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**CAPE WINELANDS DISTRICT MUNICIPALITY
BONNIEVALE (LANGEBERG LOCAL MUNICIPALITY) STORMWATER MASTER PLAN**



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Contents

INTRODUCTION	5
BRIEF	5
STUDY AREA AND LANDUSE	5
PREVIOUS MASTER PLANNING.....	5
DEFINITIONS AND SHORT DISCUSSION.....	5
Catchment Area	5
Flood occurrence	6
STRUCTURE AND SCOPE OF THE REPORT.....	6
DISCLAIMER	6
SURVEY INFORMATION AND EXISTING DRAINAGE SYSTEM	9
SURVEY INFORMATION	9
EXISTING DRAINAGE SYSTEM	9
General	9
Information to be clarified	10
CATCHMENT DATA & FLOOD ANALYSIS	12
METHODOLOGY	12
RUN-OFF PARAMETERS	12
FLOOD ANALYSIS	12
MASTER PLAN.....	17
GENERAL.....	17
FUTURE DEVELOPMENTS	17
MASTER PLAN PHASES	18
Phase A – Upgrading of Main Road (CBD area), Church-, Reitz- and Voortrekker Street (Including in front of the old age units and crossing the Irrigation Council channel)	18
Phase B – Upgrading of Forrest Street and new retention facility for future development	20
Phase C – Upgrading of structures in Milners Road.....	26
Phase D – Upgrading of stormwater drainage facilities next to main road outside the CBD	30
Phase E – Upgrading of access to erven over stormwater sidedrain.	36
COST ESTIMATE	38
CONCLUSION	39

LIST OF FIGURES

Figure BSW 1.1: Locality Plan	7
Figure BSW 1.2: Catchments	8
Figure BSW 2.1: Existing Stormwater System	11
Figure BSW 4.1: Master Plan	37

LIST OF TABLES

Table BSW 1.1: Design flood frequencies for minor systems.....	6
Table BSW 3.1: Sub – Catchment Data and run-off parameters.....	13
Table BSW 3.2: Pre-development run-off	15
Table BSW 3.3: Post development run-off.....	16
Table BSW 5.1: MP Cost Estimate	39
Table BSW 5.2: MP Project Summary.....	41

LIST OF ABBREVIATIONS & ACRONYMS

d	-	day
GIS	-	Geographic Information System
GLS	-	GLS Consulting Engineers
GOV	-	Government (Land Use)
h	-	hour
ha	-	hectare
kl	-	kilolitre
kl/d	-	Kilolitre/day
km	-	Kilometre
l	-	litre
l/min	-	Litre/minute
l/min/m pipe/m Ø	-	Litre/minute/meter pipe length/meter pipe diameter
l/s	-	Litre/second
m	-	metre
m/s	-	Metres per second
ML	-	Megalitre
mm	-	Millimetre
P&G	-	Preliminary and general
PS	-	Pumping Station
s	-	second
SG	-	Surveyor General
UH	-	Unit Hydrograph
uPVC	-	Unplasticised polyvinylchloride
v	-	Flow velocity (in m/s)
VAT	-	Value Added Tax

INTRODUCTION

BRIEF

GLS Consulting (GLS) were appointed in December 2012 by the Winelands District Municipality to compile the master plan of the stormwater system for Bonnievale in the Langeberg Local Municipality.

The project entails the surveying and capturing of existing stormwater infrastructure information, compiling of a computer model for the stormwater system in Bonnievale, analysing the capability of the network for the 1 in 2-, 5- and 10 year flood occurrences and master planning of the stormwater system to accommodate anticipated future growth as per the Spatial Development Framework.

This report describes the analyses and findings of the study.

STUDY AREA AND LANDUSE

The study area occupies an area of 913 ha north of the Breede River, north of the R62. The location of Bonnievale within the Western Cape Province is shown on Figure BSW1.1. The area drains into the Breede River to the south of the town.

The study area comprises approximately 70% undeveloped area and 30 % developed urban area

PREVIOUS MASTER PLANNING

No previous master planning has been done for the stormwater system components of Bonnievale.

DEFINITIONS AND SHORT DISCUSSION

Catchment Area

The study area consists of both urban (developed) areas and rural areas (farms and natural field) that flow through the urban area. The study area was subdivided into different catchment (drainage) areas with sub-catchment areas, to allow for various run-off/infiltration coefficients: slope, soil type, permeability and ground cover for pervious and impervious areas.

The catchment area was determined through investigation of 1:10 000 topographical maps. Some of the internal areas were surveyed to accumulate more accurate information of existing slopes, pipe sizes and diameters and position of existing services.

The catchment and sub-catchment areas are indicated on Figure BSW 1.2.

The existing cadastral layout is shown on the plan. Indicated on the plan are the original positions of the flow path of the “streams” and/or “sheet flow”.

Flood occurrence

The different 2-, 5- and 10 year pre-development flood calculations were done to determine the current required capacity of the existing stormwater network and to plan a network for areas without any stormwater infrastructure. The table below should be used to extract the different calculated discharges/flows from the tables for the relevant land use.

Table BSW 1.1: Design flood frequencies for minor systems

LAND USE	DESIGN FLOOD RECURRENCE INTERVAL
Residential	1 - 5 years
Institutional (e.g. schools)	2 - 5 years
General commercial and industrial	5 years
High value central business districts	5 - 10 years

The 50- and 100-year flood occurrence calculations were also done in order to advise on future retention dam facilities as well as to test the flow in the road reserves.

STRUCTURE AND SCOPE OF THE REPORT

This report addresses the drainage of stormwater in Bonnievale.

The scope of the report includes comments on the following:

- Existing services and inefficiencies
- Pre and post development run-off
- Required future upgrading to existing infrastructure
- Possible abandoning or relocation of existing infrastructure
- Location and size of required future infrastructure

