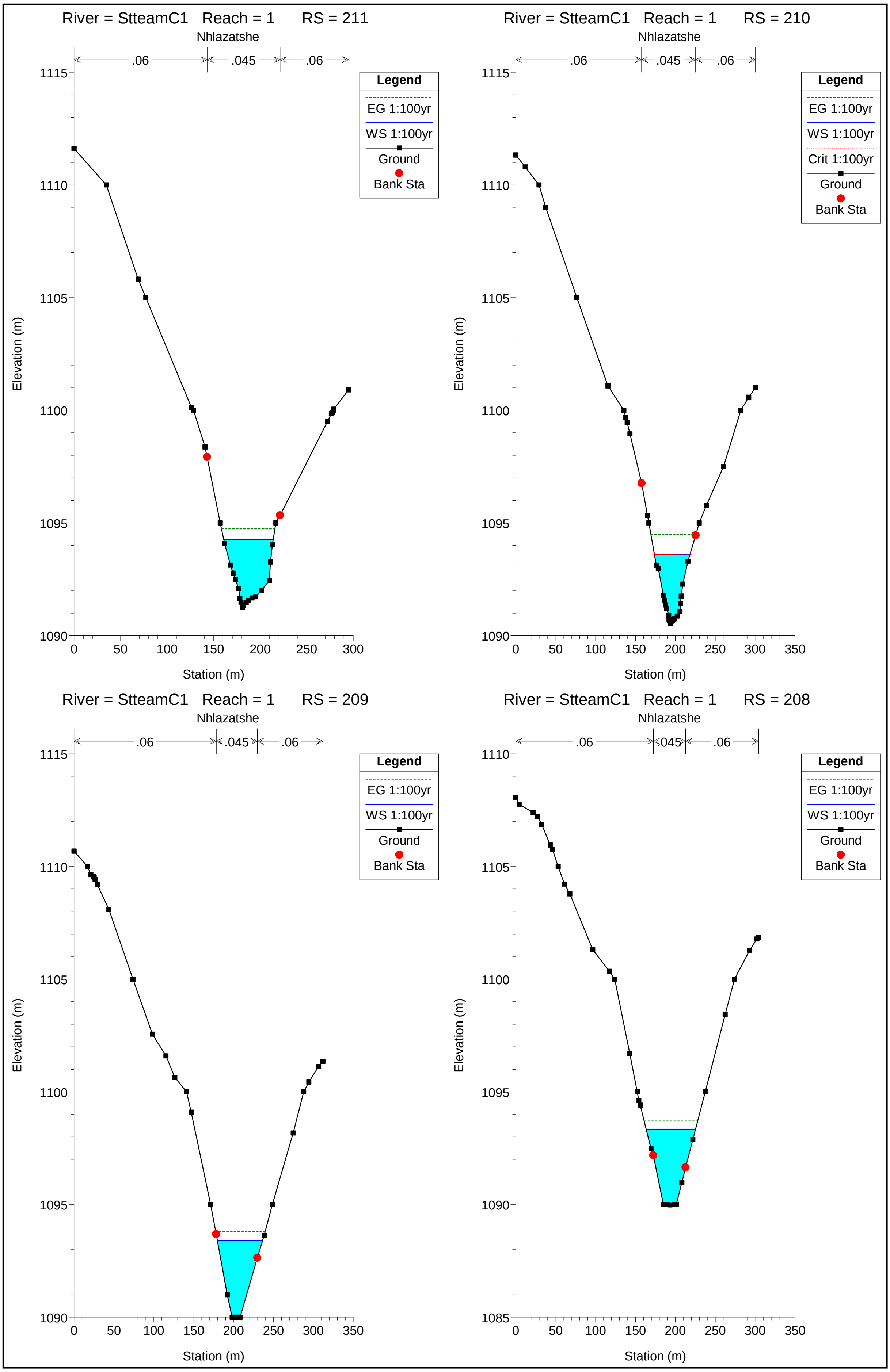

River = StteamC1 Reach = 1 RS = 219
Nhlazatshe
.06
.045
.06
Elevation (m)
Station (m)
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta

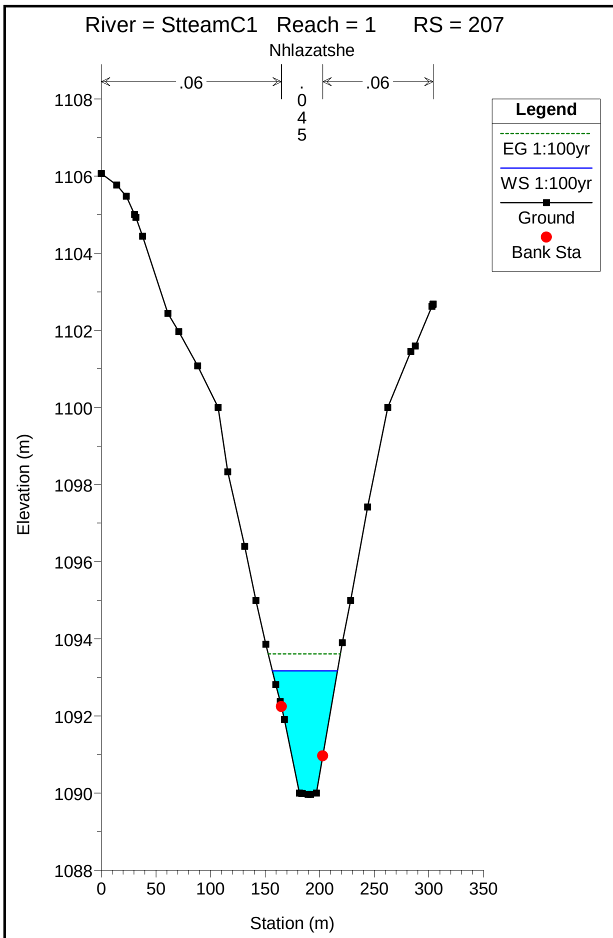

River = StteamC1 Reach = 1 RS = 218
Nhlazatshe
.06
.045
.06
Elevation (m)
Station (m)
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta

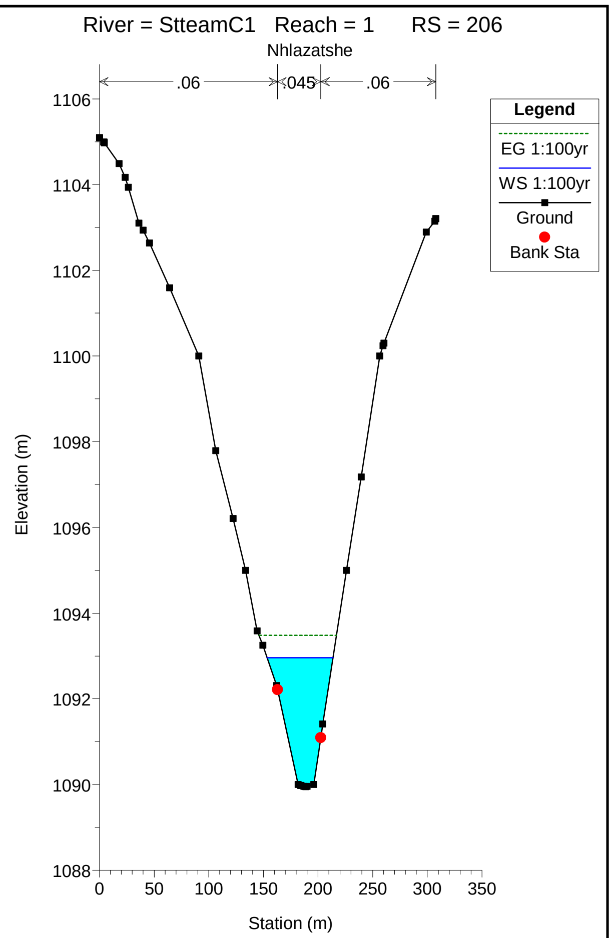

River = StteamC1 Reach = 1 RS = 217
Nhlazatshe
.06
.045
.06
Elevation (m)
Station (m)
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta

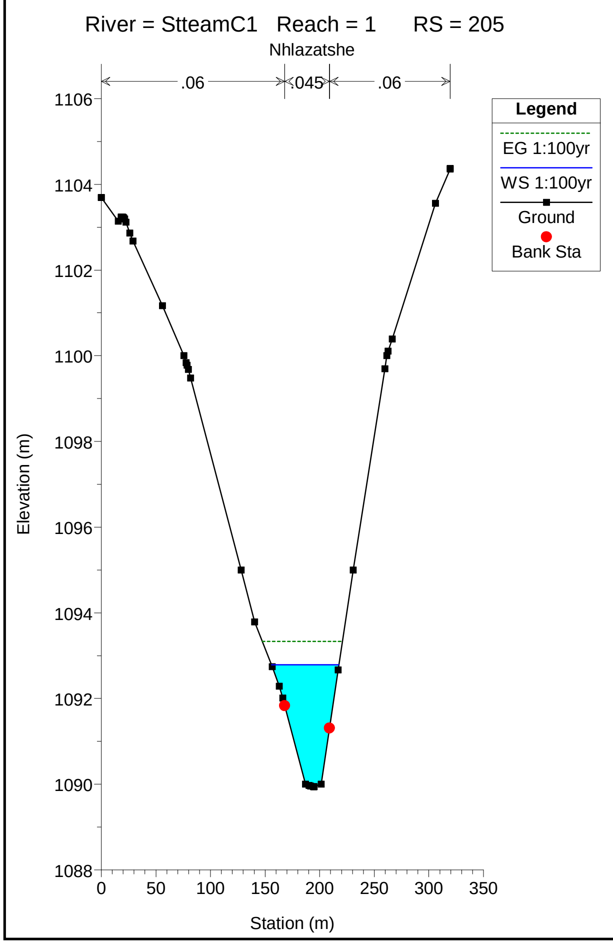

River = StteamC1 Reach = 1 RS = 216
Nhlazatshe
.06
.045
.06
Elevation (m)
Station (m)
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta

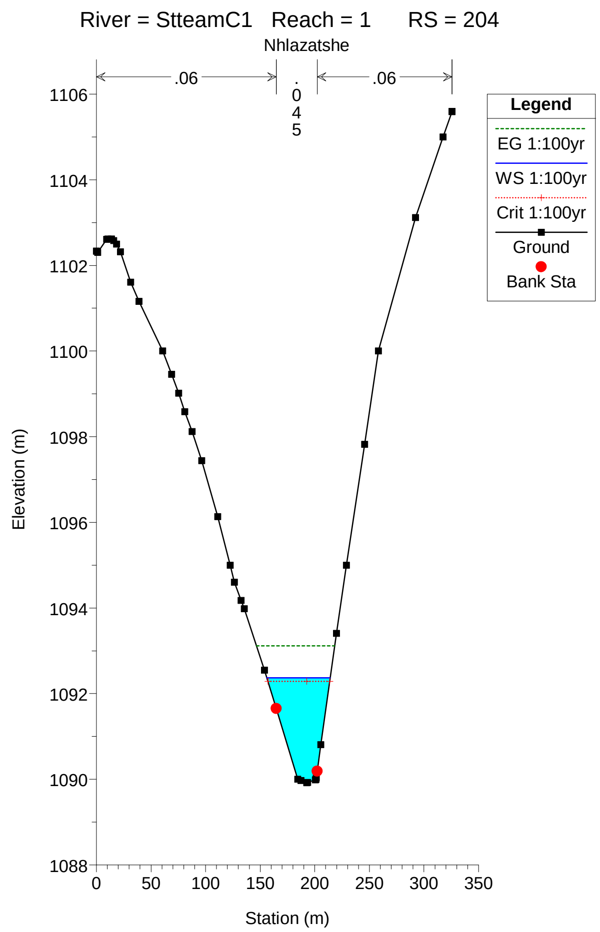

River = StteamC1 Reach = 1 RS = 215
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 214
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 213
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 212
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

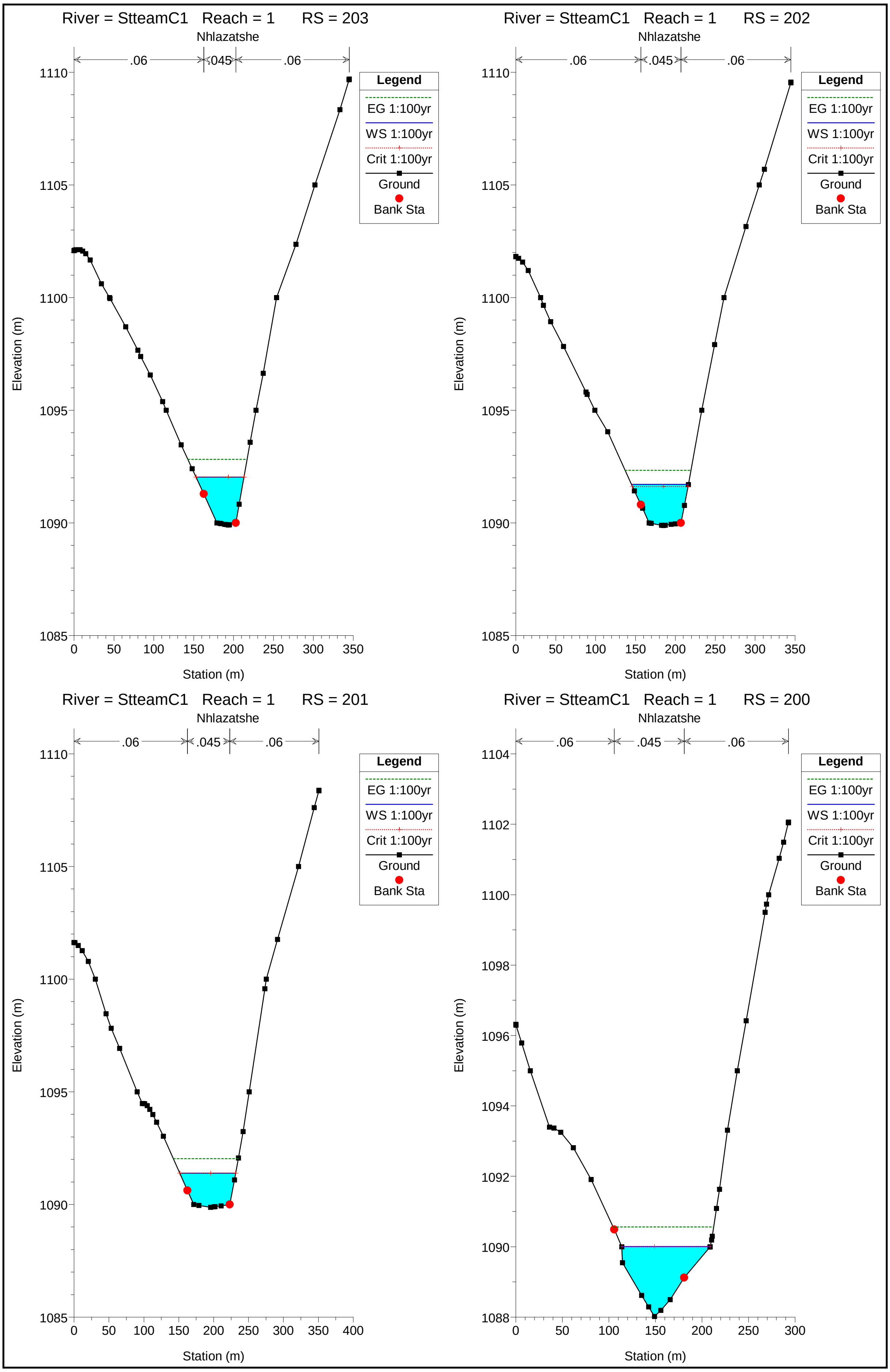

River = StteamC1 Reach = 1 RS = 211
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1115
1110
1105
1100
1095
1090
0
50
100
150
200
250
300
Station (m)
River = StteamC1 Reach = 1 RS = 210
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1115
1110
1105
1100
1095
1090
0
50
100
150
200
250
300
350
Station (m)
River = StteamC1 Reach = 1 RS = 209
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1115
1110
1105
1100
1095
1090
0
50
100
150
200
250
300
350
Station (m)
River = StteamC1 Reach = 1 RS = 208
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1110
1105
1100
1095
1090
1085
0
50
100
150
200
250
300
350
Station (m)

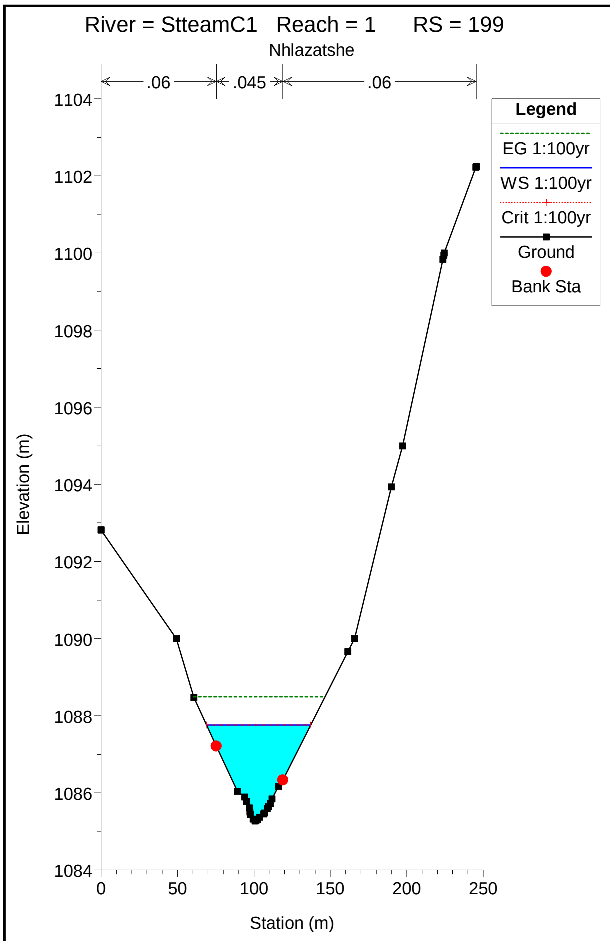

River = StteamC1 Reach = 1 RS = 207
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1088
1090
1092
1094
1096
1098
1100
1102
1104
1106
1108
0
50
100
150
200
250
300
350

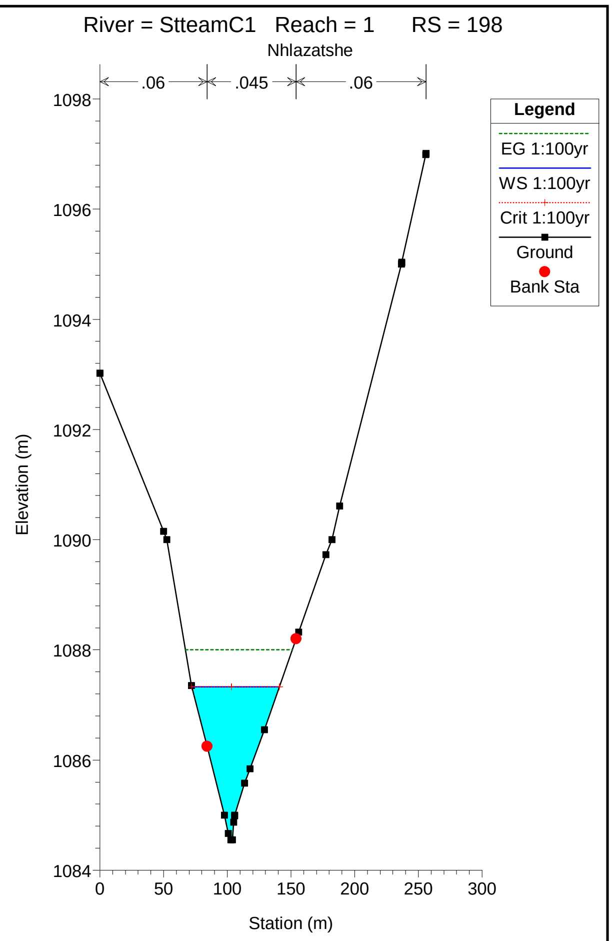

River = StteamC1 Reach = 1 RS = 206
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1088
1090
1092
1094
1096
1098
1100
1102
1104
1106
0
50
100
150
200
250
300
350

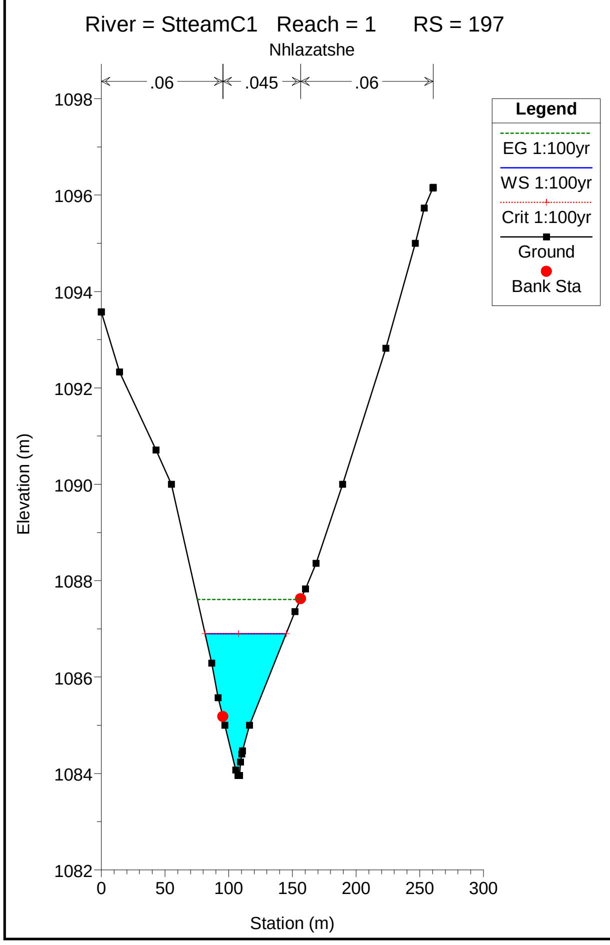

River = StteamC1 Reach = 1 RS = 205
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1088
1090
1092
1094
1096
1098
1100
1102
1104
1106
0
50
100
150
200
250
300
350

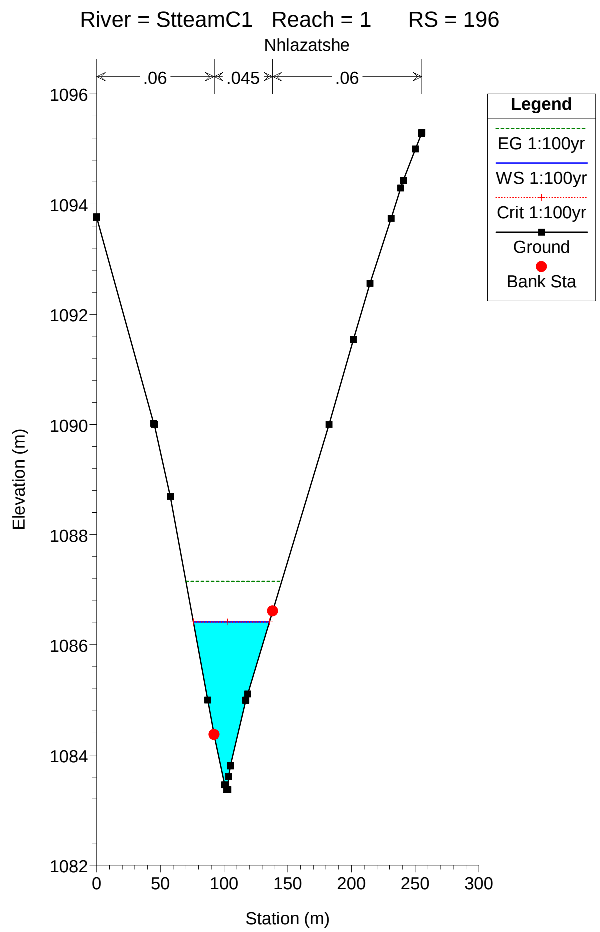

River = StteamC1 Reach = 1 RS = 204
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1088
1090
1092
1094
1096
1098
1100
1102
1104
1106
0
50
100
150
200
250
300
350

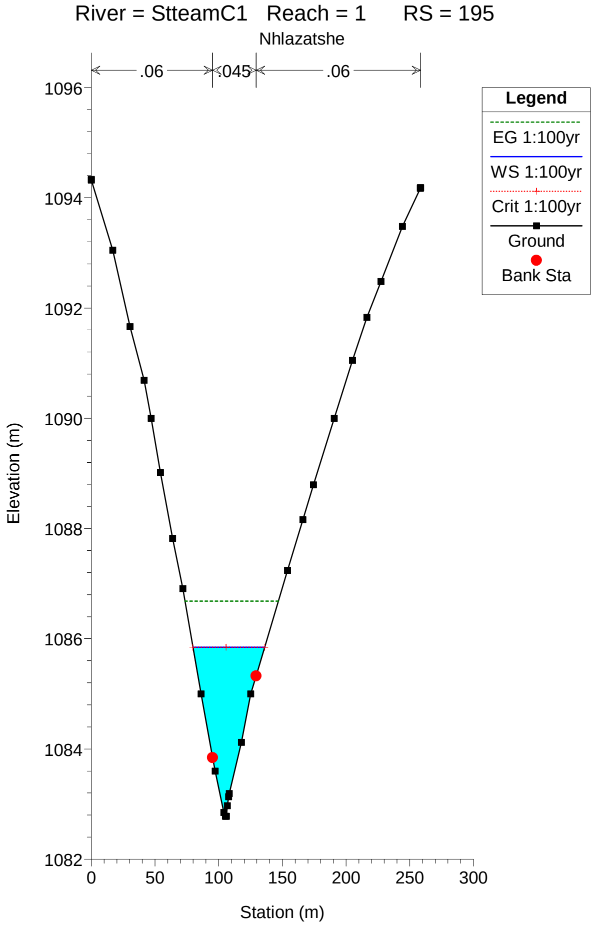

River = StteamC1 Reach = 1 RS = 203
Nhlazatshe
River = StteamC1 Reach = 1 RS = 202
Nhlazatshe
River = StteamC1 Reach = 1 RS = 201
Nhlazatshe
River = StteamC1 Reach = 1 RS = 200
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

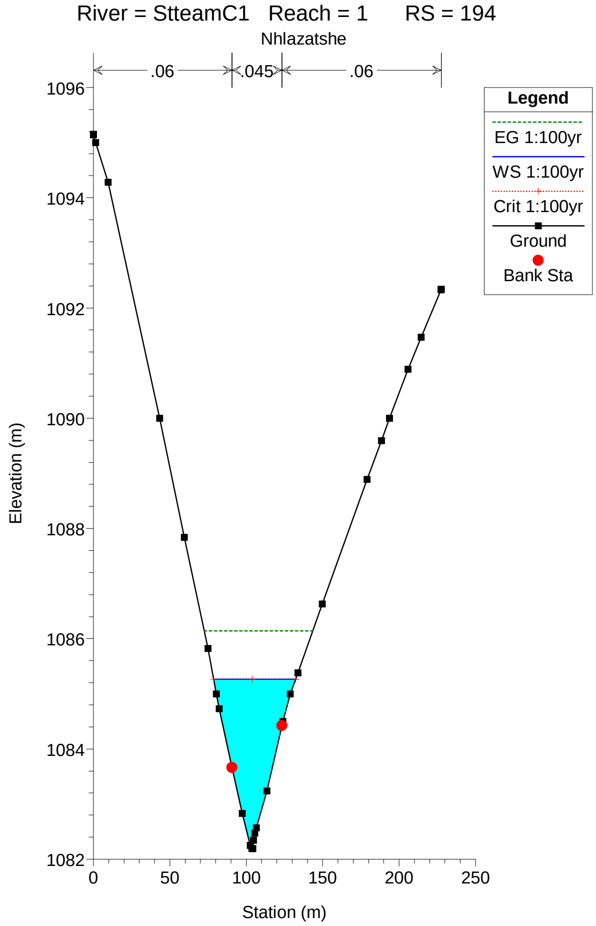

River = StteamC1 Reach = 1 RS = 199
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1084
1086
1088
1090
1092
1094
1096
1098
1100
1102
1104
0
50
100
150
200
250

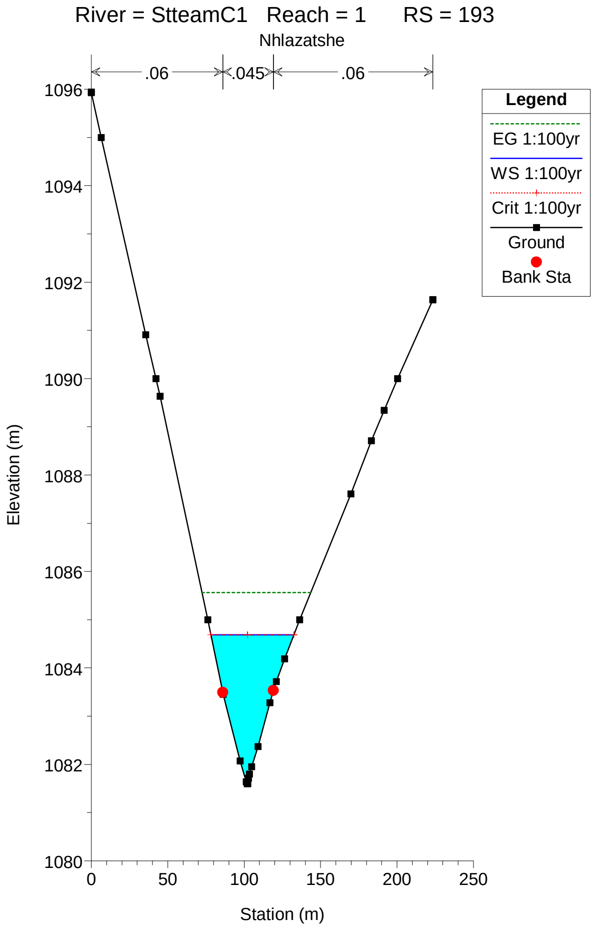

River = StteamC1 Reach = 1 RS = 198
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1084
1086
1088
1090
1092
1094
1096
1098
0
50
100
150
200
250
300

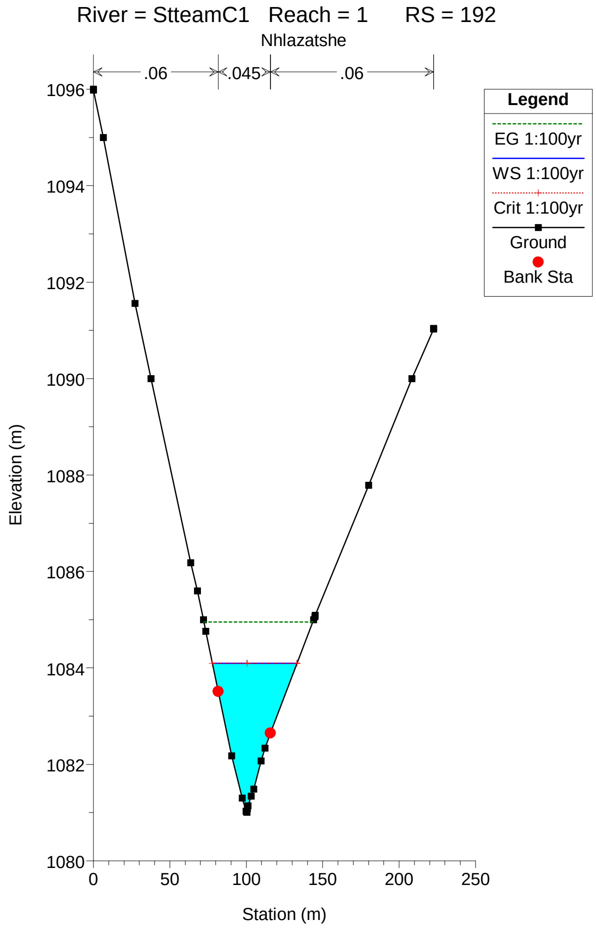

River = StteamC1 Reach = 1 RS = 197
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1082
1084
1086
1088
1090
1092
1094
1096
1098
0
50
100
150
200
250
300

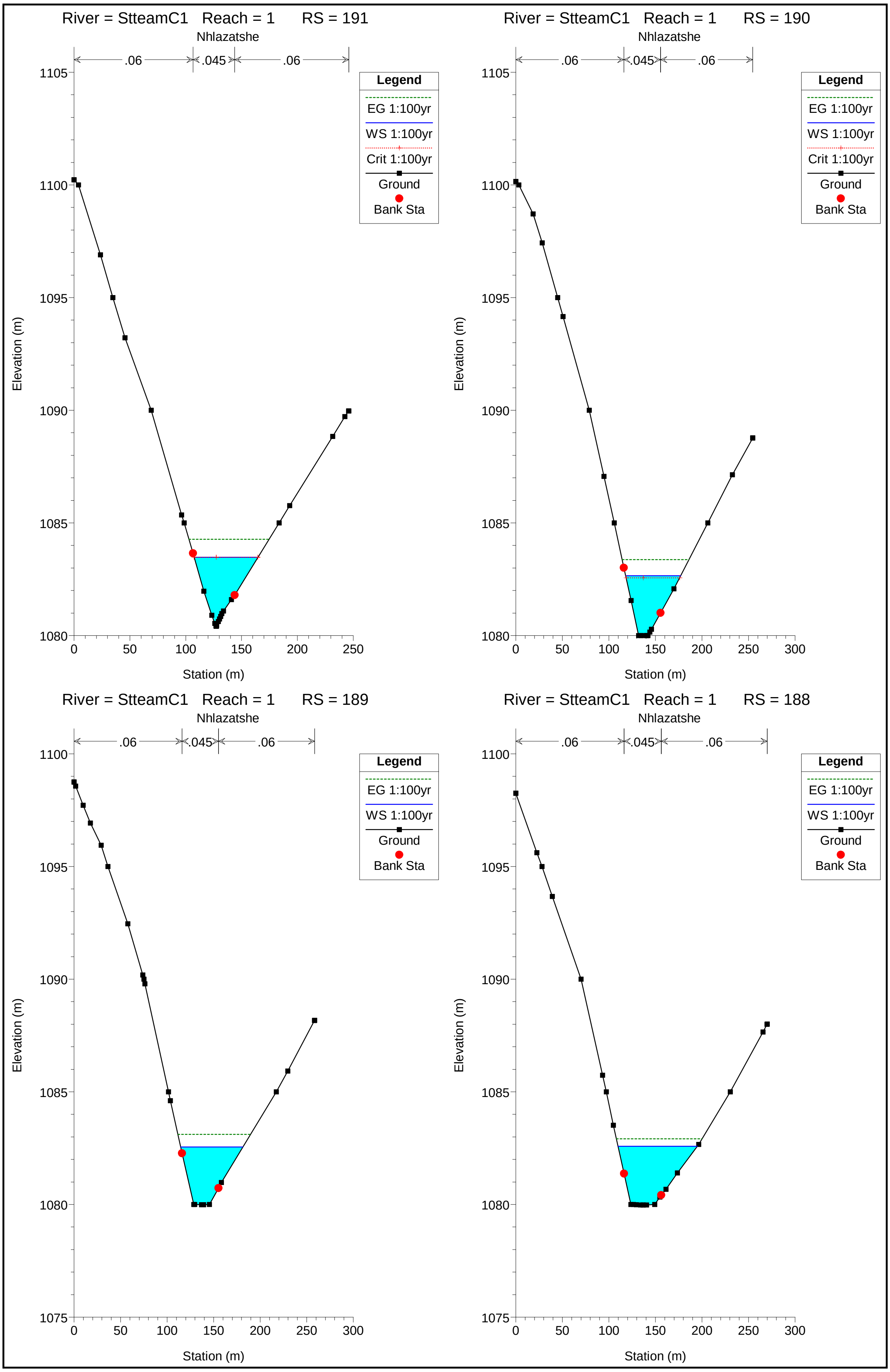

River = StteamC1 Reach = 1 RS = 196
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1082
1084
1086
1088
1090
1092
1094
1096
0
50
100
150
200
250
300

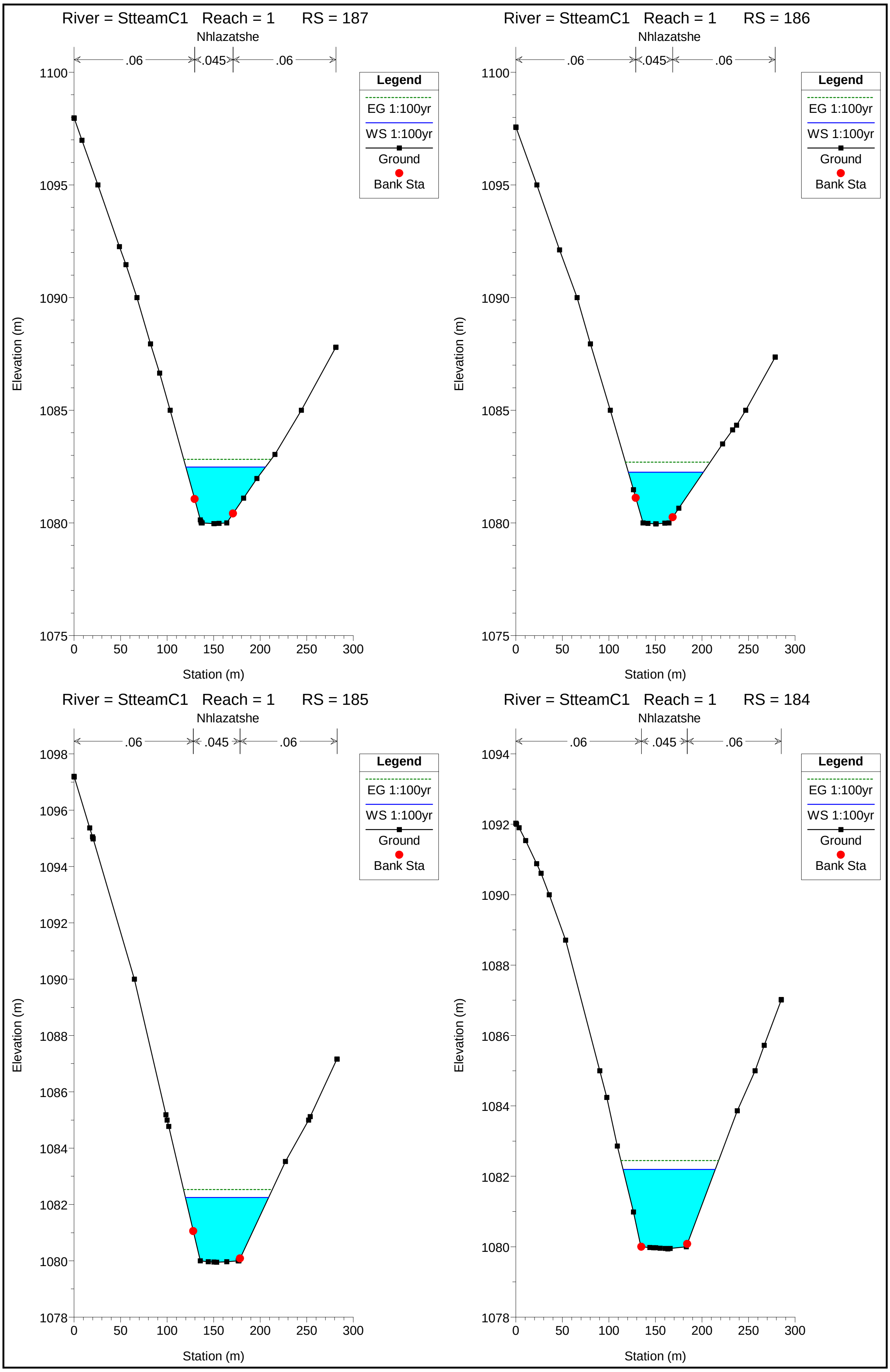

River = StteamC1 Reach = 1 RS = 195
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1096
1094
1092
1090
1088
1086
1084
1082
0
50
100
150
200
250
300
Station (m)

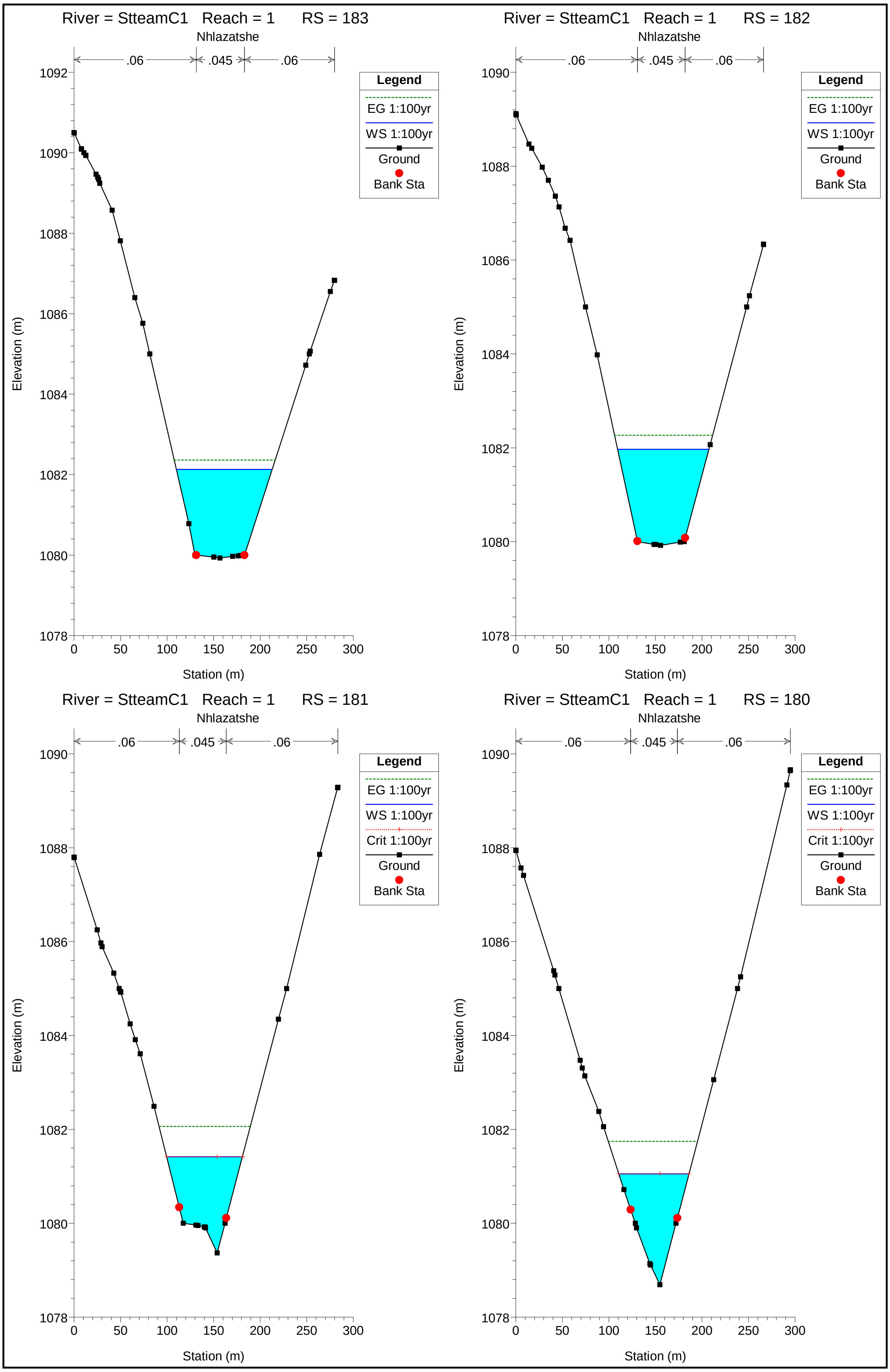

River = StteamC1 Reach = 1 RS = 194
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1096
1094
1092
1090
1088
1086
1084
1082
0
50
100
150
200
250
Station (m)

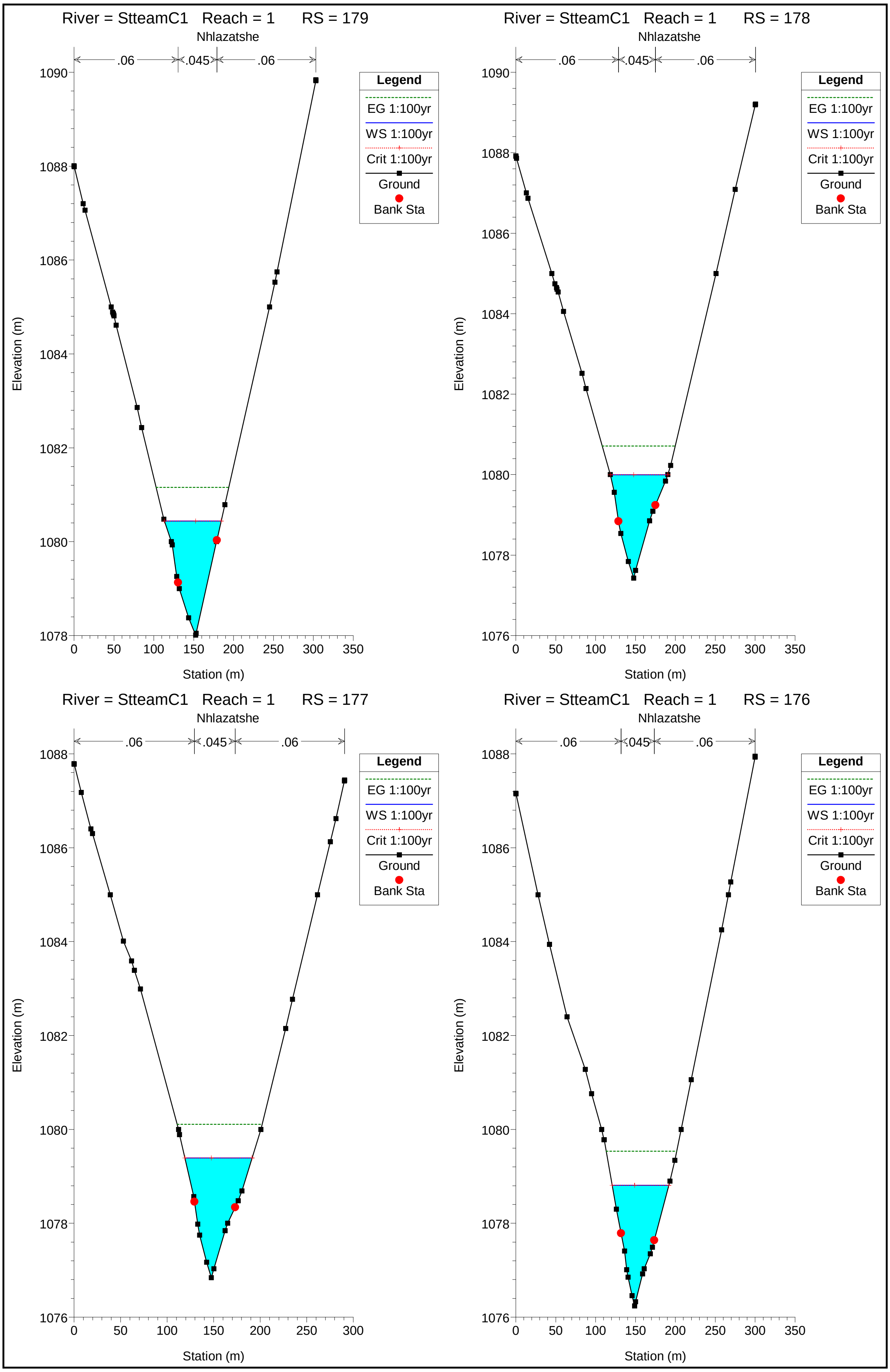

River = StteamC1 Reach = 1 RS = 193
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1096
1094
1092
1090
1088
1086
1084
1082
1080
0
50
100
150
200
250
Station (m)

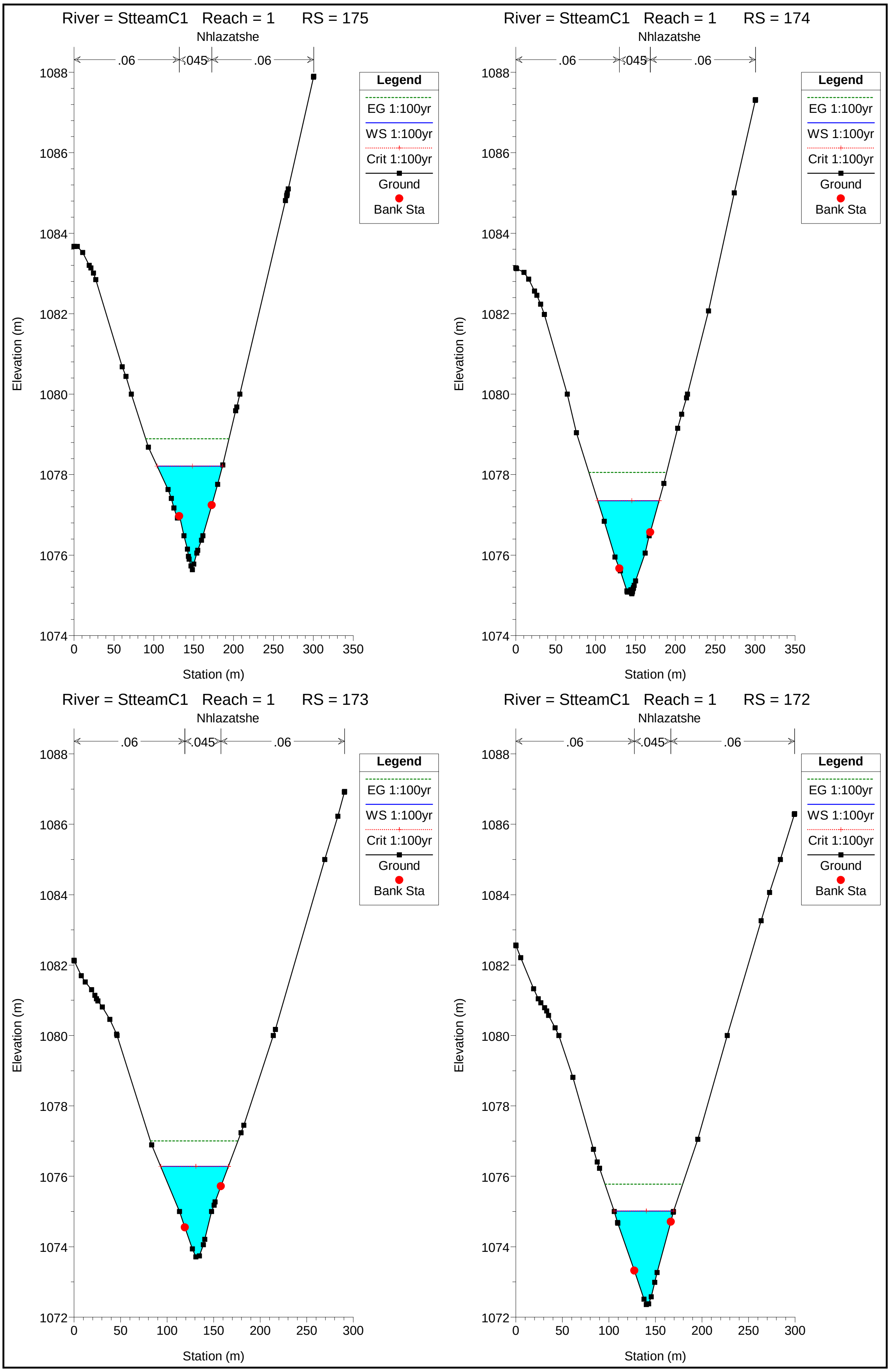

River = StteamC1 Reach = 1 RS = 192
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1096
1094
1092
1090
1088
1086
1084
1082
1080
0
50
100
150
200
250
Station (m)

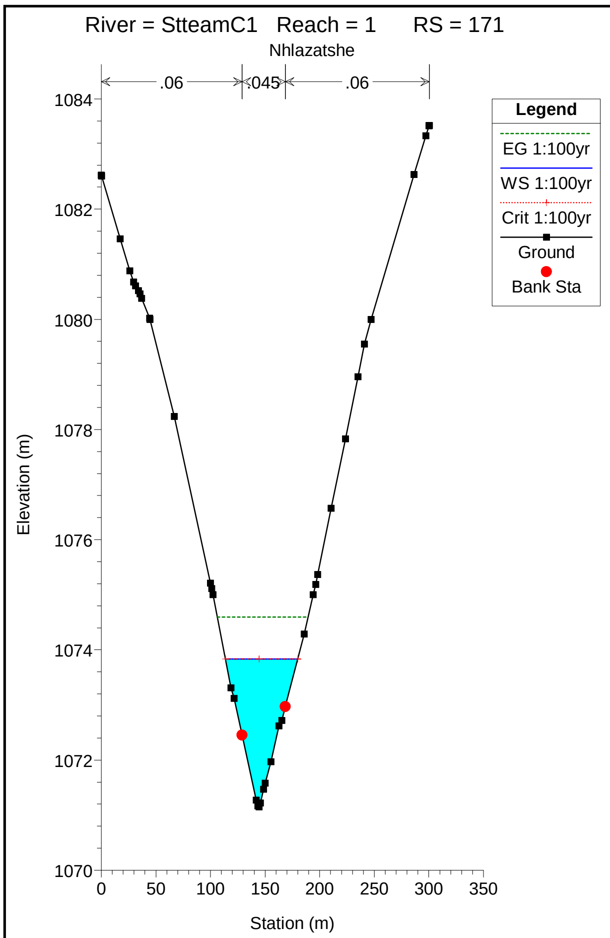

River = SteamC1 Reach = 1 RS = 191
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1105
1100
1095
1090
1085
1080
0
50
100
150
200
250
Station (m)
River = SteamC1 Reach = 1 RS = 190
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1105
1100
1095
1090
1085
1080
0
50
100
150
200
250
300
Station (m)
River = SteamC1 Reach = 1 RS = 189
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1100
1095
1090
1085
1080
1075
0
50
100
150
200
250
300
Station (m)
River = SteamC1 Reach = 1 RS = 188
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1100
1095
1090
1085
1080
1075
0
50
100
150
200
250
300
Station (m)

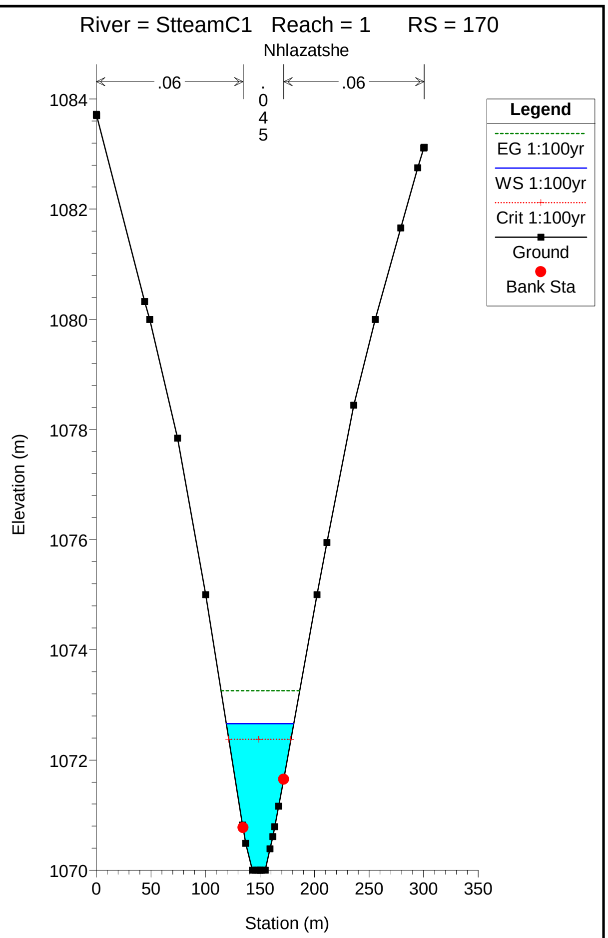

River = SteamC1 Reach = 1 RS = 187
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 186
Nhlazatshe
River = SteamC1 Reach = 1 RS = 185
Nhlazatshe
River = SteamC1 Reach = 1 RS = 184
Nhlazatshe

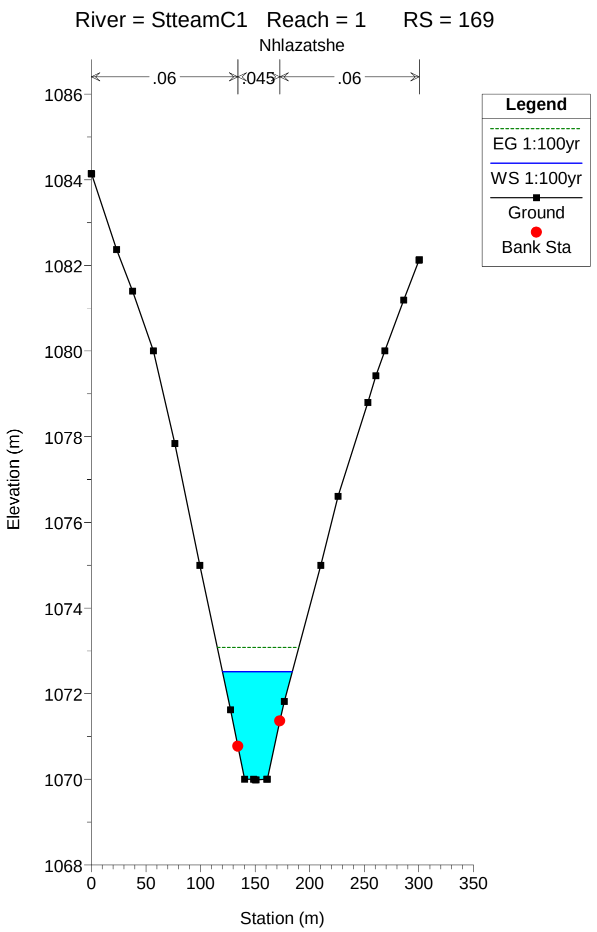

River = SteamC1 Reach = 1 RS = 183
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 182
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 181
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 180
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

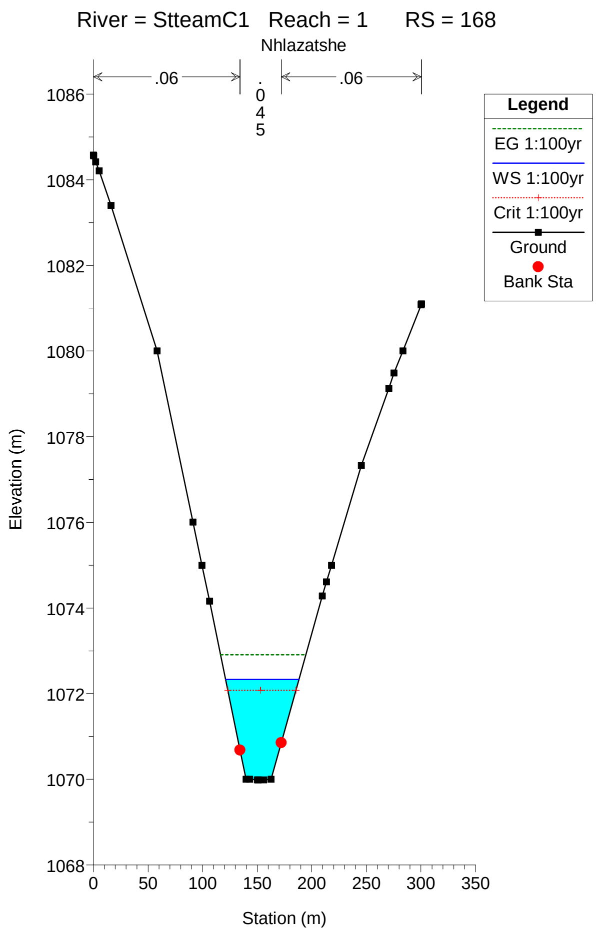

River = SteamC1 Reach = 1 RS = 179
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 178
Nhlazatshe
River = SteamC1 Reach = 1 RS = 177
Nhlazatshe
River = SteamC1 Reach = 1 RS = 176
Nhlazatshe

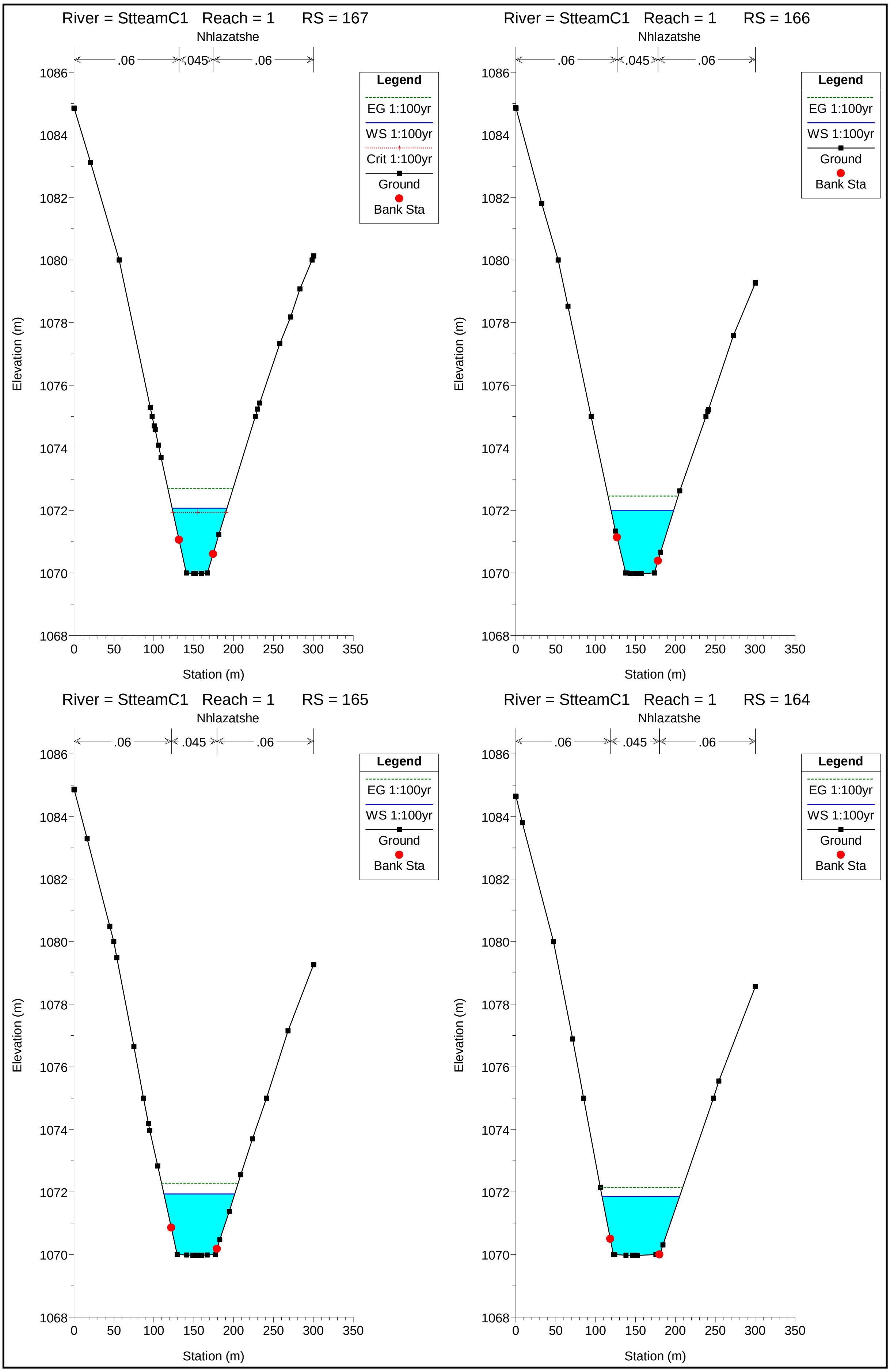

River = StteamC1 Reach = 1 RS = 175
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1074
1076
1078
1080
1082
1084
1086
1088
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 174
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1074
1076
1078
1080
1082
1084
1086
1088
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 173
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1072
1074
1076
1078
1080
1082
1084
1086
1088
Station (m)
0
50
100
150
200
250
300
River = StteamC1 Reach = 1 RS = 172
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1072
1074
1076
1078
1080
1082
1084
1086
1088
Station (m)
0
50
100
150
200
250
300

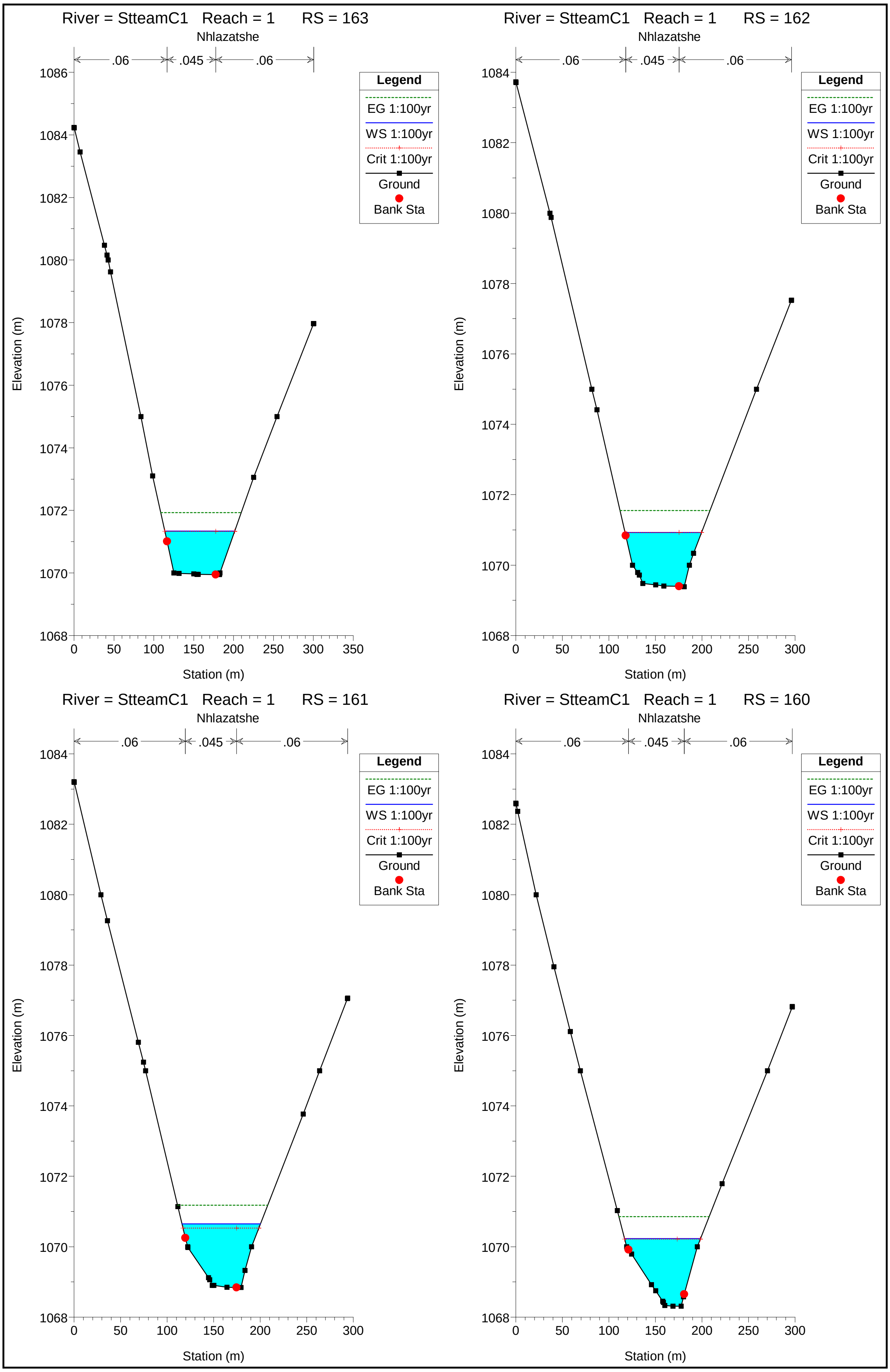

River = StteamC1 Reach = 1 RS = 171
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1070
1072
1074
1076
1078
1080
1082
1084
0
50
100
150
200
250
300
350
Station (m)


River = StteamC1 Reach = 1 RS = 170
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1070
1072
1074
1076
1078
1080
1082
1084
0
50
100
150
200
250
300
350
Station (m)

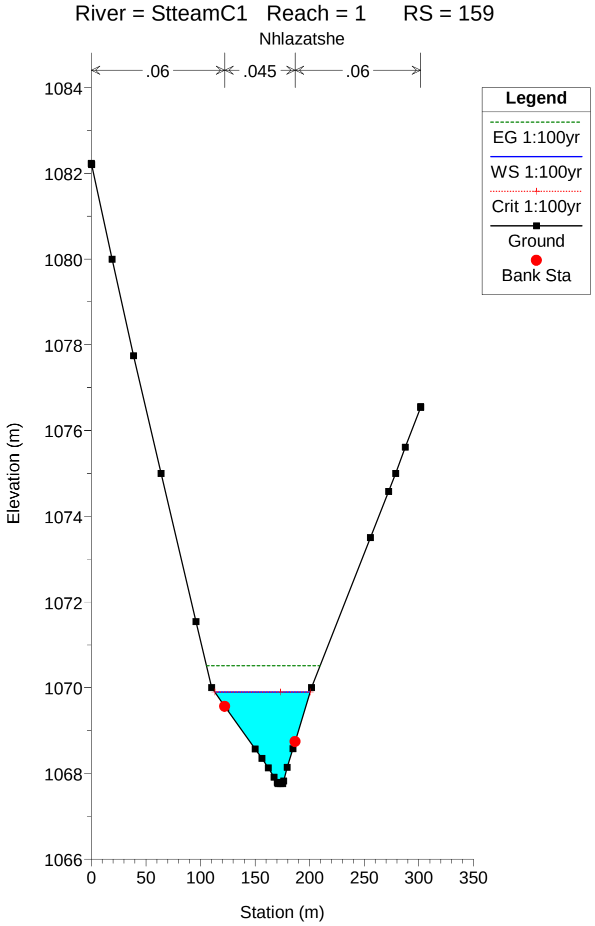

River = StteamC1 Reach = 1 RS = 169
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1068
1070
1072
1074
1076
1078
1080
1082
1084
1086
0
50
100
150
200
250
300
350
Station (m)

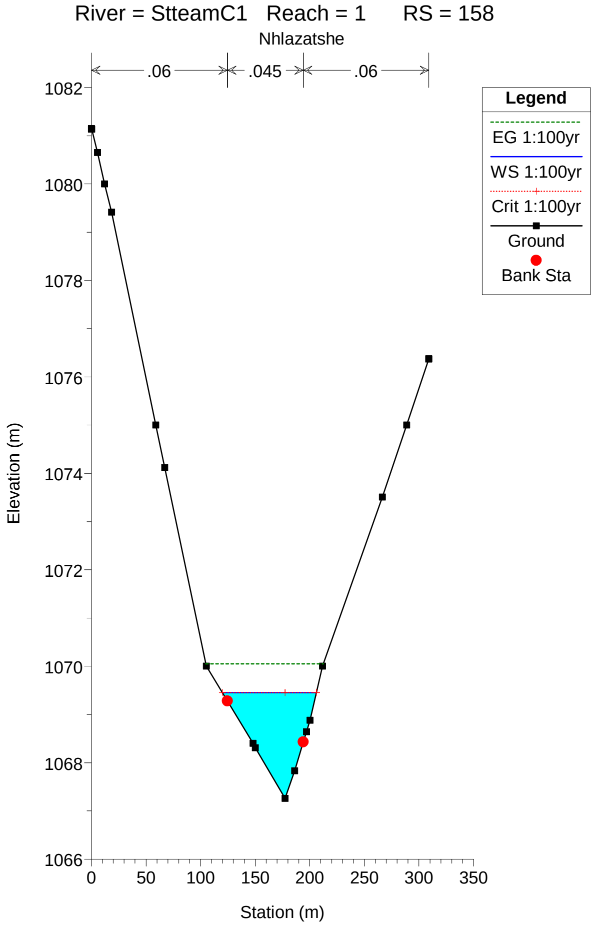

River = StteamC1 Reach = 1 RS = 168
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1068
1070
1072
1074
1076
1078
1080
1082
1084
1086
0
50
100
150
200
250
300
350
Station (m)

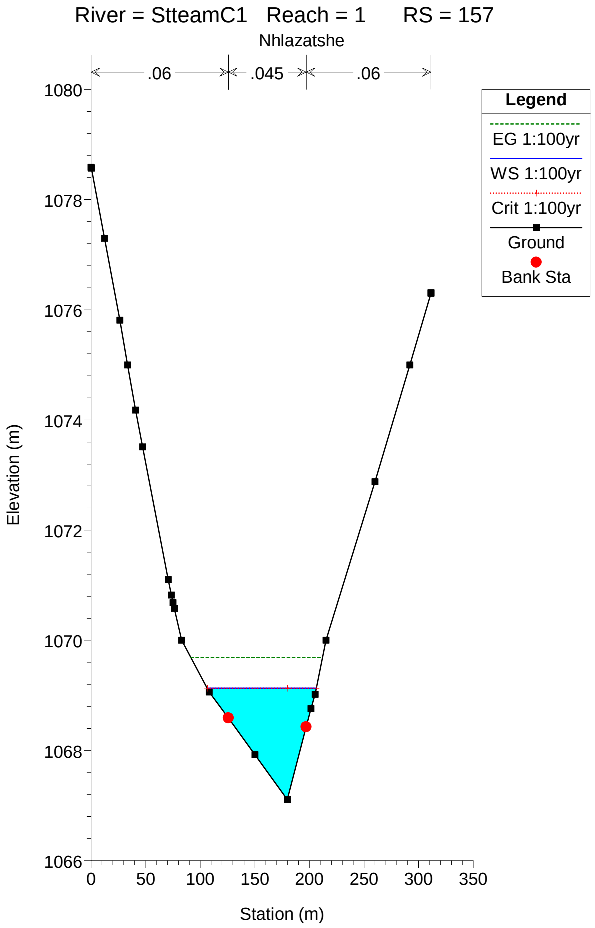

River = StteamC1 Reach = 1 RS = 167
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 166
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 165
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 164
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

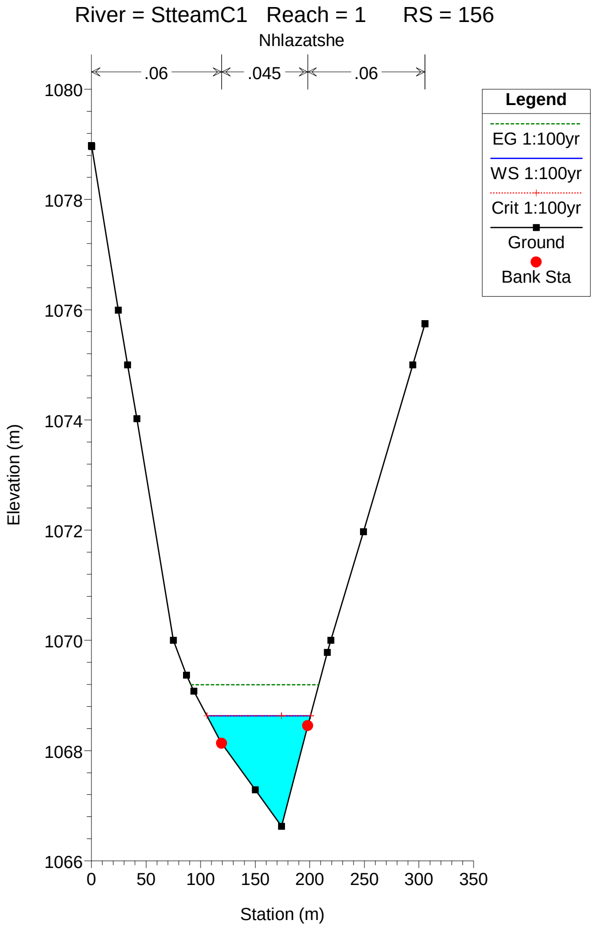


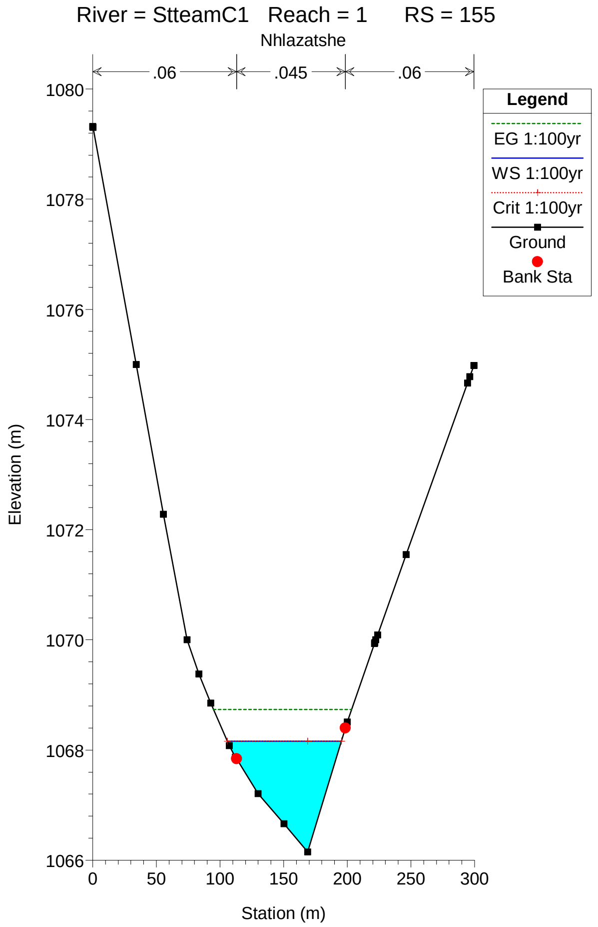
River = StteamC1 Reach = 1 RS = 163
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1086
1084
1082
1080
1078
1076
1074
1072
1070
1068
0 50 100 150 200 250 300 350
Station (m)
River = StteamC1 Reach = 1 RS = 162
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1084
1082
1080
1078
1076
1074
1072
1070
1068
0 50 100 150 200 250 300
Station (m)
River = StteamC1 Reach = 1 RS = 161
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1084
1082
1080
1078
1076
1074
1072
1070
1068
0 50 100 150 200 250 300
Station (m)
River = StteamC1 Reach = 1 RS = 160
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1084
1082
1080
1078
1076
1074
1072
1070
1068
0 50 100 150 200 250 300
Station (m)

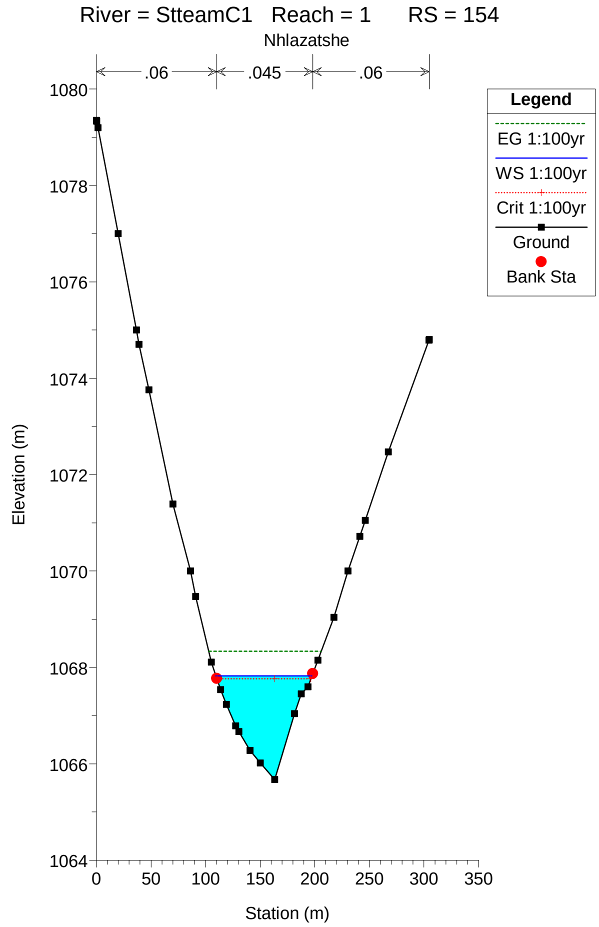

River = SteamC1 Reach = 1 RS = 159
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1084
1082
1080
1078
1076
1074
1072
1070
1068
1066
0
50
100
150
200
250
300
350

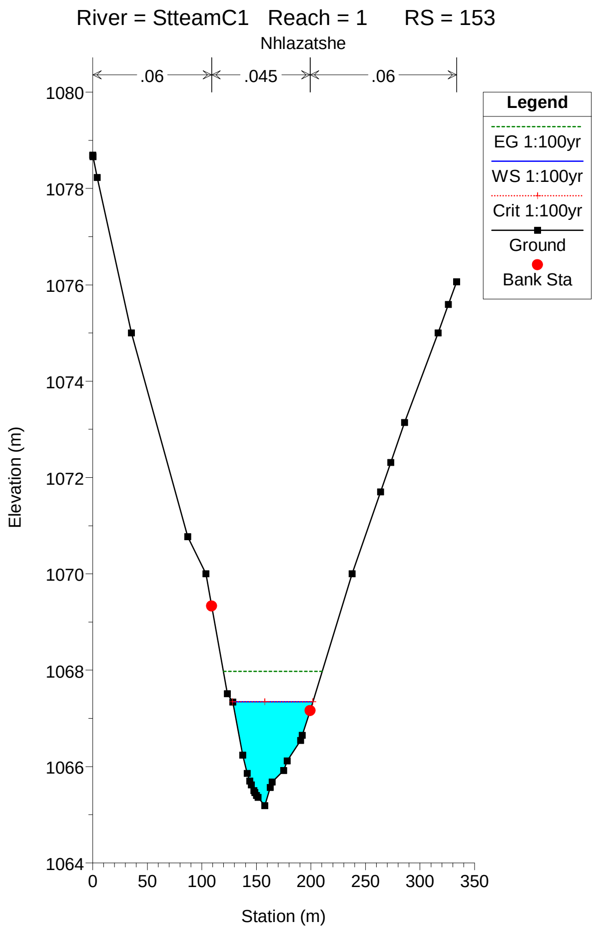

River = SteamC1 Reach = 1 RS = 158
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1082
1080
1078
1076
1074
1072
1070
1068
1066
0
50
100
150
200
250
300
350

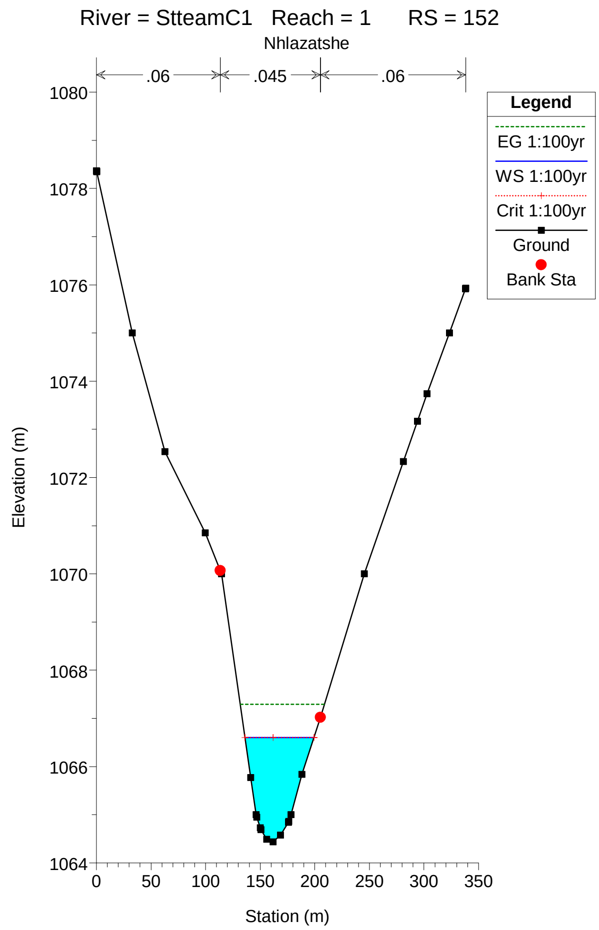

River = SteamC1 Reach = 1 RS = 157
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1080
1078
1076
1074
1072
1070
1068
1066
0
50
100
150
200
250
300
350

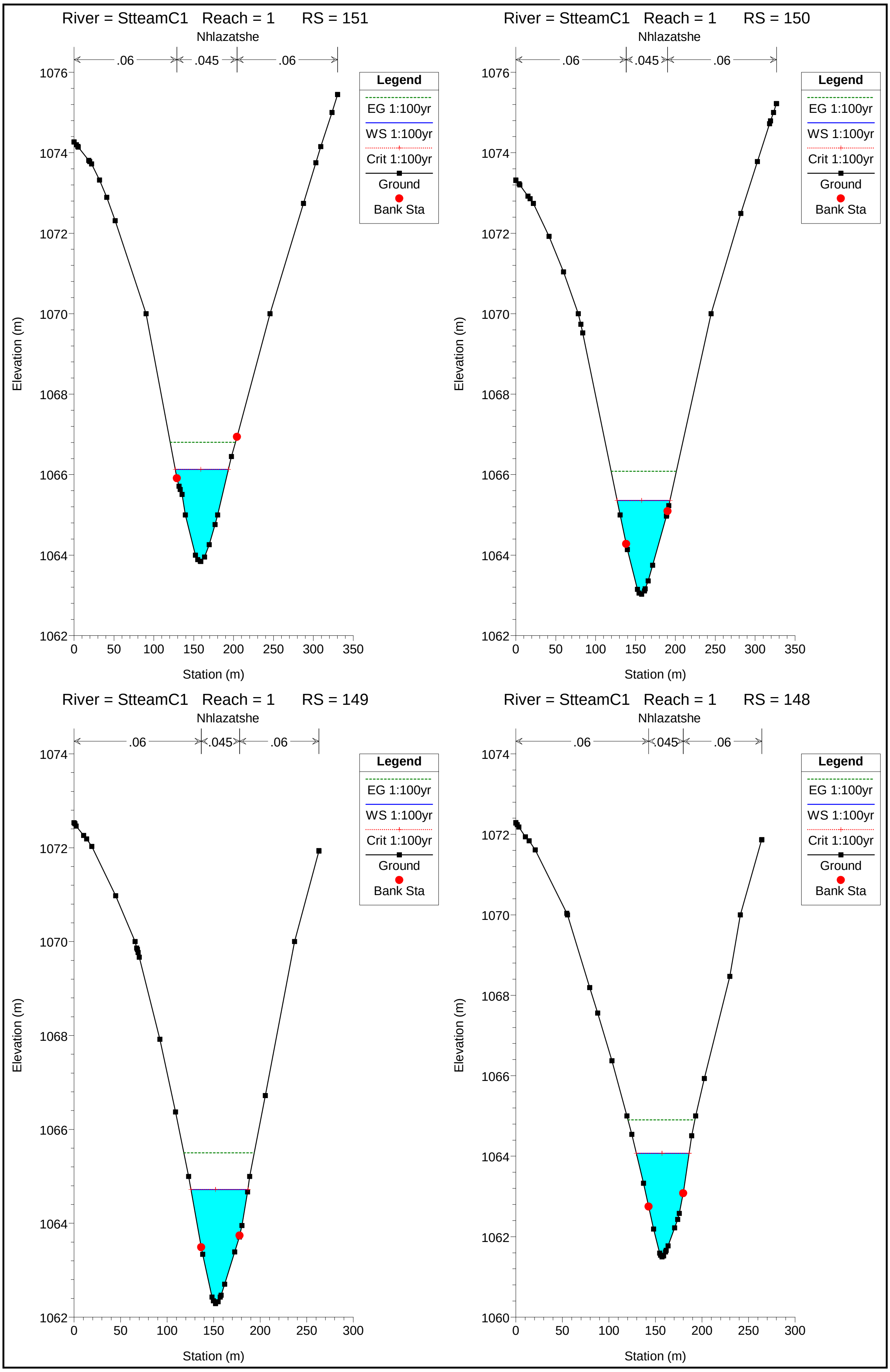

River = SteamC1 Reach = 1 RS = 156
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1080
1078
1076
1074
1072
1070
1068
1066
0
50
100
150
200
250
300
350


River = StteamC1 Reach = 1 RS = 155
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1066
1068
1070
1072
1074
1076
1078
1080
0
50
100
150
200
250
300

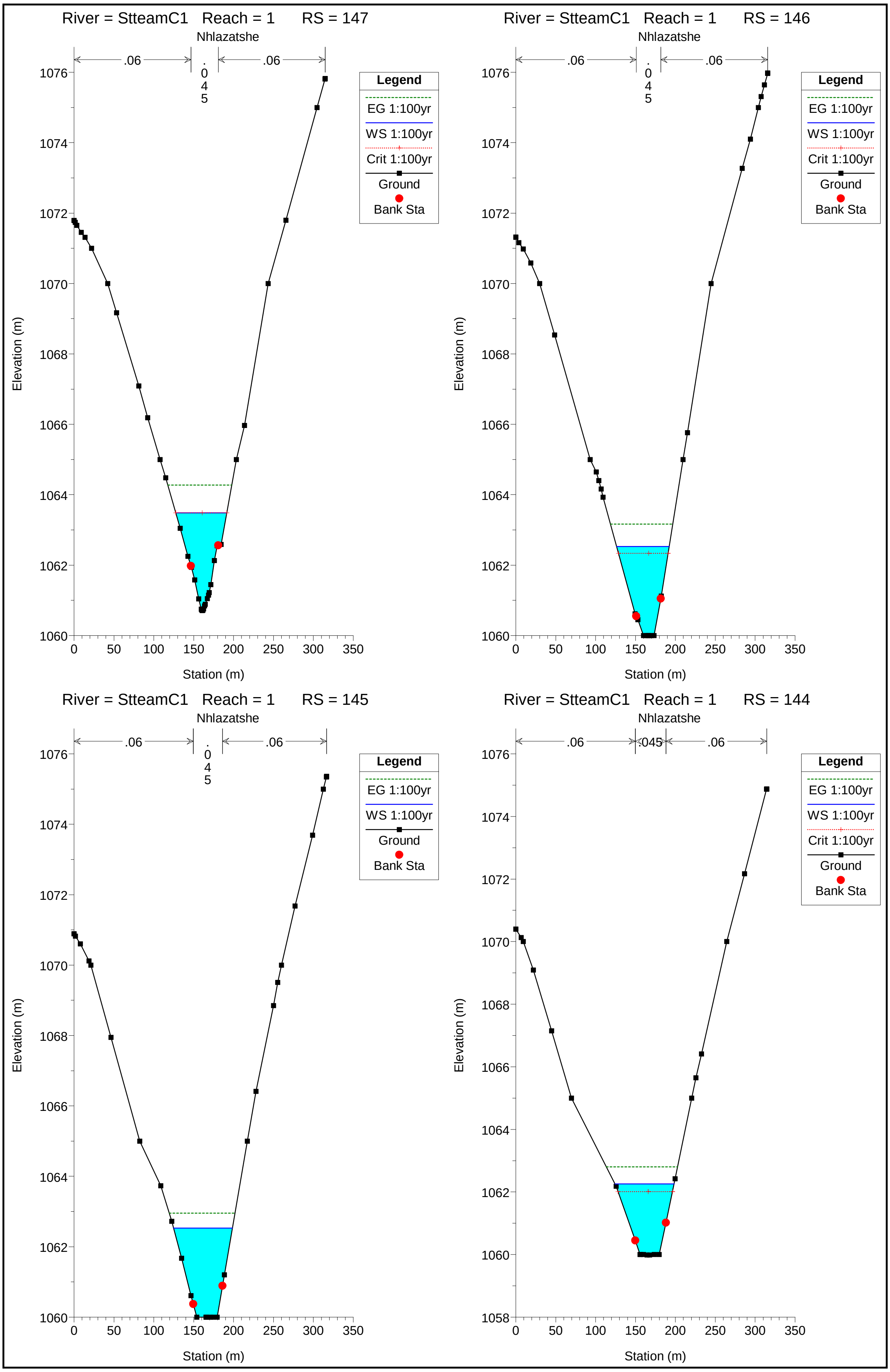

River = StteamC1 Reach = 1 RS = 154
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1064
1066
1068
1070
1072
1074
1076
1078
1080
0
50
100
150
200
250
300
350

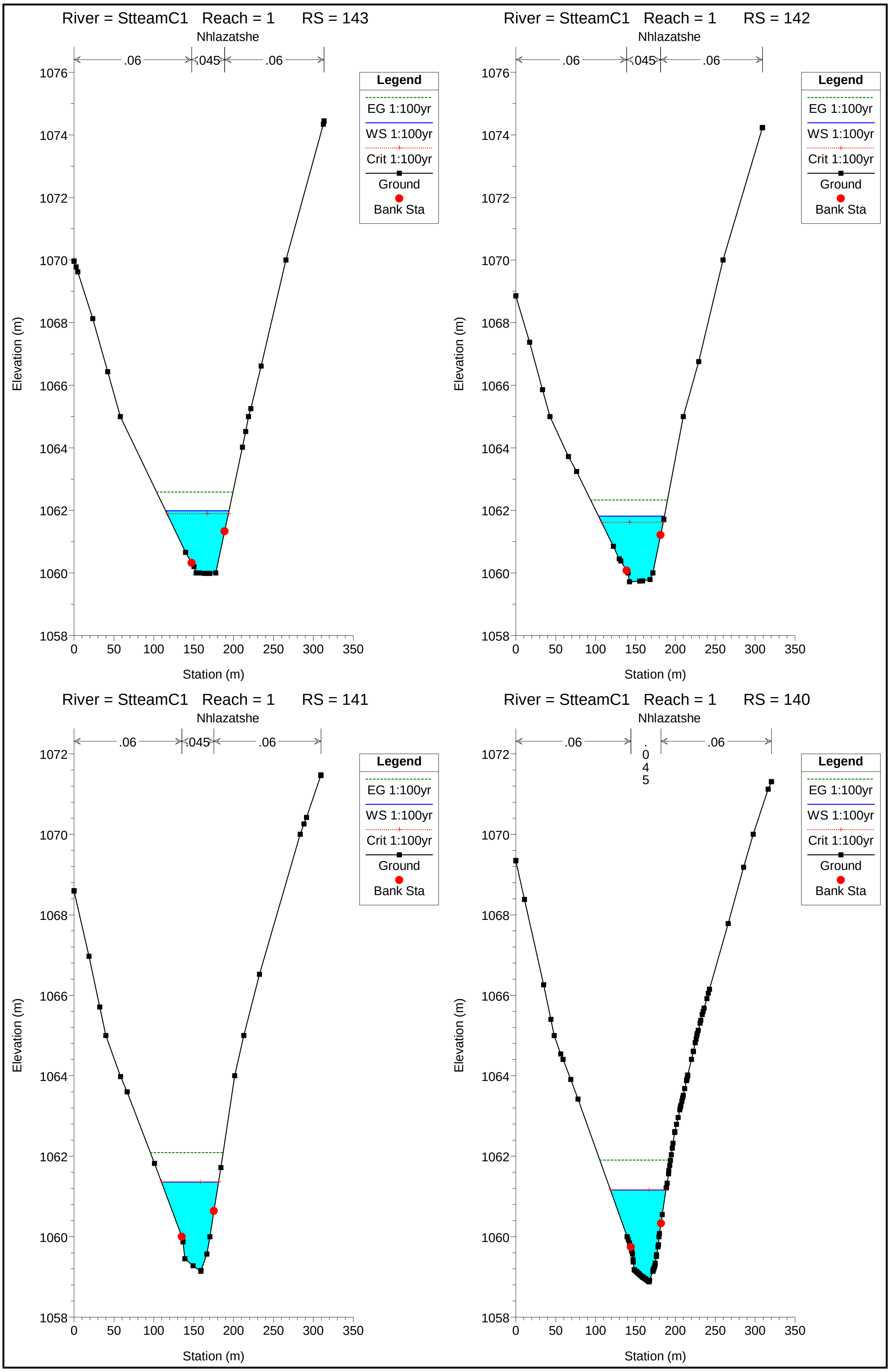

River = StteamC1 Reach = 1 RS = 153
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1064
1066
1068
1070
1072
1074
1076
1078
1080
0
50
100
150
200
250
300
350

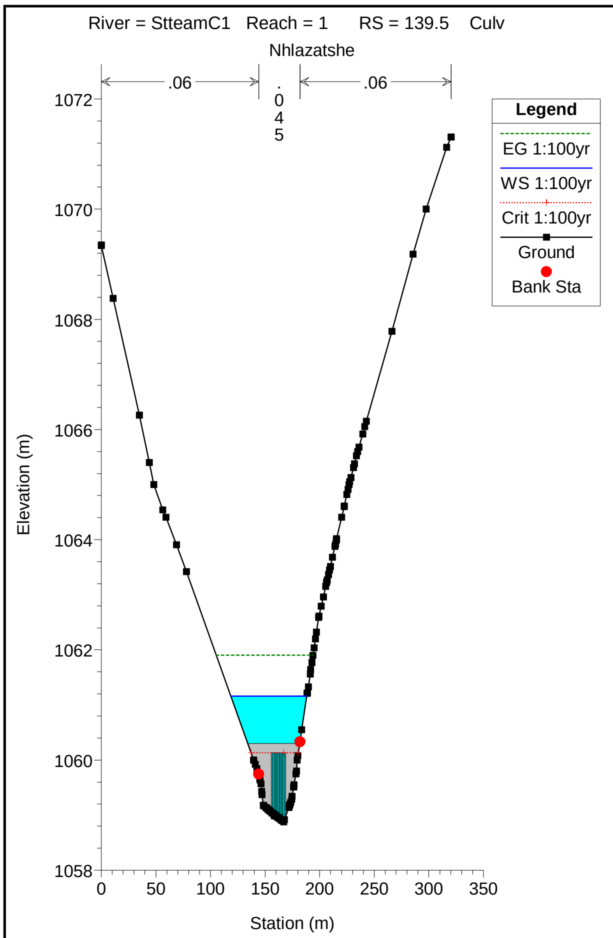

River = StteamC1 Reach = 1 RS = 152
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1064
1066
1068
1070
1072
1074
1076
1078
1080
0
50
100
150
200
250
300
350

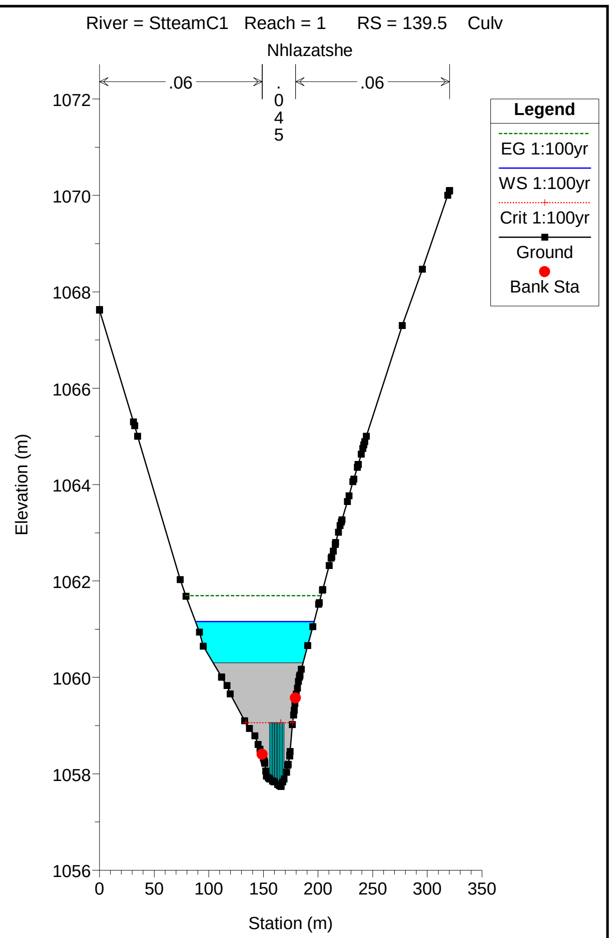


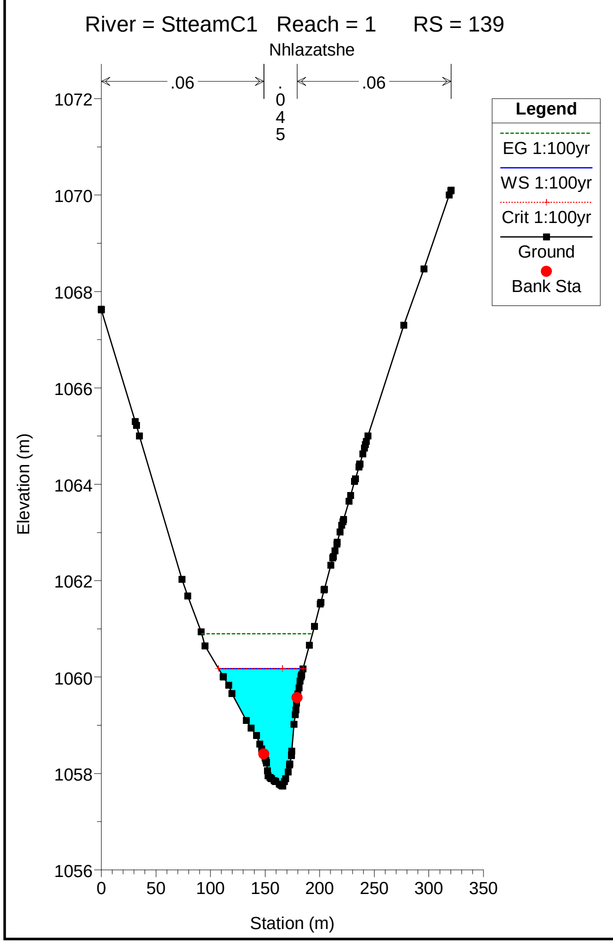
River = StteamC1 Reach = 1 RS = 151
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1062
1064
1066
1068
1070
1072
1074
1076
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 150
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1062
1064
1066
1068
1070
1072
1074
1076
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 149
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1062
1064
1066
1068
1070
1072
1074
Station (m)
0
50
100
150
200
250
300
River = StteamC1 Reach = 1 RS = 148
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1060
1062
1064
1066
1068
1070
1072
1074
Station (m)
0
50
100
150
200
250
300