DISCLAIMER

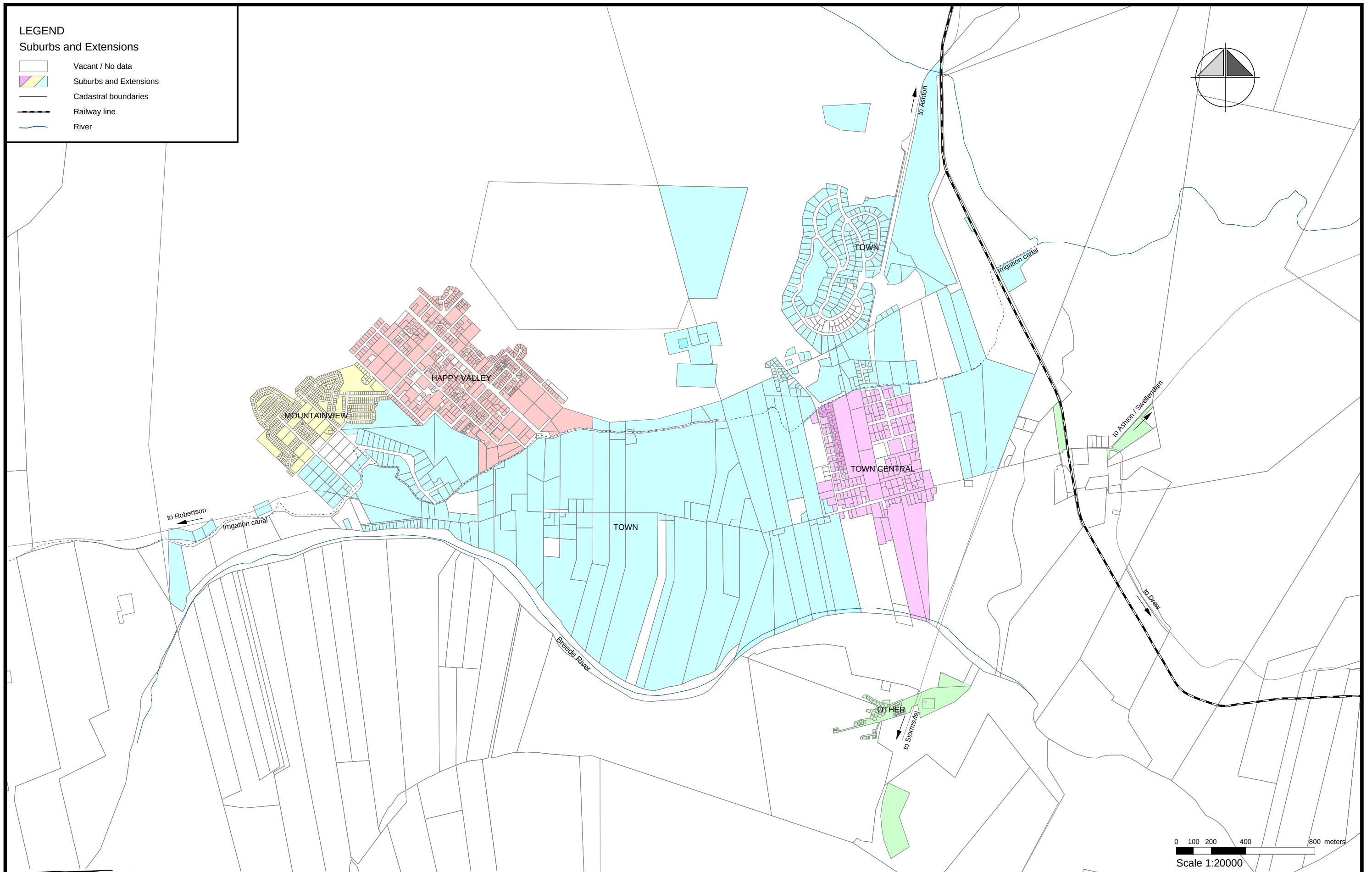
The investigation was performed and this report was compiled based on the information made available to GLS. All efforts, within budget constraints, were made during the gathering of information to ensure the highest degree of data integrity. The information supplied to GLS by the Langeberg Local Municipality and other consultants at the outset of this master planning process is assumed to be the most accurate representation of the existing system up to date hereof.

Critical areas in Bonnievale were identified and surveyed and captured as as-built plans where this information was lacking.

The information in this report is intended for the use by the Winelands District Municipality only.

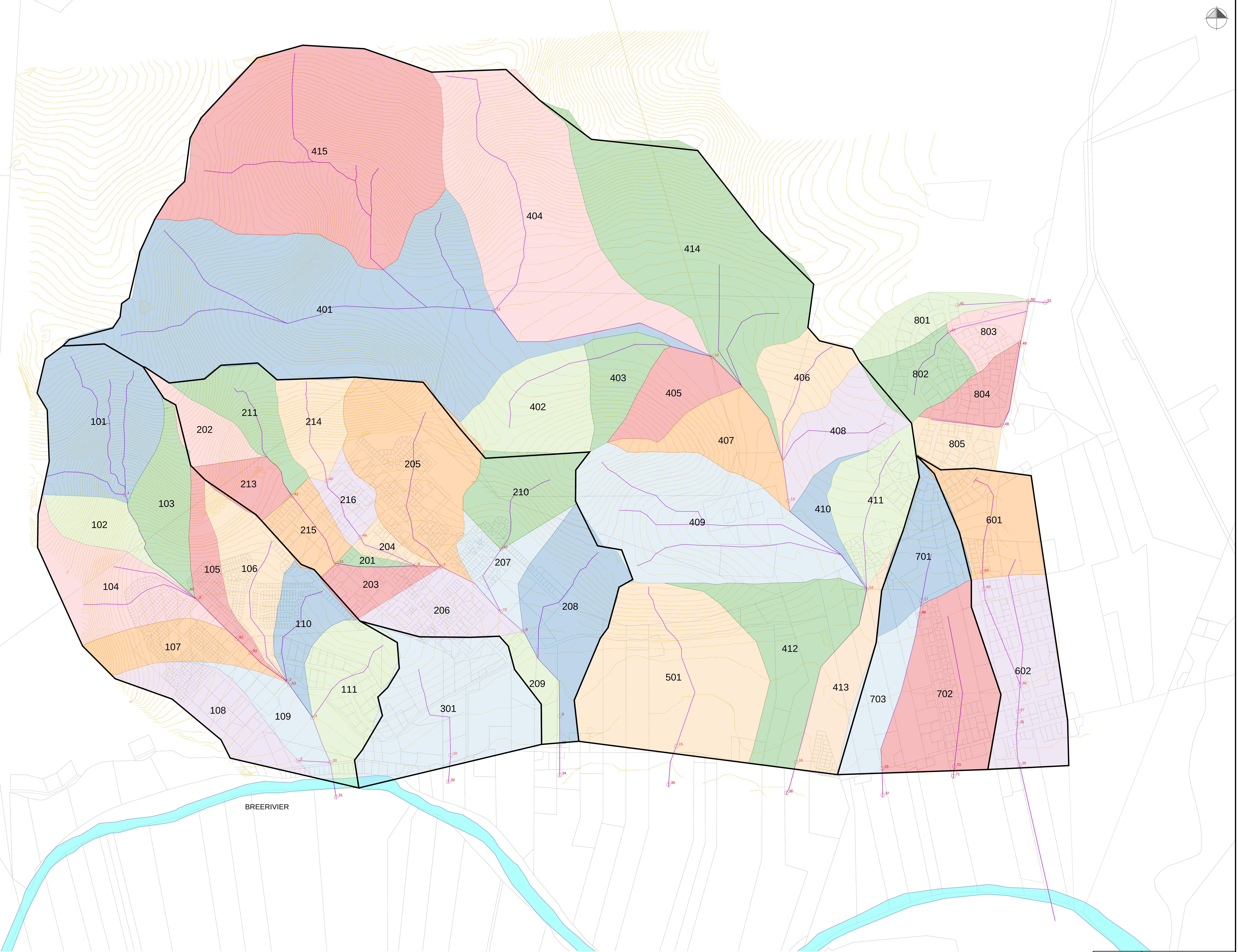
LEGEND
Suburbs and Extensions

-  Vacant / No data
-  Suburbs and Extensions
-  Cadastral boundaries
-  Railway line
-  River



Legend

- Catchment area
- Sub-catchment area
- 213 Sub-catchment number
- Flow path
- Node nr



SURVEY INFORMATION AND EXISTING DRAINAGE SYSTEM

SURVEY INFORMATION

No as-built data were available from the Municipality. Some data was available from other consultants who had tried to solve some localized problems. Where manholes and other structures could not be found (covered by soil), GLS could not produce accurate/complete as-built plans and interpolation was performed.

EXISTING DRAINAGE SYSTEM

General

The existing stormwater system consists of various surface channels (some lined and others as earth drains) and is in some cases combined with the minor irrigation channel network.

The major irrigation channel is a prominent structure that can divert/cut-off stormwater from the natural drainage route. It is controlled by the Zandrif Irrigation Council that does not allow the discharge of any concentrated stormwater into the main irrigation channel.

The minor irrigation channel is currently used by the local authority as a stormwater system where no minor stormwater system exists. This minor irrigation channel system is used, in most of the cases, as the outfall for the stormwater network system, to the river. This channel system was only designed to cart the un-used irrigation water to the river. The irrigation system is still in use; certain sections are situated within the municipal road reserves and other sections cross private property. Both the stormwater and irrigation system are not necessarily maintained adequately by their owners at this stage.

The existing roads were designed to be rural roads. The new alignment for the main road that is proposed by SANRAL should follow standards for an urban road that allows water drainage onto the road as a stormwater collector.

The stormwater system in the CBD was never designed as a gravity system on its own. The largest part of the drainage system is linked to the very shallow minor irrigation channels.

There is a dedicated stormwater system in Happy Valley consisting of underground pipes and catch pits in Milners street; it starts as a 600mm pipe upstream approximately at the corner of Milners and Andendorf Street and then becomes an 800mm pipe just before it crosses the main irrigation channel downstream to the Main Road. The remainder of Happy Valley is not serviced by a stormwater system and stormwater is drained in the roads and through erven.

There are side drains next to most of the roads in Mountain View. The side drains at road crossings are connected to each other with pipes going under the road.

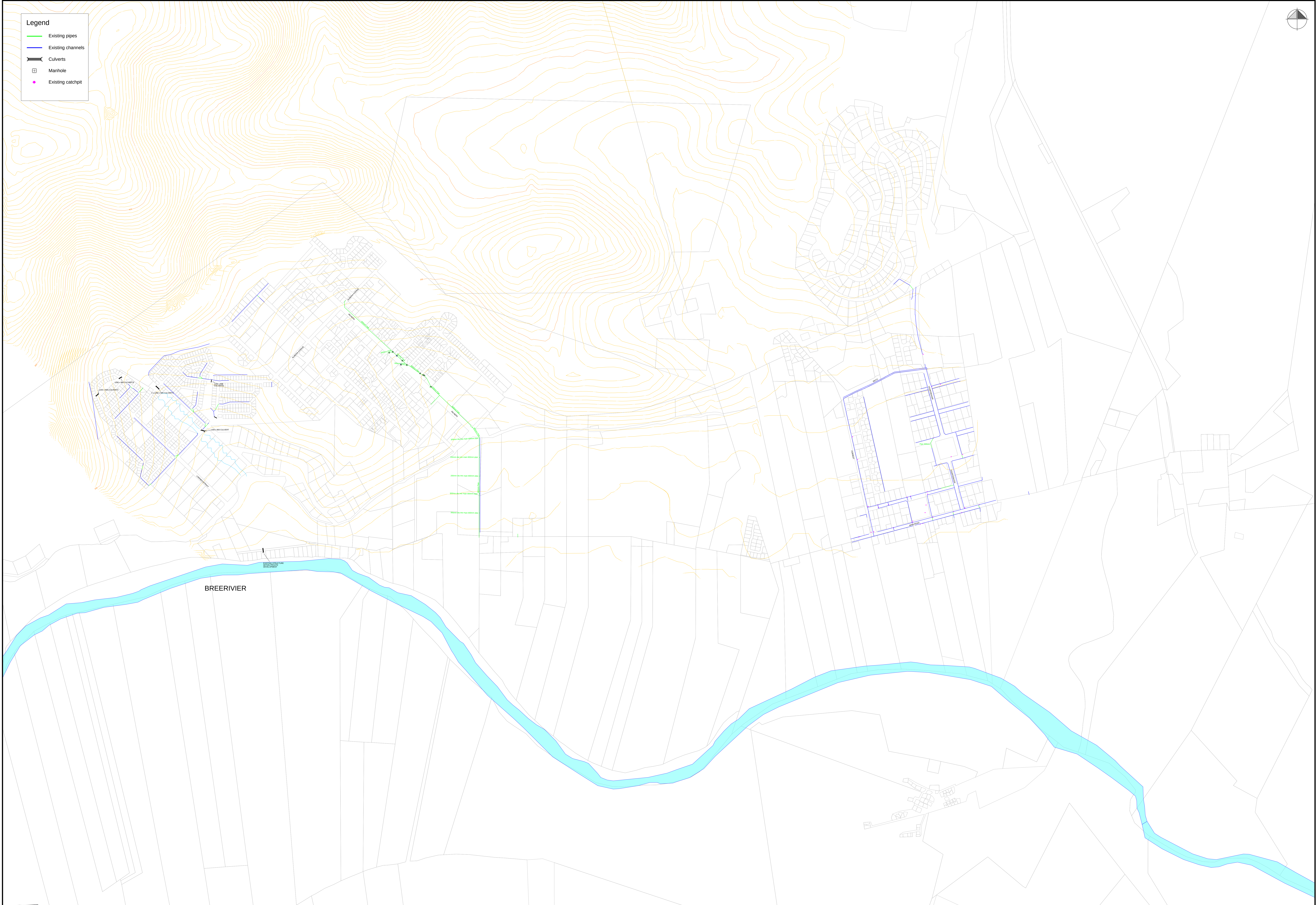
The observation can be made that most of the current problems experienced with stormwater drainage are due to inadequate road alignment design and a lack of maintenance on the existing stormwater system.

The existing stormwater system is shown on Figure BSW2.1.

Information to be clarified

For the purposes of formalizing stormwater drainage practises in Bonnievale the use of the irrigation channels, as stormwater conduits, by the Local Authority, must be authorized or abandoned in the long run. When making this decision the option to combine the irrigation channel with the stormwater network in some places, especially where the irrigation channel is currently only a “dumping place” of un-used water into the river, should be considered. This item must first be agreed upon internally by the Local Authority, before further design action can be taken. This will bring about the necessity for synchronization with the irrigation owners. For the interim, the irrigation channels are the only way to drain stormwater in most places.

The use of the main irrigation channel as a “surface stormwater collector” should also be negotiated, as the large irrigation channel is a prominent structure in the natural path of the stormwater run-off.



CATCHMENT DATA & FLOOD ANALYSIS

Methodology

The catchment area was demarcated from 1:10 000 orthophoto maps, overlaid with cadastral plans and electronic contours from Google maps.

Each main area draining into a stream was subdivided into sub catchment areas as indicated on Figure BSW1.2.

The 1 in 2-, 5-, 10-year pre-development run-off was calculated using the Hydrosim stormwater simulation package. The 1 in 50- and 100-year post development run-off was also calculated and used in determining the preliminary retention pond sizes and positions.

A triangular rainfall distribution type was used in combination with a time-shift routing methodology. Due to the size of the catchment area an aerial reduction factor was applied. The general soil type for the catchment area is a thin layer of good agricultural soil overlaid on impervious clay interspersed with areas of sandstone on the upstream catchment perimeter. The mean annual precipitation from the Robertson rainwater station is approximately 260mm. The inland storm parameters were used.

The following return periods were used in determining the required pipe sizes in different areas of the town:

- For the CBD area and the main irrigation channel crossings : 1 in 10-year;
- For the rural Main Road crossings: 1 in 50-year;
- For the general residential areas: 1 in 2-year.

The existing long section grade of the roads were used as a guideline for the slope of proposed pipes and should be checked when the final design is being done.

Run-Off Parameters

The run-off parameters of the catchment were estimated according to land use and soil permeability. The values used for each sub catchment is shown in Table BSW3.1.

Flood Analysis

The results of the pre-development flood analysis for the 1 in 2-, 5- and 10-year return periods are shown in Table BSW3.2.

The results of the post development flood analysis for the 1 in 50- and 100-year return periods are shown in Table BSW3.3.