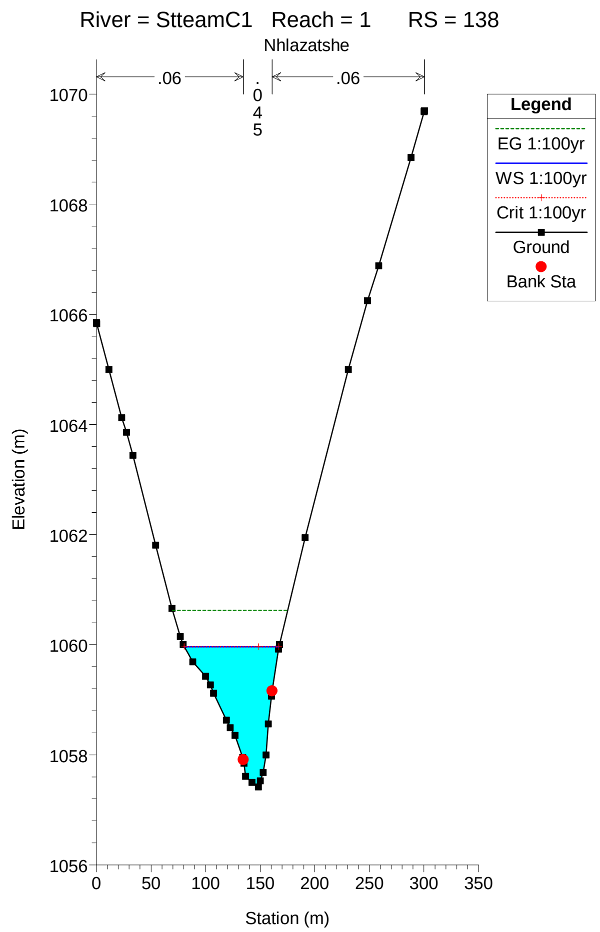

River = StteamC1 Reach = 1 RS = 147
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 146
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 145
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 144
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

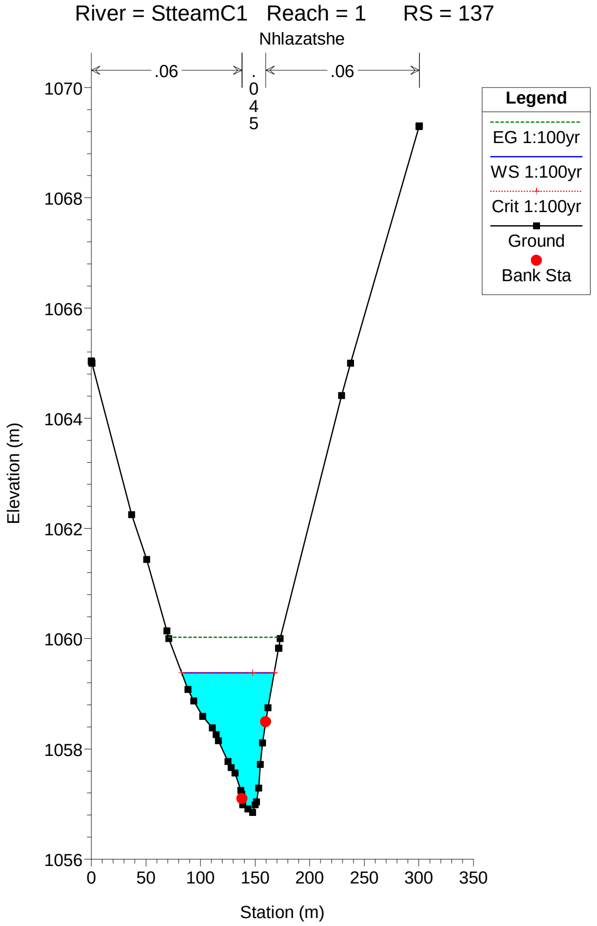

River = SteamC1 Reach = 1 RS = 143
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 142
Nhlazatshe
River = SteamC1 Reach = 1 RS = 141
Nhlazatshe
River = SteamC1 Reach = 1 RS = 140
Nhlazatshe

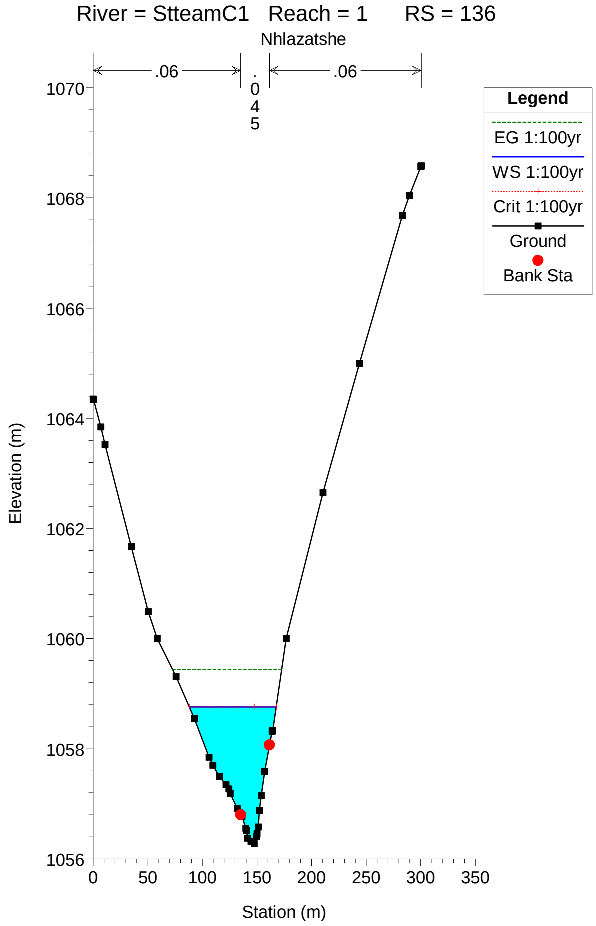

River = SteamC1 Reach = 1 RS = 139.5 Culv
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1058
1060
1062
1064
1066
1068
1070
1072
0
50
100
150
200
250
300
350

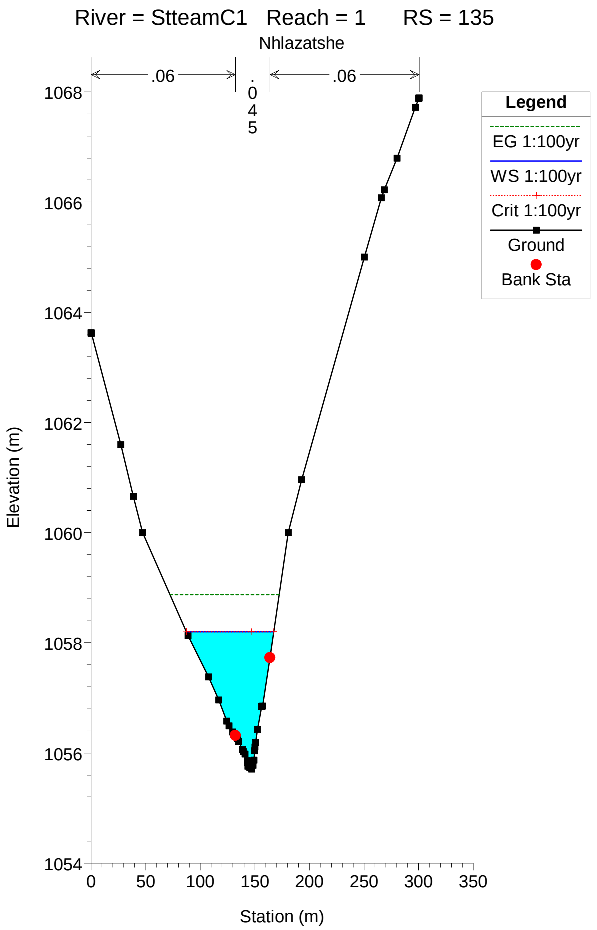

River = SteamC1 Reach = 1 RS = 139.5 Culv
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1056
1058
1060
1062
1064
1066
1068
1070
1072
0
50
100
150
200
250
300
350

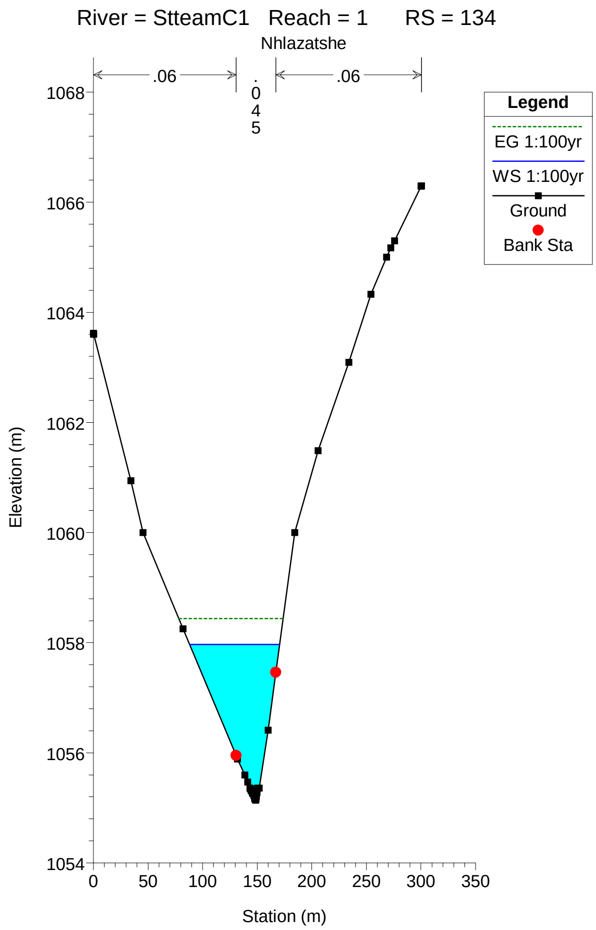

River = SteamC1 Reach = 1 RS = 139
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1056
1058
1060
1062
1064
1066
1068
1070
1072
0
50
100
150
200
250
300
350

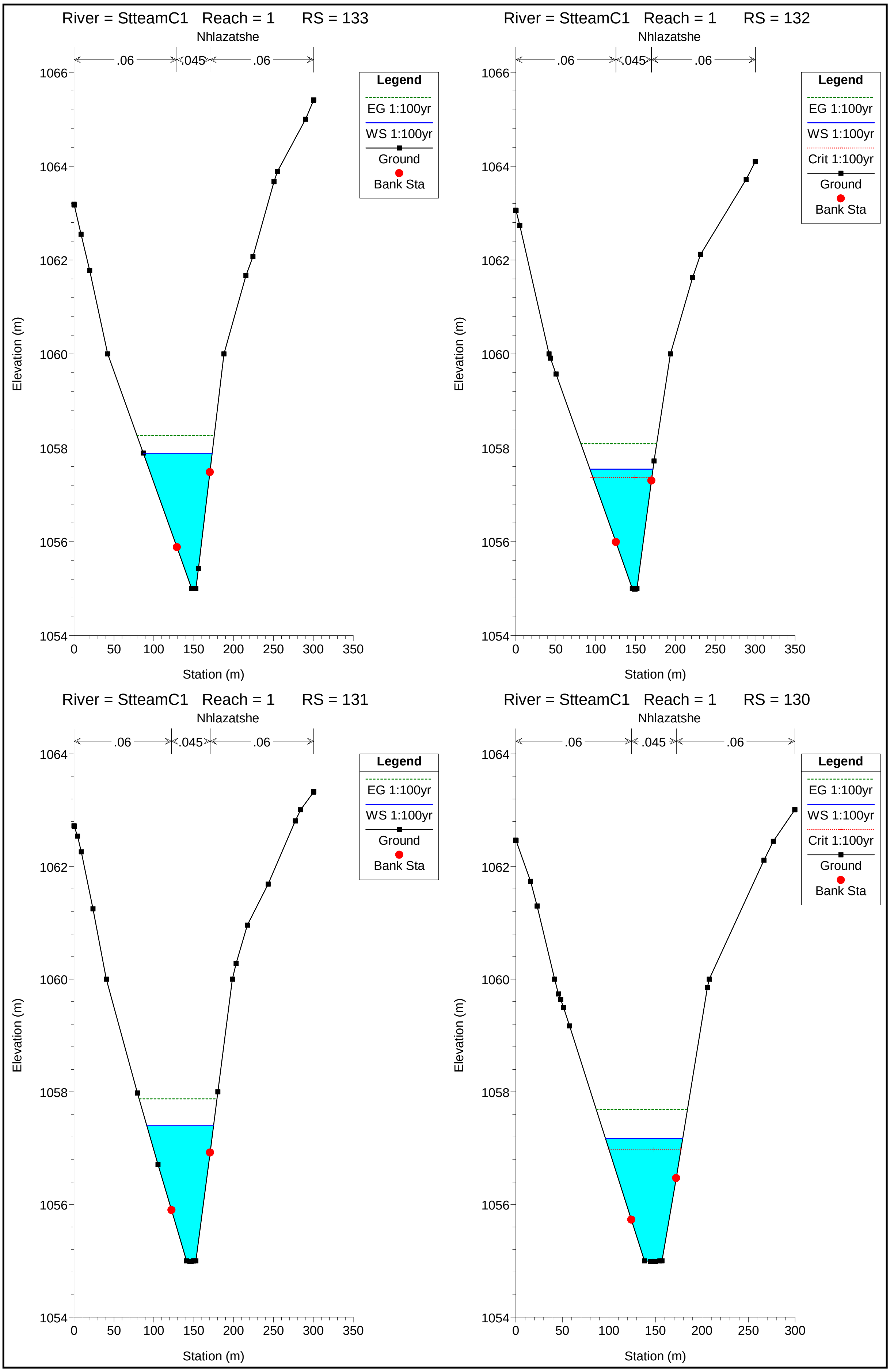

River = SteamC1 Reach = 1 RS = 138
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1056
1058
1060
1062
1064
1066
1068
1070
0
50
100
150
200
250
300
350


River = StteamC1 Reach = 1 RS = 137
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

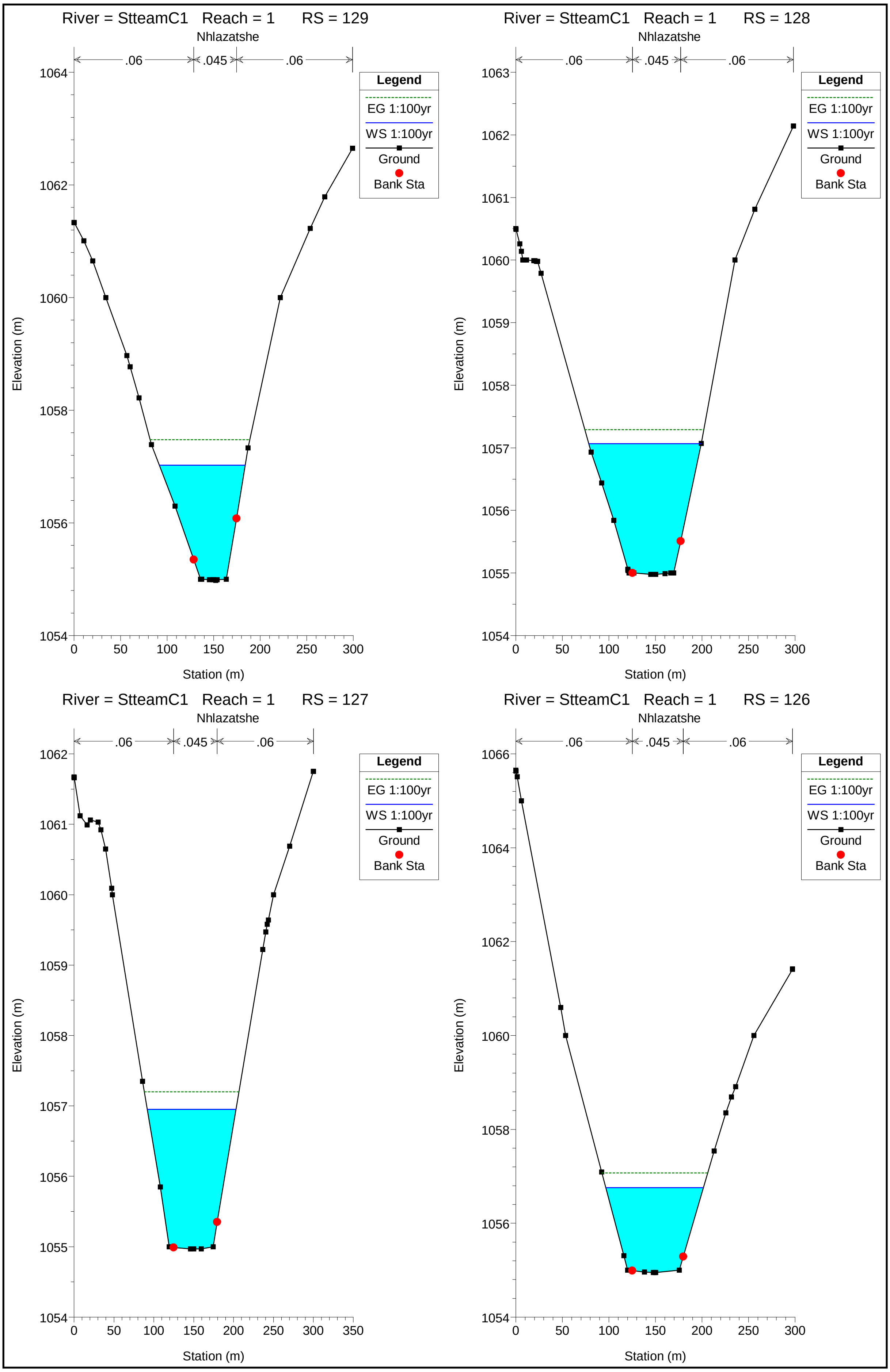

River = StteamC1 Reach = 1 RS = 136
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = StteamC1 Reach = 1 RS = 135
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

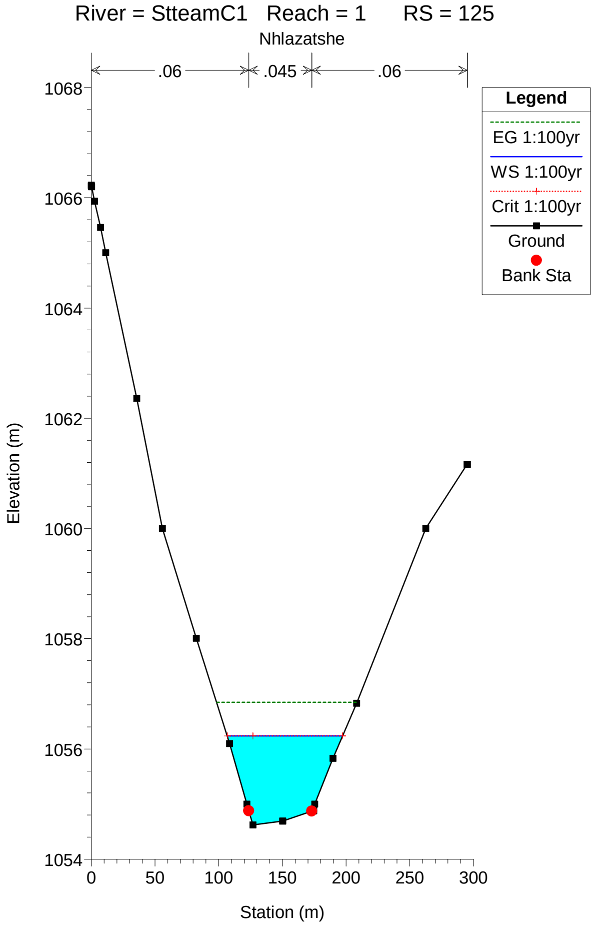

River = StteamC1 Reach = 1 RS = 134
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

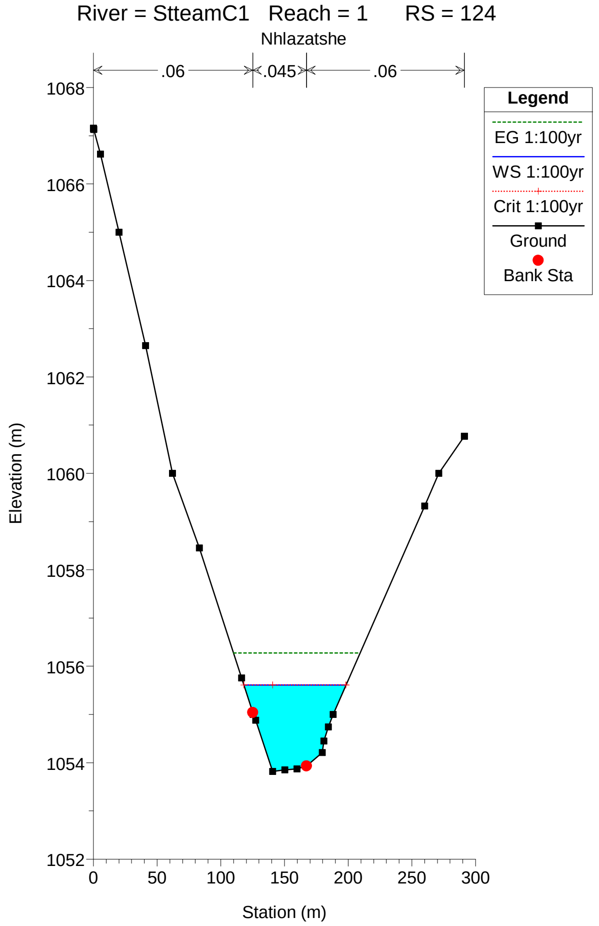


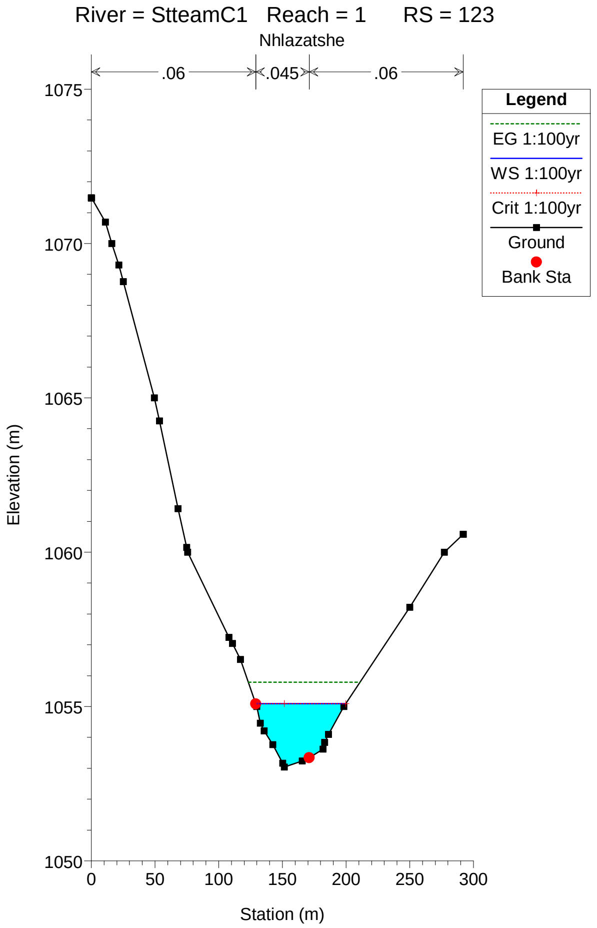
River = StteamC1 Reach = 1 RS = 133
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
1066
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 132
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
1066
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 131
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
Station (m)
0
50
100
150
200
250
300
350
River = StteamC1 Reach = 1 RS = 130
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
Station (m)
0
50
100
150
200
250
300

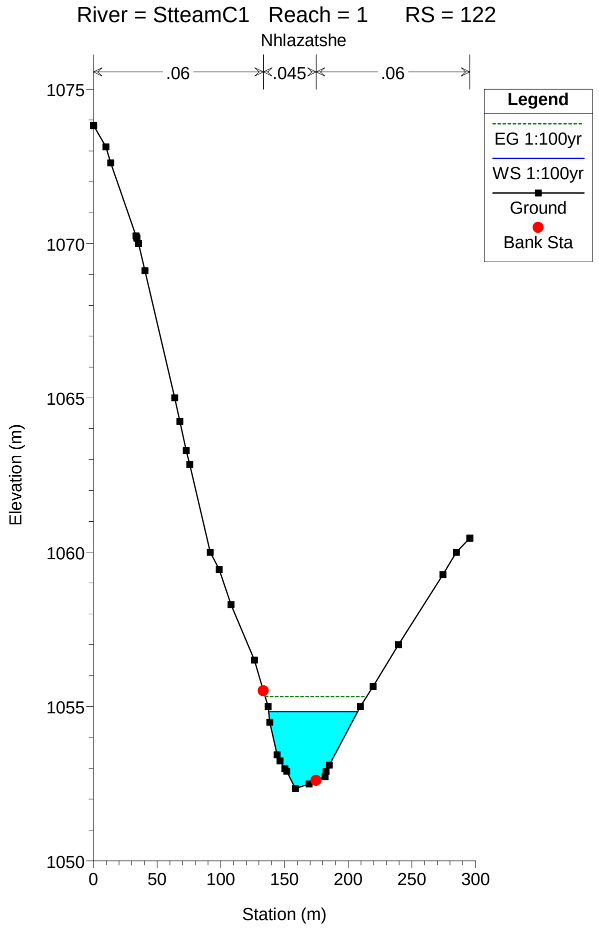


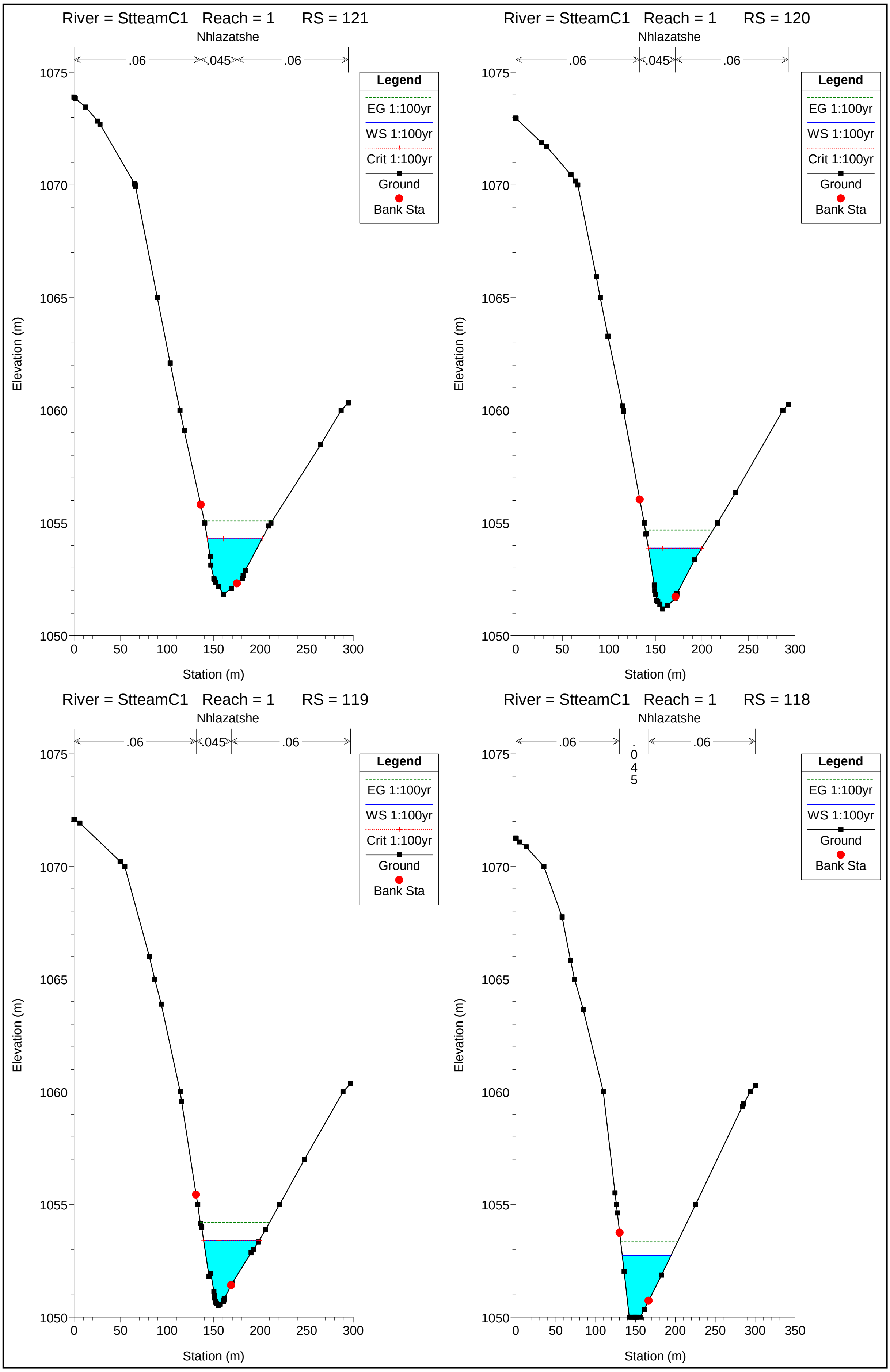
River = StteamC1 Reach = 1 RS = 129
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 128
Nhlazatshe
River = StteamC1 Reach = 1 RS = 127
Nhlazatshe
River = StteamC1 Reach = 1 RS = 126
Nhlazatshe

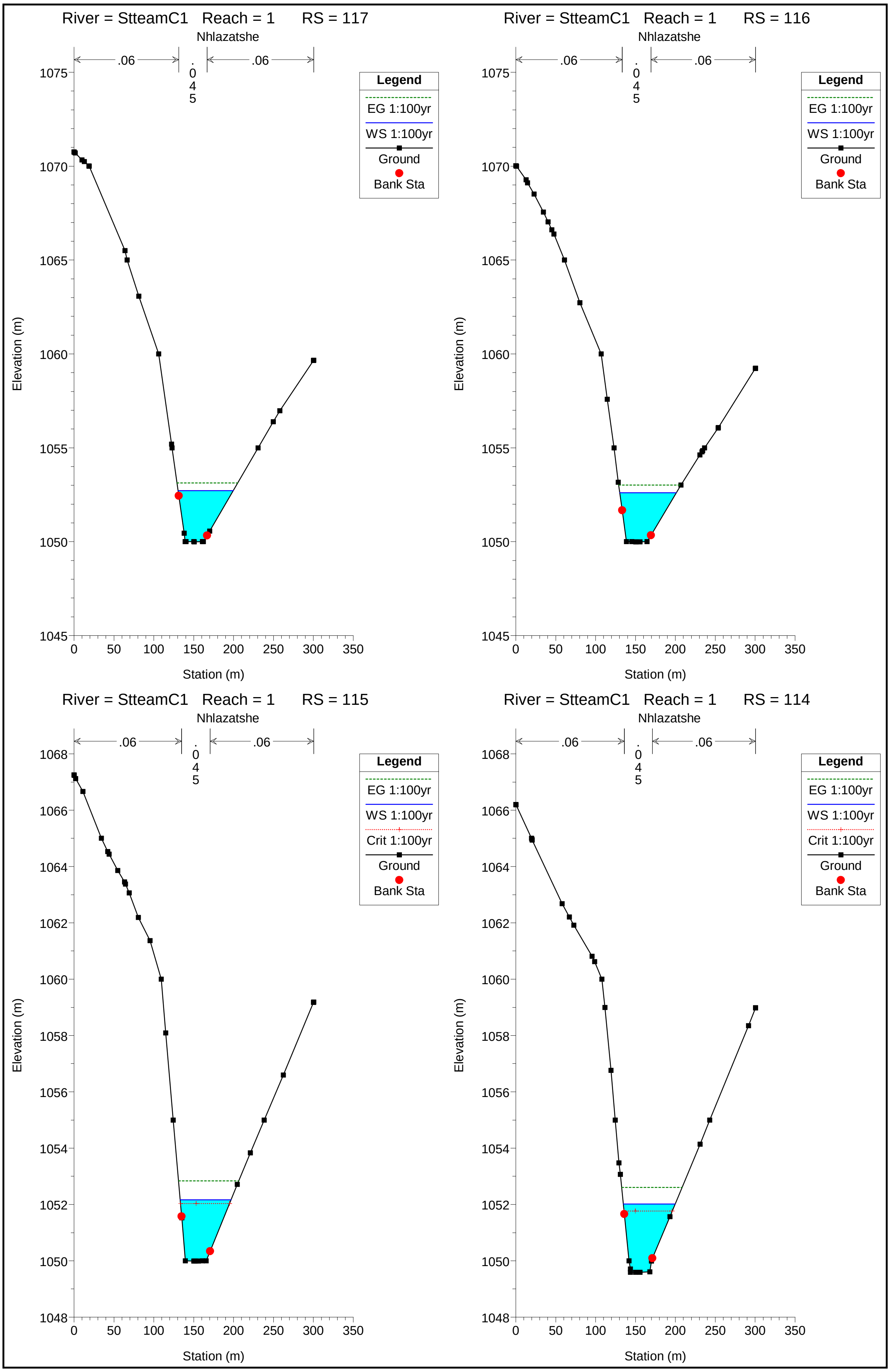

River = StteamC1 Reach = 1 RS = 125
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1054
1056
1058
1060
1062
1064
1066
1068
0
50
100
150
200
250
300
Station (m)


River = StteamC1 Reach = 1 RS = 124
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1052
1054
1056
1058
1060
1062
1064
1066
1068
0
50
100
150
200
250
300
Station (m)

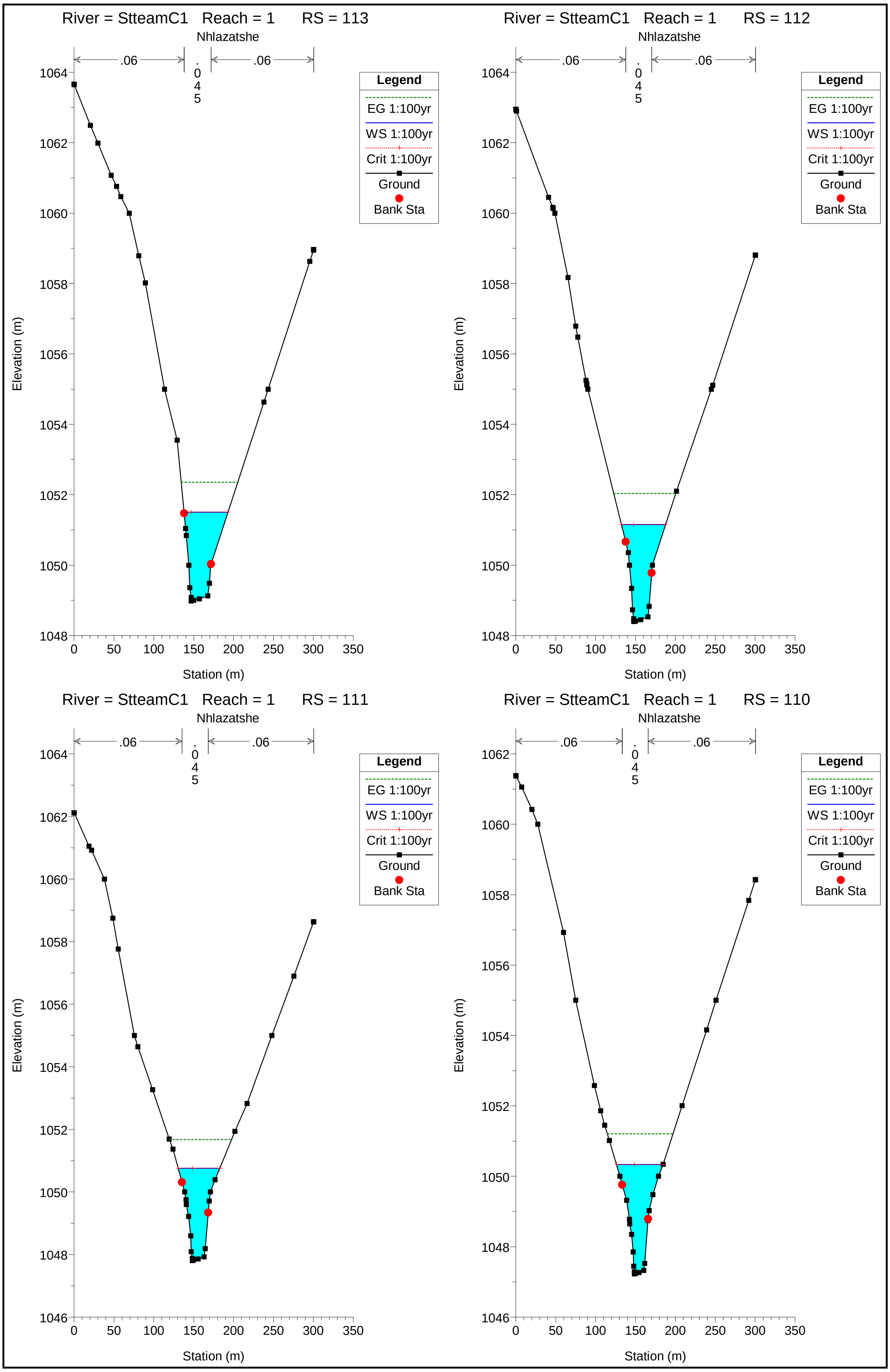

River = StteamC1 Reach = 1 RS = 123
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1050
1055
1060
1065
1070
1075
0
50
100
150
200
250
300
Station (m)

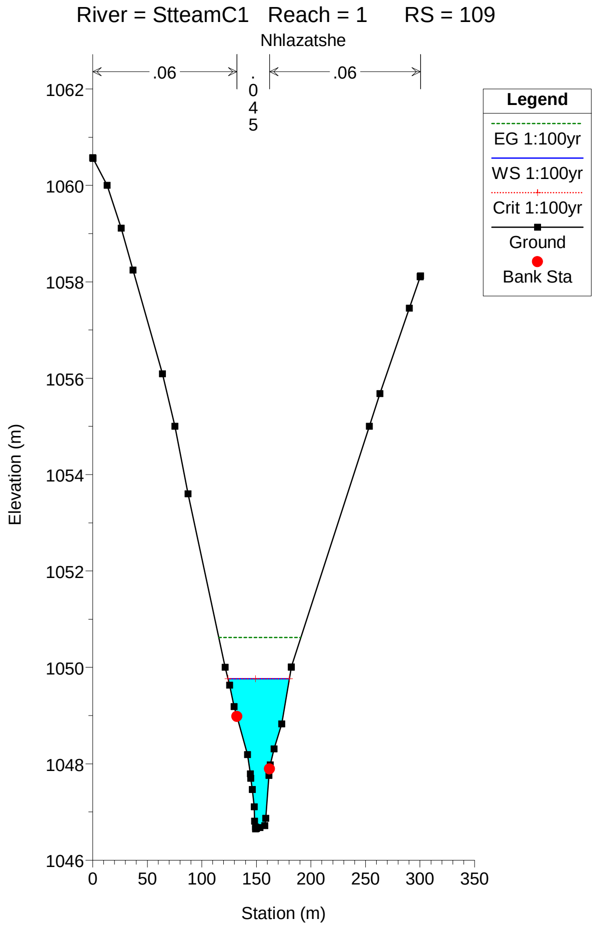

River = StteamC1 Reach = 1 RS = 122
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1050
1055
1060
1065
1070
1075
0
50
100
150
200
250
300
Station (m)

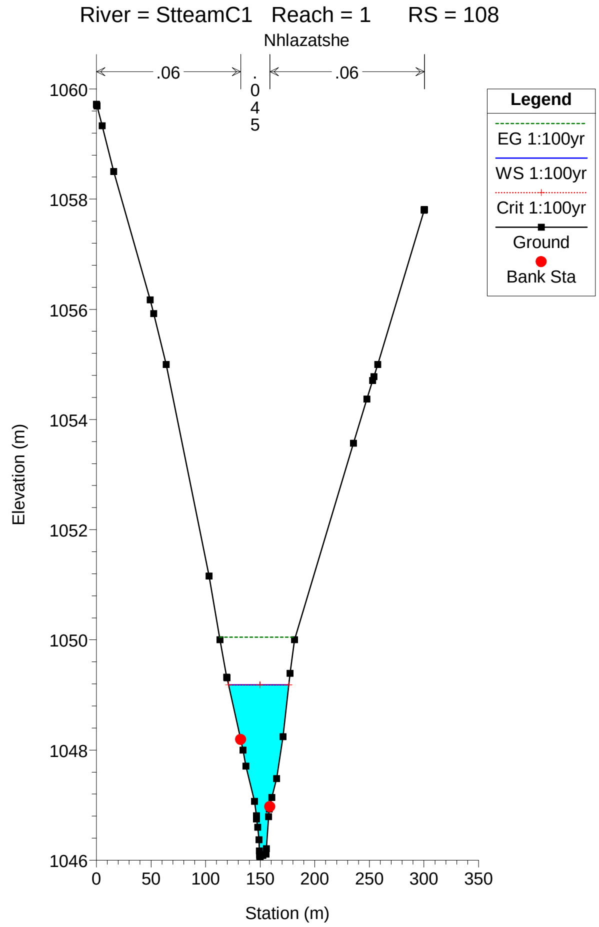

River = SteamC1 Reach = 1 RS = 121
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1050
1055
1060
1065
1070
1075
Station (m)
0
50
100
150
200
250
300
River = SteamC1 Reach = 1 RS = 120
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 119
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = SteamC1 Reach = 1 RS = 118
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
350

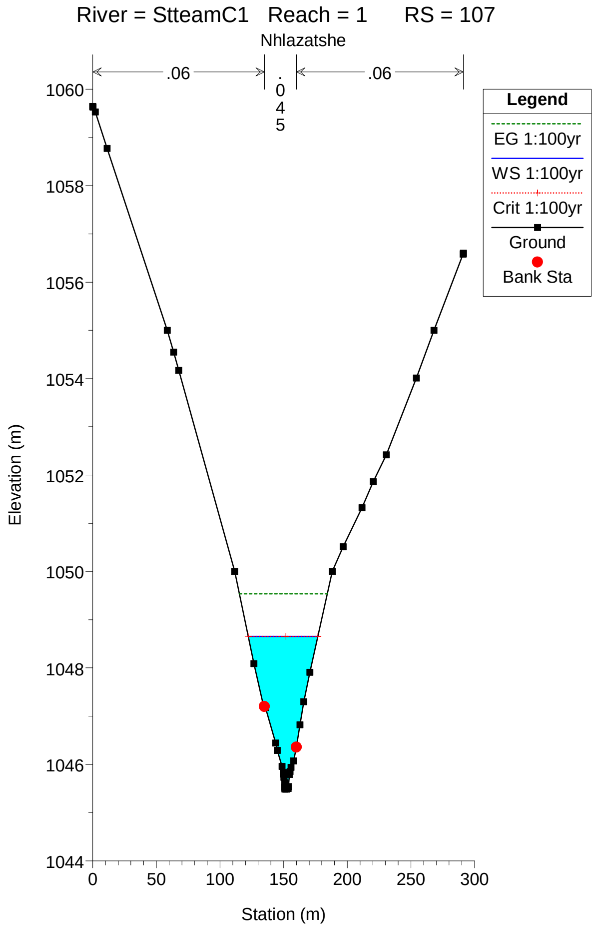


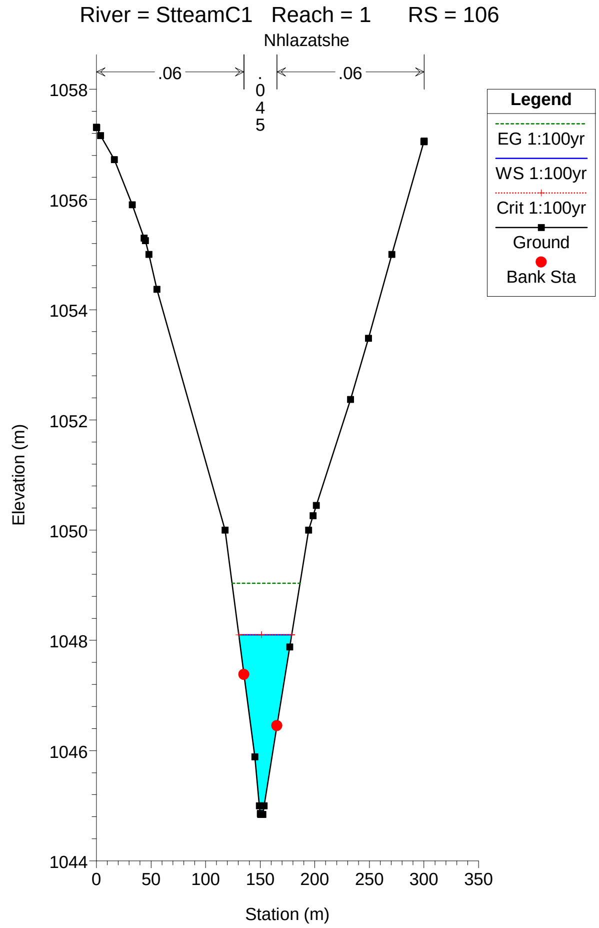
River = StteamC1 Reach = 1 RS = 117
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 116
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 115
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 114
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

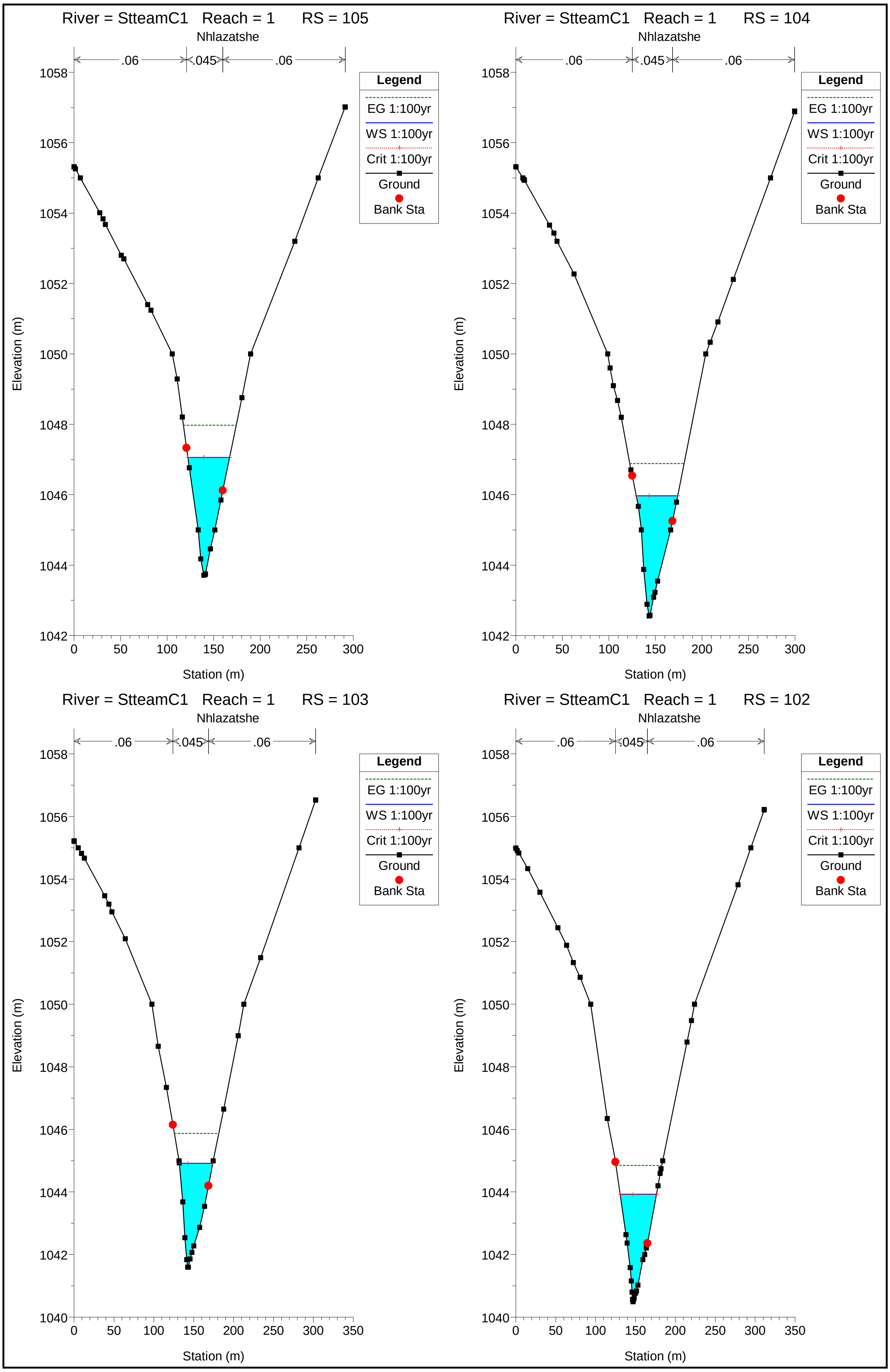

River = StteamC1 Reach = 1 RS = 113
Nhlazatshe
River = StteamC1 Reach = 1 RS = 112
Nhlazatshe
River = StteamC1 Reach = 1 RS = 111
Nhlazatshe
River = StteamC1 Reach = 1 RS = 110
Nhlazatshe
.06
.045
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = StteamC1 Reach = 1 RS = 109
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1046
1048
1050
1052
1054
1056
1058
1060
1062
Station (m)
0
50
100
150
200
250
300
350