Table BSW3.1: Catchment data and run-off parameters

Total Area: 915.74

StormShape: Triangular

M.A.P: 260

Catchment	Drain To	Area (ha)	Length (m)	Slope (m/m)	% Impervious	Future % Impervious	Depression storage		Initial infiltration rate (mm/hr)	Final infiltration rate (mm/hr)	Manning's n	
							Impervious fraction	Pervious fraction			Pervious fraction	Impervious fraction
101	1	26.70	705.00	0.3500	5	5	5.0	25.0	50	5	0.200	0.010
102	60	7.50	755.00	0.2800	5	5	5.0	25.0	50	5	0.200	0.010
103	60	11.90	841.00	0.3000	5	5	5.0	25.0	50	5	0.200	0.010
104	60	18.40	975.00	0.2300	5	13	5.0	25.0	50	5	0.200	0.010
105	61	7.20	996.00	0.2000	5	27	5.0	25.0	50	5	0.200	0.010
106	3	13.50	911.00	0.2000	5	23	5.0	25.0	50	5	0.200	0.010
107	61	9.90	861.00	0.1900	5	37	5.0	25.0	50	5	0.200	0.010
108	5	14.20	1 001.00	0.1200	5	43	5.0	25.0	50	5	0.200	0.010
109	30	8.30	802.00	0.0560	5	29	5.0	25.0	50	5	0.200	0.010
110	3	9.30	648.00	0.0850	5	34	5.0	25.0	50	5	0.200	0.010
111	30	16.40	641.00	0.0860	5	23	5.0	25.0	50	5	0.200	0.010
201	6	1.04	1 336.00	0.1980	5	50	5.0	25.0	50	5	0.200	0.010
202	41	6.80	628.00	0.3580	5	5	5.0	25.0	50	5	0.200	0.010
203	6	5.90	720.00	0.2500	5	50	5.0	25.0	50	5	0.200	0.010
204	6	2.80	1 042.00	0.1300	5	50	5.0	25.0	50	5	0.200	0.010
205	7	30.60	858.00	0.1570	5	22	5.0	25.0	50	5	0.200	0.010
206	8	11.20	693.00	0.0580	5	50	5.0	25.0	50	5	0.200	0.010
207	8	8.50	838.00	0.1970	5	40	5.0	25.0	50	5	0.200	0.010
208	9	21.40	955.00	0.1100	5	5	5.0	25.0	50	5	0.200	0.010
209	9	4.40	448.00	0.0330	5	5	5.0	25.0	50	5	0.200	0.010
210	45	13.80	539.00	0.1760	5	5	5.0	25.0	50	5	0.200	0.010
211	41	10.90	699.00	0.0430	5	5	5.0	25.0	50	5	0.200	0.010
213	41	6.10	437.00	0.3200	5	5	5.0	25.0	50	5	0.200	0.010
214	42	9.60	451.00	0.2770	5	5	5.0	25.0	50	5	0.200	0.010
215	43	7.50	334.00	0.0600	5	50	5.0	25.0	50	5	0.200	0.010
216	44	5.40	395.00	0.1140	5	50	5.0	25.0	50	5	0.200	0.010
301	10	32.40	734.00	0.0750	5	5	5.0	25.0	50	5	0.200	0.010
401	11	8.60	2 703.00	0.1170	5	5	5.0	25.0	50	5	0.200	0.010
402	12	17.60	438.00	0.1600	5	5	5.0	25.0	50	5	0.200	0.010
403	12	9.10	566.00	0.1410	5	5	5.0	25.0	50	5	0.200	0.010
404	12	60.30	1 645.00	0.1370	5	5	5.0	25.0	50	5	0.200	0.010

Catchment	Drain To	Area (ha)	Length (m)	Slope (m/m)	% Impervious	Future % Impervious	Depression storage		Initial infiltration rate (mm/hr)	Final infiltration rate (mm/hr)	Manning's n	
							Impervious fraction	Pervious fraction			Pervious fraction	Impervious fraction
405	12	10.20	599.00	0.1500	5	5	5.0	25.0	50	5	0.200	0.010
406	13	11.20	558.00	0.0810	5	5	5.0	25.0	50	5	0.200	0.010
407	13	13.20	679.00	0.0740	5	5	5.0	25.0	50	5	0.200	0.010
408	13	13.40	679.00	0.0740	5	5	5.0	25.0	50	5	0.200	0.010
409	14	43.90	1 278.00	0.0900	5	5	5.0	25.0	50	5	0.200	0.010
410	14	4.10	710.00	0.5600	5	5	5.0	25.0	50	5	0.200	0.010
411	14	15.30	705.00	0.0640	5	23	5.0	25.0	50	5	0.200	0.010
412	16	26.30	976.00	0.0720	5	5	5.0	25.0	50	5	0.200	0.010
413	16	12.50	1 118.00	0.0220	5	5	5.0	25.0	50	5	0.200	0.010
414	13	57.20	1 851.00	0.1220	5	5	5.0	25.0	50	5	0.200	0.010
415	11	75.30	987.00	0.2130	5	5	5.0	25.0	50	5	0.200	0.010
501	15	48.50	764.00	0.0980	5	5	5.0	25.0	50	5	0.200	0.010
601	64	11.30	675.00	0.0740	5	32	5.0	25.0	50	5	0.200	0.010
602	66	18.00	756.00	0.0200	5	47	5.0	25.0	50	5	0.200	0.010
701	17	19.70	550.00	0.0450	5	23	5.0	25.0	50	5	0.200	0.010
702	70	20.00	700.00	0.0450	5	28	5.0	25.0	50	5	0.200	0.010
703	19	10.00	700.00	0.0450	5	8	5.0	25.0	50	5	0.200	0.010
801	46	8.30	755.00	0.0660	5	20	5.0	25.0	50	5	0.200	0.010
802	47	10.40	389.00	0.0900	5	29	5.0	25.0	50	5	0.200	0.010
803	50	57.00	355.00	0.0420	5	5	5.0	25.0	50	5	0.200	0.010
804	49	6.10	535.00	0.0650	5	49	5.0	25.0	50	5	0.200	0.010
805	48	6.60	375.00	0.0670	5	44	5.0	25.0	50	5	0.200	0.010