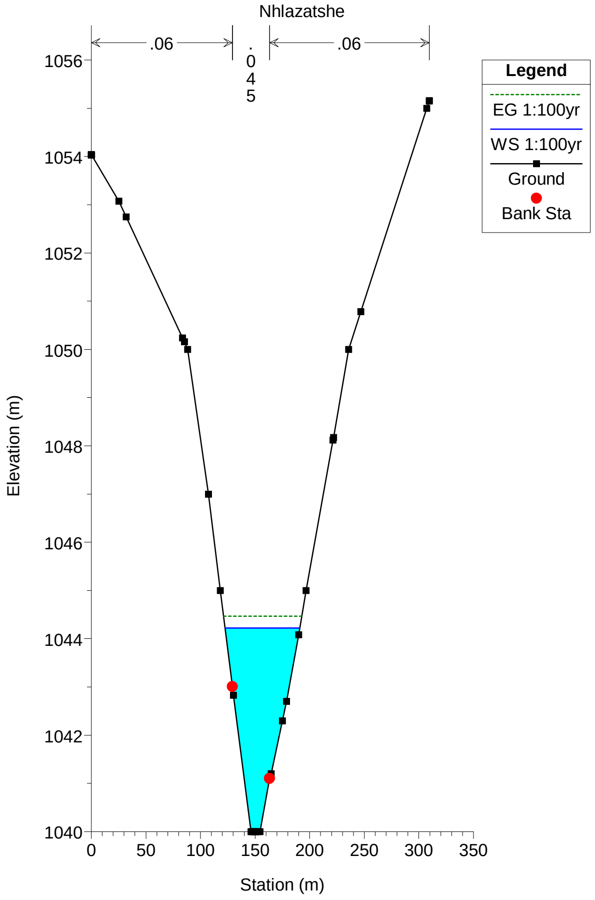

River = StteamC1 Reach = 1 RS = 108
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1046
1048
1050
1052
1054
1056
1058
1060
Station (m)
0
50
100
150
200
250
300
350

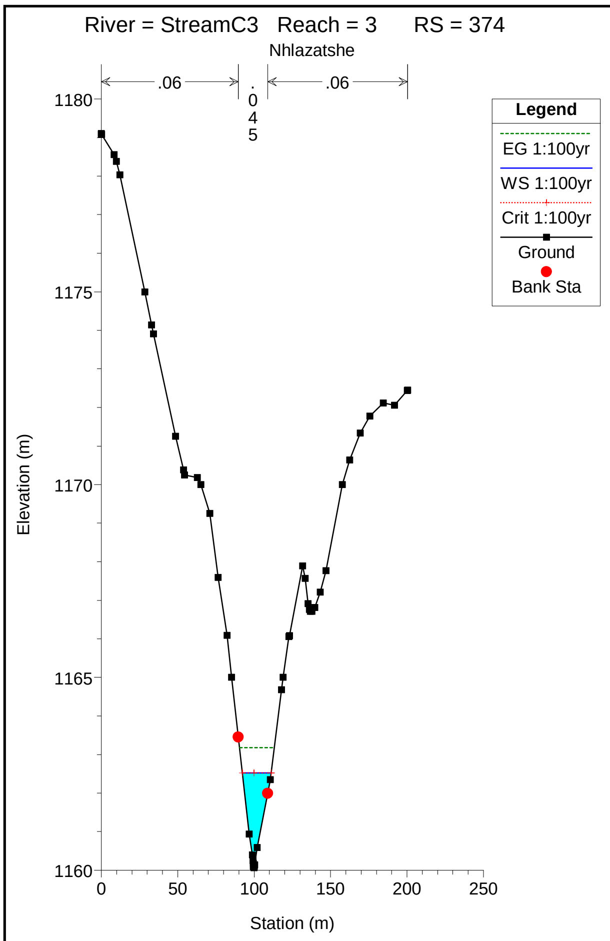

River = StteamC1 Reach = 1 RS = 107
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1044
1046
1048
1050
1052
1054
1056
1058
1060
Station (m)
0
50
100
150
200
250
300

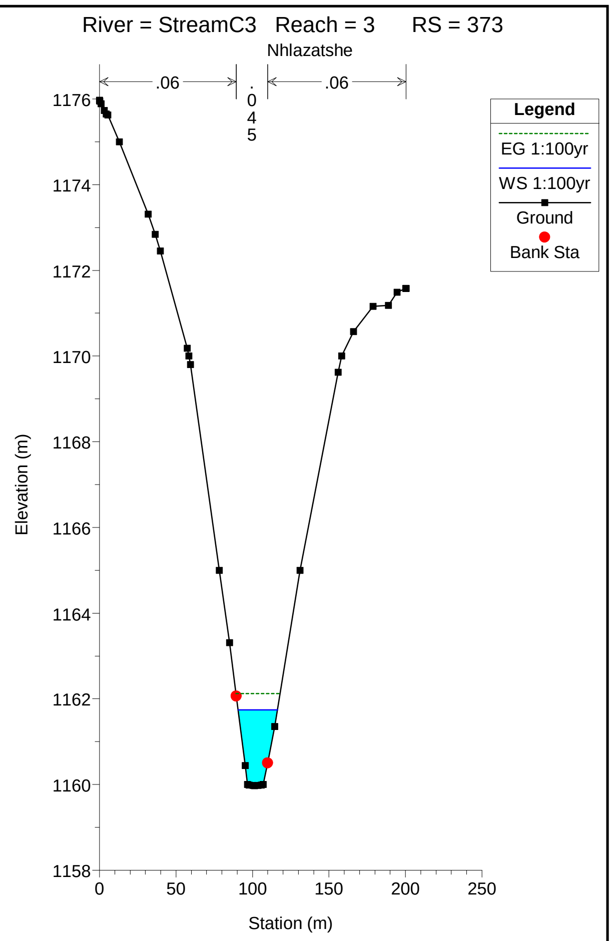

River = StteamC1 Reach = 1 RS = 106
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1044
1046
1048
1050
1052
1054
1056
1058
Station (m)
0
50
100
150
200
250
300
350

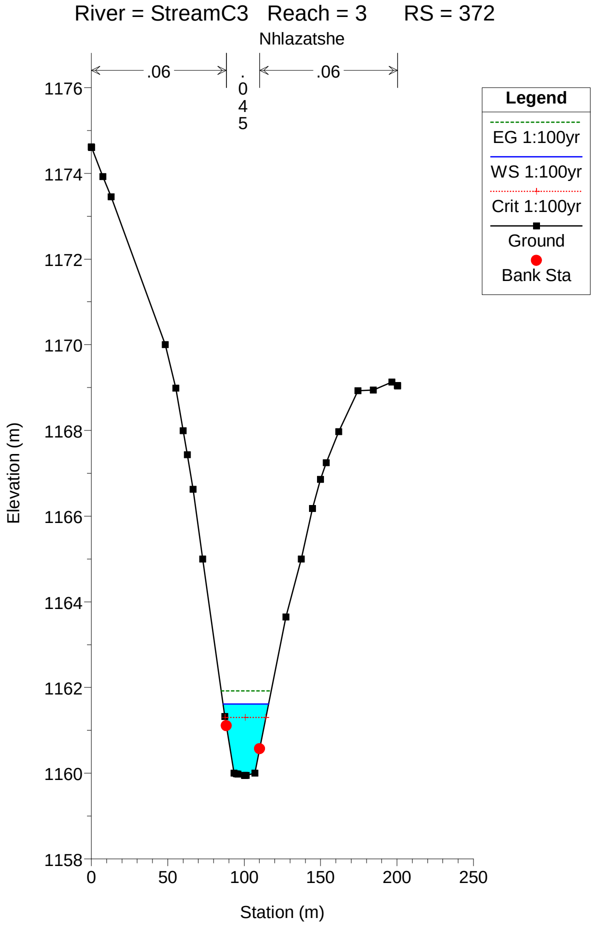

River = StteamC1 Reach = 1 RS = 105
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 104
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 103
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StteamC1 Reach = 1 RS = 102
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

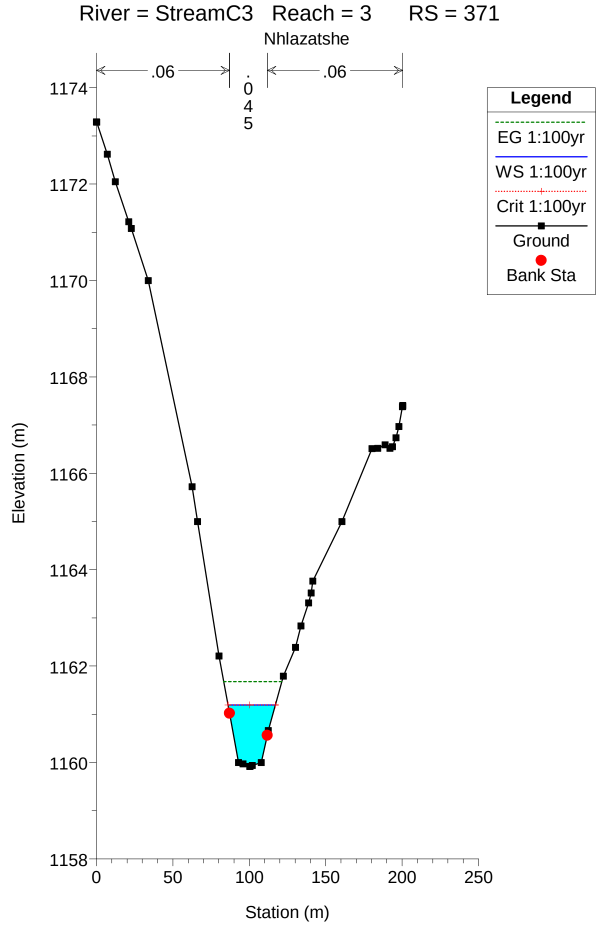
River = StteamC1 Reach = 1 RS = 101

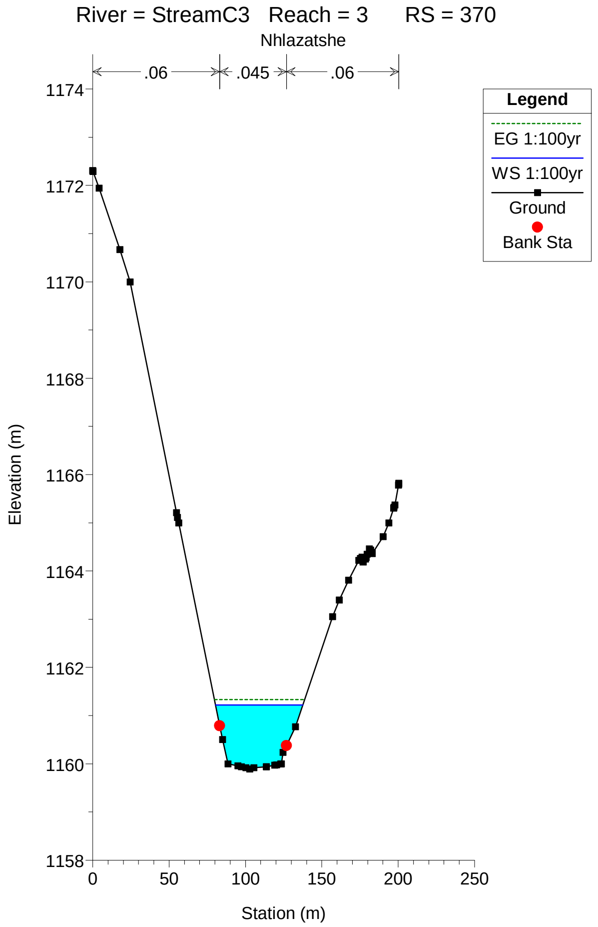


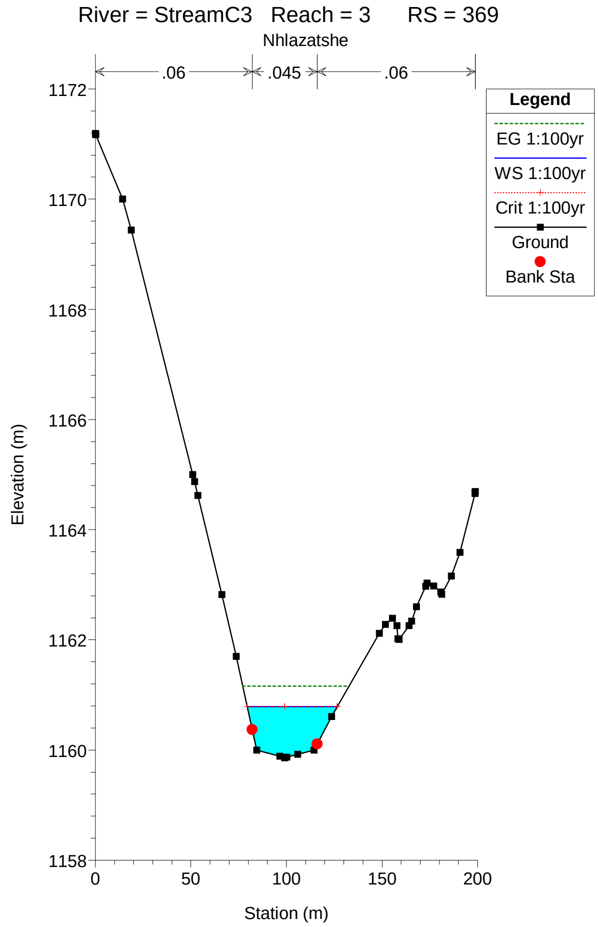

River = StreamC3 Reach = 3 RS = 374
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1160
1165
1170
1175
1180
Station (m)
0
50
100
150
200
250

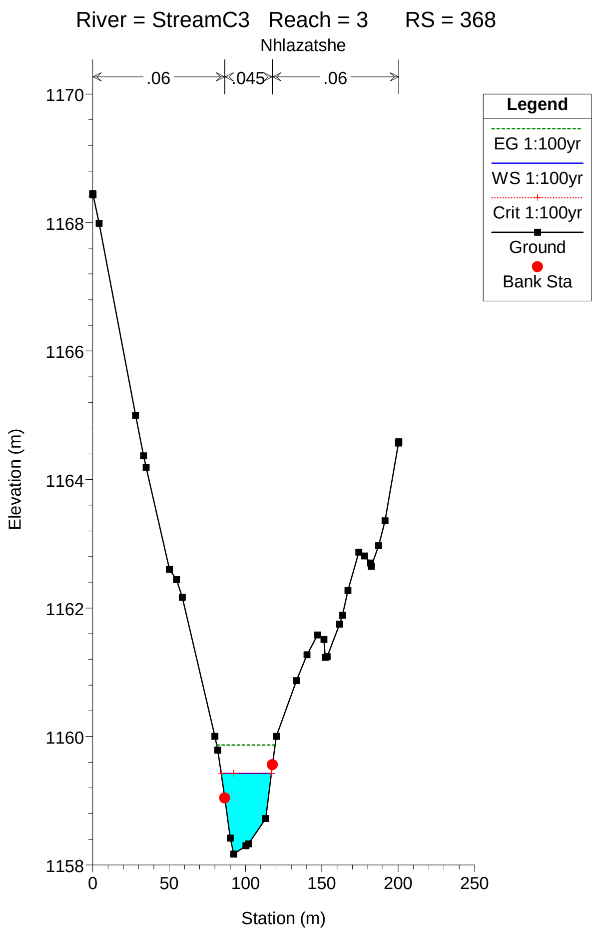

River = StreamC3 Reach = 3 RS = 373
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1158
1160
1162
1164
1166
1168
1170
1172
1174
1176
Station (m)
0
50
100
150
200
250

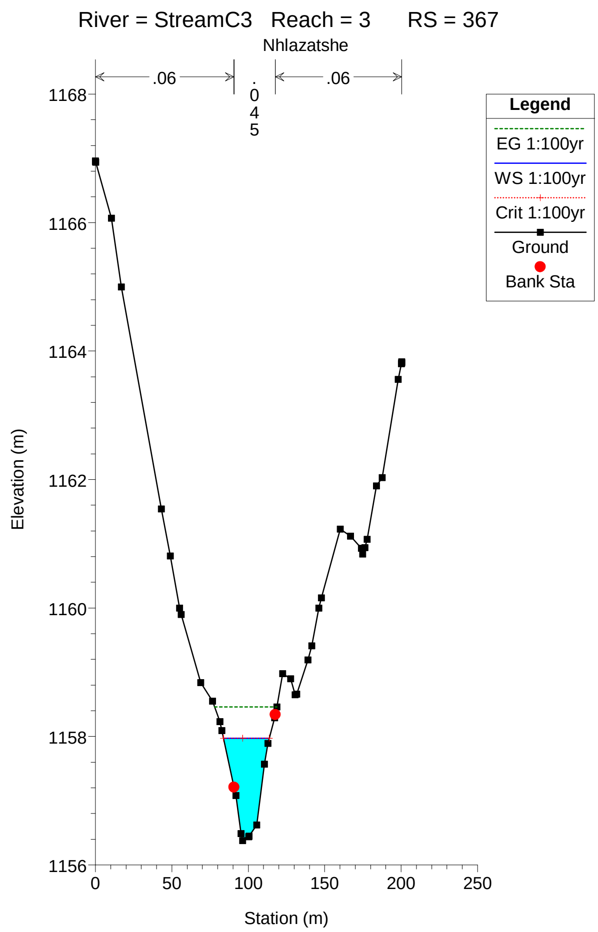

River = StreamC3 Reach = 3 RS = 372
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1158
1160
1162
1164
1166
1168
1170
1172
1174
1176
Station (m)
0
50
100
150
200
250

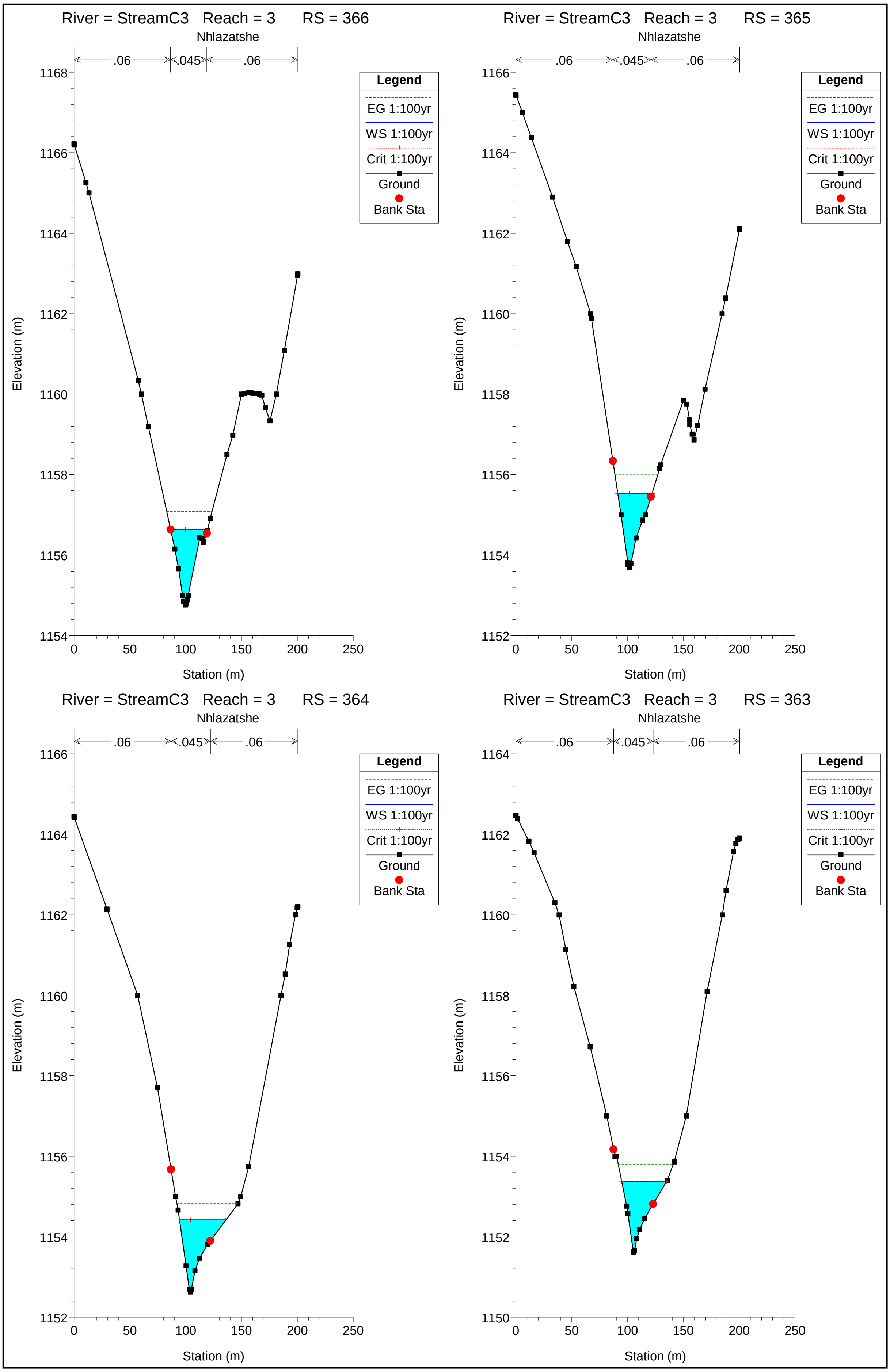

River = StreamC3 Reach = 3 RS = 371
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1158
1160
1162
1164
1166
1168
1170
1172
1174
Station (m)
0
50
100
150
200
250

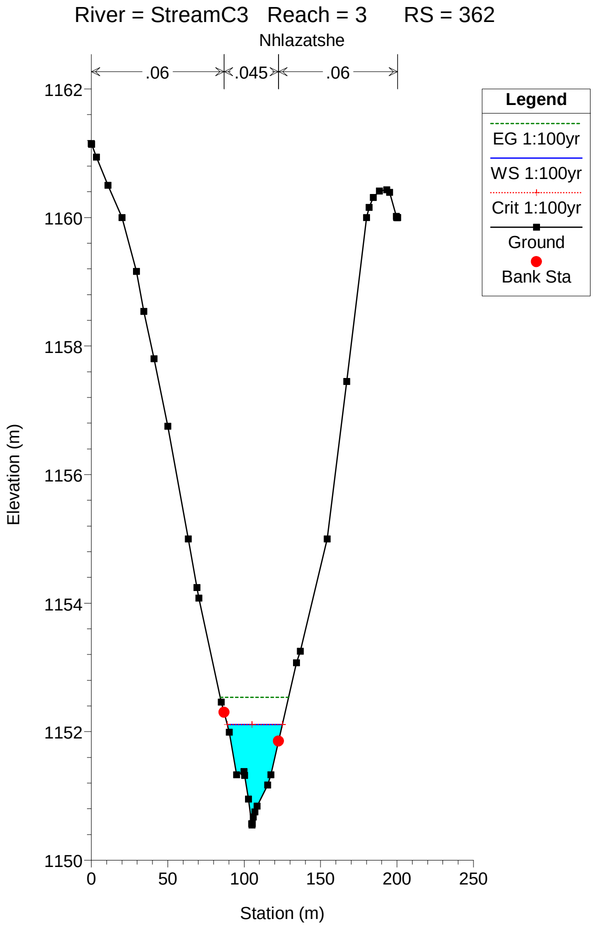

River = StreamC3 Reach = 3 RS = 370
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1158
1160
1162
1164
1166
1168
1170
1172
1174
0
50
100
150
200
250

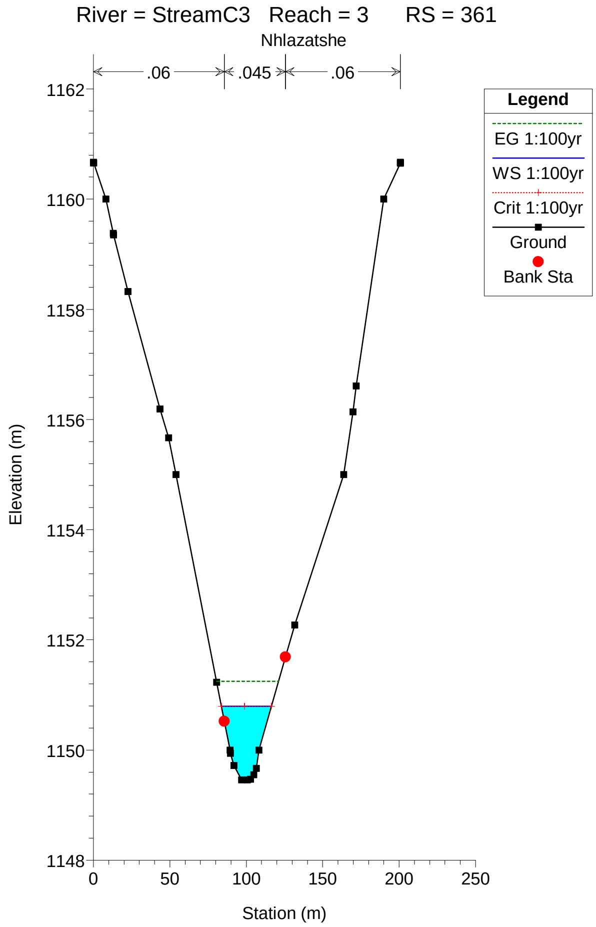

River = StreamC3 Reach = 3 RS = 369
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1158
1160
1162
1164
1166
1168
1170
1172
0
50
100
150
200

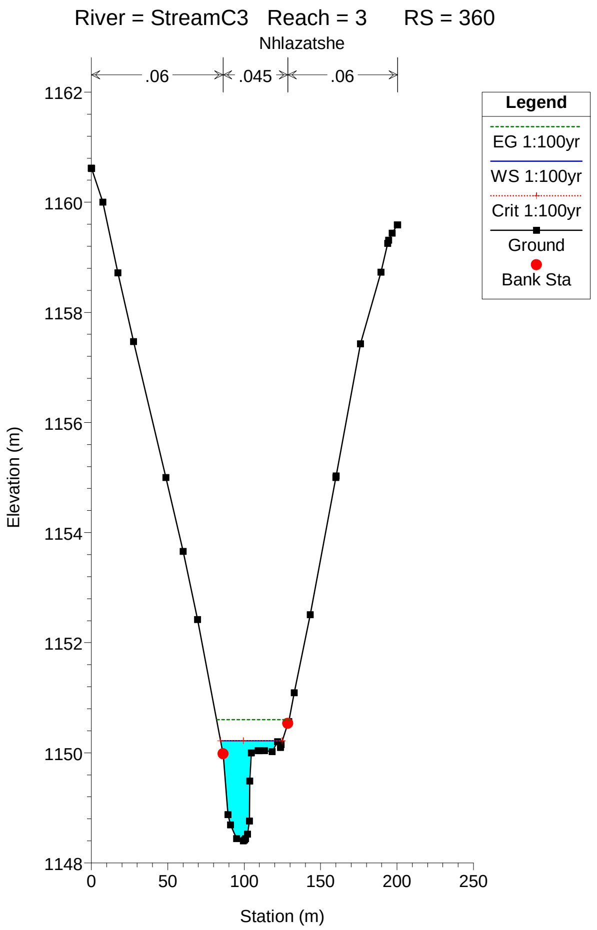

River = StreamC3 Reach = 3 RS = 368
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1158
1160
1162
1164
1166
1168
1170
0
50
100
150
200
250

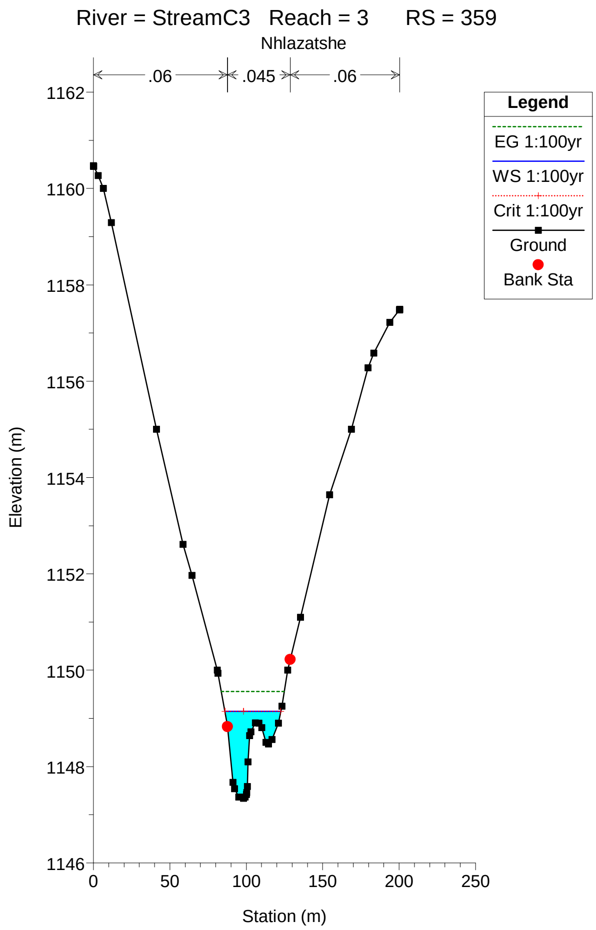

River = StreamC3 Reach = 3 RS = 367
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1156
1158
1160
1162
1164
1166
1168
0
50
100
150
200
250

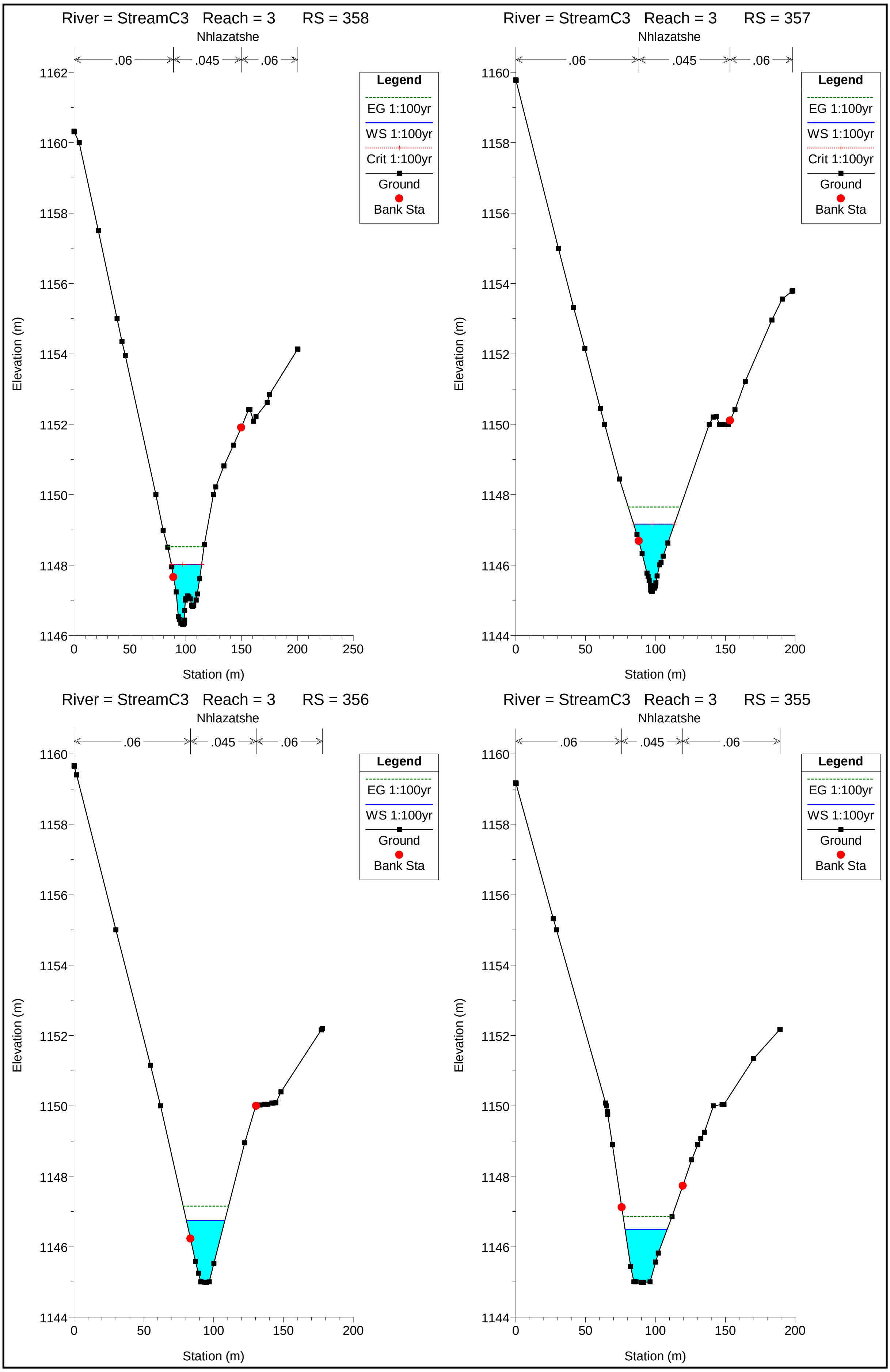

River = StreamC3 Reach = 3 RS = 366
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 365
Nhlazatshe
River = StreamC3 Reach = 3 RS = 364
Nhlazatshe
River = StreamC3 Reach = 3 RS = 363
Nhlazatshe

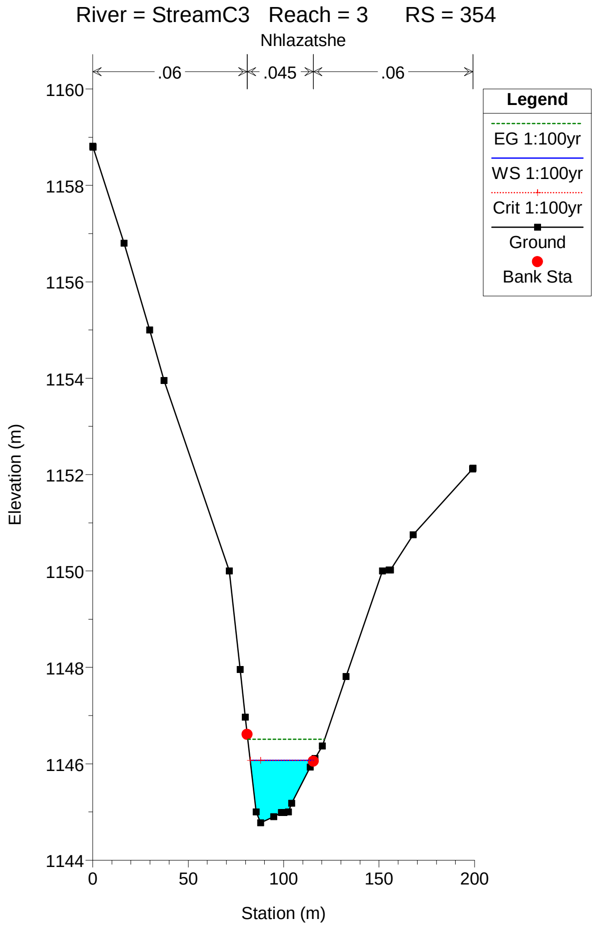

River = StreamC3 Reach = 3 RS = 362
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1162
1160
1158
1156
1154
1152
1150
0
50
100
150
200
250
Station (m)

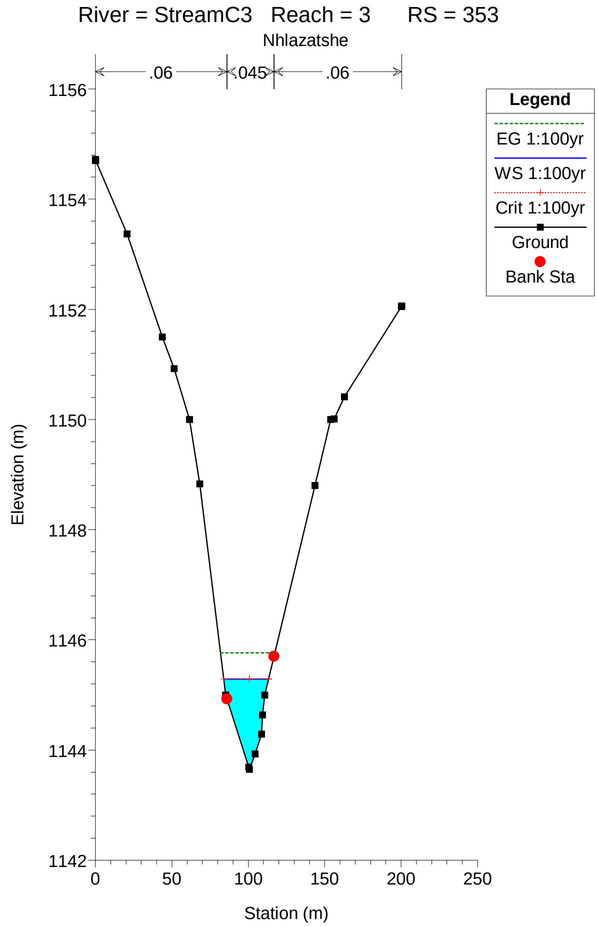

River = StreamC3 Reach = 3 RS = 361
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1162
1160
1158
1156
1154
1152
1150
1148
0
50
100
150
200
250
Station (m)

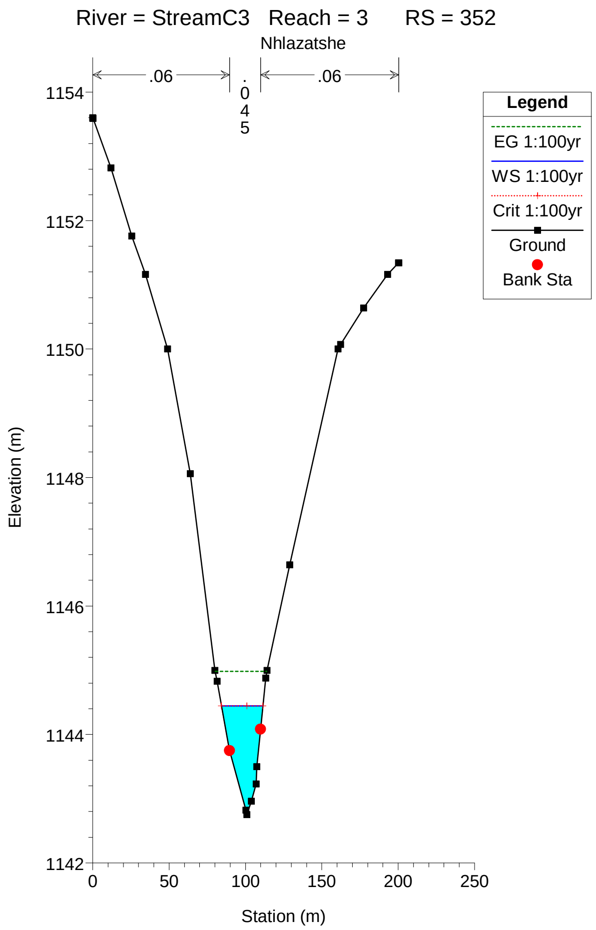

River = StreamC3 Reach = 3 RS = 360
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1162
1160
1158
1156
1154
1152
1150
1148
0
50
100
150
200
250
Station (m)

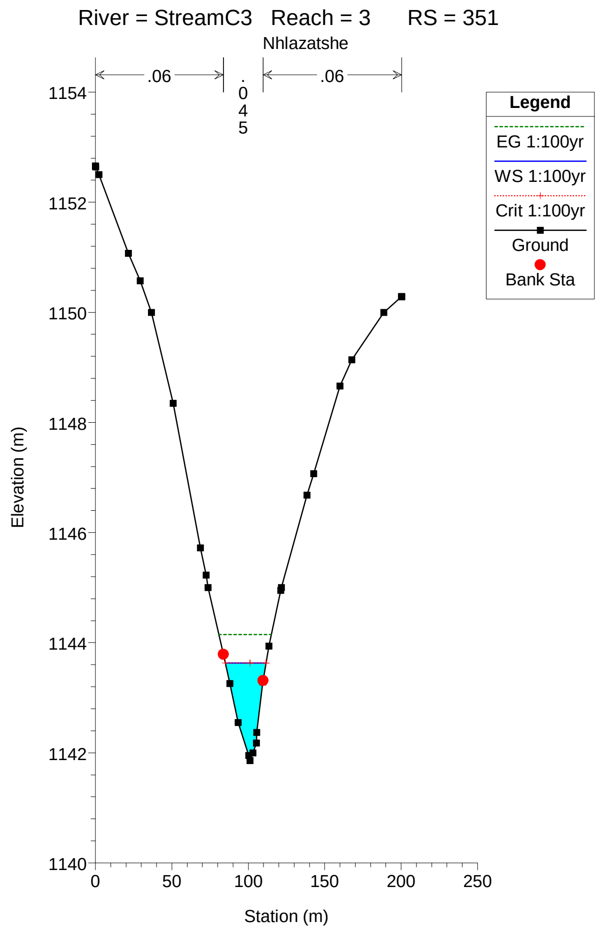

River = StreamC3 Reach = 3 RS = 359
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1162
1160
1158
1156
1154
1152
1150
1148
1146
0
50
100
150
200
250
Station (m)

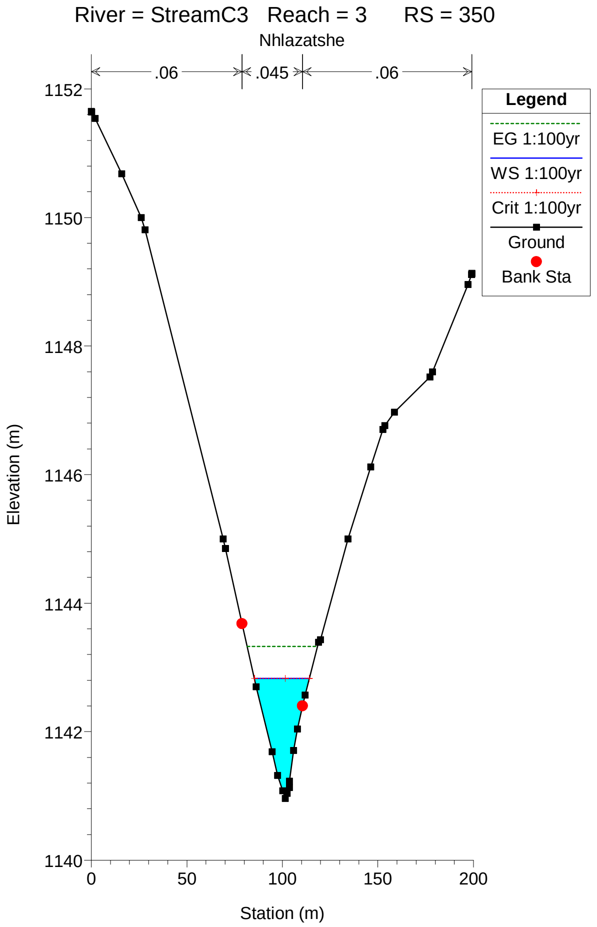

River = StreamC3 Reach = 3 RS = 358
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 357
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 356
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 355
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

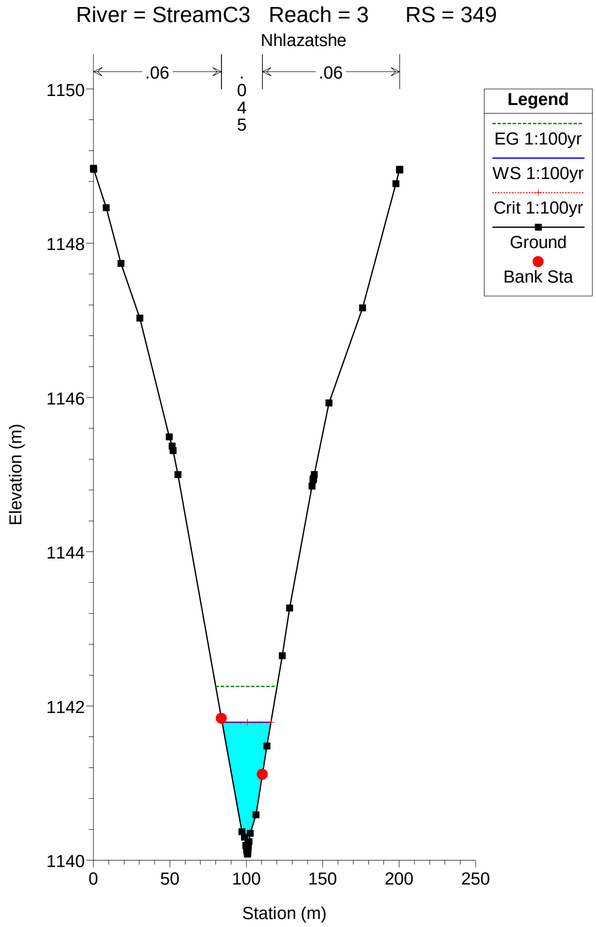

River = StreamC3 Reach = 3 RS = 354
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1144
1146
1148
1150
1152
1154
1156
1158
1160
0
50
100
150
200
Station (m)

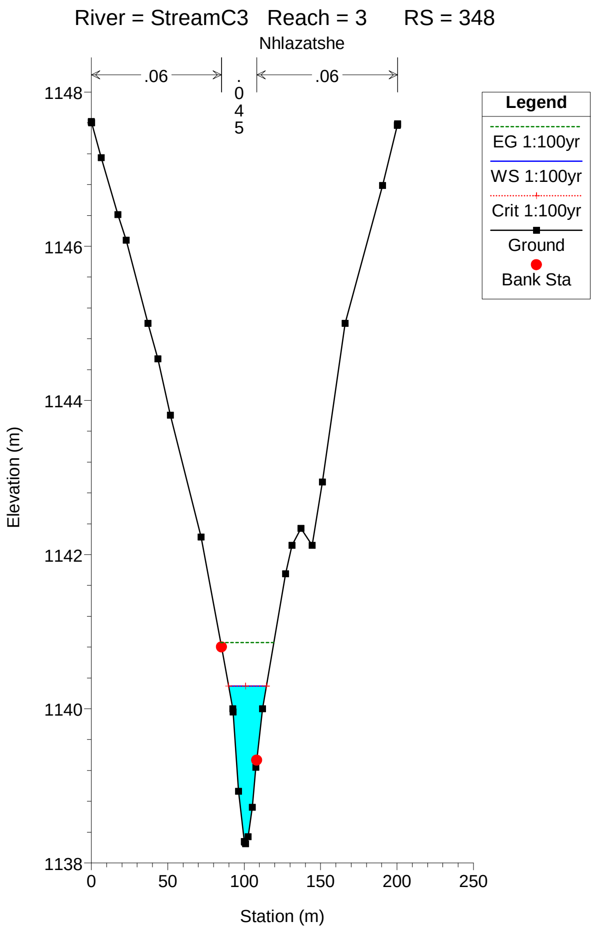

River = StreamC3 Reach = 3 RS = 353
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1142
1144
1146
1148
1150
1152
1154
1156
0
50
100
150
200
250
Station (m)

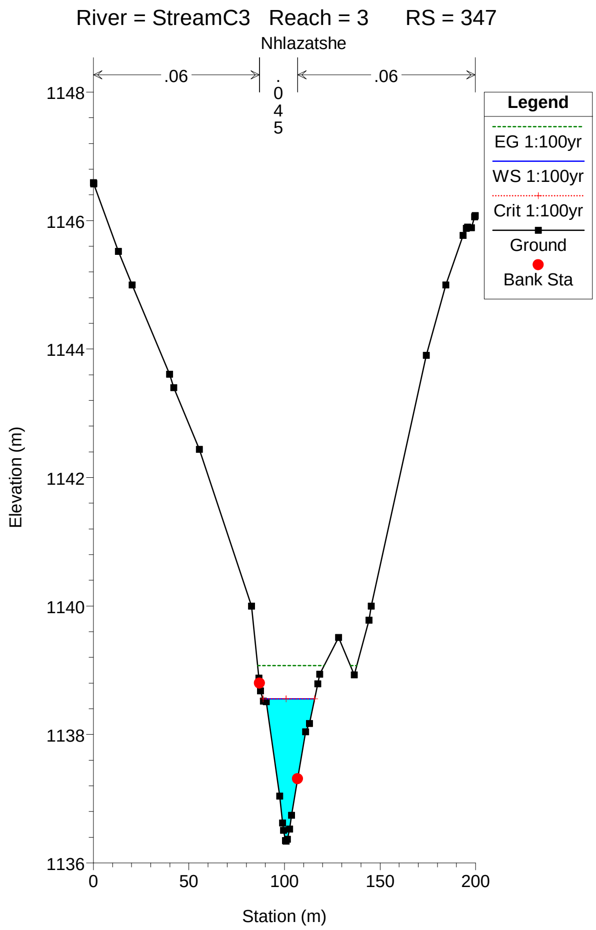

River = StreamC3 Reach = 3 RS = 352
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1142
1144
1146
1148
1150
1152
1154
0
50
100
150
200
250
Station (m)

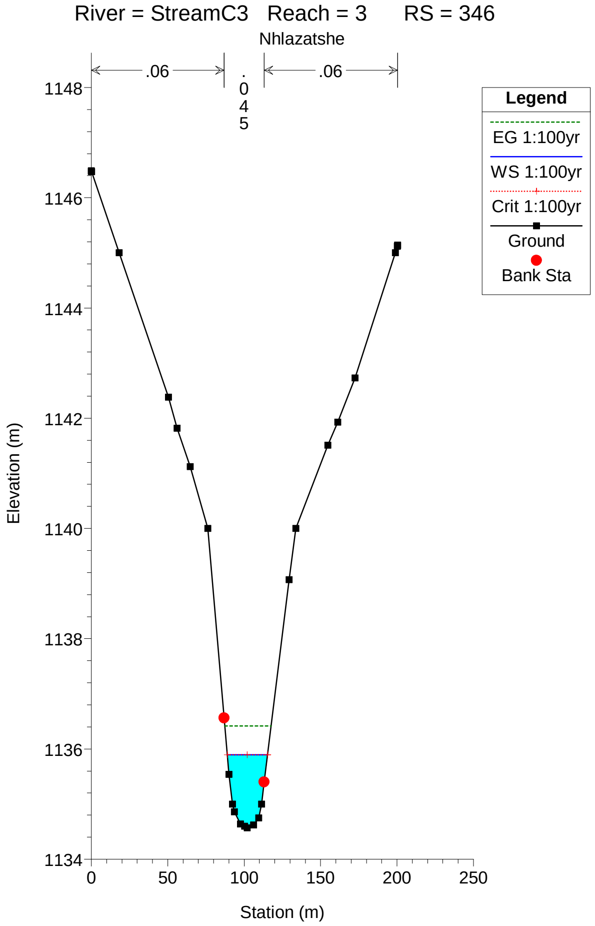

River = StreamC3 Reach = 3 RS = 351
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1140
1142
1144
1146
1148
1150
1152
1154
0
50
100
150
200
250
Station (m)

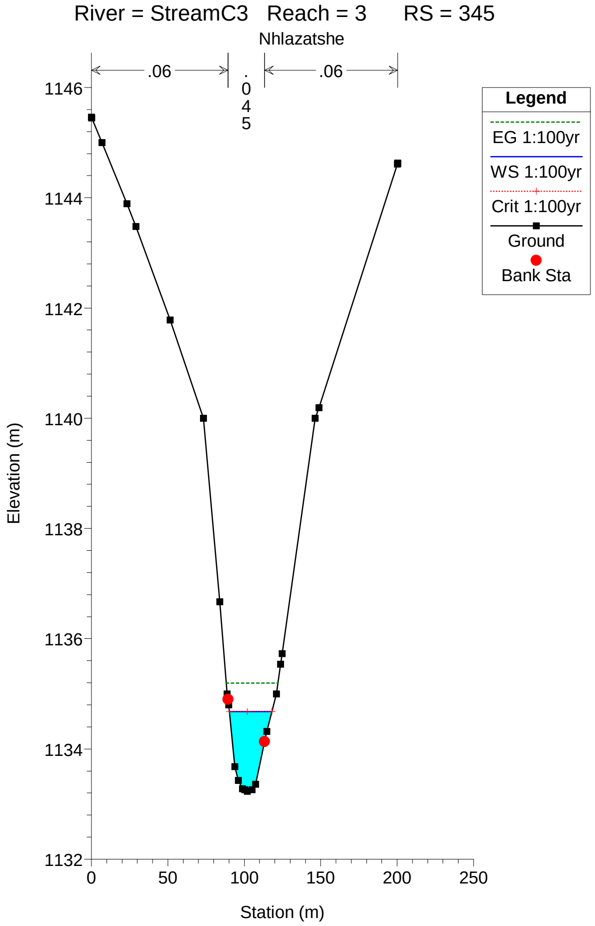

River = StreamC3 Reach = 3 RS = 350
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1140
1142
1144
1146
1148
1150
1152
0
50
100
150
200

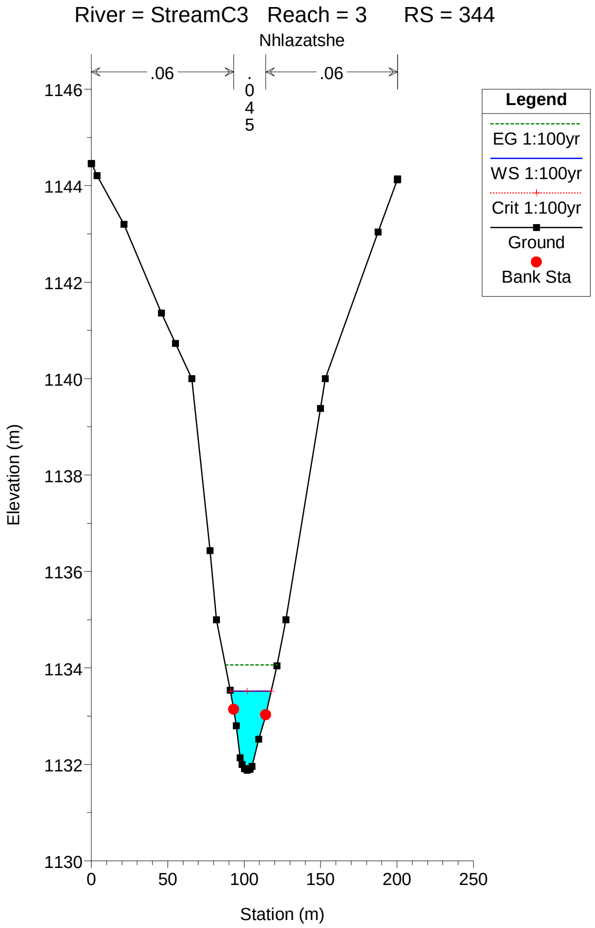

River = StreamC3 Reach = 3 RS = 349
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1140
1142
1144
1146
1148
1150
0
50
100
150
200
250

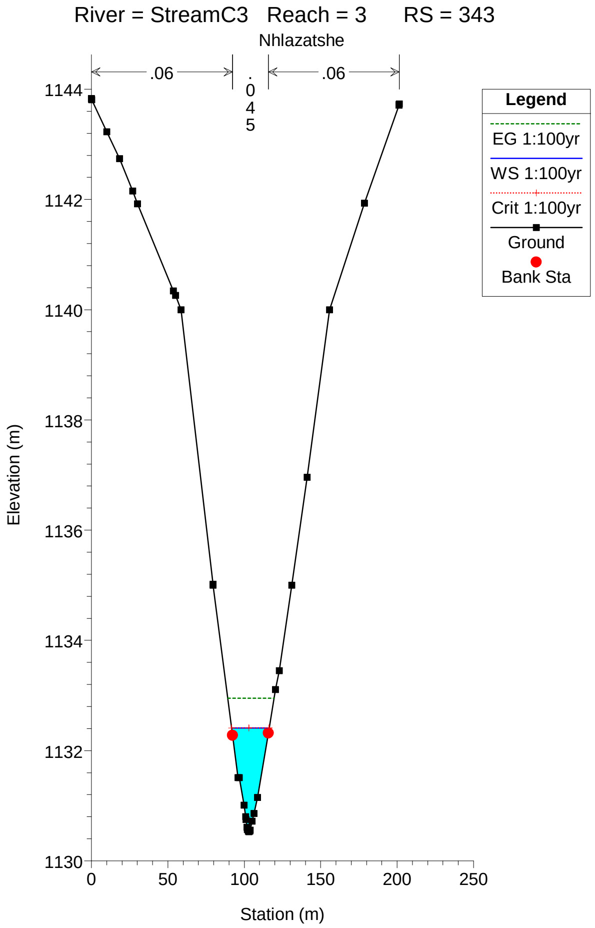

River = StreamC3 Reach = 3 RS = 348
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1138
1140
1142
1144
1146
1148
0
50
100
150
200
250

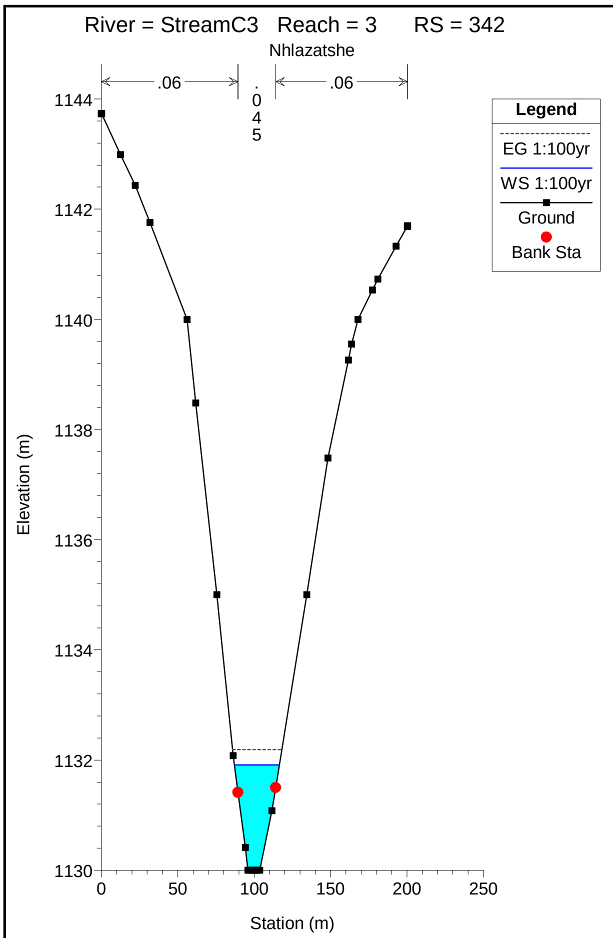

River = StreamC3 Reach = 3 RS = 347
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1136
1138
1140
1142
1144
1146
1148
0
50
100
150
200

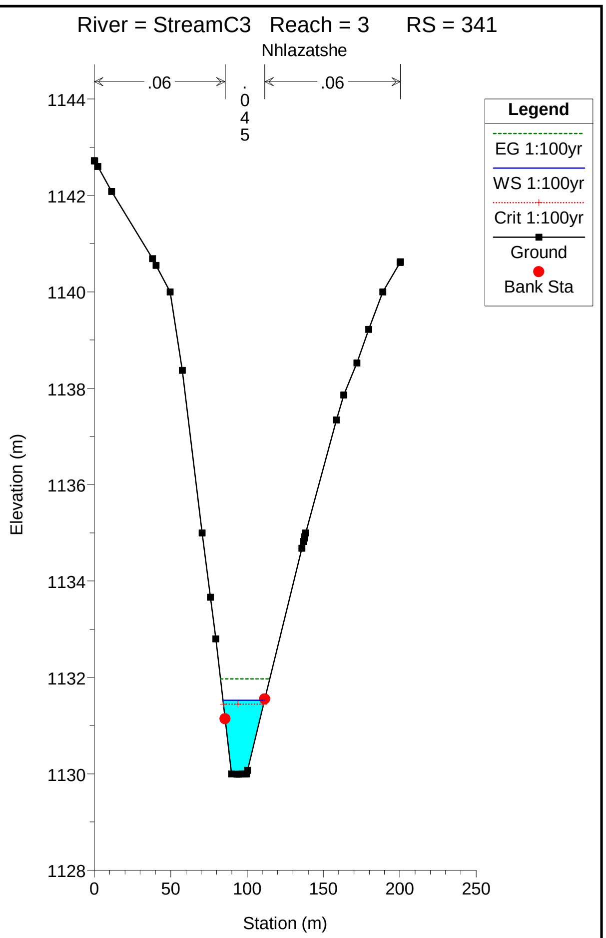

River = StreamC3 Reach = 3 RS = 346
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1134
1136
1138
1140
1142
1144
1146
1148
Station (m)
0
50
100
150
200
250

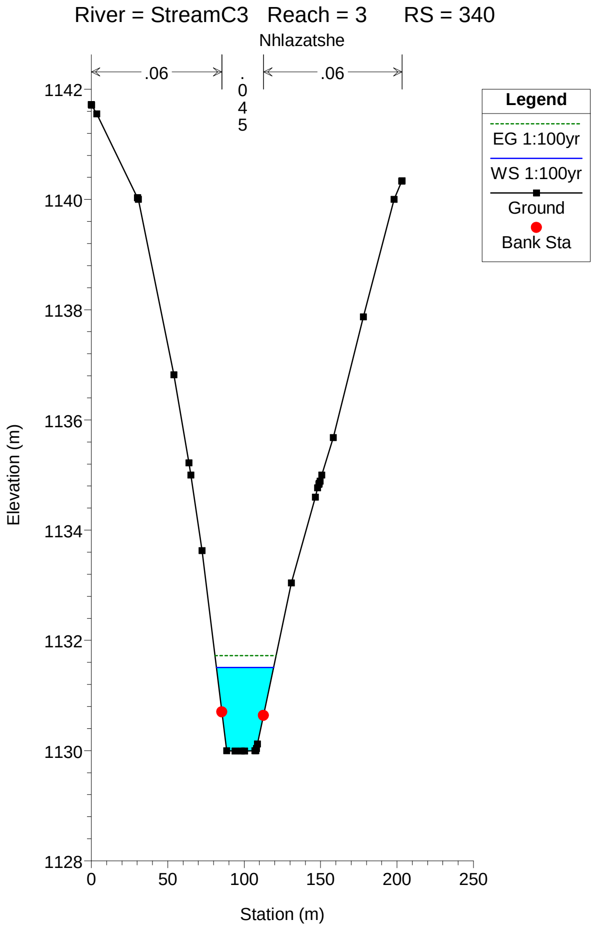

River = StreamC3 Reach = 3 RS = 345
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1132
1134
1136
1138
1140
1142
1144
1146
Station (m)
0
50
100
150
200
250

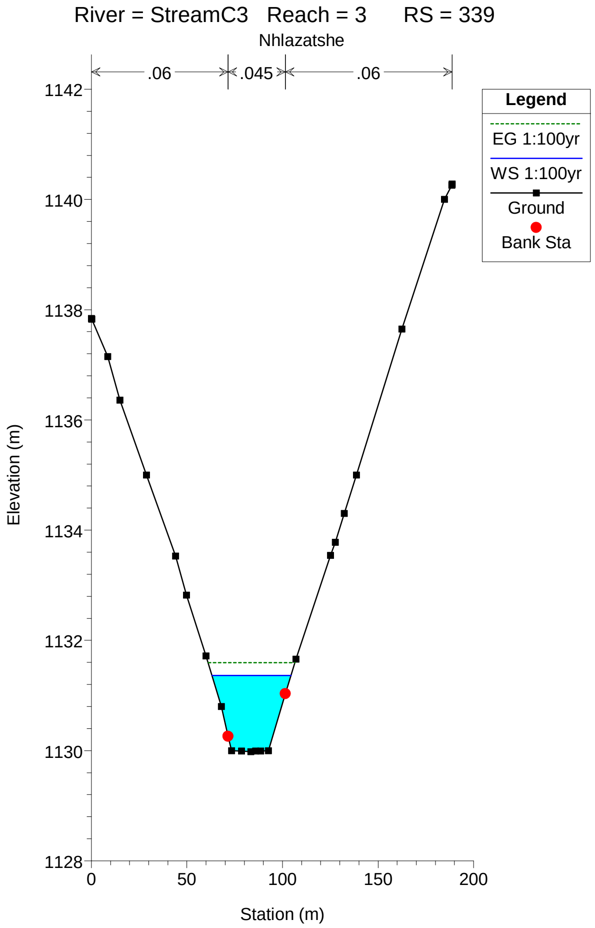

River = StreamC3 Reach = 3 RS = 344
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1130
1132
1134
1136
1138
1140
1142
1144
1146
Station (m)
0
50
100
150
200
250

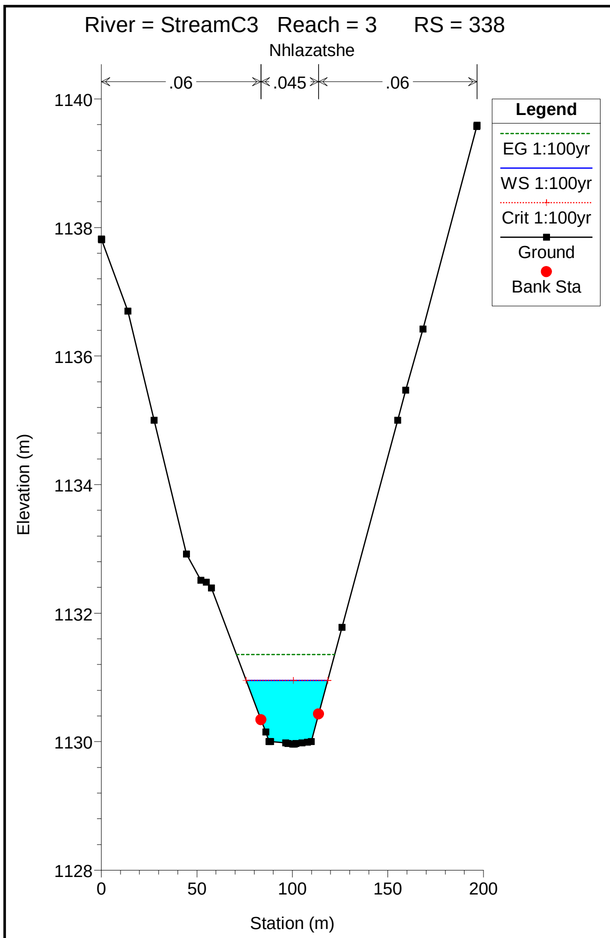

River = StreamC3 Reach = 3 RS = 343
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1130
1132
1134
1136
1138
1140
1142
1144
Station (m)
0
50
100
150
200
250

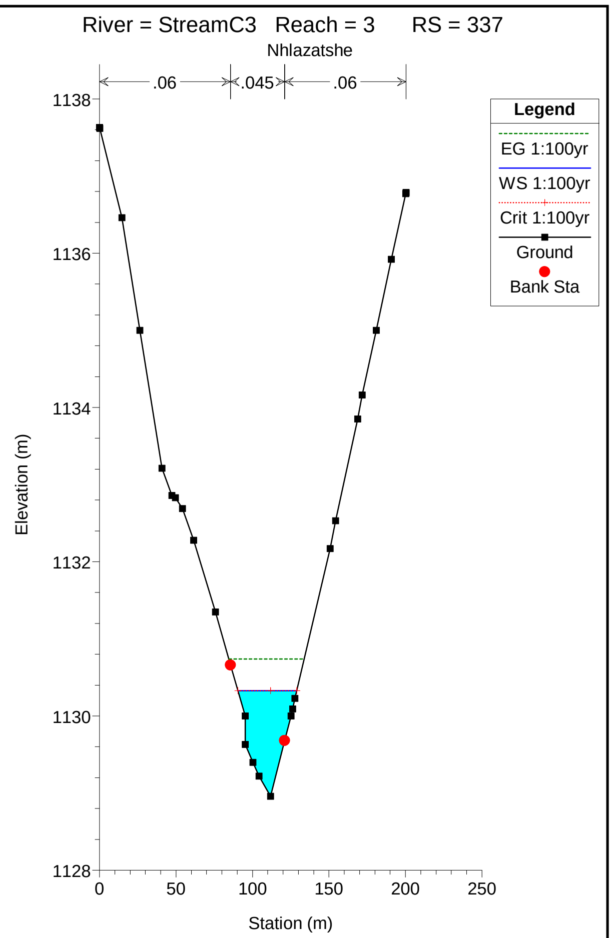

River = StreamC3 Reach = 3 RS = 342
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1130
1132
1134
1136
1138
1140
1142
1144
Station (m)
0
50
100
150
200
250

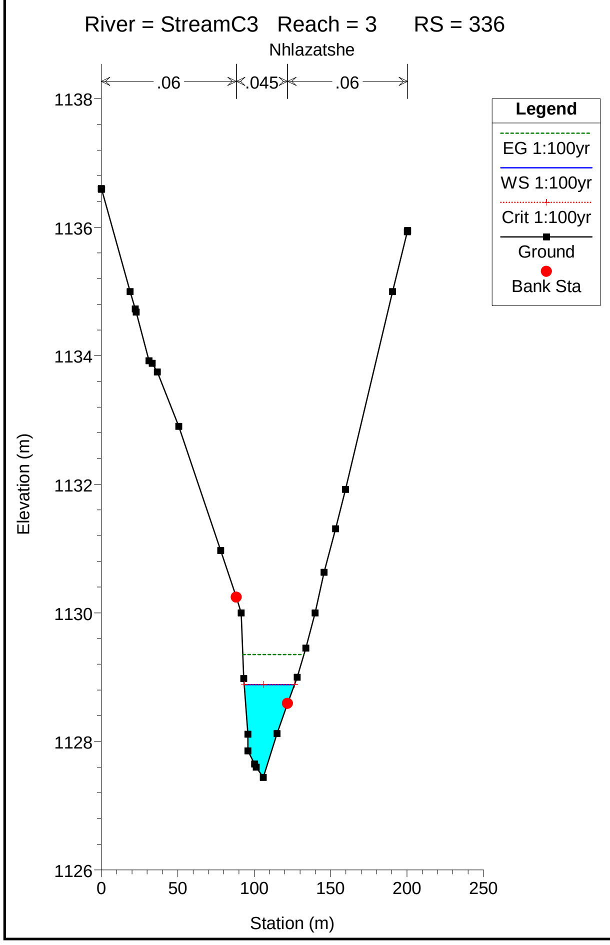

River = StreamC3 Reach = 3 RS = 341
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1128
1130
1132
1134
1136
1138
1140
1142
1144
Station (m)
0
50
100
150
200
250

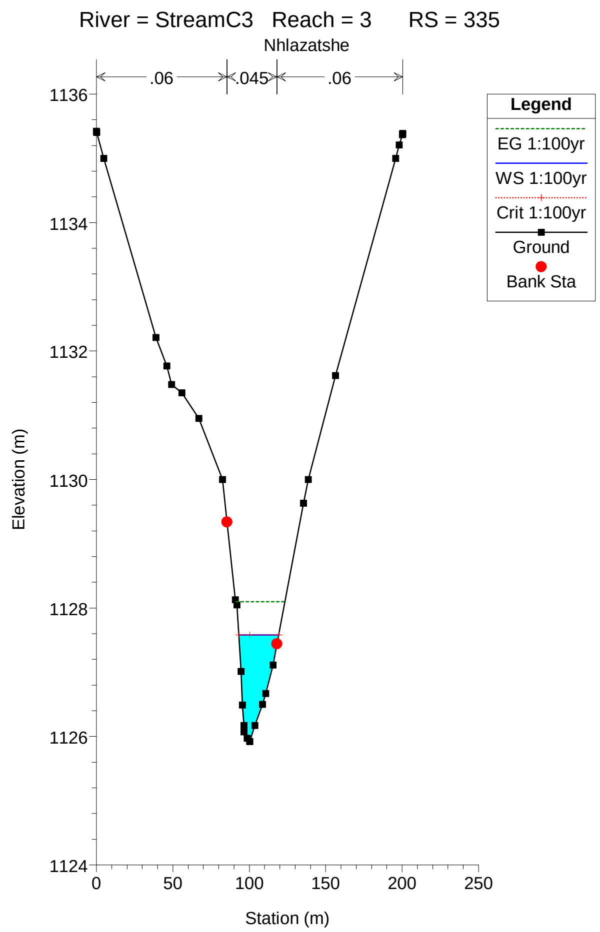

River = StreamC3 Reach = 3 RS = 340
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1128
1130
1132
1134
1136
1138
1140
1142
Station (m)
0
50
100
150
200
250


River = StreamC3 Reach = 3 RS = 339
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1128
1130
1132
1134
1136
1138
1140
1142
Station (m)
0
50
100
150
200


River = StreamC3 Reach = 3 RS = 338
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1128
1130
1132
1134
1136
1138
1140
0
50
100
150
200

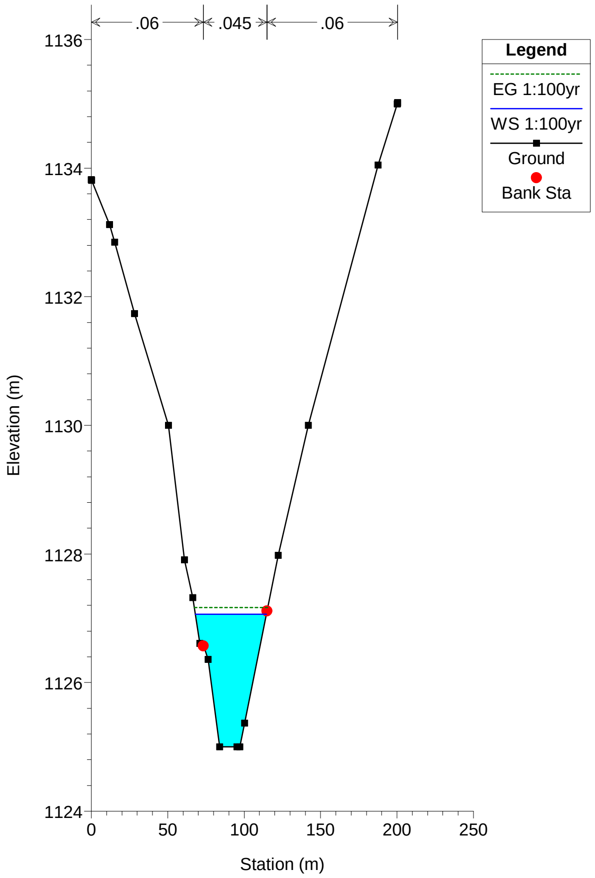

River = StreamC3 Reach = 3 RS = 337
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1128
1130
1132
1134
1136
1138
0
50
100
150
200
250


River = StreamC3 Reach = 3 RS = 336
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1126
1128
1130
1132
1134
1136
1138
0
50
100
150
200
250


River = StreamC3 Reach = 3 RS = 335
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
1124
1126
1128
1130
1132
1134
1136
0
50
100
150
200
250

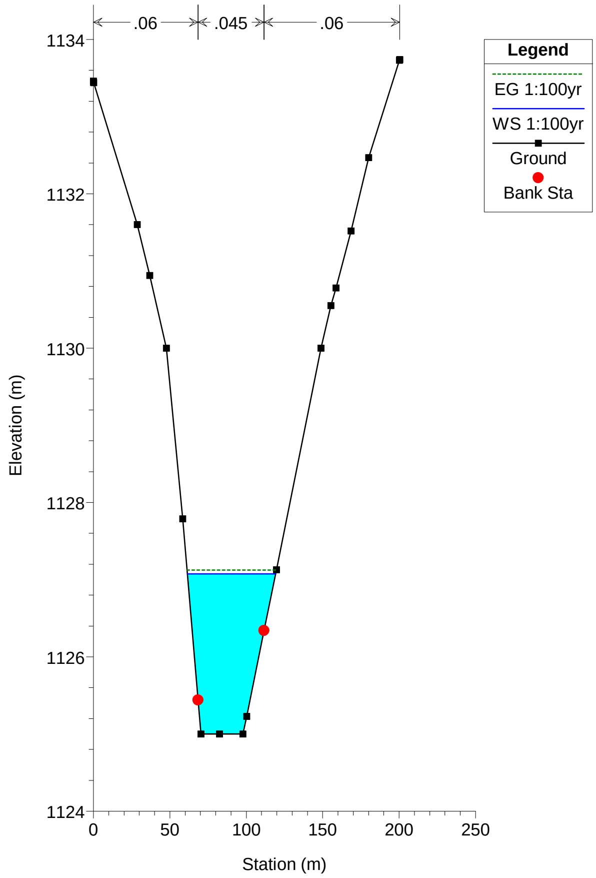
River = StreamC3 Reach = 3 RS = 334

Nhlazatshe



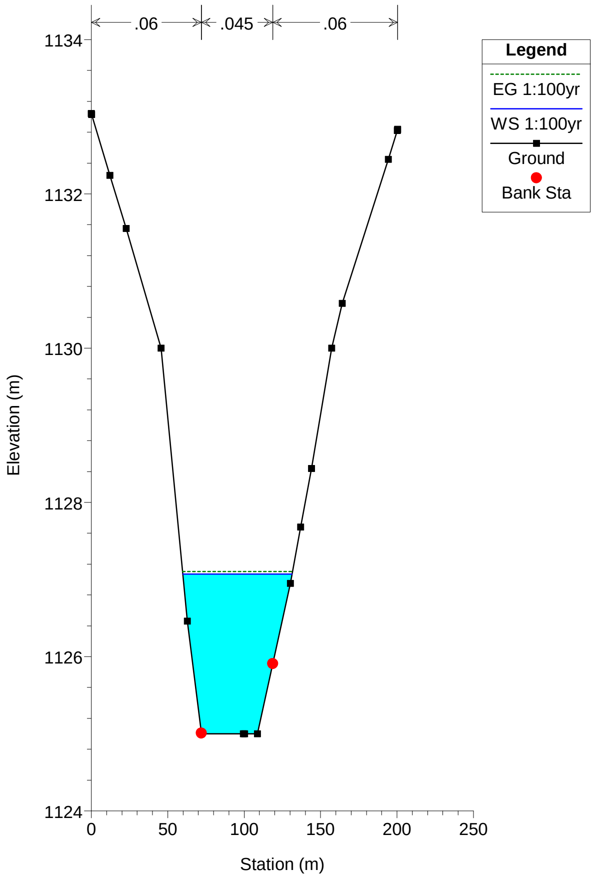
River = StreamC3 Reach = 3 RS = 333

Nhlazatshe



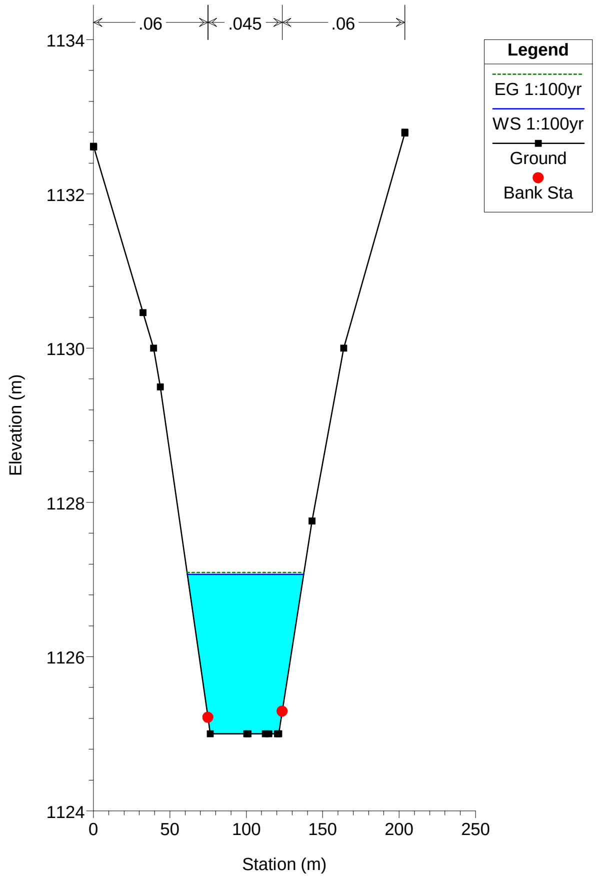
River = StreamC3 Reach = 3 RS = 332

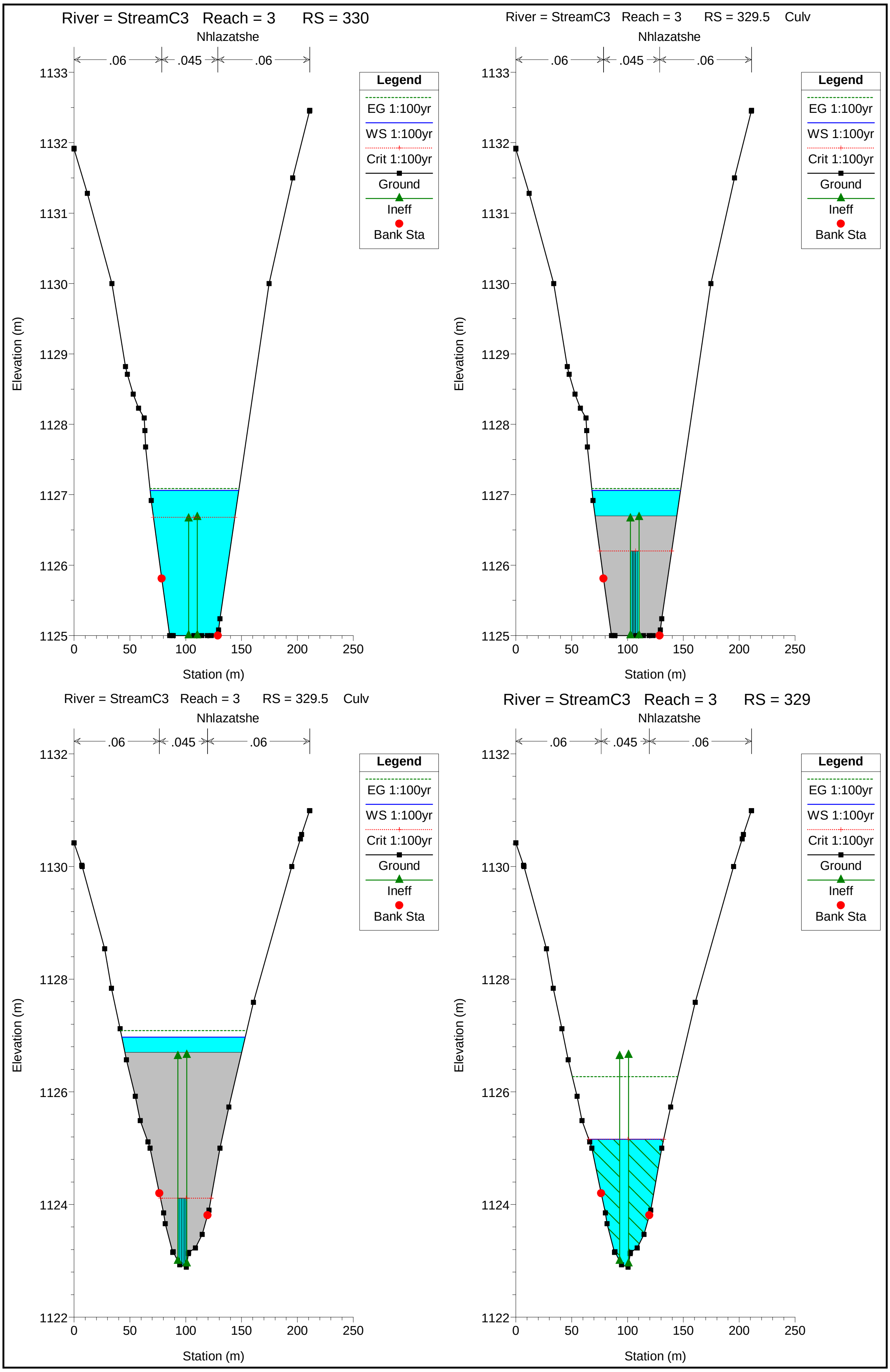
Nhlazatshe

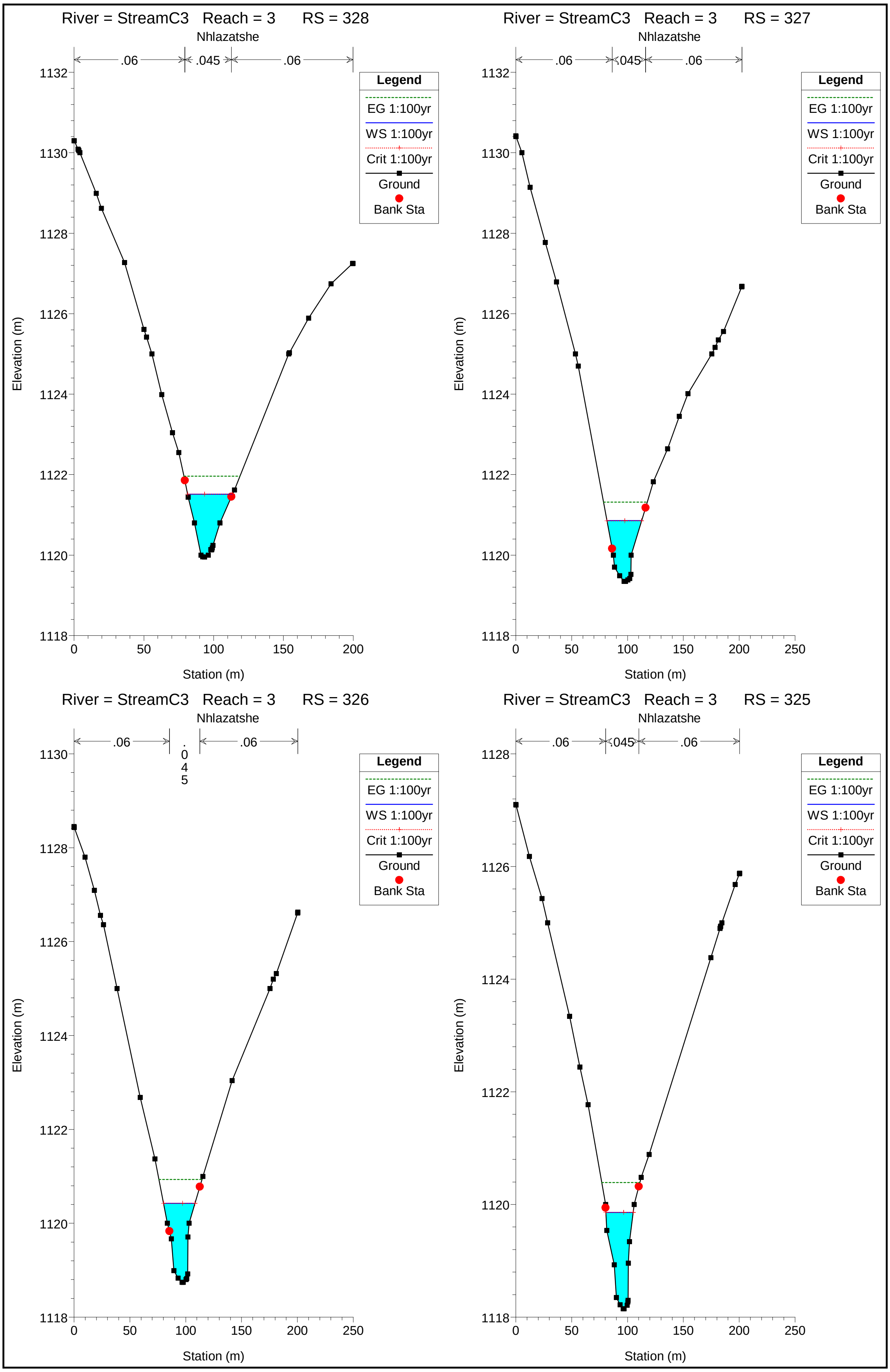


River = StreamC3 Reach = 3 RS = 331

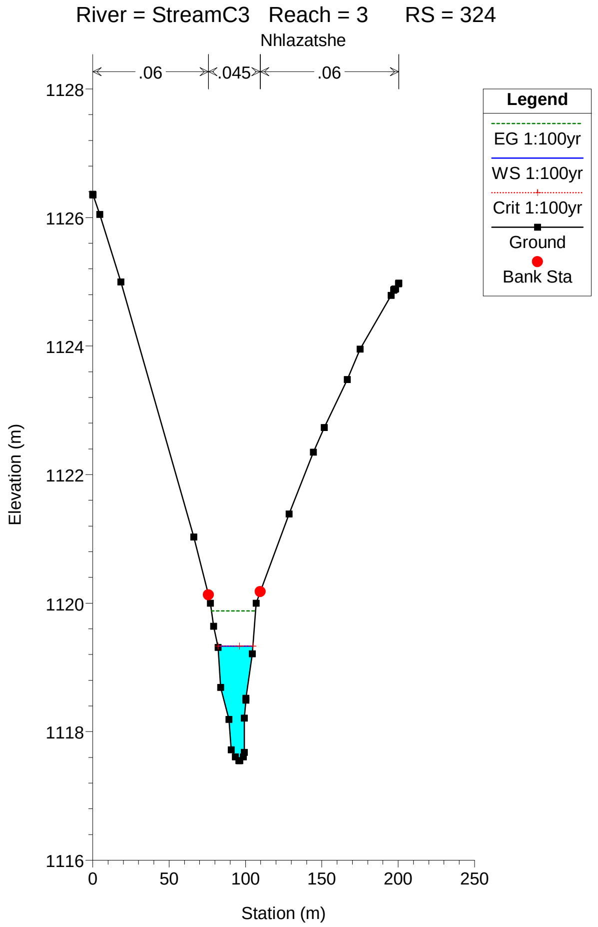
Nhlazatshe

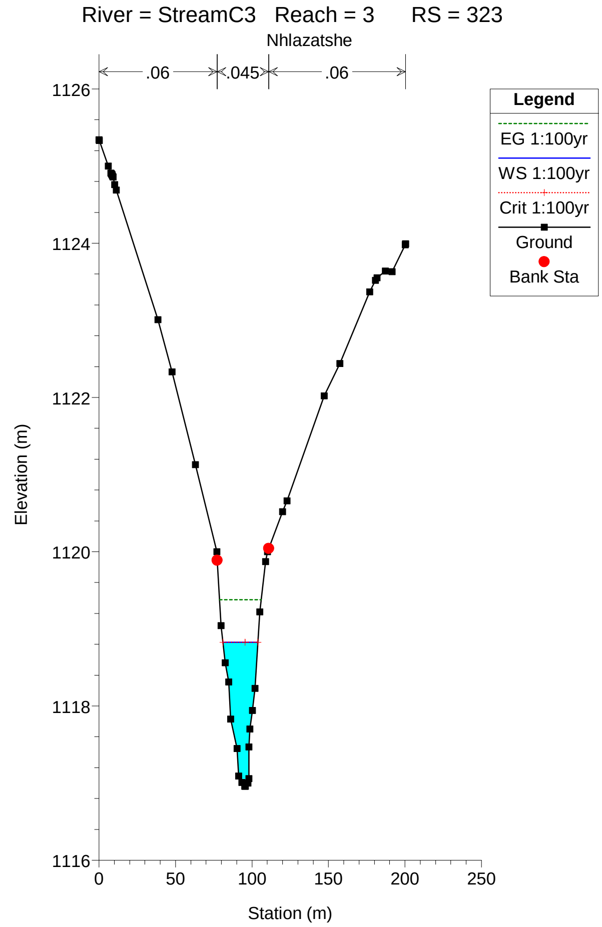


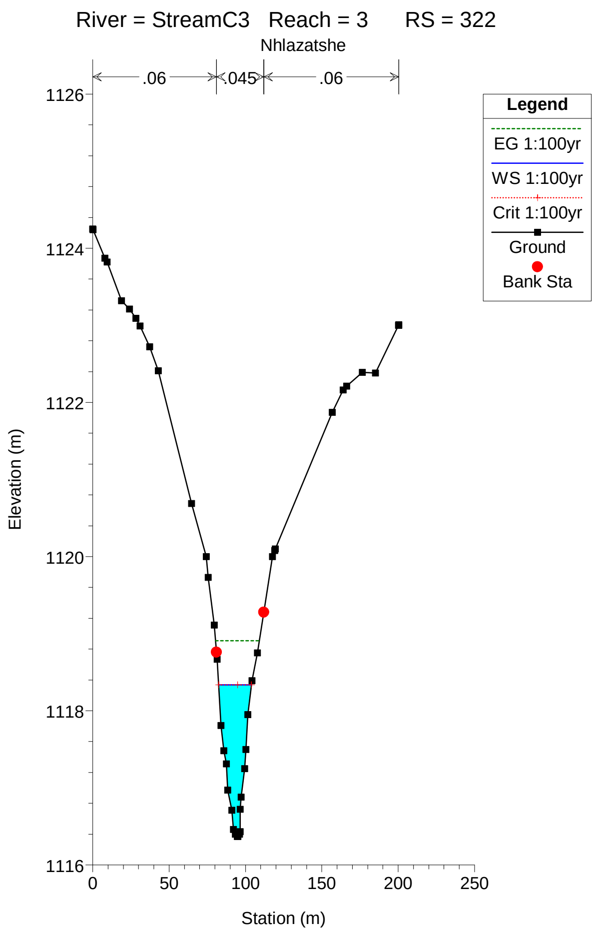

River = StreamC3 Reach = 3 RS = 330
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
1125
1126
1127
1128
1129
1130
1131
1132
1133
0
50
100
150
200
250
River = StreamC3 Reach = 3 RS = 329.5 Culv
Nhlazatshe
River = StreamC3 Reach = 3 RS = 329.5 Culv
Nhlazatshe
1122
1124
1126
1128
1130
1132
River = StreamC3 Reach = 3 RS = 329
Nhlazatshe

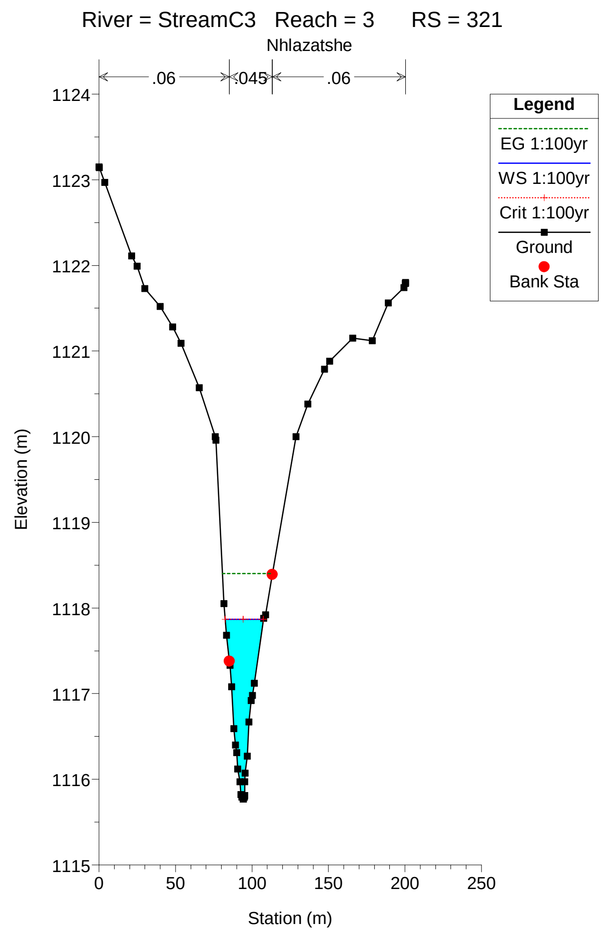


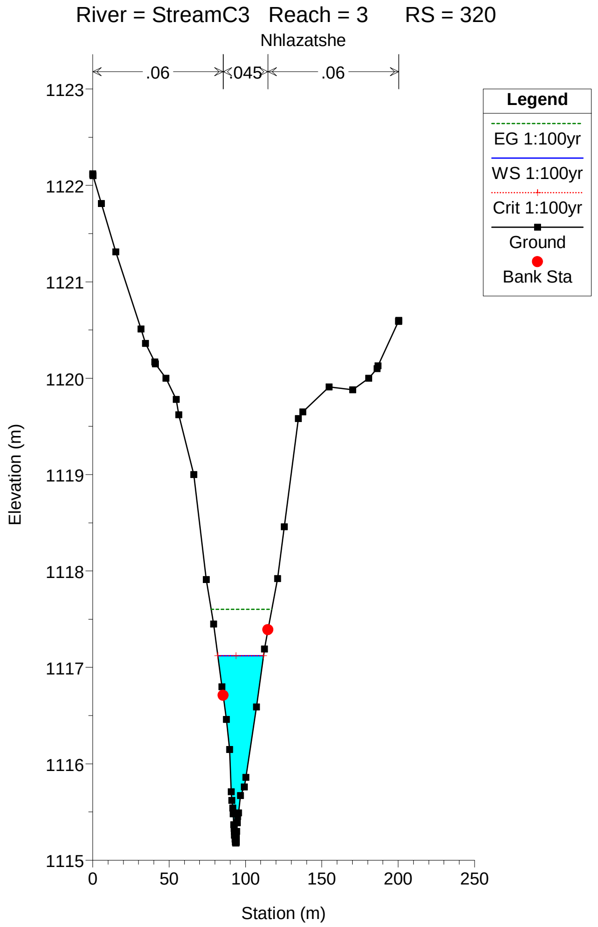
River = StreamC3 Reach = 3 RS = 328
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 327
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 326
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 325
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

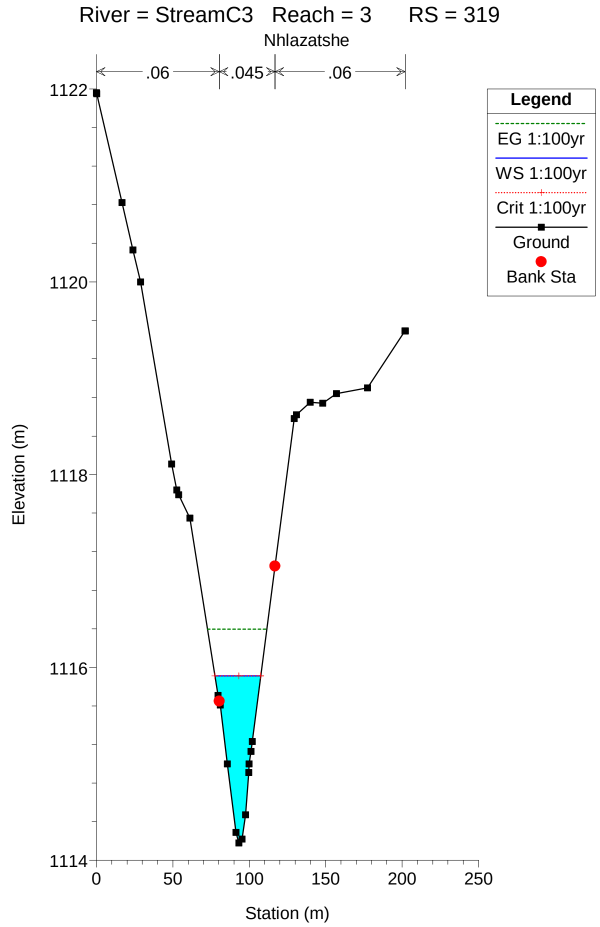

River = StreamC3 Reach = 3 RS = 324
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1116
1118
1120
1122
1124
1126
1128
0
50
100
150
200
250
Station (m)