Table BSW3.2: Pre-development run-off

Total Area: 915.74
M.A.P: 260

StormShape: Triangular
Analysis type: Present

Sub-catchment	Peak-Outlet (m3/sec)			Storm Duration (Min)		
	2 RI	5RI	10 RI	2 RI	5RI	10 RI
101	0.75	1.10	1.47	60	55	45
102	0.19	0.28	0.37	65	60	45
103	0.29	0.42	0.56	65	60	45
104	0.37	0.55	0.72	75	65	45
105	0.14	0.20	0.27	75	70	45
106	0.27	0.40	0.53	75	65	45
107	0.20	0.30	0.40	75	65	45
108	0.23	0.34	0.44	90	80	45
109	0.12	0.18	0.23	90	85	45
110	0.18	0.26	0.34	75	70	45
111	0.32	0.47	0.61	75	70	45
201	0.02	0.02	0.03	90	80	45
202	0.21	0.30	0.40	55	50	45
203	0.15	0.22	0.29	65	60	45
204	0.05	0.07	0.09	90	80	45
205	0.60	0.88	1.15	75	70	45
206	0.18	0.27	0.35	90	80	45
207	0.18	0.27	0.35	70	65	45
208	0.35	0.51	0.66	90	80	45
209	0.08	0.12	0.15	80	75	45
210	0.37	0.55	0.72	60	55	45
211	0.16	0.24	0.30	90	85	45
213	0.22	0.32	0.43	50	50	45
214	0.33	0.48	0.64	50	50	45
215	0.19	0.29	0.38	60	55	45
216	0.15	0.23	0.30	55	55	45
301	0.55	0.81	1.05	85	75	45
401	0.07	0.10	0.13	120	100	45
402	0.52	0.76	1.02	55	50	45
403	0.22	0.33	0.43	65	60	45
404	0.73	1.09	1.36	100	95	45
405	0.25	0.36	0.48	65	60	45
406	0.23	0.34	0.45	70	65	45
407	0.23	0.35	0.45	80	75	45
408	0.24	0.35	0.46	80	75	45
409	0.55	0.81	1.02	100	95	45
410	0.13	0.19	0.26	55	50	45
411	0.25	0.37	0.48	85	80	45
412	0.36	0.54	0.69	100	85	45
413	0.10	0.16	0.19	120	100	45
414	0.61	0.92	1.13	115	100	45
415	1.48	2.18	2.85	75	70	45
501	0.87	1.29	1.68	80	75	45
601	0.20	0.30	0.39	80	75	45
602	0.19	0.29	0.35	115	100	45
701	0.34	0.51	0.65	80	75	45
702	0.30	0.44	0.56	90	85	45
703	0.15	0.22	0.28	90	85	45
801	0.13	0.20	0.25	90	80	45
802	0.28	0.41	0.54	60	55	45
803	1.28	1.88	2.48	70	65	45
804	0.12	0.18	0.23	75	70	45
805	0.17					

Table BSW3.3: Post development run-off

Total Area: 915.74
M.A.P: 260

StormShape: Triangular
Analysis type: Future

Sub-catchment	Peak-Outlet (m3/sec)		Storm Duration (Min)	
	50 RI	100 RI	50 RI	100 RI
101	2.15	2.26	15	10
102	0.53	0.55	15	10
103	0.79	0.82	15	10
104	1.27	1.34	15	10
105	0.67	0.70	15	10
106	1.21	1.28	15	10
107	1.19	1.28	15	20
108	1.56	1.91	15	30
109	0.63	0.73	15	30
110	1.00	1.07	15	20
111	1.41	1.48	15	10
201	0.12	0.16	15	30
202	0.60	0.63	15	10
2				

MASTER PLAN

GENERAL

The master plan has been divided into 5 phases from Phase A to Phase E. Each phase is discussed below with pictures to indicate the existing problems and locations where services/upgrading of existing services are required.

All master plan items are indicated on Figure BSW4.1. The diameters as indicated on Figure BSW4.1 should be revised during final detailed design as it is dependent on the slope that can be achieved during construction.

The design of the upgrade of Main Road by SANRAL must take cognizance of the master plan.

Implementation of the master plan should be done in a sequence proposed on the master plan starting at the lowest point of the system (the river) and proceeding upstream. Master plan items are numbered in order of priority starting at A1.

FUTURE DEVELOPMENTS

The SDF indicates a number of potential future developments that are shown on Figure BSW4.1 and discussed below:

1. Erf 500 – this development is just upstream of the main irrigation channel. A retention pond is recommended as part of the development with a 1:2 year predevelopment outlet structure. A temporary solution can be the implementation of the crossing of the main irrigation channel between nodes 64 and 65 in Voortrekker street as indicated on Figure BSW4.1. The master plan recommends a 450mm pipe that can daylight just downstream of the channel due to the slope.
2. Erf 488 and former rugby field – this development is also upstream of the main irrigation channel. A retention pond is recommended as part of the development with a 1:2 year predevelopment outlet structure. A temporary solution can be the implementation of the crossing of the main irrigation channel between nodes 17 and 68 in Forrest street as indicated on Figure BSW4.1. The master plan recommends a 450mm pipe that will daylight further down Forrest street.
3. Industrial development - A retention pond is recommended as part of the development with a 1:2 year predevelopment outlet structure. The proposed location is indicated on Figure BSW4.1 and numbered B3.a
4. Future low/medium income housing - two retention ponds are recommended as part of the development both with a 1:2 year predevelopment outlet structure. The proposed locations are indicated on Figure BSW4.1 and numbered B3.b and B3.c
5. Low density developments adjacent to the golf course – A conventional drainage system is acceptable. No retention facilities are required.</

MASTER PLAN PHASES

Phase A – Upgrading of Main Road (CBD area), Church-, Reitz- and Voortrekker Street (Including in front of the old age units and crossing the Irrigation Council channel)

The absence of a main stormwater gravity line is the main reason why ponding of water takes place in Main Road and Church road. Water cannot drain via the existing irrigation channels due to the low grade and small size:

- The gradient of the irrigation channels were designed to minimize velocity.
- The catchpit invert levels are, in most cases, just higher than the irrigation channel invert level.
- The irrigation channels either drain onto private property where the “leiwat beurt” was taken and the sluice was not closed or else drain across the downstream farms to the Breede River.
- In some cases the channel is higher than the natural ground level to maintain a slope to cart a calculated quantity of water.
- Stormwater also overtops from the irrigation channels onto private property due to the small size of the channel.
- Sections of the irrigation channels are covered with slabs for long distances for access purposes. The slabs frequently break and fall into the channels.
- The irrigation channels also leak under the road level causing subsidence.

The main irrigation channel on the southern side of Reitz Steet also contributes to the non-drainage or slow drainage of the water that is concentrated upstream of the channel. Most stormwater flows uncontrolled over the channel into private properties:

The drainage of surface stormwater should be allowed into the main irrigation channel as this channel is a major structure (obstruction) in the natural stormwater flow paths. The main irrigation channel has level control over flows at certain positions that can be upgraded for this purpose.

Crossing the main irrigation channel can only happen during short maintenance periods in winter time, via a “backdrop” type structure. The gradient of the natural ground, downstream of the channel, is rather flat. This brings about that the main outfall will be in a deep excavation for quite a distance and all structures will be larger than normal. Once the system is underground, the pipe might not be able to “daylight”. The long section designs will need special attention, as downstream existing services might also influence the final design (MP Items A6 and B1).

The master plan proposes implementation of Phase A to address these problems. Items A1 to A8 propose a main stormwater pipe from Buiten Crescent upstream all the way down in Voortrekker Street, across Main Road and draining into the Breede River.

The following pictures illustrate the problems described above:

Node 66 - Voortrekker Street / Old age home:



Corner of Van Zyl Street and Voortrekker Street
Date: 09/09/2006

Node 64 – Main irrigation crossing:



The main irrigation channel on the left cuts off the natural stormwater flow, causing the water to pond in the road



The existing 160mm drain pipe crossing the street currently has insufficient capacity leading to ponding of water in the road. The master plan proposes an upgrade to a 375mm pipe. (Shallow crossing cast in concrete) – MP Item A7



The main irrigation channel (Zandriff Irrigation Council) during irrigation season. This channel undergoes yearly maintenance during winter season. Sheet flow ends up in channel during rain sessions.



Grid inlet (in line with main stormwater that drains via "leiwater" irrigation water crossing under main irrigation channel) to be upgraded to triple side inlet with major flood escape over main irrigation channel.



Surface water drains into open earth side drain where major scouring takes place on the steep grade.

Stormwater from existing upstream development also drain into this channel.

Stormwater pipe/concrete lined side drain combination is proposed to solve this problem.

Phase B – Upgrading of Forrest Street and new retention facility for future development

The problems experienced in Forrest Street and addressed by Phase B is similar to the situation in Voortrekker Street. The only existing way of conveying the stormwater is in the irrigation channel and this leads to the same problems as discussed previously. The main irrigation channel also obstructs the natural flow path of the stormwater that drains into Forrest Street.

The master plan proposes a main stormwater pipe from upstream of the main irrigation channel in Reitz Street all the way down in Forrester Street and in Main Road until it joins the stormwater pipe in Main Road which formed part of Phase A (MP Item A2). From there it will cross Main Road (MP Item A1) and be conveyed to the Breede River.

Node 70 - Crossing 7 (Main Road at Forrest Street intersection):



Corner of Main Road and Forrest Street



Water over flows into private property



Existing irrigation channel filled with sand and debris



Node 70 – Crossing 7 (Main road at ABSA):



Grid inlet in V-drain flows across the street towards irrigation channel with approximately the same inlet level



Escape route for existing 1:50 year flood grid inlet installed on irrigation channel



Insufficient grade of the V-drain results in the formation of ponds. Water evaporates or soaks away into layer works of road.

Node 70 – Crossing 7 (Main road at Municipality):



V-drain with insufficient drainage gradients



Escape route for 1:50 year flood



Escape route for 1:50 year flood drains into irrigation channel of insufficient size and grade as previously discussed.

Node 38 – Crossing 8 (Main road at BP garage):



V-drain with insufficient drainage gradients

Node 38 – Crossing 9 (Main road proposed low point and future main stormwater pipe outfall and flood escape route):



Escape route for 1:50 year flood; drains into minor irrigation channel



Grid inlet in V-drain damaged by heavy vehicles



Sluice on the minor irrigation channel is open or closed at inappropriate times



The minor irrigation channel, flowing from Main Road to the Breede River in the picture above, was designed with slope and size for slow irrigation water flow. Irrigation channels are above natural ground level at places to maintain grade

Node 67 – Crossing 10 (at Caltex):



V-drain with insufficient drainage gradient: Water evaporates or soaks away into layer works of road.

Node 17 – Main irrigation crossing (Corner of Forrest and Reitz Street):



Corner of Forrest and Reitz Street



There is inadequate stormwater drainage capacity in Reitz Street resulting in stormwater flowing over the road and the balance to soak away and infiltrate into the road layer works



Surface run off stormwater enters into main irrigation channel.



Corner of Forrest and Reitz Street



Forrest Street crossing of the main irrigation channel: The pipe (in line with main stormwater that drains via “leiwater” irrigation water crossing under main irrigation channel) to be upgraded to triple side inlet with major flood escape over main irrigation channel.

Phase C – Upgrading of structures in Milners Road

There is dedicated stormwater infrastructure in this part of Bonnievale but it fails due to a combination of issues:

- The 600mm and 800mm pipe in Milners road is in a good and clean condition, but
- The manhole structures are very large and most of the covers are made from thin steel plates that have broken or deformed.
- The rest of Happy Valley is not serviced by a dedicated stormwater system.

Phase C can be divided into 3 categories:

- Upgrading of structures in Milners Road.
- Upgrading of inlet/outlet structures in the stream north-east of Landbou Street.
- Upgrading of structures and associated pipework in Almeria Avenue.

Each of these categories is discussed below with pictures to identify problem areas.

Upgrading of structures in Milners Road:

This part of Phase C includes the construction of a new retention dam upstream of the township and a dedicated stormwater pipe from the outlet of the retention dam up to the existing infrastructure in Milners Road (MP Items C1 to C6).

The pictures below indicate a number of existing manholes that should be upgraded as part of the master plan.



Replace steel covers with concrete slabs with access hinged type 2B DI cover and frame



Replace steel covers with concrete slabs with 3x access hinged grate inlet DI cover and frame and 300 mm surround apron slab.



Replace steel cover with concrete slab with access hinged type 2B DI cover and frame



Replace steel cover with concrete slab with 3x access hinged grate inlet DI cover and frame and 300 mm surround apron slab.



Replace with 2x access hinged grate inlet DI cover and frame and 300 mm surround apron slab

Node 9 – Main irrigation crossing (Milners Street):



Pipe crossing under channel completed



Inlet control upstream of main irrigation channel crossing to be upgraded, cover with concrete cover slab and access lockable-hinged manhole cover and frame



Same inlet/outlet control from different angle

Phase C – Upgrading of inlet/outlet structures in the stream:



Upgrade inlet/outlet structure with pollution control structure.



Upgrade inlet/outlet structure with pollution control structure.



Upgrade inlet/outlet structure with pollution control structure. Retention dam to be constructed upstream of this node 60. Retention dam outlet structure to be designed for 2 year predevelopment flow.



Upgrade outlet structure with scouring control measures.

Phase C – Upgrading of structures and associated pipe work in Almeria Avenue:



Install 450 mm diameter pipe with side drain inlet and outlet structures to connect items C3 en C2 – node 44



Install 450 mm diameter pipe with side drain inlet and outlet structures (MP Item C9)



Install side drain inlet structures and connect to new proposed 450 mm diameter pipe (MP Item C9)



Install side drain inlet structures and connect to new proposed 450mm diameter pipe (MP Item C9)

Phase D – Upgrading of stormwater drainage facilities next to Main Road outside the CBD

The Main Road classification will probably stay a rural road. 50-year stormwater design data should be implemented either before or during the upgrading of Main Road. SANRAL should confirm the recurrence interval on which design should be based.

Photos of crossings with relevant node numbers are shown below:

Node 30 – Crossing 1:



Existing upstream inlet



Existing road crossing, install 2 x 1200 x 600 mm culverts for the full length of road reserve, with inlet and outlet structures



Existing downstream outlet



Existing downstream outlet flows into new developments inlet, install 2 x 1200 x 600 mm culverts with outlet structure behind boundary wall

Node 10 – Crossing 2:



No existing stormwater road crossing: water soaks away over time. Install 600 mm diameter pipe with inlet and outlet structures

Node 33 – Crossing 3 (at intersection):



Corner of Main Road and Milners Road to be upgraded with bellmouth curbing and stormwater inlets. Connect to existing 800 mm pipe that crosses Main Road (MP Item C10)



Outlet of existing 800 mm stormwater pipe from Milners Road into concrete lined channel. Most of the stormwater calculated at node 33 is diverted via this pipe



Concrete lined channel with subsurface drainage inlets to the river. (In good condition)

Node 33 – Crossing 3 (at original low point)



Install 600 mm diameter pipe with side drain inlet and outlet structures



Proposed 600 mm diameter pipe outlet structure position (Upgrade existing)



Proposed stormwater outlet should convert concentrated flow to sheet flow upstream of existing grass paddock

Node 33 – Crossing 3 (at block making factory):



Install 450 mm stormwater pipe parallel to road with side inlets next to the road edges. The pipe should drain towards pipe crossing upstream of paddock



Node 15(A) – Crossing 4 downstream:



Existing downstream outlet structure to be upgraded to 900 x 600 mm culvert with outlet structure



Channel to be upgraded to 2400 x 1200 mm



Existing downstream earth channel is in an acceptable condition

Node 15(B) – Crossing 4 at existing ponds upstream:



Upstream inlet control to be upgraded to 900 x 600 mm inlet structure



Approach channel to be upgraded to 2400 x 1200 mm and lined with armoured flex



Overflow of the feature dam to be upgraded to size 8000 x 400 mm and lined with armoured flex

Node 16 – Crossing 5:



Upgrade existing pipe crossing with 2 x 1200 x 600 mm culverts with associated headwall inlets/outlets

Node 19 - Crossing 6:



Upgrade existing pipe crossing with 750 x 600 mm culverts with associated headwall inlets/outlets

Phase E – Upgrading of access to erven over stormwater sidedrain

The side drains next to most erven in Mountain View and Happy Valley are blocked with a small pipe on the channel that is covered with soil or subbase to provide vehicular access to the erven. This method causes a “blockage” in the side drain and the soil filling get washed downstream with even small floods.