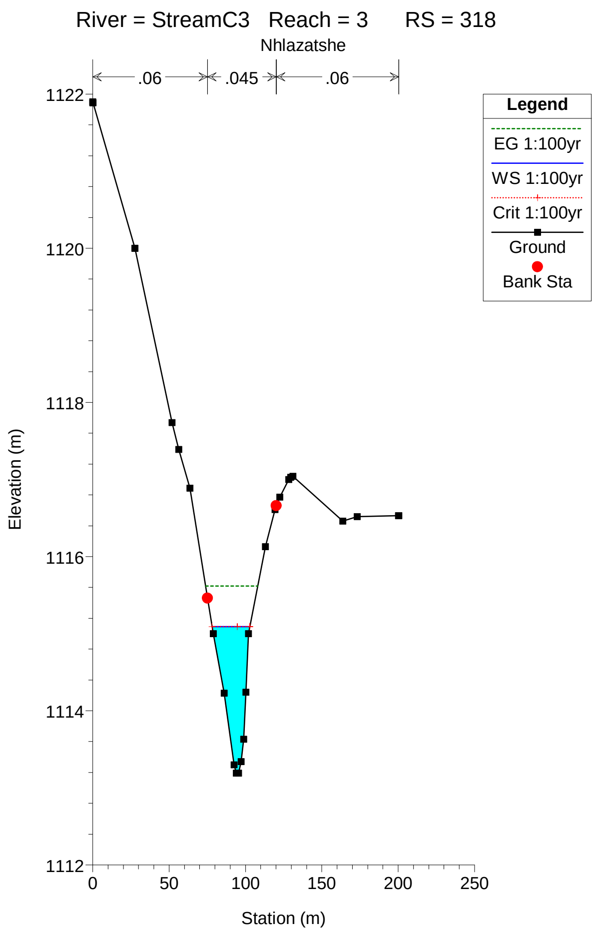

River = StreamC3 Reach = 3 RS = 323
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1116
1118
1120
1122
1124
1126
0
50
100
150
200
250
Station (m)

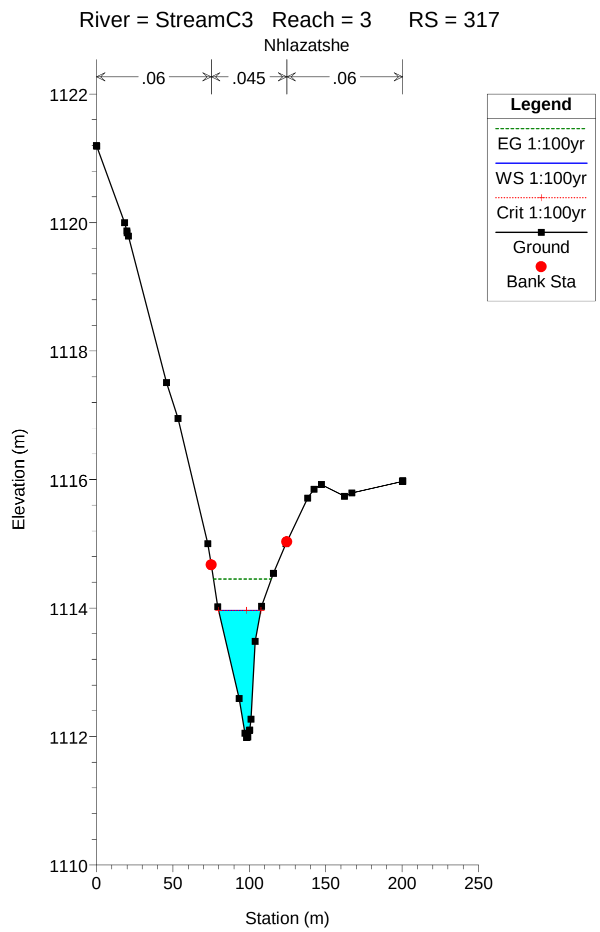

River = StreamC3 Reach = 3 RS = 322
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1116
1118
1120
1122
1124
1126
0
50
100
150
200
250
Station (m)


River = StreamC3 Reach = 3 RS = 321
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
0
50
100
150
200
250
Station (m)


River = StreamC3 Reach = 3 RS = 320
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1115
1116
1117
1118
1119
1120
1121
1122
1123
Station (m)
0
50
100
150
200
250


River = StreamC3 Reach = 3 RS = 319
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1114
1116
1118
1120
1122
Station (m)
0
50
100
150
200
250


River = StreamC3 Reach = 3 RS = 318
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1112
1114
1116
1118
1120
1122
Station (m)
0
50
100
150
200
250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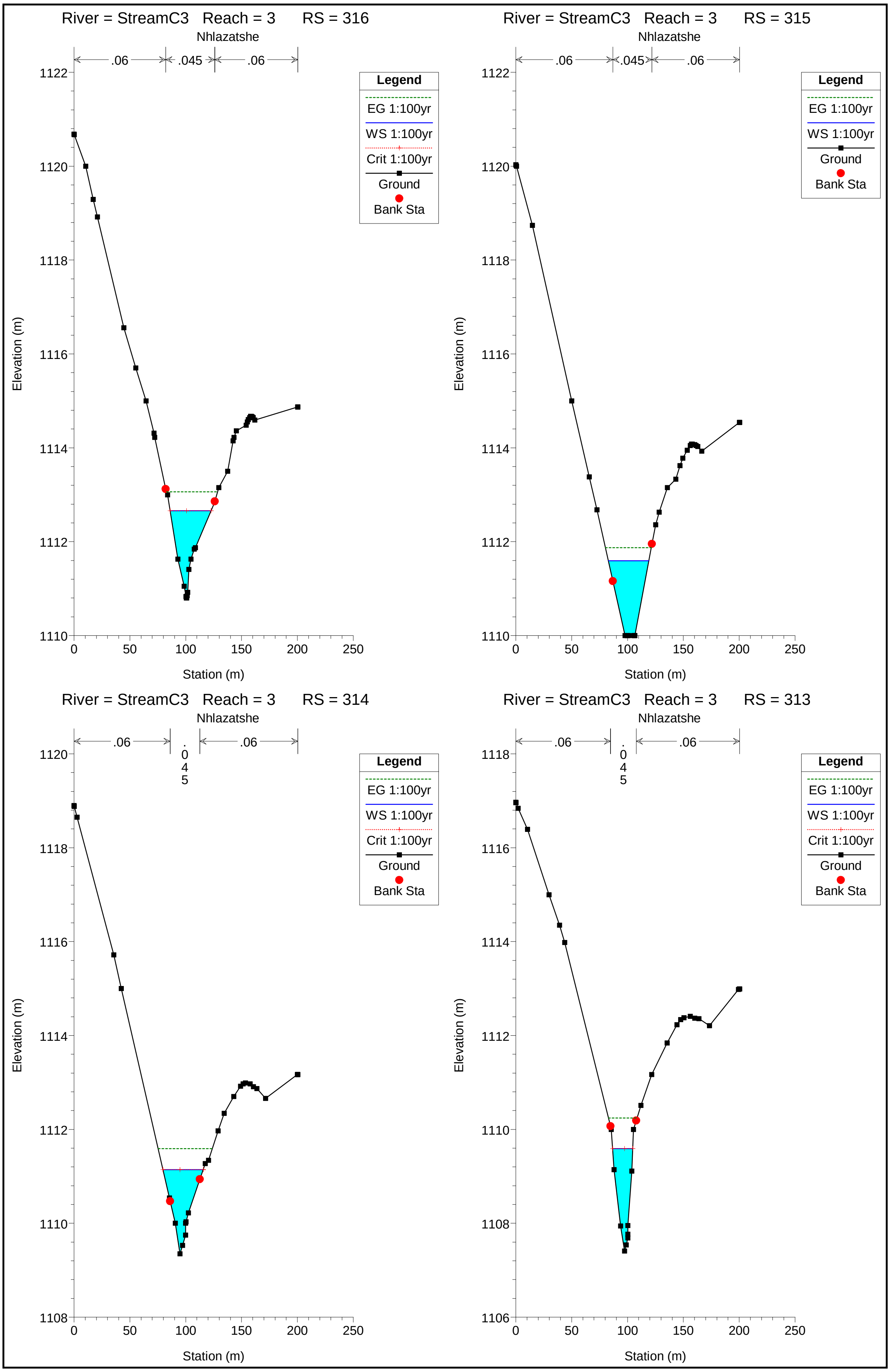
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1110
1112
1114
1116
1118
1120
1122
Station (m)
0
50
100
150
200
250



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Nhlazatshe
.06 .045 .06
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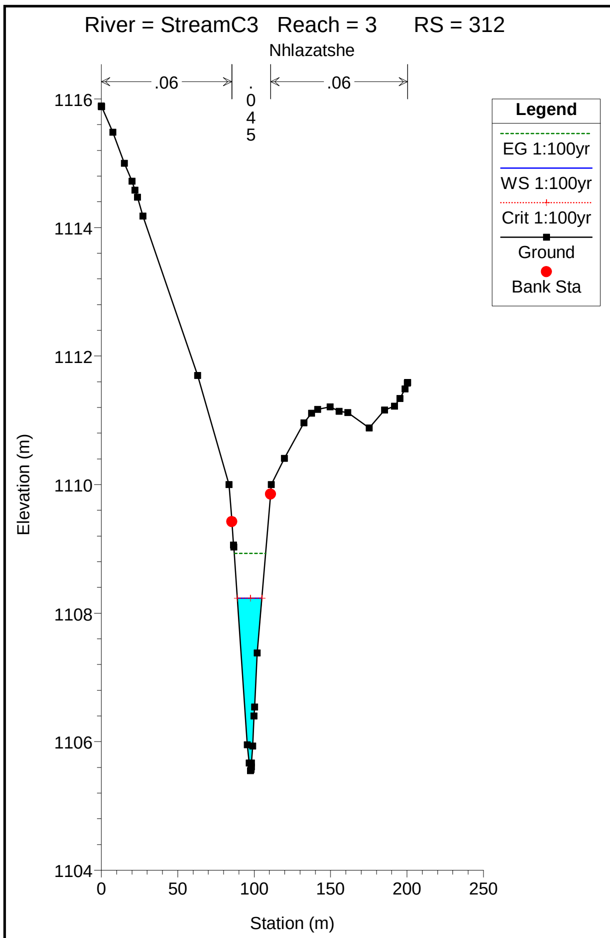
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 315
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 314
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 313
Nhlazatshe
.06 .045 .06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)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Nhlazatshe
.06
.045
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Legend
EG 1:100yr
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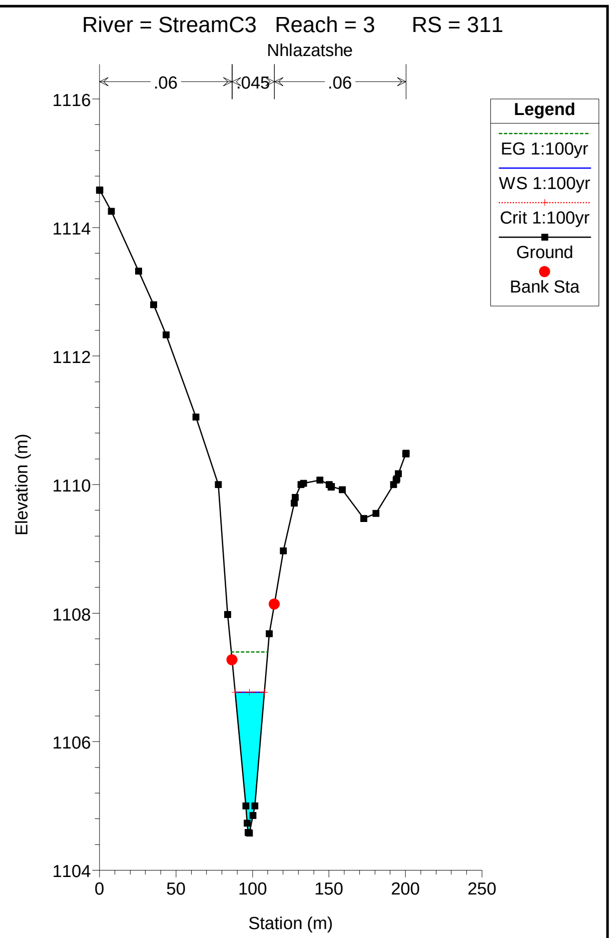
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)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Nhlazatshe
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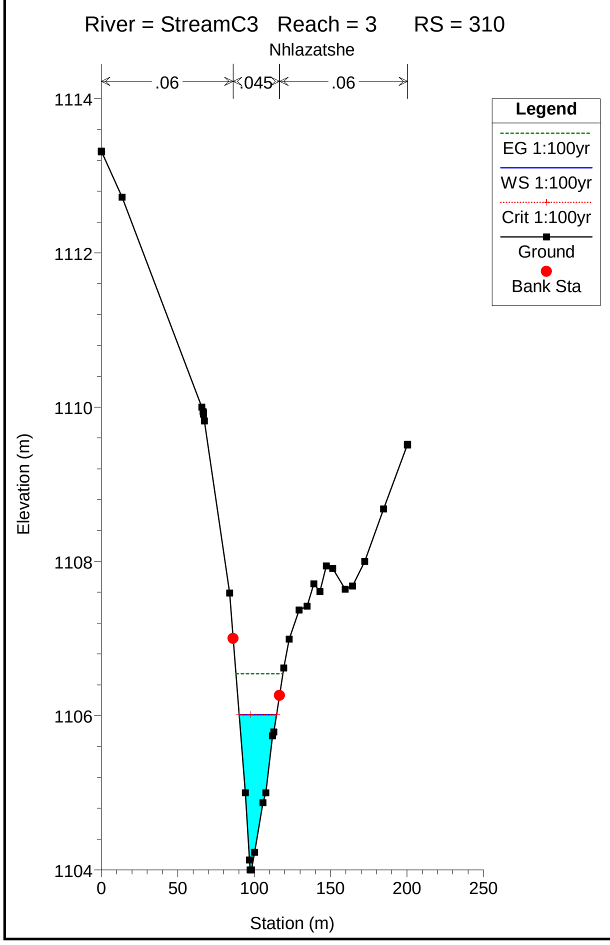
Ground
Bank Sta
Elevation (m)
Station (m)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Nhlazatshe
.06
.045
.06
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EG 1:100yr
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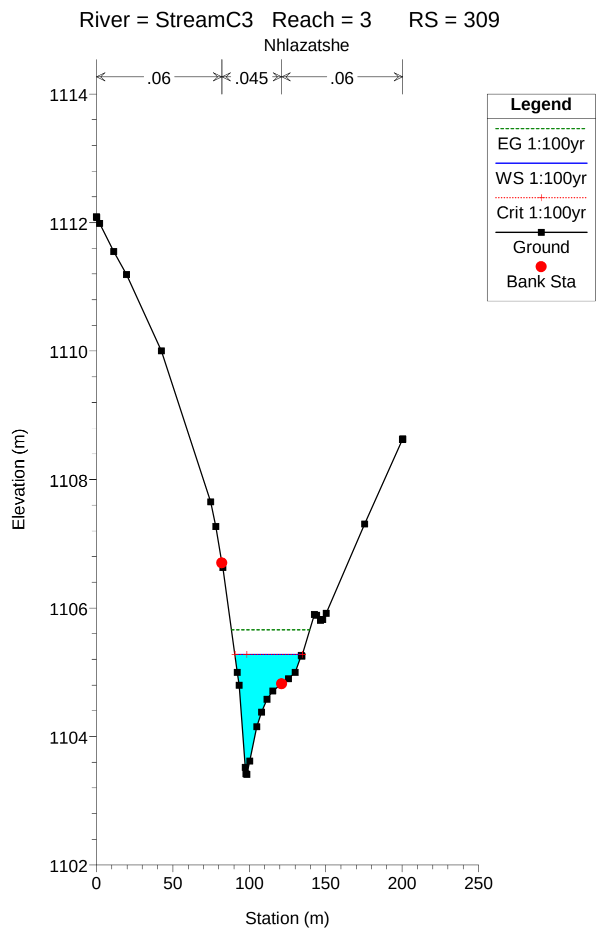
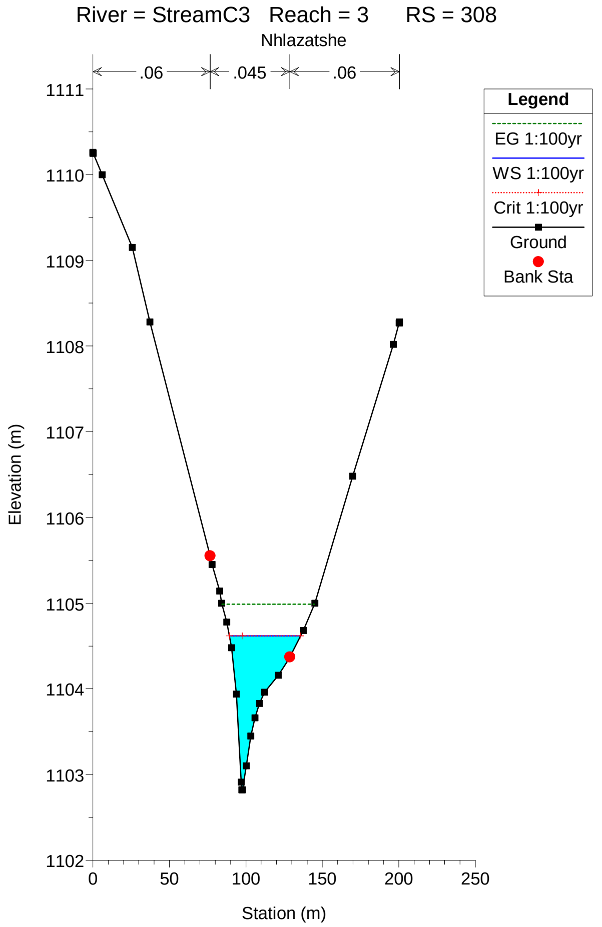
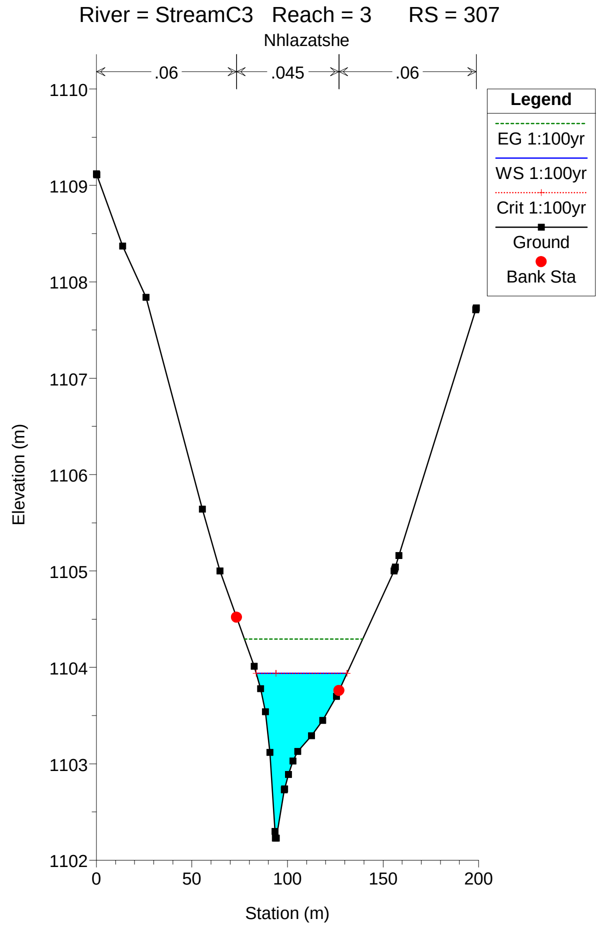
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = StreamC3 Reach = 3 RS = 309
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = StreamC3 Reach = 3 RS = 308
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
0
50
100
150
200
250
Station (m)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.045
.06
Legend
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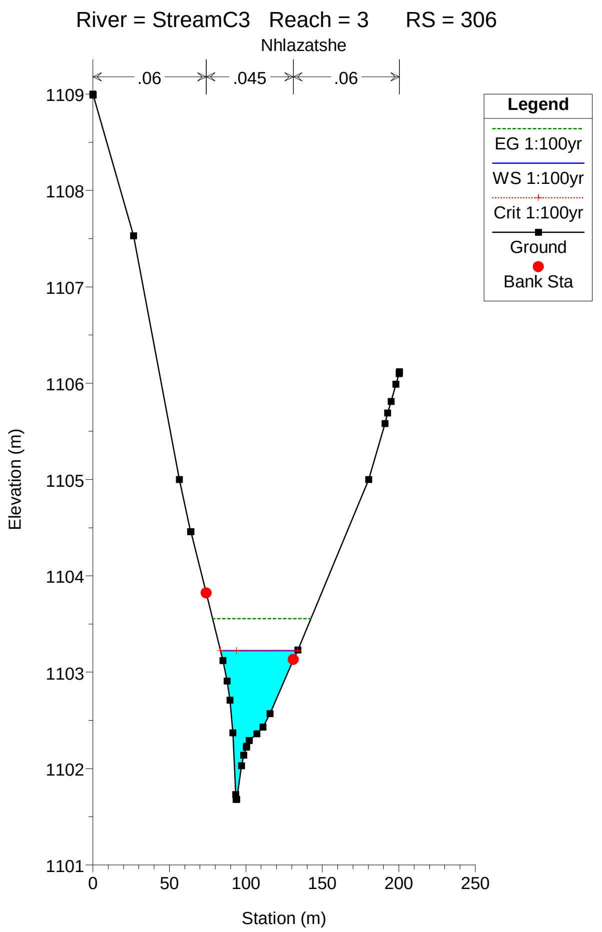
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1102
1103
1104
1105
1106
1107
1108
1109
1110
0
50
100
150
200
Station (m)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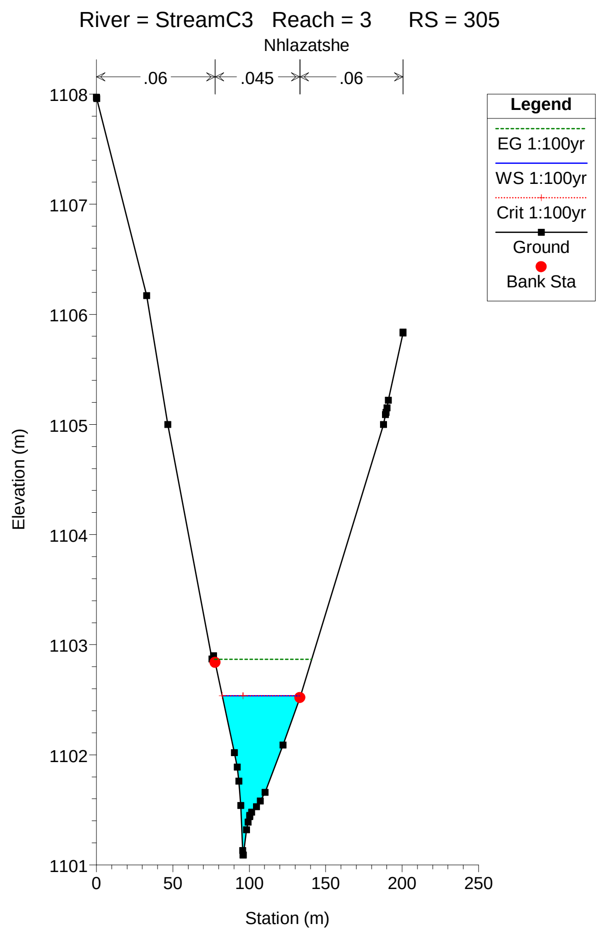
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1101
1102
1103
1104
1105
1106
1107
1108
1109
0
50
100
150
200
250
Station (m)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Nhlazatshe
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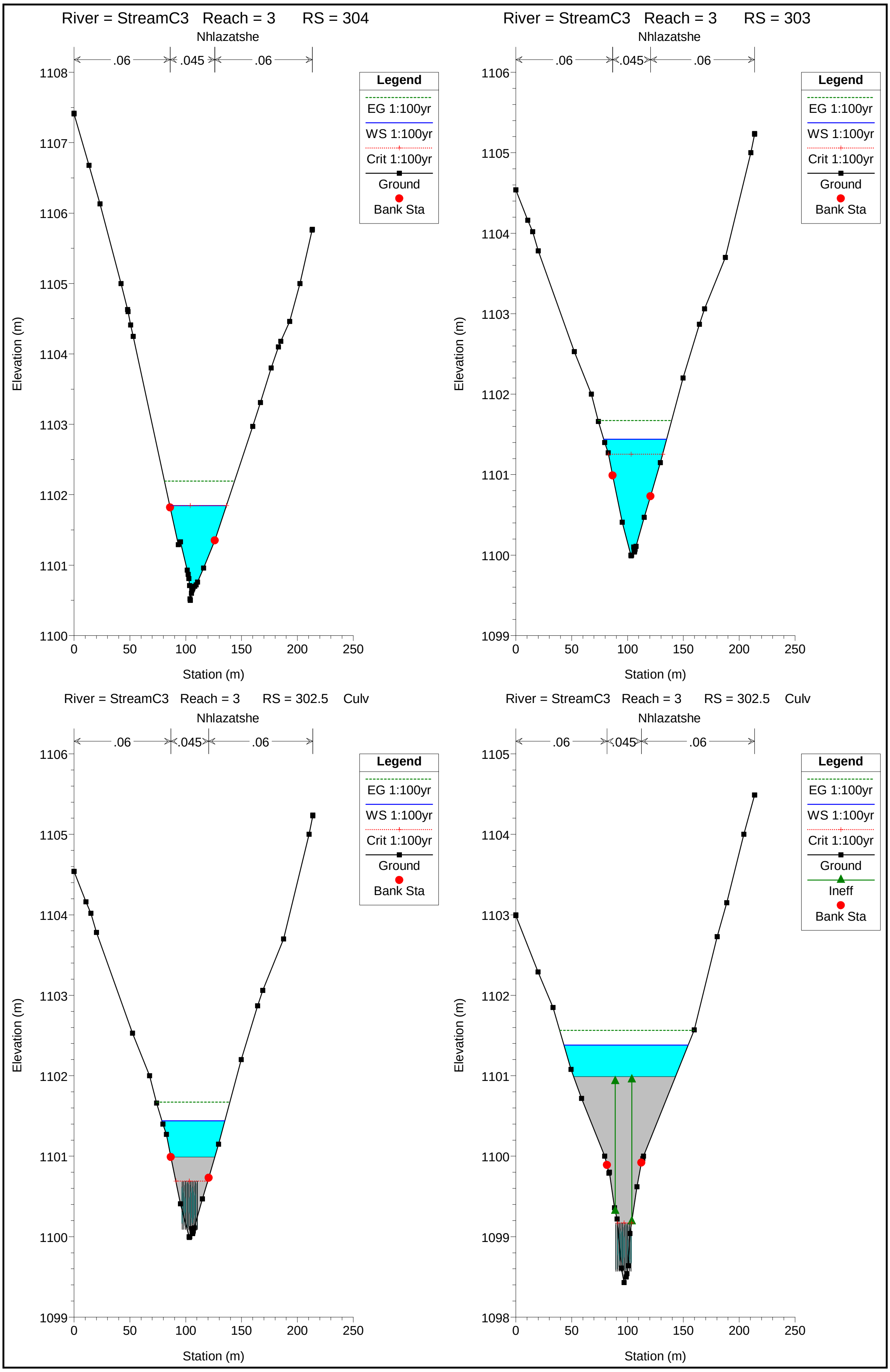
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1101
1102
1103
1104
1105
1106
1107
1108
0
50
100
150
200
250
Station (m)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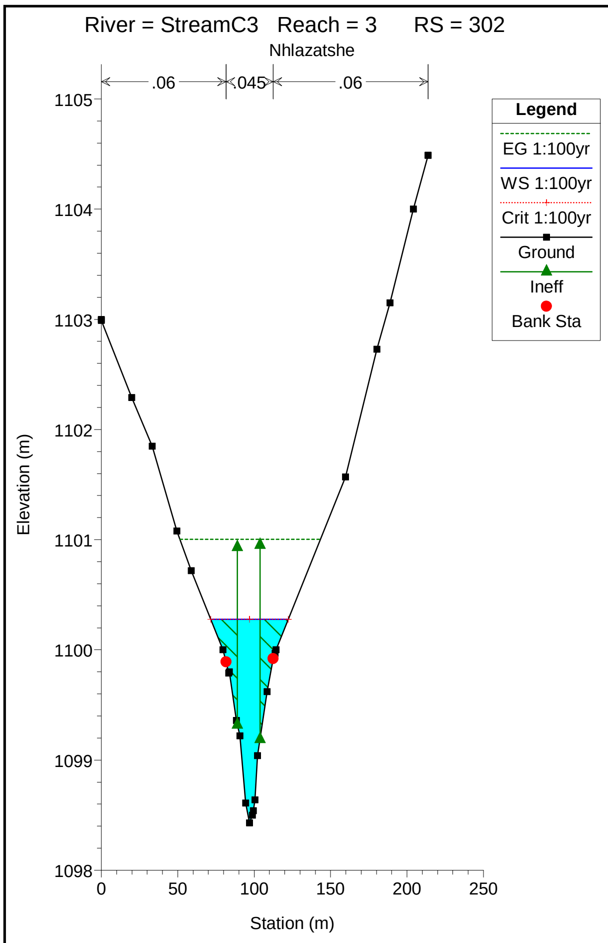
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 303
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 302.5 Culv
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = StreamC3 Reach = 3 RS = 302.5 Culv
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)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.045
.06
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WS 1:100yr
Crit 1:100yr
Ground
Ineff
Bank Sta
Elevation (m)
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1099
1100
1101
1102
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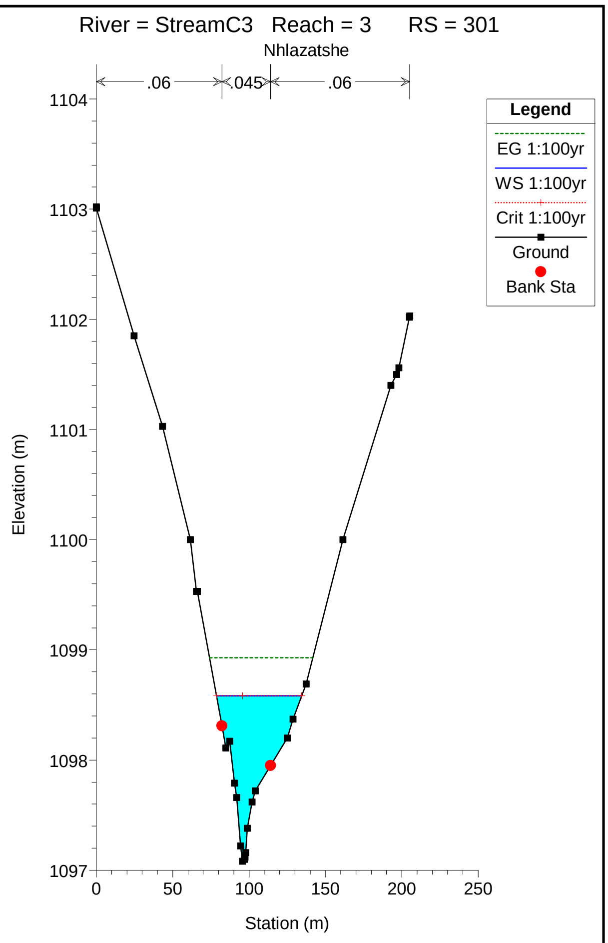
1104
1105
Station (m)
0
50
100
150
200
250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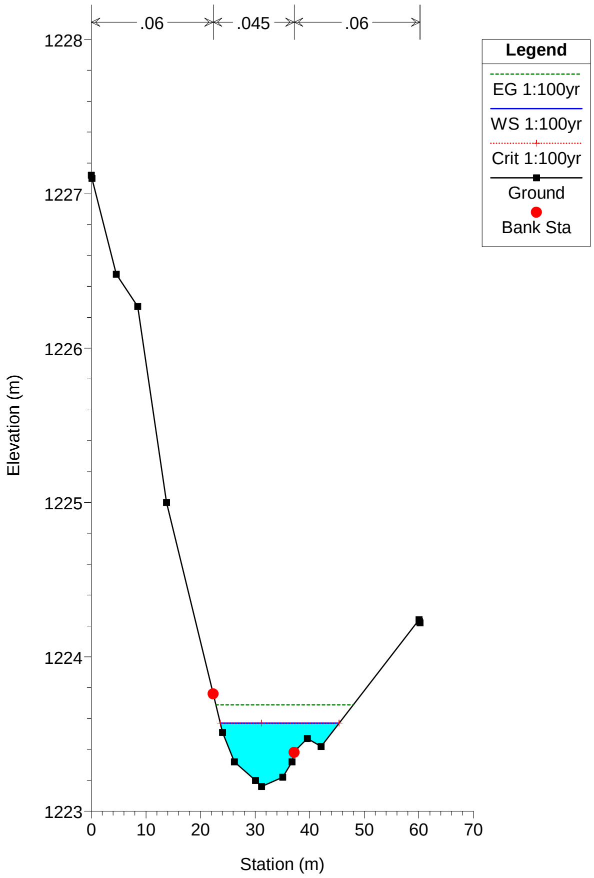
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1097
1098
1099
1100
1101
1102
1103
1104
Station (m)
0
50
100
150
200
250

River = StreamC4   Reach = 4   RS = 419

Nhlazatshe



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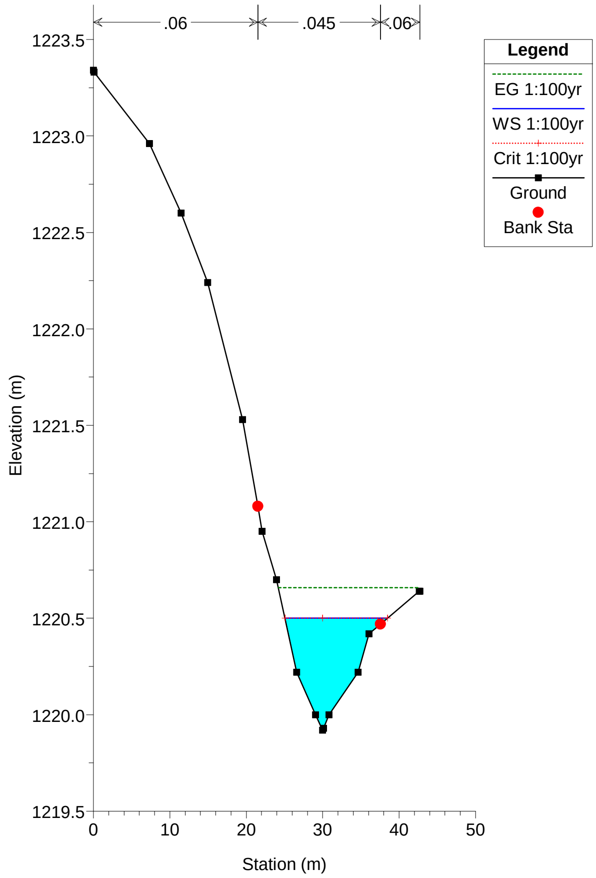
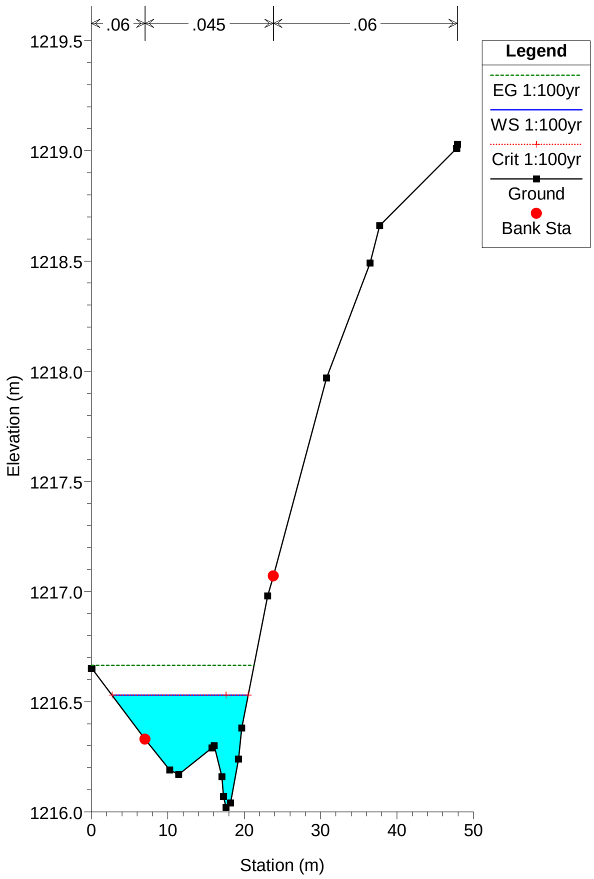
Nhlazatshe



River = StreamC4   Reach = 4   RS = 417

Nhlazatshe



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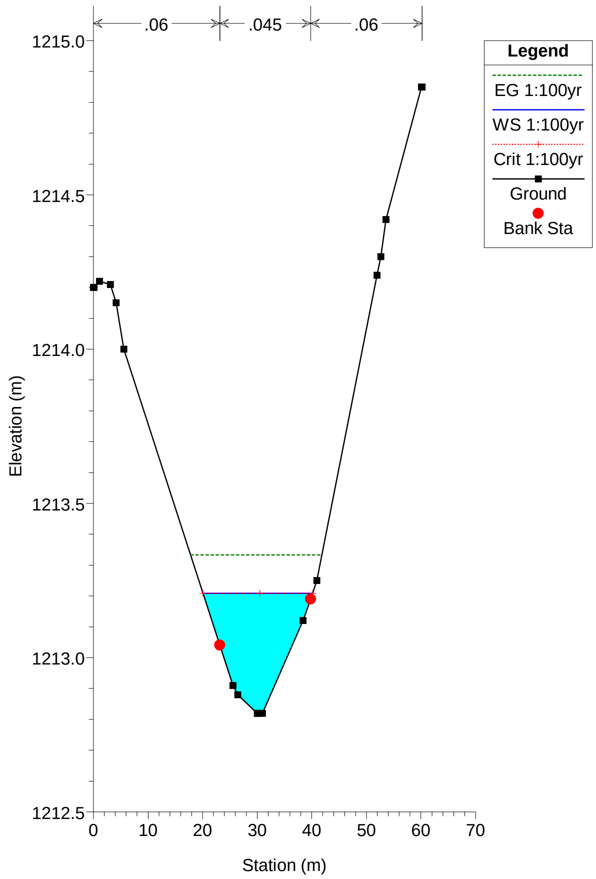
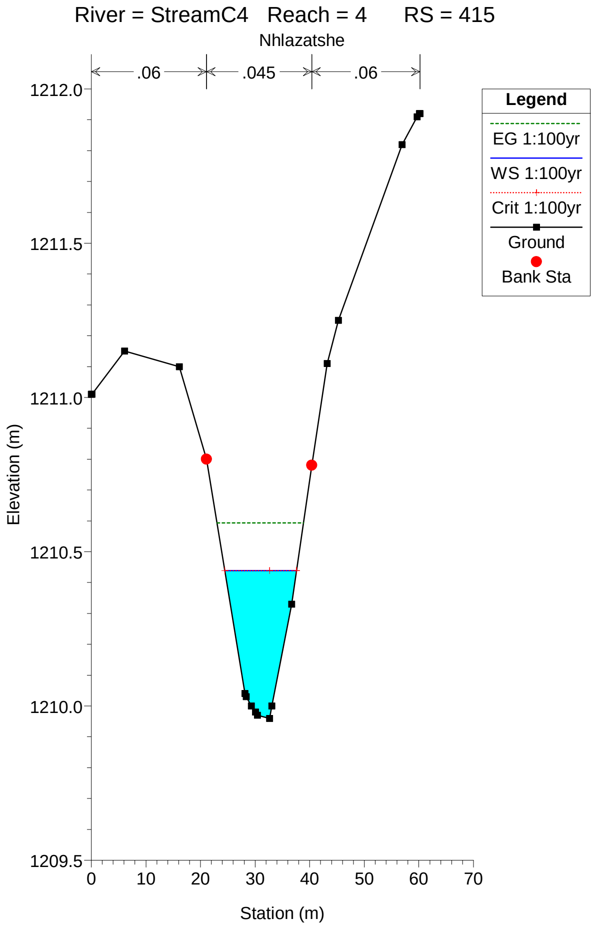
Nhlazatshe

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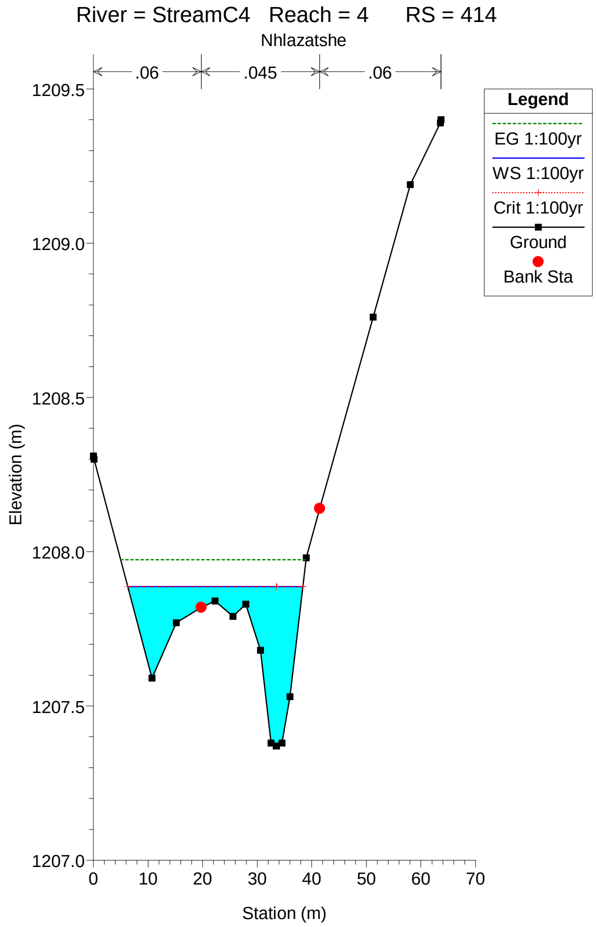
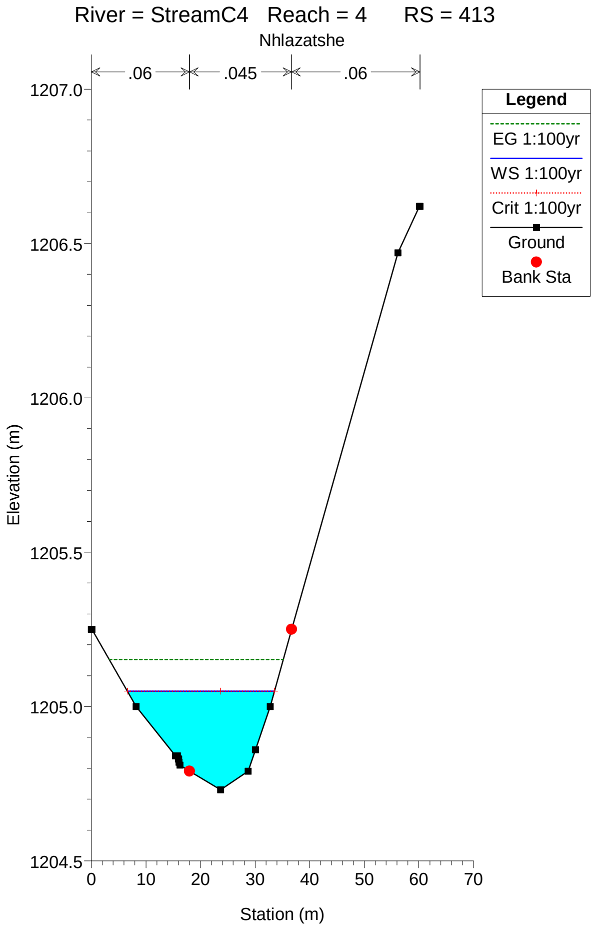
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1212.0
1211.5
1211.0
1210.5
1210.0
1209.5
0 10 20 30 40 50 60 70
Station (m)