Typical access to erven:



Access to erven is problematic in many cases. Treat access on ad hoc-basis where stormwater flows onto private property from the road reserve or where vehicle access is requested and/or as funds are available.



Add kerb and sidewalk where long section has a steep gradient.



Replace V-drain with roll over kerb, and transition at point of vehicle entrance.



COST ESTIMATE

The implementation of the master plan has been divided into five phases. The estimated cost of implementing each phase is given below. The following is included in determining the price: required changes to existing services (roads, water, sewer and electrical), installation of stormwater services, contingency fees, P&G's and engineering fees. All costs are based on June 2013 values and are shown in Table BSW5.1 and Table BSW5.2.

1. Phase A

CBD area and Voortrekker Street, including Van Zyl- and Reitz Street: New bulk stormwater outfall system has been proposed for this area

The cost estimate to implement phase A = R 3,985,000.00

2. Phase B

Forrest Street and retention dam for future development

The cost estimate to implement phase B = R 2,823,500.00

3. Phase C

Upgrading of structures in Milners road and extension of stormwater system

The cost estimate to implement phase C = R 1,652,600.00

4. Phase D

Upgrading of Main Road old stormwater crossings. This phase should be completed before or during the upgrading of Main Road

The cost estimate to implement phase D = R 1,694,750.00

5. Phase E

Upgrading various items e.g. providing sidewalks, kerbs and access to residential erven