River = StreamC4 Reach = 4 RS = 414
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1209.5
1209.0
1208.5
1208.0
1207.5
1207.0
0 10 20 30 40 50 60 70
Station (m)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.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
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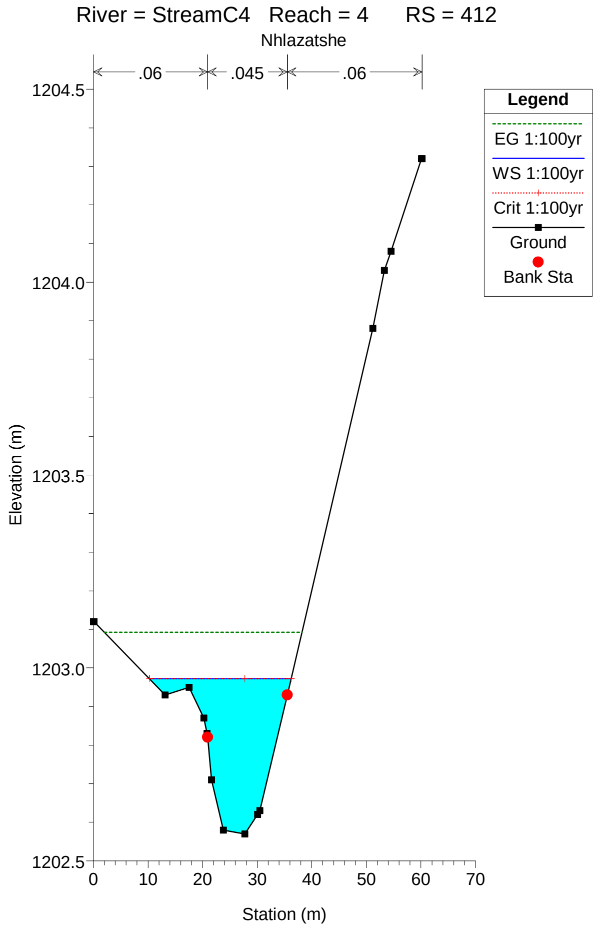
1206.5
1206.0
1205.5
1205.0
1204.5
0 10 20 30 40 50 60 70
Station (m)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Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1204.5
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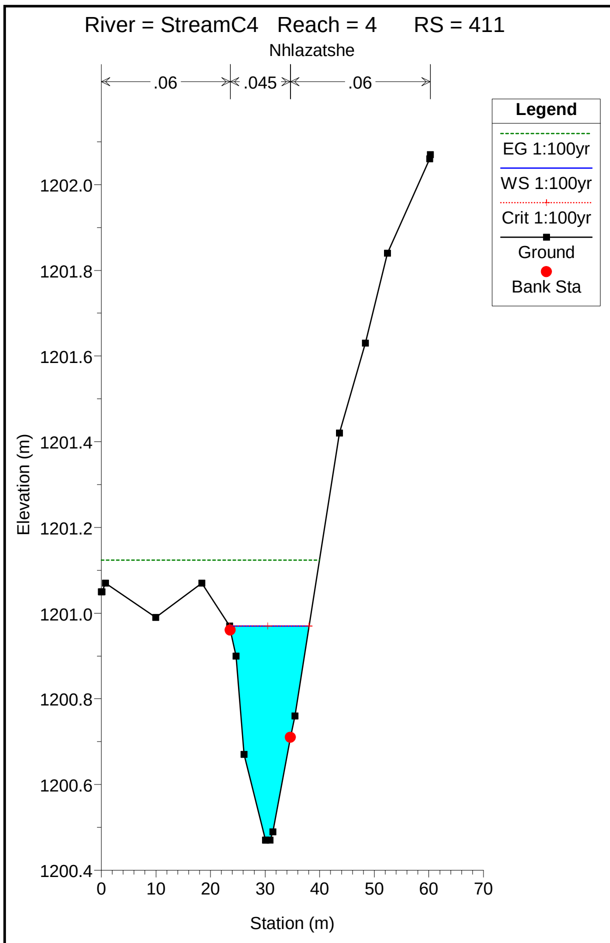
1203.5
1203.0
1202.5
0 10 20 30 40 50 60 70
Station (m)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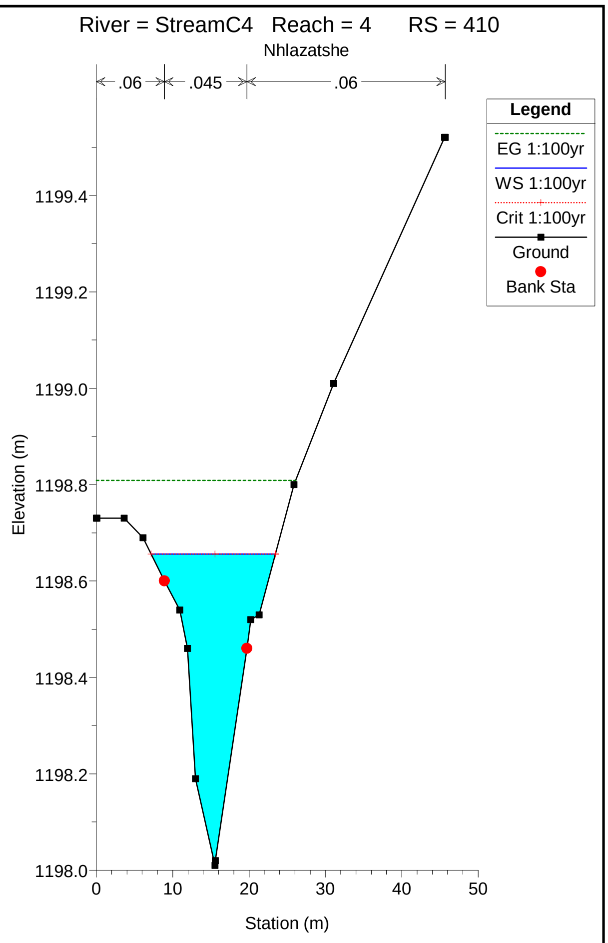
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1200.4
1200.6
1200.8
1201.0
1201.2
1201.4
1201.6
1201.8
1202.0
0 10 20 30 40 50 60 70
Station (m)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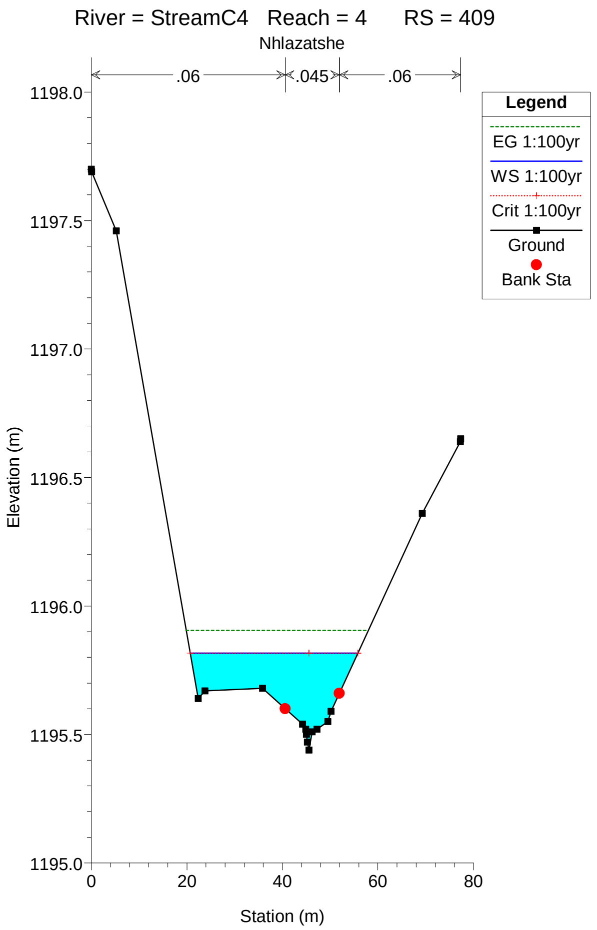
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1198.0
1198.2
1198.4
1198.6
1198.8
1199.0
1199.2
1199.4
0 10 20 30 40 50
Station (m)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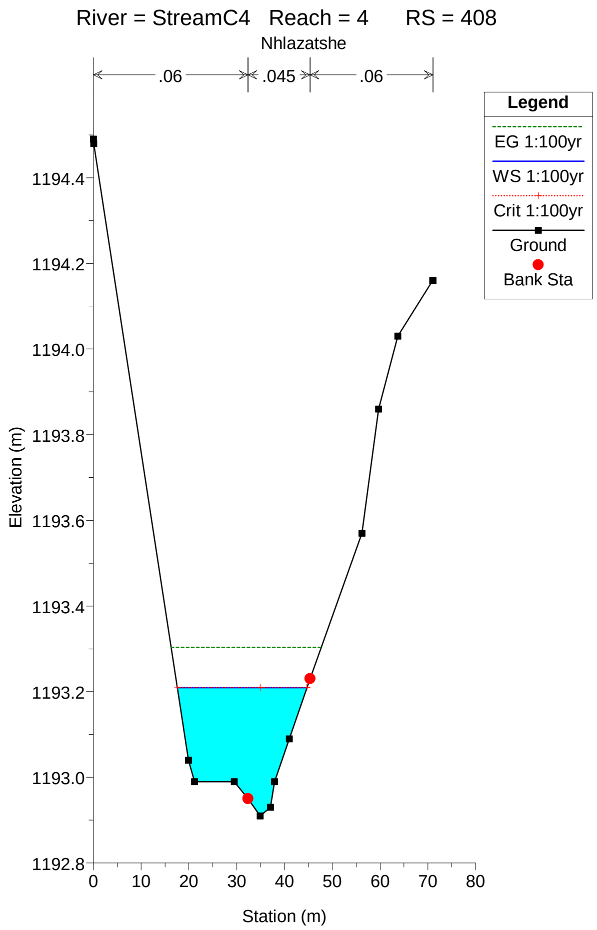
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1195.0
1195.5
1196.0
1196.5
1197.0
1197.5
1198.0
0 20 40 60 80
Station (m)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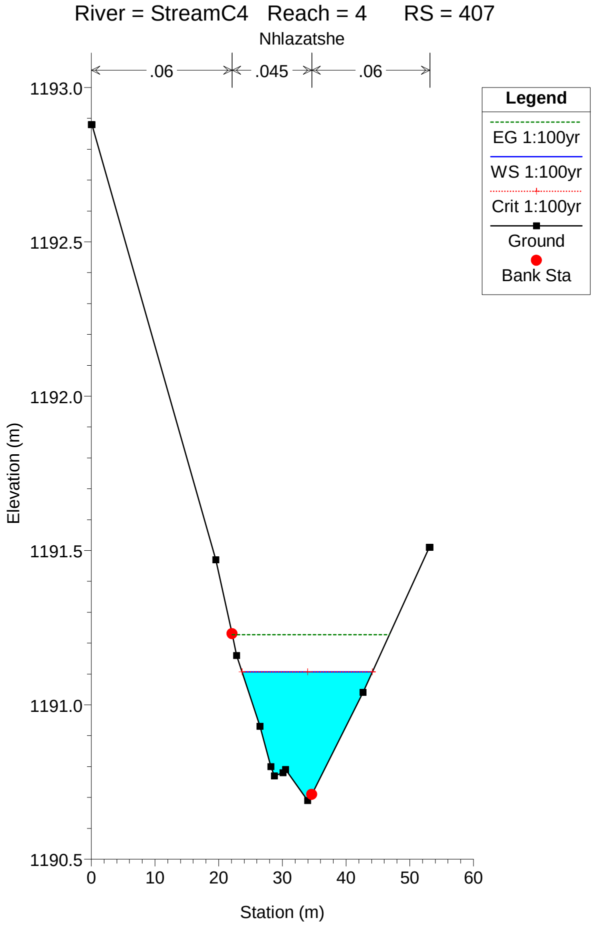
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1192.8
1193.0
1193.2
1193.4
1193.6
1193.8
1194.0
1194.2
1194.4
0 10 20 30 40 50 60 70 80
Station (m)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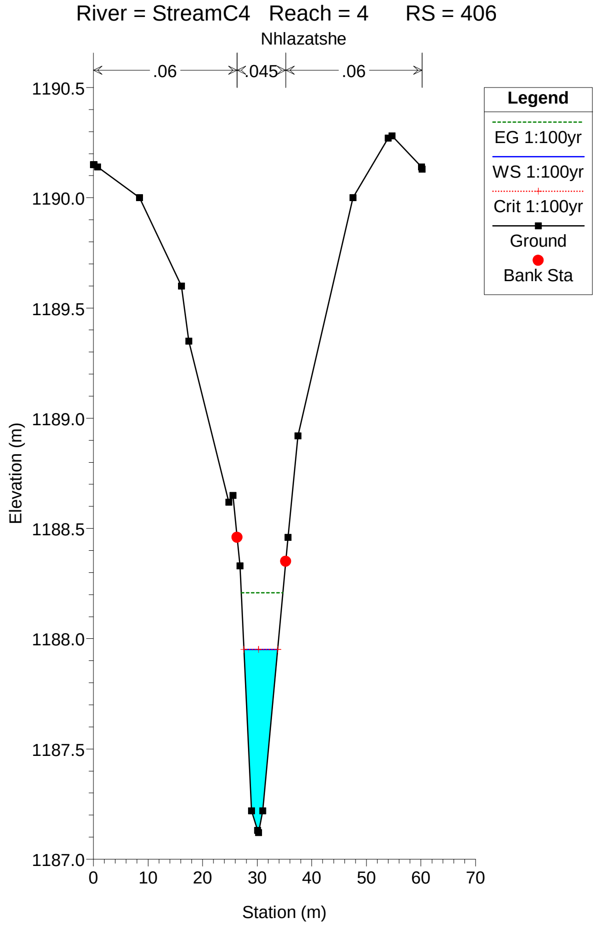
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1193.0
1192.5
1192.0
1191.5
1191.0
1190.5
0
10
20
30
40
50
60
Station (m)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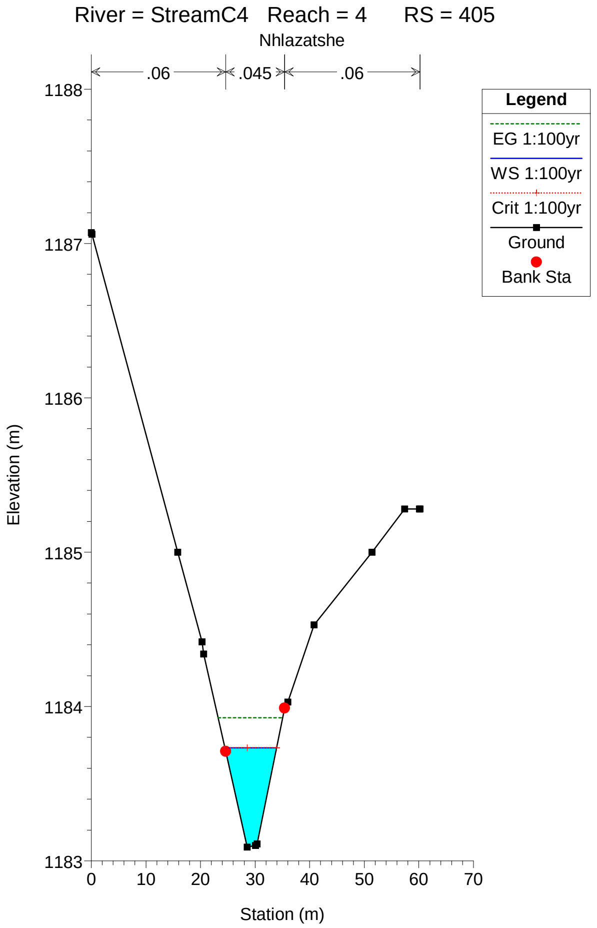
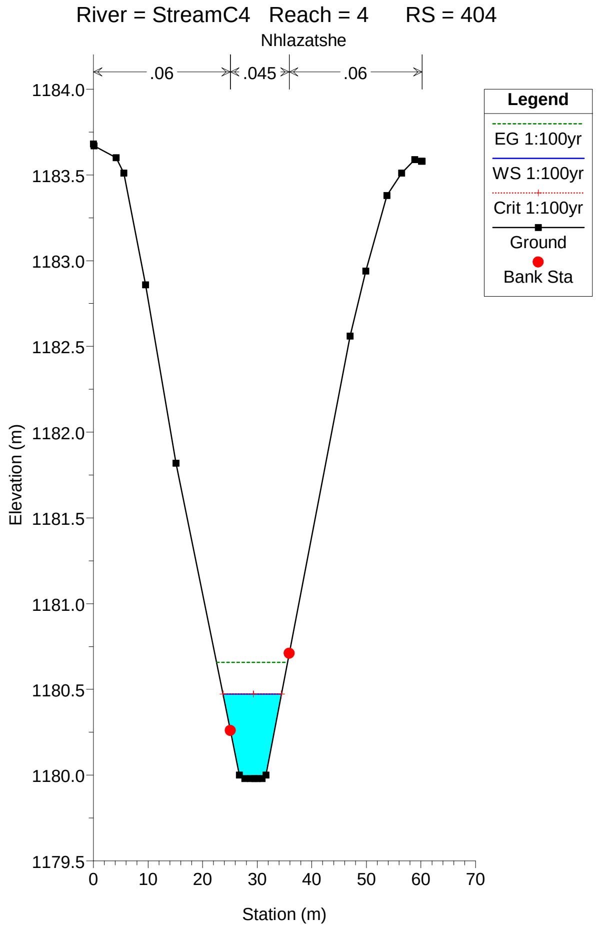
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1190.5
1190.0
1189.5
1189.0
1188.5
1188.0
1187.5
1187.0
0
10
20
30
40
50
60
70
Station (m)


River = StreamC4 Reach = 4 RS = 405
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1188
1187
1186
1185
1184
1183
0
10
20
30
40
50
60
70
Station (m)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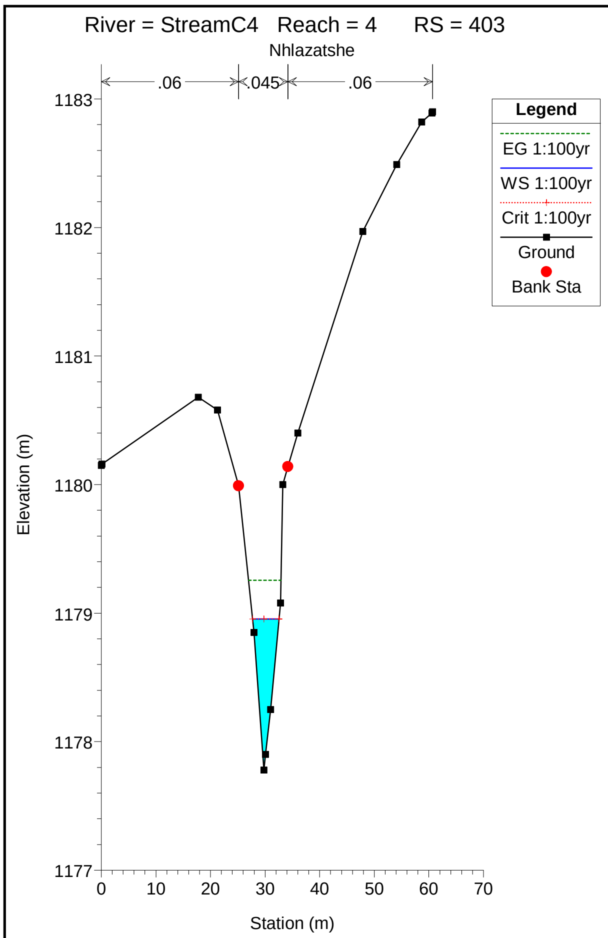
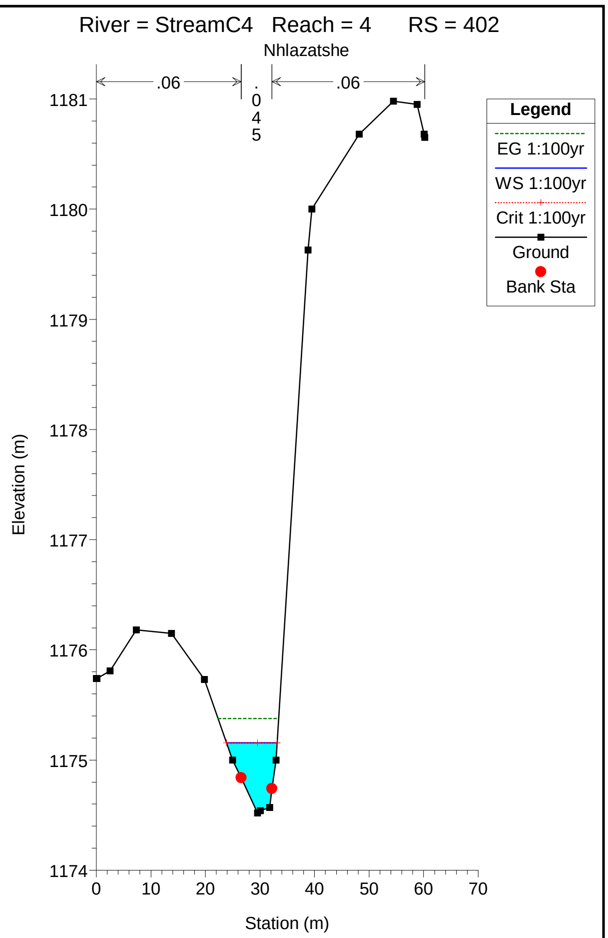
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1184.0
1183.5
1183.0
1182.5
1182.0
1181.5
1181.0
1180.5
1180.0
1179.5
0
10
20
30
40
50
60
70
Station (m)



River = StreamC4 Reach = 4 RS = 403
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)



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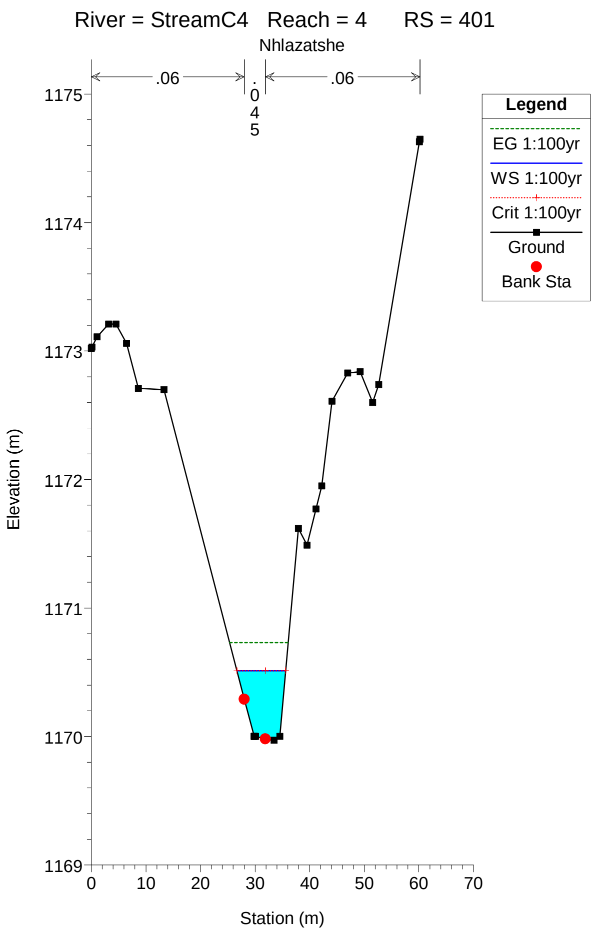
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)



River = StreamC4 Reach = 4 RS = 401
Nhlazatshe
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)

Wetland Report

WETLAND DELINEATION AND IMPACT ASESSMENT REPORT AT NHLAZATSHE

Prepared by:

Africa Ecological and Development Services Company

Prepared for

MangGeo Enviro services

Reference Number: MANG_Wetland_0001

Project Name:

WETLAND DELINEATION AND IMPACT ASSESSMENT REPORT FOR THE PROPOSED FORMALISATION OF THE NHLAZATSHE TOWNSHIP WITHIN THE CHIEF ALBERT LUTHULI LOCAL MUNICIPALITY IN MPUMALANGA PROVINCE.

Compiled by:

Africa Ecological and Development Services (Pty) Ltd
P.O. Box 1163,
Fauna Park, 0787, South Africa.

Client:
MangGeo Enviro services

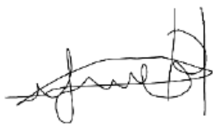
Date:

September 2020

Location:

Fauna Park

Approved by:
Humbulani Munzhelele



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Signature

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DECLARATION OF INDEPENDENCE

I, Humbulani Munzhelele, in my capacity as a specialist consultant, hereby declare that**:**

- I act as the independent specialist in this application;
- I will perform the work relating to this application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may comprise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislations;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24(f) of the Act.

Humbulani Munzhelele
Wetland Ecologist
Africa Ecological and Development Services (Pty) Ltd.
19 September 2020

1. Introduction

MangGeoEnviro services has appointed Africa Ecological and Development Services to undertake wetland delineation and assessment and produce a specialist report for the proposed formalization of the Nhlazatshe township within the Chief Albert Luthuli Local Municipality in Mpumalanga Province **(Figure 1)**. The project area is approximately 230 hectares in extent.

The focus for the study was to do delineation and assessment of wetland areas that may have directly impacted on by the township development, with a general wetland identification and delineation for systems within the 30 m, 100 m and 150 m river buffer zone of the project. Furthermore, the study was conducted to provide a description of the current ecological integrity and impacts pertaining to any township development activities and wetland systems that may have been impacted by the construction of the existing development, as well as providing appropriate management recommendations to mitigate the impacts on the water resources systems. The study was conducted to meet the requirements of a wetland ecological specialist assessment.

Site visit was conducted on the 02nd September 2022, and this would constitute a dry season survey. This report, after taking into consideration the findings and recommendation provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making with regards to the wetland functionality assessment.

1.1. Aims of the study (Project Terms of Reference)

The aims of the study are to:

- Verify the occurrence and typology of wetlands on the study site as delineated through desktop methods, and to correct the delineation based on field-based assessment, thus enabling all wetlands on the study site to be mapped.
- Assess all wetland areas on the study site in the field
- Based on the field assessment gain an understanding of the characteristics of the wetland, including hydrology, vegetation, soils and geomorphology.
- Assess the impacts of the proposed development on the wetland, and suggest suitable mitigation measures, if relevant, to ameliorate or remove these predicted impacts.

- Conduct Wet-Health for the determination of Present Ecological State (PES) of the wetland
- Conduct Wet-Eco Services for determination of ecosystem services.

1.2. Assumptions and Limitations

Only wetlands within the boundaries of the study site were assessed as part of this study. The wetland survey was undertaken in the spring (early September). This entails that the wetland was assessed during the spring season. Although there was some vegetative component that were still propagating or germinating, this did not lower the confidence in the delineation as the wetland delineation is also based on primarily the analysis of soil-based indicators, terrain unit indicators, hydromorphic unit indicators and water table and zonation. The predominantly grassy vegetation still displayed sufficient inflorescences in order to broadly identify the vegetative composition within the wetland.

The primary aim of this wetland assessment study was the delineation of the wetland, and stipulation of the buffer surrounding the wetland, in line with the stipulations of the Department of Water Affairs (DWAF) (DWAF, 2005), as well as the identification of potential impacts on the wetland associated with the proposed township development, as part of the EIA studies being undertaken for the proposed project. Although no water use licence process is being undertaken for the proposed development, a wider assessment of the functionality and present ecological state of the wetland have been undertaken to augment the scope of this study.

1.3. Definitions and the Legislative Framework.

The proposed township formalization should take cognizance of the legislative requirements, policies, guidelines and principles of the relevant regulatory documents such as the National Spatial Development Framework, the Chief Albert Luthuli Local Municipality Integrated Development Plan (IDP) and Biodiversity Plan; Mpumalanga biodiversity sector plan and the National Environmental Management Act (NEMA).

The National Environmental Management Act (NEMA) outlines several principles that give guidance to developers, private land owners, members of the public and authorities, of which principle number three of the act stipulates that a development must be socially, environmentally and economically sustainable. Section number 4(a) of the Act states that consideration should be given to all relevant factors which include ecosystems disturbance and loss of biological diversity must be avoided and prevented, and or where they cannot be completely avoided must be minimised and mitigation measures applied; and that pollution and environmental degradation be avoided, and or where such cannot be completely avoided remedial action to the environment be instituted.

2. PROJECT DESCRIPTION

2.1. Site Location and Description (Study area)

Site is located along the Nhlazatshe river which flows from the southwestern side to the east. Its riparian zone has some degraded wetlands. Degradation is associated to sand mining by local people. The study was done in an area into which the residential area has rapidly been expanding over the past years. The existing site is in a remnant rural component in the form of vestiges of open space as shown in Figure 1 below. The approximates coordinates in which the site is situated are: Latitude: -26,07557; Longitude: 30,75629; Altitude: 1175 m.

Since the site is currently situated in a rural based context, there is evidence of livestock rearing activities taking place there. Certain types of inland wetlands are common to particular regions of the country. Many of these wetlands are seasonal (meaning that they are dry one or more seasons every year), and particularly in the arid and semiarid west, may be wet only periodically. Permanent zones and seasonal zones are mainly located on both western and eastern sides. The quantity of water present and the timing of its presence in part determine the functions of a wetland and its role in the environment. Even wetlands that appear dry at times for significant parts of the year, such as vernal or ephemeral pools, often provide critical habitat for wildlife adapted to breeding exclusively in these areas. For example, the schools of fish were observed in pools, water channels and gorges. On the top of the catchment.

Some other findings from the wetland study conducted from Nhlazatshe wetland site.

A field verification which was conducted on the 02nd of September 2022, revealed that the functional wetland areas which for the purpose of this study are specified as wetland and riparian zones, denoted the following:

- Sedimentation/infilling evidence in the Nhlazatshe ephemeral wetland. This is due to an increase in the deposition of sediments because of sand mining and overgrazing, resulting in the partial or even complete burial of organisms and the alterations of substrates.

- There is a typically evidence of land-use changes, agriculture (For example, cultivation gum trees planted directly within the wetland site) settlements within the 20m radius of the wetland, disturbance of the stream or wetland flow regimes and runoff were noted.
- Due to disturbance on and around the wetland vicinity, there is evidence of increased sedimentation on the wetlands site with more effects caused by vegetation removal, over grazing and sand mining.
- The Nhlazatshe wetland is exposed to human-related stressors, where the wetland is subjected to alteration of the hydroperiod due to a reduction in wetland water levels and water residence time and/or increased frequency, duration, or extent of desiccation of wetlands sediments, since most of the vegetation are removed or cleared.
- The wetland area is currently used for livestock grazing (cattle and goats).
- The hydrology of the wetland system was and is still currently being transformed due to continuous overgrazing and trampling by livestock, human and vehicle, including infrastructure development such as bridges, secondary roads tracks and wetland area crossings and river crossings.
- The system, however, still represent typical characteristics of an ephemeral wetland such as wetland soils and vegetation.
-

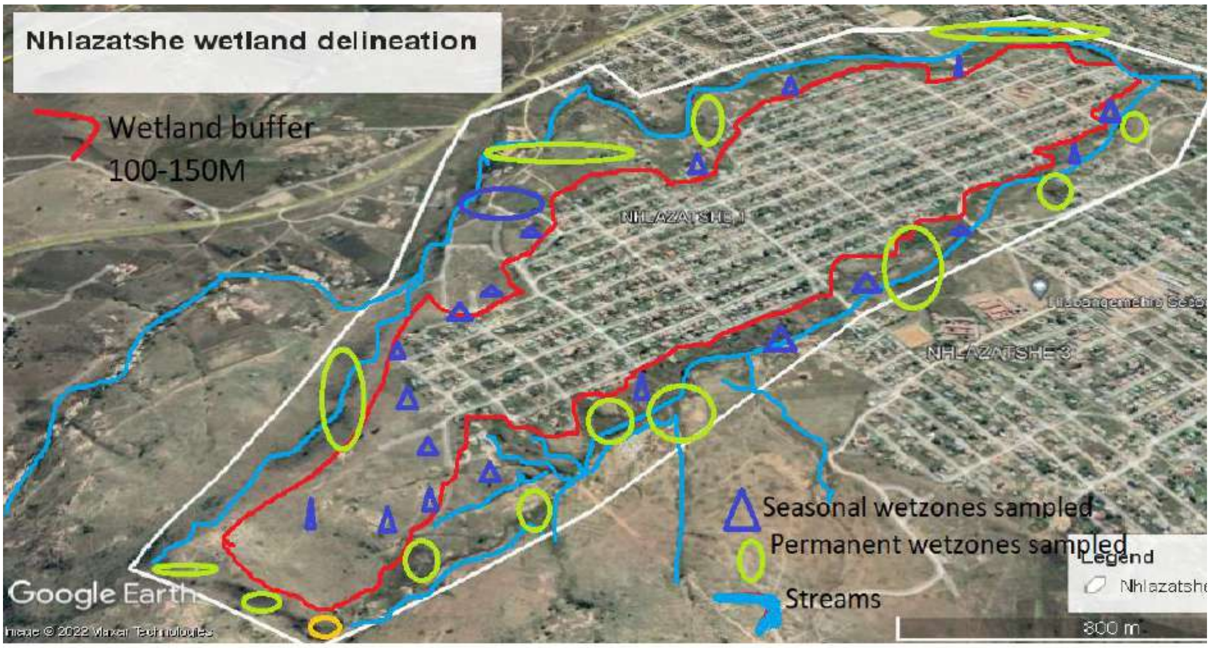

Figure 1: Site Location Map detailing delineation for wetland and buffer zone

2.2. Aquatic Vegetation type and Indicator Species.

Vegetation survey in Nhlazatshe wetland showed large areas of dominant plant species with very little diversity. The wetland was dominated by a typical wetland sedges and reeds and other grasses types (Table 1).

Table 1: Presence of dominant plant species found within the quadrats examined at the Nhlazatshe wetlands.

Family	**Taxon**	**Common name**
Asteraceae	*Xanthium strumarium*	Rough cocklebur
Cyperaceae	*Scirpus ancistrochaetus*	North-eastern bulrush
Juncaceae	*Juncus effusus*	Soft rush
Poaceae	*Cynodon dactylon*	Bermuda grass
Poaceae	*Urochloa mosambicensis*	Bushveld signal grass
Typhaceae	*Typha capensis*	Bulrush
Poaceae	*Themeda triandra*	Red grass
Poaceae	*Eragrostis curvula*	Weeping lovegrass
Poaceae	*Cymbopogon pospischilii*	Lemongrass

It is important to note that the Nhlazatshe wetlands were dominated by the grasses from the families Poaceae, Juncaceae and Typhaceae. These vegetation species are well suited and adapted to the conditions of wetlands conditions. These vegetation species have evolved and developed mechanisms for maturing and growing fast to withstand the unfavourable and unpredictable conditions.

2.3. Fauna Biodiversity recorded at Wetland site during the field survey on the 2nd September 2022.

2.3.1. Aquatic Macroinvertebrates.

Invertebrates samples were dominated by the hemipterans Notonectidae (*Anisops spp*) and Corixidae (*Sigara spp*). There was a very low biodiversity of invertebrates but high numbers or abundance of those taxa present. The taxa identified are all very tolerant of a wide range of water quality and adapted to low levels of oxygen. Some have the capability to burrow themselves beneath the mud to complete their growing phases in case the ephemeral wetlands ponds become dry out or desiccated. Some of the observed invertebrates recorded are shown in Table 2 below.

Table 2: Presence of aquatic macroinvertebrates species examined in the Sikhwahlane Wetland site.

Order	**Family**	**Taxon**	**Common name**
Hemiptera	Corixidae	*Hesperocorixa castenea*	Water boatmen
Hemiptera	Naucoridae	*Ilyocoris cimicoides*	Creeping water bugs
Hemiptera	Notonectidae	*Notonecta maculata*	Backswimmers
Hemiptera	Nepidae	*Nepa cinerea*	Water scorpion
Diptera	Chironomidae	*Chironomous spp*	Midges
Mollusca	Lymnaedae	*Lymnaea columella*	Reticulate pond snail
Diptera	Tabanidae	*Tabanus sulcifrons*	Horse flies

It is important to note that the aquatic invertebrate families recorded at the Nhlazatshe ephemeral wetlands (Table 2 above) are dominated by species from the order Hemiptera and Diptera. It is important to note that most of the species from these orders or families are airbreathers and adapted to life in ephemeral wetlands or vernal ponds conditions. When condition in the aquatic environment become unsuitable or desiccated and not supporting the livelihoods, these species do take another form so that they can survive terrestrial.

2.3.2. Bird biodiversity surveyed in Sikhwahlane ephemeral wetland site.

Despite some disturbance of the Sikhwahlane wetland site, the bird life was seen to be thriving. Most of the birds are perceived to be around the wetlands sites for ecological benefits such as breeding, feeding and protection. Birds that were readily recognisable were recorded (Table 3).

Table 3: List of birds recorded on site during field survey and delineation of the wetland site and their abundance on the days of survey.

Common name	**Species name**	**Abundance**
Cattle egrets	*Bubulcus ibis*	++++
Brown-hooded kingfisher	*Halcyon albiventris*	++
Blue Waxbill	*Uraeginthus angolensis*	++++
Dark-capped Bulbul	*Pycnonotus tricolor*	++++
Cape Sparrow	*Passer melanurus*	++++
Hammerhead bird	*Scopus umbretta*	++
White-throated Swallow	*Hirundo albigularis*	++++
Fork-tailed Drongo bird	*Dicrurus adsimilis*	++
Grey heron	*Ardea cinerea*	+
Green-winged Pytilia	*Pytilia melba*	++++
African Masked Weaver	*Ploceus velatus*	++++
Red-billed quelea	*Quelea quelea*	++++
Spur-winged lapwing	*Vanellus spinosus*	++++
Laughing dove	*Streptopelia senegalensis*	++++
Cape turtle-dove	*Streptopelia capicola*	++++
Red-faced mousebird	*Urocolius indicus*	++++
Little Bee-eater	*Merops pusillus*	++

+ (one individual), ++ (two individuals), +++ (three individuals) and ++++ (four or more individuals), denote the abundance level.

2.3.3. The Anurans or amphibians identified from the wetland sites.
Suitable environmental conditions, especially at breeding sites are critically important to frogs, and most species tend to be in specific habitats such as wetlands and rivers (Du Preez and Carruthers, 2017). The frogs are shown in Table 4 below.

Table 4: List of frogs recorded on the at the Nhlazatshe wetland site survey.

Family	**Species name**	**Common name**
Racophoridae	*Chiromantis xerampelina*	Foam nest frogs
Pipidae	*Xenopus laevis*	African clawed frog

It is important to note that these frogs are plentiful in ponds and rivers respectively. They are aquatic and highly adaptable and will lay their eggs whenever conditions allow it. During wet rainy seasons they will travel to other ponds or vernal pools of water to search for food. During drought times these frogs burrow themselves in the mud, becoming dormant for up to a year. This is indeed one of the mechanisms these frogs use to survive the unpredictable and harsh environment of the ephemeral wetlands. These frogs were noticed to have laid many eggs in the wetlands for their offspring (tadpoles) to survive the unpredictable conditions even if some offspring may die some will stand a high probable chance of surviving depending on the area, they are located on within the wetland system. It is also important for Nhlazatshe wetlands to be protected from impacts and degradation for these frogs' species to thrive in this unique freshwater environment. It important to control human activities that are posing threats to drying of wetlands in the Nhlazatshe area. Sand mining and grazing have been identified as measure activities destroying the wetlands.

3. METHODOLOGY FOR ASSESSMENT

3.1. Wetland Field Assessment

The wetland area was delineated by desktop methodology prior to this study was visited in the field, focusing on the boundaries of the wetland area. Use was made of a GPS to identify important points (e.g. wetland boundaries). These GPS points were converted into a GIS shapefile to allow these points to be mapped and to facilitate the correction of wetland boundaries and the identification of very sensitive wetlands portions within the study area.

3.2. Wetland Delineation

In determining the zone of the wetlands require the delineator to give consideration to specific indicators. The indicators must always be present in the wetlands, and under normal circumstances vegetation indicator is deemed to be primary indicator. Soil indicator tends to be the most important indicator, and the other two indicators (The Terrain Unit and Soil Form Indicators) are used for confirmatory purposes (DWAF, 2005).

The National Water Act (Act 36 of 1998) defined wetland as a "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and the land in which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetland based delineation and sampling of wetland was based upon the DWAF guidelines "A practical field procedure for the identification and delineation of wetlands and riparian areas" (DWAF, 2005), which stipulates that consideration be given to four specific wetland indicators to determine the boundary of the wetland. These indicators are: terrain unit indicator, soil form indicator, soil wetness indicator and vegetation indicator.

This according to the DWAF (2005) guidelines for the delineation and identification of wetlands, soil wetness indicators are the most indicator of wetland occurrence, due to the fact that soil wetness indicators remain in wetland soils, even if the wetland site is degraded or drying out.

3.3. Wetland Functional Assessment

Wetland functionality is defined by Macfarlane *et al*. (2007), as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is also based on a theoretical undisturbed state which is derived from an understanding of undisturbed regional vegetation and hydrological conditions knowledge (Macfarlane *et al*., 2007). Kotze *et al*. (2007) emphasized that the wetland systems are critical for groundwater recharges, although flows through them are supplemented by surface water contributions from rain. Kotze *et al.* (2007) further reported that wetlands serve as unit for ecological services and a functional wetland system could contribute to the following: surface flow attenuation, contribution of water to the stream during dry seasons, provide water quality enhancement benefits, and as such the systems have a high potential to remove nitrogen and nitrates as well as carbon sequestration.

3.4. Determination of the Present Ecological Status (PES) of wetlands

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health on the other hand is defined as a measure of the deviation of wetland structure and function from the wetland`s natural reference condition. This technique is used to assess hydrological, geomorphological and vegetation heath in the form of ecological status categories and descriptions as shown in Table below.

Table 3.4.1: The Present Ecological Status (PES) categories and descriptions for WET-Health (Adapted from Macfarlane *et al.*, 2007).

Category	Description	Range
A	Unmodified, natural	0-0.9
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.5-5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	6-7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10

3.5. Determination of the Ecological Importance and Sensitivity (EIS) of Wetlands.

The ecological importance is an expression of a wetland`s importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system`s ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (MacFarlane *et al.*, 2007). Water resources can be classified for an appropriate management class based on EIS. The EIS allows classification of ecological importance in ecosystems and biodiversity for the estimation of species diversity and abundance. The EIS use the rating scale for the estimation of scores **(Table 3.5.1).** Furthermore, these wetlands provide specialized habitat and dispersal corridors and basic human needs such as subsistence farming and water use.

Table 3.5.1: Ecological Importance and Sensitivity rating scale used for the estimation of scores.

Ecological Importance and Sensitivity Categories	**Rating**
Very High These are wetlands that are considered ecologically important and sensitive on a natural or even international level. Biodiversity of these wetlands is usually very sensitive to flow and habitat alterations. They moderate the water quality and quantity of major rivers.	>3 and <=4
High These wetlands are considered to be ecologically important and sensitive. Biodiversity of these wetlands may be sensitive to flow and habitat alterations. Plays a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate These wetlands are considered ecologically important and sensitive at a local or provincial scale. Biodiversity in these wetlands is not usually sensitive to flow and habitat alterations. However, they play a small role in moderating the quantity and quality of water in major rivers.	>1 and <=2
Low/Marginal Wetlands that are not ecologically important and sensitive at any site. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat alterations. However, they play a role in moderating the quantity and quality of water in major rivers.	>0 and <=1

3.6. Determination of Buffer Requirements

The pre-mitigation buffer requirements for the construction and operational phases are 30 m, 100 m and 150 m for river and wetlands sites respectively. These buffer requirements are relevant to all the delineated wetlands sites and should be ideal after the successful application of recommended mitigation measures.

4. Results and Discussions

4.1. Functions and values of the Nhlazatshe Wetlands

Due to the vernal pools or ephemeral pools that are created in the Nhlazatshe wetlands, such an environment is unique in nature and is considered to be good in provision of habitat for numerous rare plants and animals that are able to survive and thrive in these harsh and ever-changing conditions. Many of these plants and animals spend the dry seasons as seeds, twigs, rhizomes, eggs or cysts, and then grow and reproduce when the ponds are again filled with water. In addition, birds such as egrets, ducks, hawks, kingfishers use vernal pools as a seasonal source of food and water.

Due to the seasonal nature of the pools, both animals and plants living there have some adaptation to help them survive in these challenging environments. There are three basic types of strategies that mostly animals and sometimes plants use in order to survive and adapt, namely: getting off to a fast start; mature early or rapidly and live a prolonged period of time without water.
The facultative species include most of the other remaining frogs, few reptiles, fingernail clams, snails, insect larvae (dragonfly, damselfly, caddisfly larvae, water scorpion, gyrinidae, veliidae, naucoridae, corixidae) and leeches. The major branchiopod crustaceans (generally of facultative ephemeral wetland taxa: Cladocera (Genus: *Daphnia pulex*) were present in the water.

4.2. Status of the Nhlazatshe Wetland proposed formalization area

The Nhlazatshe wetlands are valuable, and indications are that they are increasingly a threatened ecosystem due to human activities such as settlements, field for ploughing and vehicle activity, dumping of waste**,** trampling by livestock, digging and excavation for water and soil, sand, and gravel, overgrazing and removal of vegetation together with invasive alien plants. Most of the wetlands permanent zones have already been lost and great efforts should be made to protect the remaining wetland, as their disturbance and disappearance will mark the loss of rare and important habitat and some of the associated plant and animal species as well. In general, the loss of ephemeral wetlands due to land alterations and insufficient protections has vast ecological and social consequences.

Figure 4.2.1: Indicator for soil sampling during field survey

4.3. Wetland Delineation (soils, vegetation and soil wetness indicators)

Accordingly, all of the “wetland indicators” including soil wetness and vegetation indicators as well as the analysis topography (land form unit) and site hydrology were considered in the identification and delineation of wetland areas in the study area at Sikhwahlane site. Under most circumstances the most important indicator of the presence of hydric soils is the soil wetness indicator, i.e. examination of redoximorphic features within the soil (Collins, 2005).

4.4. Wetland Soils

The findings from the determination of wetland soils indicated that the Sikhwahlane ephemeral wetlands site is dominated by loamy-clay type of soil. The Sikhwahlane ephemeral wetlands had shown that one main wetland soil form is dominant within the delineated wetland areas during the site visit. Signs of wetness within the soils studied on site lacks the typical mottling usually found in wetland soils. The reason for this phenomenon may be due to the lack of iron in the soil. It is however important to note that another property of wetland soils known as gleying can be seen within the wetlands sites.

Figure 4.4.1: indicator for soil sampled on seasonal sone

4.5. Description of Wetland Type

Ephemeral wetlands are formed in closed depressions lacking a surface outlet and are wet only seasonally or in wet years. Depressions in Sikhwahlane wetlands are in an inward draining basins with an enclosing topography which allows water to accumulate within the system.

4.6. Present Ecological Status

The Present Ecological Status (PES) for the assessed Nhlazatshe wetland system, the ephemeral or vernal pool is presented in Table below.

The Nhlazatshe wetland is in a Category D: Largely modified. The hydrological processes and vegetation of the wetland have undergone the most significant alterations, primarily due to impacts associated with the extensive agricultural activities and sand mining**.** Additionally, impacts such as informal road traversing the wetland area, and pipeline crossings that have resulted in soil disturbances, showing developing cracks and soil instability. In so doing, the assessed area of the wetland is deemed to be in a largely modified condition.

Seeps and valley floor have been degraded with water quality been polluted in a way that green algae also got established which indicated that waste are being deposited. Green algae also indicate the disturbance on flow of water which resulted in accumulation of pollutants on dammed water and ponds.

4.7. The Ecological Health Assessment

The hydrology of Nhlazatshe wetlands sites has been “Critically Modified (F)” due to the disturbance in the various surface water runoff drainage system disturbed.

The Geomorphology component of the wetlands area has been scored “Largely Modified (D)” due to certain impacts identified as being a threat for the Nhlazatshe wetland system. The identified impacts in this regard include the changes in run-off characteristics due to high concentrations of soil degradation, riparian vegetation disappearance and the formation of eroded gullies.

The vegetation aspect of the Nhlazatshe wetland sites have been scored a “Largely Modified (D)” score. The main aspect contributing to this rating is attributed to the development of the Township developed area. Since the construction and operation of the infrastructure involved clearing indigenous vegetation and covering soil surfaces which inhibits smooth water infiltration and substantially increases run-off.

4.8. The EIS Assessment of the Remaining Wetland Areas

The EIS Category of the Nhlazatshe wetlands was determined according to Kotze et al. (2007). The findings of the EIS assessment indicates that the wetland is deemed to be of moderate ecological importance and is therefore designated a Sensitivity Category C score (Table 5). This is largely attributable to the hydrological-functional importance of the system, primarily due to its perceived ability to regulate streamflow, runoff and, control erosion. This is because these wetlands are considered ecologically important and sensitive at a local scale. Although the biodiversity in these wetlands is not usually sensitive to flow and habitat alterations. However, they play a small role in moderating the quantity and quality of water in major rivers.

4.9. Buffer Requirements

The recommended buffer zones were delineated to various ranges based on the impact that took place and status; ranging from 20- 30 m; 100m to 150 m. The buffer zones for the wetlands should be implemented in order for the activities not to cause further damage on the Nhlazatshe wetland.

4.10. IMPACT ASSESSMENT

4.10.1. IMPACT AND MITIGATION MEASURES

A development has several impacts on the surrounding environment and particularly on a wetland. The development changed the habitats, the ecological development infiltration rates, amount of runoff and runoff intensity and the hydrological regime of the site including the watercourse.

4.10.2. RECOMMENDATIONS

Recommendation 1: Wetland monitoring and assessment programmes.

Consistent, thorough and timely wetland monitoring and assessment programmes are a critical tool for municipality and community to better manage and protect their wetland resources. These programmes if considered can enhance the following attributes, namely:

- Establishment of a baseline in wetland extent, condition and function
- Detect change, and
- Characterize trends within and around the wetlands over time

Wetlands monitoring and assessment data can be used to help make decisions in:

The National Water Act, 36 of 1998 regulatory programmes

Wetland restoration and watershed planning

The development of meaningful water quality standards for wetlands

Recommendation 2: No construction or sand mining may take place within the wetlands or 100 m zone of regulation and such an area should be demarcated as a no-go area.

Recommendation 3: No dumping of waste may take place on wetland and water course.

Recommendation 4: Environmental education to raise awareness on value and protection of wetlands must be done for local community and schools.

Recommendation 5: Rehabilitation plans must be developed to restore the wetlands with support from working for wetlands program.

5. NATURE OF THE POTENTIAL IMPACTS ON WETLANDS ASSOCIATED WITH THE PROPOSED TOWNSHIP FORMALISATION

5.1. Impact Assessment

The impact assessment consider both direct and indirect impacts, if any, to the wetland systems. The area to be developed will consist of freestanding structures. The layout of the proposed project could have a potential to encroach into the wetlands and associated buffers of Sikhwahlane wetlands sites. If the mitigation measures are not taken into consideration the impacts could possibly reduce the ability of the wetland to perform many of the functions associated with this kind of ecosystems. If the wetland area could loose its integrity, the implications could be that it cannot control and manage stormwater, sediment trapping and trapping of pollutants and ultimately sediments. There could be a further biodiversity value reduction in case the wetland loses its functionality and ecological health status.

Table 7: Impacts assessed for the existing Nhlazatshe to be formalized as a Township

Impact	Aspect
Construction phase	Removal of vegetation Excavations for foundations and servitudes Clearing of area for infrastructure Hardening of surface areas Vehicle activity Domestic and industrial waste
Impeding on flow paths entering Siltation Sedimentation Eutrophication Water quality impairment	
Operational phase	Increase in hardened surfaces Wetland drainage patterns change Traffic and vehicle activity The roadkills of fauna species particularly frogs, snails, birds and reptiles that could try to negotiate or transverse the main road to the other side of the road habitat.

The above impacts already occurred since area is an established developed site.

Measures to address the impacts are to be implemented without compromise.

5.2. Associated Mitigation Measures

The mitigation measures that should be considered for the township to be formalized are as follows:

- The delineated wetland areas must be avoided where possible. Where possible, the construction of the houses must take place from the existing road and not from within the wetland areas.
- Prevent uncontrolled access of vehicles through wetlands that have caused a significant adverse impact on the hydrology and soil structure of the wetland areas which also led to the compaction of soils and in some instances enhanced soil erosion.

5.3. Impact Rating Matrix before and after mitigation measures for Sikhwahlane wetlands sites.

The impact assessment rating matrix assessment of wetland loss before mitigation is shown in Table 8, and the one after application of mitigation measures is in Table 9 below.

Table 8: The Impact Assessment Matrix of Nhlazatshe Wetland loss before mitigation measures.

Criteria	Description	Score
Extent	The loss of wetlands is likely to have a local impact, as the catchments found within the proposed township development could feed directly to the wetland system	2
Duration	The loss of wetland is likely to be permanent, as the portions in the Sikhwahlane wetland could be destroyed permanently	4
Intensity	Given the largely modified or degraded nature of the wetlands on site, it is likely that the intensity will be moderate	2
Probability of occurrence	The proposed layout could destroy wetland habitat	4

Significance of the impact: The impact of the township formalisation on site is likely to have a very high negative impact if mitigation measures are not taken into consideration.

Table 9: The Impact Assessment Matrix of Nhlazatshe Wetland loss after mitigation measures.

Criteria	Description	Score
Extent	The loss of wetlands is likely to have a site impact, as the catchments will be rehabilitated	1
Duration	The loss of wetland integrity is likely to be short-term, as the Nhlazatshe wetlands will have an offset of negative impacts by rehabilitation	1
Intensity	Given the degraded or alterations nature of the wetlands areas, it is likely that the intensity will be moderate.	2
Probability of occurrence	The proposed development offset will possibly reduce the loss of Nhlazatshe wetlands site	2

Significance of the Nhlazatshe wetlands impact: The impact of the township development is likely to have a low negative impact should the wetland be conserved and rehabilitated and treated as a no-go area following the buffer zone requirements.

6. CONCLUSIONS

A seasonal or ephemeral vernal flat; seep and valley and pool type of wetland has been identified on the site of the proposed Nhlazatshe Township formalization. The wetland occupies a part of the eastern and western area on the site. The presence of the wetland is important for the formalization, as the wetland must not be affected in any way by the proposed formalization. The wetland area and associated buffer must be kept free from all or further development, including linear developments (i.e. roads) and underground services (pipelines etc.).

The most important potential impacts that the proposed formalization could exert on the wetland relate the indirect impact that could be brought about by stormwater discharge. It is important that stormwater from the surrounding proposed formalization be of “soft” engineering in the stormwater design is strongly recommended, as these will likely prevent most of the impacts associated with the stormwater discharge.

Based on the findings of the wetland ecological assessment, it is the opinion of the wetland ecologist that the proposed township formalization poses a moderate risk to the integrity of the methods associated with the Nhlazatshe wetlands and the adjacent Nhlazatshe river. It is therefore of utmost importance that the adherence to recommendations and ecologically sensitive site development plans, and the mitigation measures provided in this report should be ideal for general good construction practice and ongoing management, maintenance and monitoring of perceived impacts to limit further degradation of the freshwater environment. Furthermore, it is also the opinion of the wetland ecologist and freshwater specialist that the proposed township formalization from a freshwater resource management perspective is acceptable provided no development takes place within the wetlands or the associated 100 m zone or so of regulation, dumping of wastes (diapers and glass bottles) are eliminated, and that strict adherence to mitigation measures is enforced to ensure that the ecological integrity of the freshwater environment is not further compromised.

The mitigation measures and recommendations listed herein should be adhered to as to ensure wetland areas associated with the township formalization as well as surrounding environment are protected.

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Appendix A: Photos and referal maps

Photo1: Nhlazatshe river near the source an its surounding wetlands

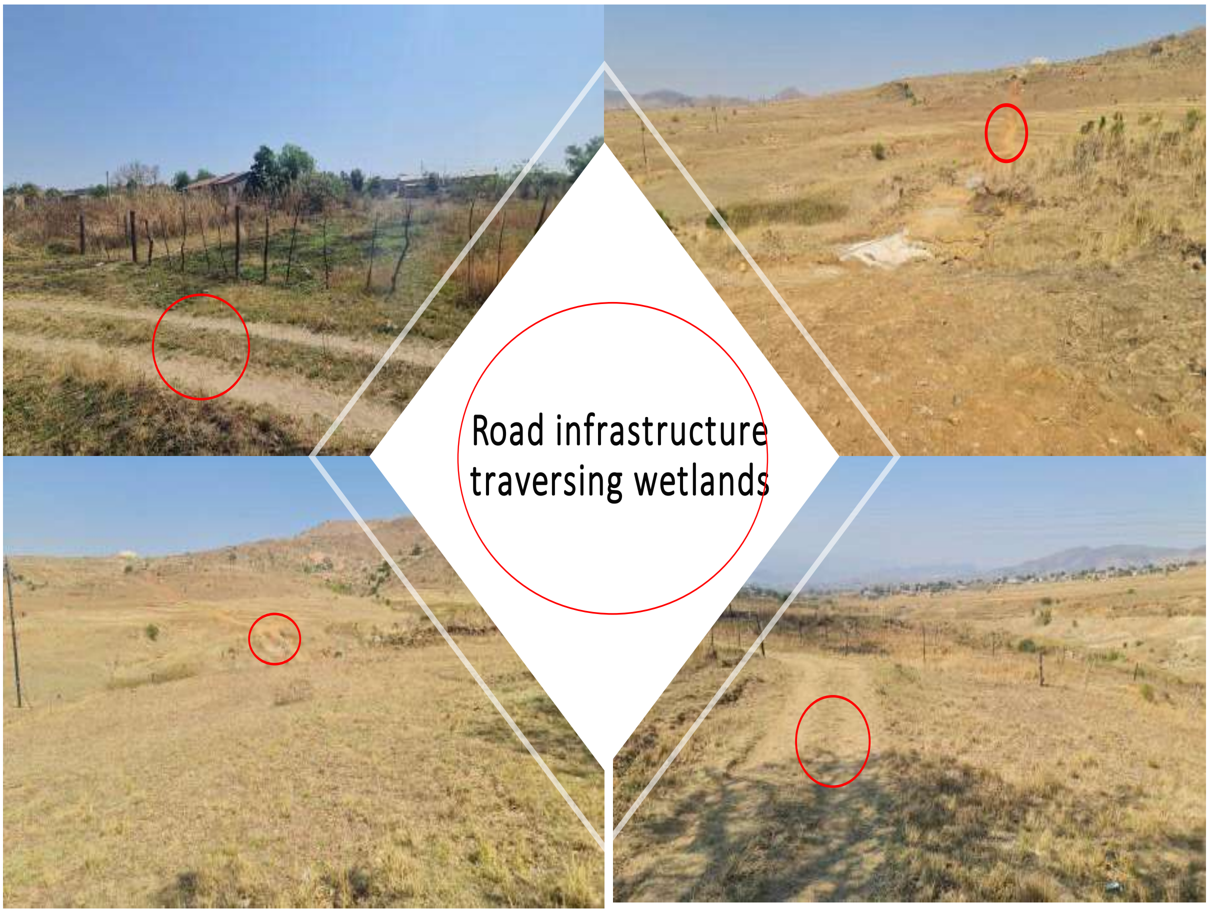
Photo 2: Wetland with head-cut erosion with home yard encroached

Wetland views as captured during surveys

Impact on wetlands

Invasive alien plant species


View of Nhlazatshe community wetlands encroached by houses


Road infrastructure traversing wetlands

Appendix H: Environmental Management Programme

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE PROPOSED FORMALIZATION OF THE NHLAZATSHE 1 ON PORTIONS OF FARM PORTIONS EERSTE HOEK 172-IT AND EERSTEHOEK 235-IT IN MPUMALANGA PROVINCE.

REF NO:

NOVEMBER 2022

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November 2022

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DECLARATION OF INTEREST

I, **Phakwago Kabelo**, as authorised representative of Mang Geoenviro Services hereby confirm my independence as an Environmental Assessment Practitioner and declare that neither I nor Mang Geoenviro Services have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Mang Geoenviro Services was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Authorisation process for the formalization of the Nhlazatshe 1.

Signature: ……………………………………….. **Date:** ……………………………………………..

ABBREVIATIONS

Contractor	(C)
Designated Environmental Officer	(DEO)
Department of Agriculture, Rural development, Land & Environmental affairs	(DARDLEA)
Department of Energy	(DE)
Environmental Management Programme/ Plan	(EMPR)
Independent Environmental Auditor	(IEA)
Environmental Control Officer	(ECO)
Environmental Consultant	(EC)
Environmental Assessment Practitioner	(EAP)
Employer's Representative/ Implementing Agent	(ER)
Operations Manager	(OM)

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Appendix A – Environmental Code of Conduct

Appendix B – Environmental Complaints Registers

Appendix C – Environmental Incidents Registers

Appendix D – Environmental Training Register

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Appendix F – EAP CV/ Expertise

DEFINITIONS

Construction:

Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity but excludes any modification, alteration or expansion of such a facility, structure or infrastructure and excluding the reconstruction of the same facility in the same location, with the same capacity and footprint.

Disturbance:

Any event or series of events that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

Earth Works:

This involves construction machinery, dampening and general preparation of the site for construction purposes.

Environmental Incident:

- *Any action undertaken (or omitted) by the proponent or his duly appointed representatives (e.g. contractors) that results in overly/unnecessary disturbance or damage to the environment.*
- *Any action undertaken (or omitted) by the proponent or his duly appointed representatives (e.g. contractors) that could lead to (has potential for) overly/unnecessary disturbance or damage to the environment.*
- *Non-adherence to environmental legal requirements/laws (including the stipulations of authorisations issued in respect of a proposed activity e.g. those contained in a Record of Decision).*

Environmental Management Plan:

A guideline document/directive outlining the Plan (EMP) for mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or control adverse environmental impacts, as well as the actions needed to implement these measures (World Bank, 1999:1).

Environmental Officer:

Person/party appointed to monitor compliance with the Environmental Management Plan.

Formalisation:

To make formal, especially for the sake of official or authorized acceptance.

Interested & Affected party:

A person, group of people, an organisation (public or private), a business, or other party that has an interest or is affected in terms of their health, property rights, or economy by a proposed activity.

Impact:

A description of the potential effect or consequence of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space.

Mitigation Measures:

Mitigation measures encompass all actions taken to eliminate, offset or reduce potentially adverse environmental impacts to acceptable levels (World Bank, 1999:1).

1 INTRODUCTION

1.1 Objectives of an EMPr

The EMPr has been compiled to provide recommendations and guidelines according to which compliance monitoring can be done during the establishment and operation of the proposed development in Nhlazatshe 1 under the jurisdiction of Chief Albert Luthuli Local Municipality in Mpumalanga Province. The objective of the EMPr is also to ensure that all relevant factors are considered to ensure an environmentally responsible development. The purpose of the EMPr is to provide specifications for "good environmental practice" for application during these phases.

This EMPr informs all relevant parties (the Project Coordinator, the Contractor, the Environmental Control Officer (ECO)) and all other staff employed by the contractor at the site as to their duties in the fulfilment of the legal requirements for the establishment and operation of the proposed development in Nhlazatshe 1, with particular reference to the prevention and mitigation of anticipated potential environmental impacts.

All parties should note that obligations imposed by the EMPr are legally binding in terms of the environmental authorisation granted by the relevant environmental permitting authority.

The objectives of an EMPr are to:

- Ensure compliance with regulatory authority stipulations and guidelines which may be local, provincial, national and/or international;
- Ensure that there is sufficient allocation of resources on the project budget so that the scale of EMPr-related activities is consistent with the significance of project impacts;
- Verify environmental performance through information on impacts as they occur;
- Respond to unforeseen events;
- Provide feedback for continual improvement in environmental performance;
- Identify a range of mitigation measures which could reduce and mitigate the potential impacts to minimal or insignificant levels;
- Detail specific actions deemed necessary to assist in mitigating the environmental impact of the project;
- Identify measures that could optimize beneficial impacts;
- Create management structures that addresses the concerns and complaints of I&APs with regards to the development;
- Establish a method of monitoring and auditing environmental management practices during all phases of the activity;
- Ensure that safety recommendations are complied with;

- Specify time periods within which the measures contemplated in the final environmental management programme must be implemented, where appropriate;

Structure and Function of an EMPr

An EMPr is focused on sound environmental management practices, which will be undertaken to minimise adverse impacts on the environment through the lifetime of a development. In addition, an EMPr identifies what measures will be in place or will be actioned to manage any incidents and emergencies that may occur during operation of the facility.

As such the EMPr provides specifications that must be adhered to, in order to minimise adverse environmental impacts associated with the construction and operations of the Nhlazatshe 1. The content of the EMPr is consistent with the requirements as set out in Appendix 4 of the EIA regulations stated below, for the construction and operation phases.

According to appendix 4 of GN R 982, an Environmental Management Programme must include:

(a) Details of –

(i) The EAP who prepared the environmental management programme; and

(ii) The expertise of the EAP to prepare an environmental management programme, including curriculum vitae;

(b) A detailed description of the aspects of the activity that are covered by the draft environmental management programme as identified by the project description;

(c) A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;

(d) Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by these Regulations, including environmental impacts or objectives in respect of –

(i) Planning and design;

(ii) Pre-construction;

(iii) construction activities;

(iv) Rehabilitation of the environment after construction and where applicable post closure; and

(v) where relevant, operation activities;

(e) a description and identification of impact outcomes required for the aspects contemplated in (d).

(f) a description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable include actions to –

(i) Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;

(ii) Comply with any prescribed environmental management standards or practices;

(iii) Comply with any applicable provisions of the Act regarding closure, where applicable;

(iv) Comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;

(g) The method of monitoring the implementation of the impact management actions contemplated in paragraph (f);

(h) The frequency of monitoring the implementation of the impact management actions contemplated in (f);

(i) An indication of the persons who will be responsible for the implementation of the impact management actions;

(j) The time periods within which the impact management actions contemplated in paragraph (f) must be implemented;

(k) The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);

(l) A program for reporting on compliance, taking into account the requirement as prescribed by the regulations;

(m) An environmental awareness plan describing the manner in which –

(i) The applicant intends to inform his or her employees of any environmental risk which may result from their work; and

(ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment; and

(n) Any specific information that may be required by the competent authority.

1.2 Legal Requirements

The proposed formalization of Nhlazatshe 1 must be established according to the best industry practices, as identified in the project documents. This EMPr, which forms an integral part of the contract documents, informs the Contractor as to his/her duties in the fulfilment of the project objectives, with particular reference to the prevention and mitigation of environmental impacts caused by construction activities associated with the project. The Contractor should note that obligations imposed by the approved EMPr are legally binding in terms of environmental statutory legislation and in terms of the additional conditions to the general conditions of contract that pertain to this project. In the event that any rights and obligations contained in this document contradict those specified in the standard or project specifications then the latter shall prevail.

The Contractor shall identify and comply with all South African national and provincial environmental legislation, including associated regulations and all local by-laws relevant to the project. Key legislation currently applicable to the construction and implementation phases of the project must be complied with.

The list of applicable legislation provided below is intended to serve as a guideline only and is not exhaustive: -

- Constitution Act (No. 108 of 1996)
- Environmental Conservation Act (No. 73 of 1989)
- EIA Regulations (2010)
- National Environment Management Act (No. 107 of 1998)
- National Environmental Management: Biodiversity Act (No. 10 of 2004)
- National Water Act (No. 36 of 1998)
- National Environmental Management: Waste Management Act (No. 59 or 2008)
- National Heritage Resource Act (No. 25 of 1999)
- Informal Land Rights Act (No. 109 of 1996)
- National Forests Act (No. 84 of 1983)
- National Heritage Resource Act (No. 25 of 1999)
- Occupational Health and Safety Act (No. 85 of 1993)

1.3 Environmental Authorization

In accordance with the requirements of the National Environmental Management Act (Act No 107 of 1998) (NEMA), and relevant EIA regulations made in terms of this Act and promulgated in August, 2010 and amended in 2014 (Government Notice 982), and listed activities under (Government Notice R 983, 984, 985), the proposed project activities were subjected to a Section 24G process.

In terms of the EIA process, all reports generated from the environmental studies form part of a series of documents for the project. The Section 24G process identified current and potentially significant environmental impacts and was the main report in the series. Additional Specialist Assessments served to supplement the assessment contained in the Section 24G report.

This Environmental Management Programme (EMPr) interprets the findings of the Section 24G report, and prescribes project-specific specifications to be achieved. In addition to the requirements of Appendix 4 of GNR 982, this EMPr is based on the principles of Integrated Environmental Management (IEM).

2 DETAILS OF THE EAP

According to appendix 4 of GN R 982, an Environmental Management Programme must include:

(a) Details of – (i) The EAP who prepared the environmental management programme; and (ii) The expertise of the EAP to prepare an environmental management programme, including curriculum vitae;

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3 PROPOSED ACTIVITY

According to appendix 4 of GN R 982, an Environmental Management Programme must include: (b) A detailed description of the aspects of the activity that are covered by the draft environmental management programme as identified by the project description; (c) A map at an appropriate sale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;

3.1 Description of proposed activity

The proposed development entails formalization of the Nhlazatshe 1 on portions of farm portions Eerste Hoek 172-IT and Eersthoek 235-IT on an extent area of approximately 191.3 hectares within Chief Albert Luthuli Local Municipality.

The proposed development site is currently occupied by illegal occupants. The existing infrastructures on the proposed development site includes residential, school, church, business and a cemetery.

Latitude: 26°4'6.62 S

Longitude: 30°45'37.91 E.

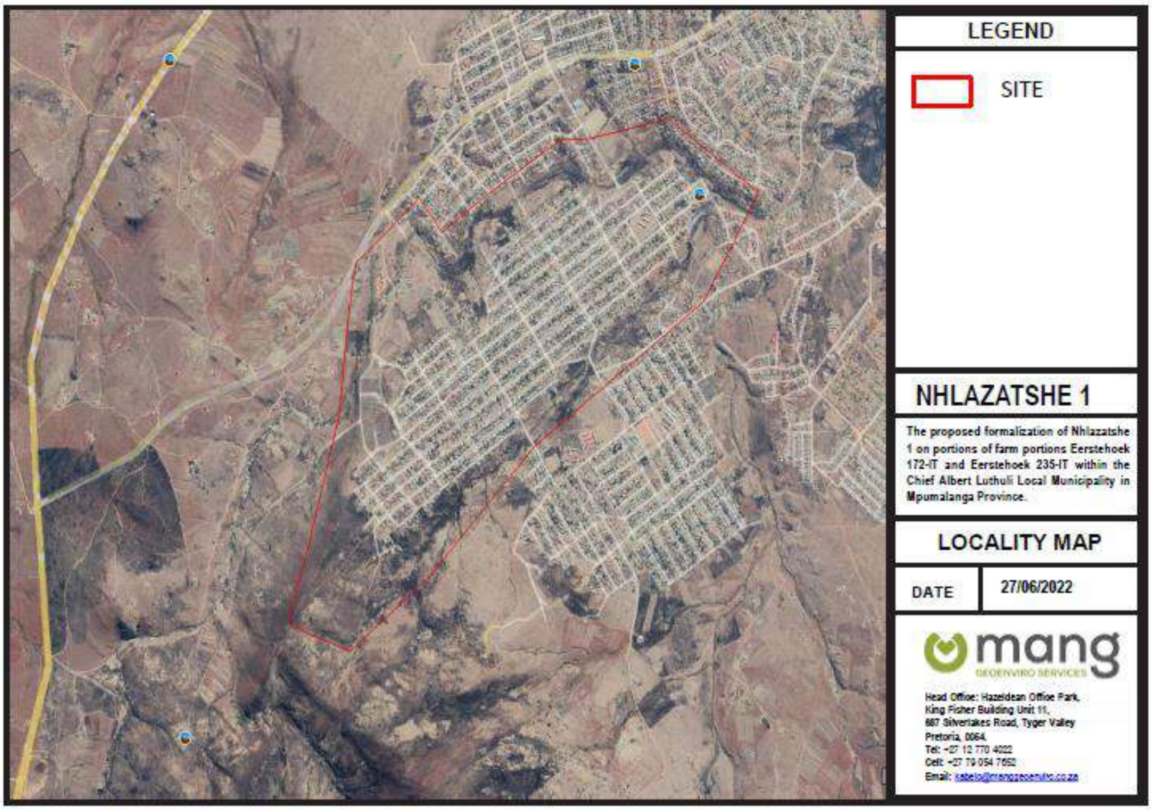

Figure 1: Locality map of the proposed development site.

4 SCOPE OF THE EMPR

In order to ensure a holistic approach to the management of environmental impacts during the establishment and operation of the proposed development, this EMPr sets out the methods by which proper environmental controls are to be implemented by the Contractor and all other parties involved.

The EMPr is a dynamic document subject to influences and changes as are wrought by variations to the provisions of the project specification.

4.1 Layout of the EMPr

The EMPr is divided into three phases of development. Each phase has specific issues unique to that period of the construction and operation of the proposed development. The impacts are identified and given a brief description. The three phases of the development are then identified as below:

4.1.1 Planning and Design Phase

This section of the EMPr provides management principles for the planning and design phase of the project. Environmental actions, procedures and responsibilities as required from the developer during the planning and design phase are specified. These specifications will form part of the contract documentation and therefore the Contractor will be required to comply with these specifications to the satisfactory of the Project Coordinator and ECO.

4.1.2 Pre-Construction Phase

This section of the EMPr provides management principles for the preconstruction phase of the project. Environmental actions, procedures and responsibilities as required during the preconstruction phase are specified. These specifications will form part of the contract documentation and therefore the Contractor will be required to comply with these specifications to the satisfactory of the Project Coordinator and ECO.

4.1.3 Construction Phase

This section of the EMPr provides management principles for the construction phase of the project. Environmental actions, procedures and responsibilities as required during the construction phase are specified. These specifications will form part of the contract documentation and therefore the Contractor will be required to comply with these specifications to the satisfactory of the Project Coordinator and ECO.

4.1.4 Operational and Maintenance Phase

This section of the EMPr provides management principles for the operation and maintenance phase of the project. Environmental actions, procedures and responsibilities as required from the developer during the operation and maintenance phase are specified.

5 MITIGATION AND MANAGEMENT MEASURES

According to appendix 4 of GN R 982, an Environmental Management Programme must include:

(d) Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by these Regulations, including environmental impacts or objectives in respect of –

- (i) Planning and design;
- (ii) Pre-construction;
- (iii) Construction activities;
- (iv) Rehabilitation of the environment after construction and where applicable post closure; and
- (v) where relevant, operation activities;

(e) a description and identification of impact outcomes required for the aspects contemplated in (d).

(f) a description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable include actions to –

- (i) Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- (ii) Comply with any prescribed environmental management standards or practices;
- (iii) Comply with any applicable provisions of the Act regarding closure, where applicable;
- (iv) Comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;

Table 5.1 impacts and mitigation measures associated with the proposed formalization of Nhlazatshe 1.

Planning/ Designing Phase	Responsibility	Monitoring	Timeframe
Signing of service agreement between the applicant and the relevant service providers	Applicant	Applicant	Once off
Appointment of the contractor	Applicant	Applicant	Once off
Construction Phase	**Responsibility**	**Monitoring**	**Timeframe**
Layout			
The Contractor is to adhere to the following with regards to the Materials Storage Area and Contractors Camp: ✓ All servitudes and existing services must be verified prior to construction; ✓ The camp site must be fenced before construction commences; and ✓ Site establishment shall not take place on steep slopes, within 50m of wetland areas and watercourses (including drainage lines), or sites declared as no-go areas.	C	ER & DEO	Before construction
Adequate parking must be provided for site staff and visitors. This must be demarcated so not as to encroach into the surrounding environment.	C	ER & DEO	Duration of Construction Phase
Temporary Fencing			
Areas where construction activities (including temporary access tracks) are prohibited are referred to as no-go areas. Entry into these areas by any person, vehicle or equipment without the ER's written permission will result in a penalty.	C	ER & DEO	Duration of Construction Phase
The Contractor shall erect temporary fencing along the perimeter of the contractor's site camp and designated no-go areas.	C	ER & DEO	Duration of Construction Phase

The Contractor shall maintain in good order all demarcation fencing and barriers for the duration of construction activities, or as otherwise instructed.	C	ER & DEO	Duration of Construction Phase
Topsoil removal and Stock pilling			
The Contractor shall remove topsoil from all areas where topsoil will be impacted on by construction activities, including temporary activities such as storage and stockpiling areas.	C	ER & DEO	Ongoing
Stripped topsoil shall be stockpiled in areas agreed with by the ER for later use in rehabilitation and shall be adequately protected. Topsoil is considered to be the natural soil covering, including all the vegetation and organic matter. The depth of the soil may vary and due to this reason the top 300mm of soil must be removed and preserved as topsoil.	C	ER & DEO	Ongoing
Topsoil stockpiles shall be convex in shape and no more than 2m high. Stockpiles shall be shaped so that no surface water ponding can take place.	C	ER & DEO	Ongoing
Topsoil stockpiles shall be protected from erosion by wind and rain by providing suitable storm water and cut-off drains (approved by the ER) and / or the establishment of temporary indigenous vegetation.	C	ER & DEO	Ongoing
Any topsoil contaminated by hazardous substances shall not be used but shall be disposed of at a registered landfill site. Proof of appropriate disposal must be filed in the Environmental File in the Contractor's Camp.	C	ER & DEO	Ongoing
The Contractor shall be held responsible for the replacement, at his expense, of any unnecessary loss of topsoil due to his failure to work according to the requirements of this EMPr.	C	ER & DEO	Ongoing

Workshop, Equipment Maintenance and storage			
All vehicles and equipment shall be kept in good working order to maximize efficiency and minimize pollution.	C	ER & DEO	Ongoing
Stockpiling			
The Contractor shall plan his activities so that materials can be transported directly to and placed at the point where it is to be used.	C	ER & DEO	Ongoing
Should temporary stockpiling become necessary, the areas for the stockpiling of excavated / imported material shall be indicated and demarcated on the site plan submitted in writing to the ER for his approval, together with the Contractor's proposed measures for prevention, containment and rehabilitation against environmental damage?	C	ER & DEO	Ongoing
Should temporary stockpiling become necessary, the areas for the stockpiling of excavated / imported material shall be indicated and demarcated on the site plan submitted in writing to the ER for his approval, together with the Contractor's proposed measures for prevention, containment and rehabilitation against environmental damage?	C	ER & DEO	Ongoing
Stockpiles shall be positioned and sloped to create the least visual impact.	C	ER	Ongoing
Stormwater Control			
Temporary stormwater control measures must be installed as and when necessary, to prevent and minimise the erosion of exposed soils.	C	ER & DEO	Ongoing
If deemed necessary to prevent erosion and environmental degradation, cut-off drains must be installed to facilitate the control of surface water runoff velocities.	C	ER & DEO	Ongoing

Stormwater control barriers must be used to divert surface water runoff into vegetative buffers and not directly into the exposed workings or onto adjacent roads.	C	ER & DEO	Ongoing
Hazardous Substances			
Should any hazardous material/substances (e.g. petrochemicals, paints, etc.) need to be stored on the site, this shall be under controlled conditions. All hazardous materials/substances shall be stored in a secured, appointed area that is fenced and has restricted entry. All storage shall take place using suitable, sealable containers to the approval of the ER. These containers must be placed within a bunded area which has the capacity to contain 110% of the total volume it stores. The floor and wall of the bund area shall be impervious to prevent infiltration of any spilled / leaked material into the soil.	C	ER & DEO	Ongoing
Material Safety Data Sheets (MSDS's) must be readily available for all chemicals / hazardous substances to be used on site. Where possible and available, MSDS's should include additional information on ecological impacts and measures to minimise and mitigate against any negative environmental impacts in the result of an accidental spill.	C/ER	ER & DEO	Before commencement of construction
Ensure that any hydrocarbon/chemical/hazardous substance spills are cleaned up as soon as possible.	C	ER & DEO	Ongoing
Noise Control			
It must be ensured that noise levels are kept to a minimum during the Construction Phase. All machinery and equipment to be utilized on the site should be fitted with mufflers and must be maintained in good working order to minimise noise levels. It is recommended further that the Contractor encourage construction workers to minimise shouting and hooting on the site.	C	ER & DEO	Ongoing

Construction work should be completed in as short a time frame as possible in order to limit the longevity of these impacts.			
The Contractor shall restrict all operations that result in undue noise disturbance to local communities and / or dwellings to daylight hours on workdays (Monday to Friday) or as otherwise agreed with the ER.	C	ER & DEO	Ongoing
The Contractor shall warn any local communities and / or residents that could be disturbed by noise generating activities well in advance and shall keep such activities to a minimum.	C	ER & DEO	Ongoing
The Contractor shall be responsible for compliance with the relevant legislation with the respect to noise.	C	ER & DEO	Ongoing
The entire Contractors' equipment shall be fitted with effective exhaust silencers and shall comply with the SANS recommended code of practice Code 0103:1983, for construction plant noise generation.	C	ER & DEO	Ongoing
Waste Management			
General construction waste: Must be removed from bins at enough intervals to prevent overflow. This waste must be stored in skips within a designated waste storage area in the Contractor's Camp. General waste must be transported to the local municipal General Waste Landfill Site by the Municipality, the Contractor or a private waste disposal Contractor. Service agreements in this regard must be obtained by the Applicant / Contractor prior to the commencement of construction activities. It is recommended that general wastes be separated on site and delivered to appropriate depots for recycling. This would be facilitated by the provision of separate and labelled bins / skips.	C	ER	Ongoing
The Contractor shall ensure that all site personnel are instructed in the proper disposal of all waste.	C	ER	Ongoing

Demarcated and fenced areas where waste can be safely contained and stored on a temporary basis within the Contractors Camp must be established. General waste storage areas must be separate from hazardous waste storage areas. When adequate volumes (not more than 1 month) have accumulated, waste is to be removed from site and disposed of at a licensed facility.	C	ER	Ongoing
Waste is not to be buried or burned on site.	C	ER	Ongoing
Dust Control			
Construction vehicles shall comply with speed limits and haul distances shall be minimised. Material loads shall be suitably covered and secured during transportation.	C	ER & DEO	Ongoing
Exposed soils and material stockpiles shall be protected against wind erosion. The location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors.	C	ER & DEO	Ongoing
The Contractor shall implement dust suppression measures (e.g. Water spray vehicles, covering material stockpiles, etc.) if and when required.	C	ER & DEO	Ongoing
Environmentally friendly soil stabilisers may be used as additional measures to control dust on gravel roads and construction areas if complaints are received regarding dust generation. This is especially pertinent as excessive dust could disturb moving vehicles on adjacent roads, creating a potential traffic hazard.	C	ER & DEO	Ongoing
The Contractor shall ensure that the generation of dust is minimised and shall implement a dust control programme, as necessary, to maintain a safe working environment and minimise nuisance for surrounding residential areas/dwellings.	C	ER & DEO	Ongoing
Protection of Fauna and Flora			

The Contractor shall ensure his employees do not undertake any hunting, trapping, shooting, poisoning or other disturbance of any fauna on-site or in the areas surrounding the site.	C	ER & DEO	Ongoing
The feeding of any wild animals is prohibited.	C	ER & DEO	Ongoing
The use of pesticides is prohibited unless approved by the ER.	C	ER & DEO	Ongoing
Fire Control			
The Contractor shall ensure that basic fire-fighting equipment is available at all construction activities on site.	C	ER & DEO	Ongoing
The Contractor shall appoint a Fire Officer who shall be responsible for ensuring immediate and appropriate action in the event of a fire.	C	ER & DEO	Ongoing
The Contractor shall ensure that all site personnel are aware of the procedure to be followed in the event of a fire.	C	ER & DEO	Ongoing
Protection of Heritage and cultural features			
If any archaeological or paleontological artefacts or remains / graves are uncovered during earthmoving activities, work in the vicinity of the find shall cease immediately. The Contractor shall immediately notify the ER, who shall contact the relevant Competent Authority (SAHRA) who will take appropriate steps.	C	ER & DEO	Ongoing
The Contractor will be required to abide by the specifications as set out by the Competent Authority or the Heritage Specialist appointed to investigate the find.	C	ER & DEO	Ongoing
The Contractor may not, without a permit issued by the relevant heritage resources authority, destroy damage, excavate, alter, deface or otherwise disturb archaeological material.	C	ER & DEO	Ongoing

Environmental Education & Awareness			
It is the Contractors' responsibility to provide the site foreman with no less than 1 hour's environmental training and to ensure that the foreman has enough understanding to pass this information onto the construction staff.	C	ER & DEO	Prior to moving on site
The Contractor / ECO must be on hand to explain any technical issues and to answer questions.	C/ECO	ER & DEO	Ongoing
Operational Phase	**Responsibility**	**Occurrence**	**Method**
Water Quality Management			
The Chief Albert Luthuli Local Municipality must be contacted with regard to any discharge to sewer	OM	Ongoing	Site inspection
Management of Contaminated Land			
Contaminated land investigations, including soils, groundwater and surface water monitoring and sampling to be implemented should impact is observed. This will take into account the source-pathway-receptor (S-P-R) linkages and should serve to determine the nature and extent of any impacts to the receiving environment as a result of site activities. These investigations are to be carried out with consideration of the relevant legal processes. Risk assessment to be undertaken if considered necessary.	OM to outsource as appropriate	Ongoing	Site investigation
Risk based corrective action (RBCA) to be implemented based on the findings of the site investigations. Remedial plans will be developed based on conceptual site model (CSM) and should consider S-P-R linkages. Remedial actions may include physical, chemical and/or microbiological intervention.	OM to outsource as appropriate	Ongoing	Site remediation
Post-remediation monitoring plan to be implemented to determine effectiveness of remedial actions and serve as an early-warning system for potential re-occurrence.	OM to outsource as appropriate	Ongoing	Ongoing monitoring
Drainage Systems			

Stormwater culverts and drains must be covered with metal grids to prevent blockages.	OM	Ongoing	Site inspection
Control of Littering			
Adequate waste disposal bins are to be provided around the township. These are to be regularly emptied and the contents thereof collected by an approved Waste Service Provider.	OM	Ongoing	Site inspection
The recycling of waste is encouraged. As such, the provision of separate recycling bins for the disposal of paper, tins and plastic should be erected and displayed in a suitable and visual location on site. A reputable Recycling Waste Company must be appointed to collect recyclable waste (**if applicable).**	OM	Ongoing	Site inspection
Waste Storage and Removal			
Burning of waste is not permitted, under any conditions.	OM	Ongoing	Site inspection
Ablution facilities serviced by septic tanks (if applicable) are to be sign posted informing the public not to deposit foreign substances or objects into the system.	OM	Ongoing	Site inspection
Health and Safety			
Ensure that all staff is trained in what to do in the case of an emergency such as an on-site fire.	OM	Ongoing	Site inspection
Staff personnel are to be trained in first aid.	OM	Ongoing	Site inspection
Fire Control			
Emergency numbers must be displayed with the correct details of the nearest firefighting station at all times.	OM	Ongoing	Site inspection
Ensure that relevant signage e.g. no smoking, is displayed in potentially dangerous areas and is abided by.	OM	Ongoing	Site inspection

6 ENVIRONMENTAL MONITORING

According to appendix 4 of GN R 982, an Environmental Management Programme must include:
(g) The method of monitoring the implementation of the impact management actions contemplated in paragraph (f);
(h) The frequency of monitoring the implementation of the impact management actions contemplated in (f);

A monitoring programme must be implemented for the duration of the construction phase of the proposed development. This programme will include:

- Establishing a baseline of pre-construction site conditions validated with photographic evidence.
- Monthly audits to be conducted by an independent ECO for the duration of the construction phase to ensure compliance to the EMPr conditions, and where necessary make recommendations for corrective action. These audits can be conducted randomly and do not require prior arrangement with the Project Coordinator.
- Compilation of an audit report with a rating of compliance with the EMPr. The ECO shall keep a photographic record of the demarcated sites and construction area. The Contractor shall be held liable for all unnecessary damage to the environment. A register shall be kept of all complaints from the community. All complaints / claims shall be handled immediately to ensure timeous rectification / payment by the responsible party.
- Compilation of a final audit report after all site construction and rehabilitation are completed.

7 ROLES AND RESPONSIBILITIES

According to appendix 4 of GN R 982, an Environmental Management Programme must include:
(i) An indication of the persons who will be responsible for the implementation of the impact management actions;

7.1 The Applicant

The Project Coordinator is responsible for overall management of project and EMPr implementation. The following tasks will fall within his / her responsibilities:

- Be familiar with the recommendations and mitigation measures of this EMPr, and implement these measures.
- Monitor site activities on a daily basis for compliance.
- Conduct internal audits of the construction site against the EMPr.
- Confine the construction site to the demarcated area.
- Rectify transgressions through the implementation of corrective action.

7.2 Contractor

The contractor is responsible for the overall execution of the activities envisioned in the construction phase including the implementation and compliance with recommendations and conditions of the EMPr. The Contractor must therefore ensure compliance with the EMPr at all times during construction activities and maintain an environmental register which keeps a record of all environmental incidents which occur on the site during formalization of the Nhlazatshe 1. These incidents may include:

- Public involvement / complaints
- Health and safety incidents
- Incidents involving Hazardous materials stored on site
- Non-compliance incidents

The Contractor is also responsible for the implementation of corrective actions issued by the ECO and Project Coordinator within a reasonable or agreed period of time.

7.3 Environmental Control Officer (ECO)

For the purposes of implementing the conditions contained herein Chief Albert Luthuli Local Municipality must appoint an ECO for the contract. The ECO shall be the responsible person for ensuring that the provisions of the EMPr and its Environmental Code of Conduct as well as the environmental authorisation are complied with during the construction period. The ECO's duties in this regard will include, inter alia, the following:

- Conduct regular site visits to be able to report on and respond to any environmental issues;
- Report compliance and non-compliance issues to the municipal representative and authorities as applicable;
- Advise the Contractor on environmental issues within the defined work areas;
- Review access and incident records that may pertain to the environment and reconcile the entries with the observations made during site inspection, monitoring and auditing;
- Recommend corrective action when required for aspects of non-compliance with the EMPr;
- Take immediate action on site where clearly defined and agreed "no-go" areas are violated or in danger of being violated and to inform Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) representative of the occurrence immediately and to take action;
- Be contactable by the public regarding matters of environmental concern as they relate to the operation of the works; and
- Take immediate action on site when prescriptive conditions are violated, or in danger of being violated and to inform the DARDLEA representative of the occurrence and action taken.

8 COMPLIANCE WITH THE EMPR

According to appendix 4 of GN R 982, an Environmental Management Programme must include:
(j) The time periods within which the impact management actions contemplated in paragraph (f) must be implemented;
(k) The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);

A copy of the EMPr must be kept on site at all times during the construction period. The EMPr will be binding on all contractors operating on the site and must be included within the Contractual Clauses.

It should be noted that in terms of Section 28 of the National Environmental Management Act (No. 107 of 1998) those responsible for environmental damage must pay the repair costs both to the environment and human health and the preventative measures to reduce or prevent further pollution and/or environmental damage (The 'polluter pays' principle).

8.1 Non-compliance

The contractors shall act immediately when notice of non-compliance is received and take corrective action. Complaints received regarding activities on the construction site pertaining to the environment shall be recorded in a dedicated register and the response noted with the date and action taken. The ECO should be made aware of any complaints.

Any non-compliance with the agreed procedures of the EMPr is a transgression of the various statutes and laws that define the manner by which the environment is managed. Failure to redress the cause shall be reported to the relevant authority for them to deal with the transgression, as it deems fit.

The Contractor is deemed not to have complied with the EMPr if, *inter alia*:

- There is evidence of contravention of the EMPr specifications within the boundaries of the construction site, site extensions and roads;
- There is contravention of the EMPr specifications which relate to activities outside the boundaries of the construction site.
- Environmental damage ensues due to negligence;
- Construction activities take place outside the defined boundaries of the site; and/or
- The Contractor fails to comply with corrective or other instructions issued by the Engineer within a specific time period.

It is recommended that the engineers/contractors institute penalties for the following less serious violations and any others determined during the course of work, as detailed below:

- Littering on site.

- Lighting of illegal fires on site.
- Persistent or unrepaired fuel and oil leaks.
- Any persons, vehicles or equipment related to the Contractor's operations found within the designated "no-go" areas.
- Excess dust or excess noise emanating from site.
- Possession or use of intoxicating substances on site.
- Any vehicles being driven in excess of designated speed limits.
- Removal and/or damage to fauna, flora or cultural or heritage objects on site.
- Urination and defecation anywhere except at designated facilities.

8.2 Emergency preparedness

The Contractor shall compile and maintain environmental emergency procedures to ensure that there will be an appropriate response to unexpected or accidental actions or incidents that will cause environmental impacts, throughout the construction period. Such activities may include, *inter alia*:

- Accidental waste water discharges to water and land.
- Accidental exposure of employees to hazardous substances.
- Accidental fires.
- Accidental spillage of hazardous substances.
- Specific environmental and ecosystem effects from accidental releases or incidents.
- These plans shall include:
- Emergency organisation (manpower) and responsibilities, accountability and liability.
- A list of key personnel and contact details.
- Details of emergency services available (e.g. the fire department, spill clean-up services, etc.).
- Internal and external communication plans, including prescribed reporting procedures where required by legislation.
- Actions to be taken in the event of different types of emergencies.
- Incident recording, progress reporting and remediation measures required to be implemented.
- Information on hazardous materials, including the potential impact associated with each, and measures to be taken in the event of accidental release.
- Training plans, testing exercises and schedules for effectiveness.

The Contractor shall comply with the emergency preparedness and incident and accident-reporting requirements, as required by the Occupational Health and Safety Act (No. 85 of 1993), the NEMA (No. 107 of 1998), the National Water Act (No. 36 of 1998) and the National Waste Act (No. 59 of 2008) as amended and/or any other relevant legislation.

8.3 Incident reporting and remedy

If a leakage or spillage of hazardous substances occurs on site, the local emergency services must be immediately notified of the incident. The following information must be provided:

- the location;
- the nature of the load;
- the extent of the impact; and
- the status at the site of the accident itself (i.e. whether further leakage is still taking place, whether the vehicle or the load is on fire).

Written records must be kept on the corrective and remedial measures decided upon and the progress achieved therewith over time. Such progress reporting is important for monitoring and auditing purposes. The written reports may be used for training purposes in an effort to prevent similar future occurrences.

8.4 Penalties

Where environmental damage is caused or a pollution incident, and/or failure to comply with any of the environmental specifications contained in the EMPr, Chief Albert Luthuli Local Municipality and/or contractor shall be liable.

The following violations, and any others determined during the course of work, should be penalised:
Hazardous chemical/oil spill and/or dumping in non-approved sites.

- Damage to sensitive environments.
- Damage to cultural and historical sites.
- Unauthorised removal/damage to indigenous trees and other vegetation, particularly in identified sensitive areas.
- Uncontrolled/unmanaged erosion.
- Unauthorised blasting activities (if applicable).
- Pollution of water sources.
- Unnecessary removal or damage to indigenous trees.

The following steps will be followed by the ECO on behalf of Chief Albert Luthuli Local Municipality, when observing a transgression:

1. **Transgression observed**: Give a warning to the Contractor, with time to remedy the situation. Report transgression and agreed remedial action to the developer.
2. **Transgression not remedied**: Report the Contractor directly to DARDLEA and Project coordinator and issue a financial penalty to the Contractor (see list of fines below) with an agreed time period to remedy the situation with the assistance of DARDLEA (if necessary).

3. **Failure to remediate**: Depending on the severity and impact significance of the transgression, which must be assessed and discussed with the developer prior to reporting to competent authority, the ECO may undertake to report directly to DARDLEA (Compliance) recommending that for:
    - HIGH impact: DARDLEA to issue a notice to cease construction.
    - MEDIUM impact: DARDLEA to issue a notice instructing Chief Albert Luthuli Local Municipality to implement recommended remedial action.
    - LOW impact: ECO to notify, but up to discretion of DARDLEA to apply sanction.

In all cases, however, non-compliance with a condition must be reported to DARDLEA in the monthly audit reports. However, the ECO will also report on corrective actions proposed and implemented.

The following schedule of fines for environmental damage or EMPr transgressions were adapted from the City of Cape Town: Standard Environmental Specifications.

Transgression or Resultant Environmental Damage	Min. fine	Max. fine
Failure to comply with prescriptions regarding ECO appointment and monitoring of EMPr	R1 000	R2 000
Failure to comply with prescriptions regarding environmental awareness training	R2000	R10 000
Failure to comply with prescriptions regarding method statements	R2 000	R10 000
Failure to report environmental damage or EMPr transgressions to the ECO	R1 000	R2 000
Failure to carry out instructions of the DEO/ECO regarding the environment of the EMPr	R1 000	R2 000
Failure to comply with prescriptions posting of emergency numbers	R2 000	R10 000
Failure to comply with prescriptions regarding information boards	R1 000	R2 000
Failure to comply with prescriptions regarding a complaints register	R1 000	R2 000
Failure to comply with prescriptions regarding site demarcation and enforcement of "no go" areas	R2 000	R10 000
Failure to comply with prescriptions regarding site clearing	R2 000	R10 000

Failure to comply with prescriptions for the storage of imported materials within a designated Contractors yard	R1 000	R2 000
Failure to comply with prescribed administration, storage or handling of hazardous substances	R1 000	R2 000
Failure to comply with prescriptions regarding equipment maintenance and storage	R1 000	R2 000
Failure to comply with fuel storage, refuelling, or clean-up prescriptions	R1 000	R2 000
Failure to comply with prescriptions regarding procedures for emergencies (spillages and fires)	R2 000	R10 000
Failure to comply with prescriptions regarding construction camp	R2 000	R10 000
Failure to comply with prescriptions for the use of ablution facilities	R1 000	R2 000
Failure to comply with prescriptions regarding water provision	R1 000	R2 000
Failure to comply with prescriptions for the use of designated eating areas, heating source for cooking or presence of fire extinguishers	R1 000	R2 000
Failure to comply with prescriptions regarding fire control	R2 000	R10 000
Failure to comply with prescriptions for solid waste management	R2 000	R10 000
Failure to comply with prescriptions to prevent water pollution and sedimentation	R2 000	R10 000
Failure to comply with prescriptions to the protection of natural features, flora, fauna and archaeology	R2 000	R10 000
Failure to comply with prescriptions regarding speed limits	R1 000	R2 000
Failure to comply with prescriptions regarding noise levels of construction activity	R2 000	R10 000
Failure to comply with prescriptions regarding working hours	R2 000	R10 000
Failure to comply with prescriptions regarding aesthetics	R1 000	R2 000
Failure to comply with prescriptions regarding dust control	R1 000	R2 000
Failure to comply with prescriptions regarding security and access onto private property	R1 000	R2 000
Failure to comply with prescriptions regarding cement and concrete batching	R2 000	R10 000

9 REPORT

According to appendix 4 of GN R 982, an environmental management programme must include:

(l) A program for reporting on compliance, taking into account the requirement as prescribed by the regulations;

9.1 Administration

Before the construction and decommissioning activities begin, the Contractor shall give to the ECO and the Project Coordinator a written method statement setting out the following:

- Location of the campsite and storage area.
- Details of the construction and decommissioning activities.
- Identification of impacts that might result from the activity (e.g. soil erosion).
- Identification of activities that may cause an impact.
- Methodology and/or specifications for impact prevention for each activity or aspect (e.g. soil stabilisation using…).
- Methodology and/or specifications for impact containment for each activity or aspect.
- Emergency/disaster incident and reaction procedures.
- Treatment and continued maintenance of impacted environment.

The Contractor may provide such information in advance of any activities provided that new submissions shall be given to the ECO and/or engineer whenever there is a change or variation to the original.

The ECO and/or engineer may provide comment on the methodology and procedures proposed by the Contractor but he shall not be responsible for the Contractor's chosen measures of impact mitigation and emergency/disaster management systems.

9.2 Good housekeeping

The Contractor shall undertake "good housekeeping" practices during construction and decommission. This will help avoid disputes on responsibility and allow for the smooth running of the contract as a whole.

Good housekeeping extends beyond the wise practice of construction methods to include the care for and preservation of the environment within which the construction is situated.

9.3 Record keeping

The Project coordinator and the ECO will continuously monitor the Contractor's adherence to the approved impact prevention procedures and the ECO shall issue to the Contractor a notice of non-compliance whenever transgressions are observed. The ECO should document the nature and magnitude of the non-compliance in a designated register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. The non-compliance shall be documented and reported to the engineer in the monthly report. These reports shall be made available to DARDLEA when requested.

9.4 Document control

The Contractor and Project coordinator shall be responsible for establishing a procedure for electronic document control. The document control procedure should comply with the following requirements:

- Documents must be identifiable by organisation, division, function, activity and contact person.
- Every document should identify the personnel and their positions, who drafted and compiled the document, who reviewed and recommended approval, and who finally approved the document for distribution.
- All documents should be dated, provided with a revision number and reference number, filed systematically, and retained for a five-year period.

The Contractor shall ensure that documents are periodically reviewed and revised, where necessary, and that current versions are available at all locations where operations essential to the functioning of the EMPr are performed. All documents shall be made available to the ECO and other independent external auditors.

10 ENVIRONMENTAL AWARENESS

According to appendix 4 of GN R 982, an Environmental Management Programme must include: (m) An environmental awareness plan describing the manner in which – (i) The applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment; and

Contractors shall ensure that its employees and any third party who carries out all or part of the Contractor's obligations are adequately trained with regard to the implementation of the EMPr, as well as regarding environmental legal requirements and obligations. Training shall be conducted by the ECO where necessary.

Environment and health awareness training programmes should be targeted at three distinct levels of employment, i.e. the executive, middle management and labour. Environmental awareness training programmes shall contain the following information:

- The names, positions and responsibilities of personnel to be trained.
- The framework for appropriate training plans.
- The summarised content of each training course.
- A schedule for the presentation of the training courses.

The ECO shall ensure that records of all training interventions are kept in accordance with the record keeping and documentation control requirements as set out in this EMPr. The training records shall verify each of the targeted personnel's training experience.

Chief Albert Luthuli Local Municipality shall ensure that adequate environmental training takes. All employees shall be given an induction presentation on environmental awareness and the content of the EMPr. The presentation needs to be conducted in the language of the employees to ensure it is understood. The environmental training shall, as a minimum, include the following:

- The importance of conformance with all environmental policies.
- The environmental impacts, actual or potential, of their work activities.
- The environmental benefits of improved personal performance.
- Their roles and responsibilities in achieving conformance with the environmental policy and procedures and with the requirement of the Agency's environmental management systems, including emergency preparedness and response requirements.
- The potential consequences of departure from specified operating procedures;
- The mitigation measures required to be implemented when carrying out their work activities.
- Environmental legal requirements and obligations.
- Details regarding floral/faunal species of special concern and protected species, and the procedures to be followed should these be encountered during the construction of approach roads or construction camps.
- The importance of not littering.
- The importance of using supplied toilet facilities.
- The need to use water sparingly.
- Details of and encouragement to minimise the production of waste and re-use, recover and recycle waste where possible.
- Details regarding archaeological and/or historical sites which may be unearthed during construction and the procedures to be followed should these be encountered.

Monitoring of environmental training

The Contractor must monitor the performance of construction workers to ensure that the points relayed during their introduction have been properly understood and are being followed. If necessary, the ECO and / or a translator should be called to the site to further explain aspects of environmental or social behaviour that are unclear. Toolbox talks are recommended.

11 CLOSURE PLANNING

Final site cleaning - the contractor shall clear and clean the site and ensure that all equipment and residual materials not forming part of the permanent works is removed from site before issuing the completion certificate or as otherwise agreed.

Rehabilitation - the contractor (landscape architect/horticulturist) shall be responsible for rehabilitating and re-vegetation of all areas disturbed/areas earmarked for conservation during construction to the satisfaction of the engineer and ECO.

11.1 Post-construction audit

A post-construction environmental audit must be carried out and submitted to DARDLEA at the expense of the developer so as to fulfil conditions of the Environmental Authorisation granted. Objectives should be to audit compliances with the key components of the EMPr, to identify main areas requiring attention and recommend priority actions. The audit should be undertaken annually and should cover a cross section of issues, including implementation of environmental controls, environmental management and environmental monitoring.

Results of the audits should inform changes required to the specifications of the EMPr or additional specifications to deal with any environmental issues which arise on site and have not been dealt with in the current document.

11.2 Management review and revision of the EMPr

The EMPr is to be reviewed annually for the first three years and then once every five years thereafter, by an independent environmental consultant, unless otherwise specified by the authorities. The auditor is to highlight issues to be addressed in the EMPr or changes required during the annual audit. These points are to be included as an annexure to the EMPr and to be considered during the review process. Recommended changes to the EMPr must be forwarded to DARDLEA for approval and comment, before subsequently being incorporated into the EMPr.

11.3 General review of EMPr

The EMPr will be reviewed by the ECO on an ongoing basis. Based on observations during site inspections and issues raised at site meetings, the ECO will determine whether any procedures require modification to improve the efficiency and applicability of the EMPr on site.

Any such changes or updates will be registered in the ECO’s record, as well as being included as an annexure to this document. Annexure of this nature must be distributed to all relevant parties.

12 CONCLUSIONS

Although all foreseeable actions and potential mitigations or management actions are contained in this document, the EMPr should be seen as a day-to-day management document. The EMPr thus sets out the environmental and social standards, which would be required to minimise the negative impacts and maximise the positive benefits of the construction and operational activities. The EMPr could thus change daily, and if managed correctly lead to a successful construction and operational phases.

All attempts should be made to have this EMPr available, as part of any tender documentation, so that the Engineer and Contractor are made aware of the potential cost and timing implications needed to fulfil the implementation of the EMPr, thus adequately costing for these.

12.1 General review of EMPr

The EMPr will be reviewed by the ECO on an on-going basis. Based on observations during site inspections and issues raised at site meetings, the ECO will determine whether any procedures require modification to improve the efficiency and applicability of the EMPr on site.

ANNEXURE A

Environmental Code of Conduct

The applicant is committed to ensuring that the operation of the development is done according to the highest environmental standards so that the ecological footprint of the development is minimised where possible.

The applicant requires that all personnel involved in the operation process accept their responsibilities towards the EMP and the environment. This includes all permanent, contract or temporary workers as well as any other person involved with the project or visiting the site. Ignorance, negligence, recklessness or a general lack of commitment will not be tolerated.

If you do not understand the rules you must seek assistance to ensure compliance. The following people can assist you in ensuring compliance with the EMP.

Your Supervisor: …………………………………………………

Environmental Control Officer:…………………………………..

Project Manager:…………………………………………………

ANNEXURE B

Environmental Complaints Register						
	Name of Complainant	**Contact Details**	**Nature of Complaint**	**Responsible Person**	**Date Action Taken**	**Details of Action Taken**

ANNEXURE C

Environmental Incidents Register					
Date	**Incident**	**Action Required**	**Responsible Person**	**Action Implemented**	**Date Action Implemented**

ANNEXURE D

Environmental Training Register				
Date Company	Employee	Employee Signature	Supervisor	Supervisor Signature

ANNEXURE E

ENVIRONMENTAL AUTHORISATION / ROD

ANNEXURE F

EAP CV/EXPERTISE