The cost estimate to implement phase E = R 3,505,000.00

Total estimated cost for implementing the Master Plan = R 13,660,850.00

Table BSW5.1: Master Plan Cost Estimate

Region	MP Item Type	MP Item No	Project No	Project Description	Extent	Unit	Size/Settling	Unit	Task	Comment	Base Year	Constr Cost (R)	Contingencies	P&Gs	Engineering fees	Total Cost (R)
Bonnievale	MP	A1	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	650	m x	600	mm Ø	Pipe to install		2012/13	520 000	52 000	85 800	78 936	736 736
Bonnievale	MP	A2	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	50	m x	600	mm Ø	Pipe to install		2012/13	40 000	4 000	6 600	6 072	56 672
Bonnievale	MP	A3	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	95	m x	375	mm Ø	Pipe to install		2012/13	47 500	4 750	7 838	7 211	67 298
Bonnievale	MP	A4	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	250	m x	450	mm Ø	Pipe to install		2012/13	150 000	15 000	24 750	22 770	212 520
Bonnievale	MP	A5	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	250	m x	450	mm Ø	Pipe to install		2012/13	150 000	15 000	24 750	22 770	212 520
Bonnievale	MP	A6	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	330	m x	450	mm Ø	Pipe to install		2012/13	198 000	19 800	32 670	30 056	280 526
Bonnievale	MP	A7	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	380	m x	375	mm Ø	Pipe to install		2012/13	190 000	19 000	31 350	28 842	269 192
Bonnievale	MP	A8	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	75	m x	375	mm Ø	Pipe to install		2012/13	37 500	3 750	6 188	5 693	53 130
Bonnievale	MP	A-Channels	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	200	m x			Channel to install at inlet/outlet structures		2012/13	225 000	22 500	37 125	34 155	318 780
Bonnievale	MP	A-Miscellaneous	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	various				Manholes/catchpits/wingwalls		2012/13	357 000	35 700	58 905	54 193	505 798
Bonnievale	MP	A-Roads	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	1815	m²	25	mm Ø	Premix/brickpave		2012/13	226 875	22 688	37 434	34 440	321 437
Bonnievale	MP	A-Roads	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	1210	m	1.5	m	Layer works		2012/13	264 000	26 400	43 560	40 075	374 035
Bonnievale	MP	A-Roads	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m			Mountable kerb and channel		2012/13	3 700	370	611	562	5 242
Bonnievale	MP	A-Roads	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m			Edging kerb		2012/13	2 500	250	413	380	3 542
Bonnievale	MP	A-Roads	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	50	m			Barrier kerb and channel		2012/13	16 000	1 600	2 640	2 429	22 669
Bonnievale	MP	A-Sewer	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	200	m	150	mm Ø	Pipe to install		2012/13	44 000	4 400	7 260	6 679	62 339
Bonnievale	MP	A-Sewer	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m	200	mm Ø	Rising main to install		2012/13	5 000	500	825	759	7 084
Bonnievale	MP	A-Sewer	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	various				Manholes/cover/erf connections		2012/13	72 000	7 200	11 880	10 930	102 010
Bonnievale	MP	A-Water	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	200	m x	110	mm Ø	Pipe to install		2012/13	36 000	3 600	5 940	5 465	51 005
Bonnievale	MP	A-Water	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	50	m x	160	mm Ø	Pipe to install		2012/13	10 000	1 000	1 650	1 518	14 168
Bonnievale	MP	A-Water	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	400	m x	200	mm Ø	Pipe to install		2012/13	128 000	12 800	21 120	19 430	181 350
Bonnievale	MP	A-Water	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	various				Valves/hydrants/erf connections		2012/13	82 000	8 200	13 530	12 448	116 178
Bonnievale	MP	A-Ducting and Electrical	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m x	110	mm Ø	Telkom trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	A-Ducting and Electrical	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m x	110	mm Ø	Electrical trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	A-Ducting and Electrical	Phase A	Upgrading of Main Road (CBD area), Church- Reitz- and Voortrekker Street (including in front of the old age units and crossing the Irrigation Council channel)	20	m x	160	mm Ø	Electrical trench and pipe		2012/13	2 800	280	462	425	3 967
Bonnievale	MP	B1	Phase B	Upgrading of Forrest Street and new retention facility for future development	690	m x	450	mm Ø	Pipe to install		2012/13	420 000	42 000	69 300	63 756	595 056
Bonnievale	MP	B2	Phase B	Upgrading of Forrest Street and new retention facility for future development	400	m x	525	mm Ø	Pipe to install		2012/13	280 000	28 000	46 200	42 504	396 704
Bonnievale	MP	B3a	Phase B	Upgrading of Forrest Street and new retention facility for future development	1	x			Construct retention pond		2012/13	75 000	7 500	12 375	11 385	106 260
Bonnievale	MP	B3b	Phase B	Upgrading of Forrest Street and new retention facility for future development	1	x			Construct retention pond		2012/13	250 000	25 000	41 250	37 950	354 200
Bonnievale	MP	B3c	Phase B	Upgrading of Forrest Street and new retention facility for future development	1	x			Construct retention pond		2012/13	25 000	2 500	4 125	3 750	354 200
Bonnievale	MP	B-Channels	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m x			Channel to install at inlet/outlet structures		2012/13	22 500	2 250	3 713	3 416	31 879
Bonnievale	MP	B-Additional	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m x	600	mm Ø	Pipe to install		2012/13	16 000	1 600	2 640	2 429	22 669
Bonnievale	MP	B-Miscellaneous	Phase B	Upgrading of Forrest Street and new retention facility for future development	various				Manholes/catchpits/wingwalls		2012/13	154 500	15 450	25 493	23 453	218 896
Bonnievale	MP	B-Roads	Phase B	Upgrading of Forrest Street and new retention facility for future development	1155	m²	25	mm Ø	Premix/brickpave		2012/13	144 375	14 438	23 822	21 916	204 551
Bonnievale	MP	B-Roads	Phase B	Upgrading of Forrest Street and new retention facility for future development	770	m	1.5	m	Layer works		2012/13	168 000	16 800	27 720	25 502	238 022
Bonnievale	MP	B-Roads	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m			Mountable kerb and channel		2012/13	3 700	370	611	562	5 242
Bonnievale	MP	B-Roads	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m			Edging kerb		2012/13	2 500	250	413	380	3 542
Bonnievale	MP	B-Roads	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m			Barrier kerb and channel		2012/13	16 000	1 600	2 640	2 429	22 669
Bonnievale	MP	B-Sewer	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m	150	mm Ø	Pipe to install		2012/13	11 000	1 100	1 815	1 670	15 585
Bonnievale	MP	B-Sewer	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m	200	mm Ø	Rising main to install		2012/13	12 500	1 250	2 063	1 898	17 710
Bonnievale	MP	B-Sewer	Phase B	Upgrading of Forrest Street and new retention facility for future development	various				Manholes/cover/erf connections		2012/13	26 000	2 600	4 290	3 947	36 837
Bonnievale	MP	B-Water	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m x	110	mm Ø	Pipe to install		2012/13	9 000	900	1 485	1 366	12 751
Bonnievale	MP	B-Water	Phase B	Upgrading of Forrest Street and new retention facility for future development	50	m x	160	mm Ø	Pipe to install		2012/13	10 000	1 000	1 650	1 518	14 168
Bonnievale	MP	B-Water	Phase B	Upgrading of Forrest Street and new retention facility for future development	10	m x	200	mm Ø	Pipe to install		2012/13	3 200	320	528	486	4 534
Bonnievale	MP	B-Water	Phase B	Upgrading of Forrest Street and new retention facility for future development	various				Valves/hydrants/erf connections		2012/13	31 000	3 100	5 115	4 706	43 921
Bonnievale	MP	B-Ducting and Electrical	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m x	110	mm Ø	Telkom trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	B-Ducting and Electrical	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m x	110	mm Ø	Electrical trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	B-Ducting and Electrical	Phase B	Upgrading of Forrest Street and new retention facility for future development	20	m x	160	mm Ø	Electrical trench and pipe		2012/13	2 800	280	462	425	3 967
Bonnievale	MP	B-Ducting and Electrical	Phase B	Upgrading of Forrest Street and new retention facility for future development					Repair costs		2012/13	80 000	8 000	13 200	12 144	113 344
Bonnievale	MP	C1	Phase C	Upgrading of structures in Miners Road	225	m x	450	mm Ø	Pipe to install		2012/13	110 100	11 010	18 167	16 713	155 990
Bonnievale	MP	C2	Phase C	Upgrading of structures in Miners Road	225	m x	450	mm Ø	Pipe to install		2012/13	110 100	11 010	18 167	16 713	155 990
Bonnievale	MP	C3	Phase C	Upgrading of structures in Miners Road	100	m x	450	mm Ø	Pipe to install		2012/13	48 940	4 894	8 075	7 429	69 338
Bonnievale	MP	C4	Phase C	Upgrading of structures in Miners Road	75	m x	450	mm Ø	Pipe to install		2012/13	36 700	3 670	6 056	5 571	51 997
Bonnievale	MP	C5	Phase C	Upgrading of structures in Miners Road	150	m x	450	mm Ø	Pipe to install		2012/13	72 400	7 240	12 111	11 142	103 993
Bonnievale	MP	C6	Phase C	Upgrading of structures in Miners Road	1	x			Construct retention pond		2012/13	37 500	3 750	6 188	5 693	53 130
Bonnievale	MP	C7	Phase C	Upgrading of structures in Miners Road	1	x			Construct retention pond		2012/13	37 500	3 750	6 188	5 693	53 130
Bonnievale	MP	C8	Phase C	Upgrading of structures in Miners Road	various						2012/13	45 000	4 500	7 425	6 831	63 756
Bonnievale	MP	C9	Phase C	Upgrading of structures in Miners Road	22.0	m x	450	mm Ø	Pipe to install		2012/13	10 760	1 076	1 775	1 633	15 245
Bonnievale	MP	C10	Phase C	Upgrading of structures in Miners Road	various						2012/13	45 000	4 500	7 425	6 831	63 756
Bonnievale	MP	C-Replace existing manhole covers	Phase C	Upgrading of structures in Miners Road	various				Replace/upgrade existing manhole covers		2012/13	90 000	9 000	14 850	13 662	127 512
Bonnievale	MP	C-Miscellaneous	Phase C	Upgrading of structures in Miners Road	various				Manholes/catchpits/wingwalls		2012/13	151 000	15 100	24 915	22 922	213 937
Bonnievale	MP	C-Roads	Phase C	Upgrading of structures in Miners Road	585	m²	25	mm Ø	Premix/brickpave		2012/13	73 125	7 313	12 066	11 100	103 604
Bonnievale	MP	C-Roads	Phase C	Upgrading of structures in Miners Road	390	m	1.5	m	Layer works		2012/13	85 090	8 509	14 040	12 917	120 556
Bonnievale	MP	C-Roads	Phase C	Upgrading of structures in Miners Road	50	m			Mountable kerb and channel		2012/13	9 250	925	1 526	1 404	13 105
Bonnievale	MP	C-Roads	Phase C	Upgrading of structures in Miners Road	50	m			Edging kerb		2012/13	6 250	625	1 031	949	8 855
Bonnievale	MP	C-Roads	Phase C	Upgrading of structures in Miners Road	50	m			Barrier kerb and channel		2012/13	16 000	1 600	2 640	2 429	22 669
Bonnievale	MP	C-Sewer	Phase C	Upgrading of structures in Miners Road	120	m	150	mm Ø	Pipe to install		2012/13	26 400	2 640	4 356	4 008	37 404
Bonnievale	MP	C-Sewer	Phase C	Upgrading of structures in Miners Road	50	m	200	mm Ø	Rising main to install		2012/13	12 500	1 250	2 063	1 898	17 710
Bonnievale	MP	C-Sewer	Phase C	Upgrading of structures in Miners Road	various				Manholes/cover/erf connections		2012/13	21 000	2 100	3 465	3 188	29 753
Bonnievale	MP	C-Water	Phase C	Upgrading of structures in Miners Road	50	m x	110	mm Ø	Pipe to install		2012/13	9 000	900	1 485	1 366	12 751
Bonnievale	MP	C-Water	Phase C	Upgrading of structures in Miners Road	50	m x	160	mm Ø	Pipe to install		2012/13	10 000	1 000	1 650	1 518	14 168
Bonnievale	MP	C-Water	Phase C	Upgrading of structures in Miners Road	10	m x	200	mm Ø	Pipe to install		2012/13	3 200	320	528	486	4 534
Bonnievale	MP	C-Water	Phase C	Upgrading of structures in Miners Road	various				Valves/hydrants/erf connections		2012/13	31 000	3 100	5 115	4 706	43 921
Bonnievale	MP	C-Ducting and Electrical	Phase C	Upgrading of structures in Miners Road	20	m x	110	mm Ø	Telkom trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	C-Ducting and Electrical	Phase C	Upgrading of structures in Miners Road	20	m x	110	mm Ø	Electrical trench and pipe		2012/13	2 400	240	396	364	3 400
Bonnievale	MP	C-Ducting and Electrical	Phase C	Upgrading of structures in Miners Road	20	m x	160	mm Ø	Electrical trench and pipe		2012/13	2 800	280	462	425	3 967
Bonnievale	MP	C-Ducting and Electrical	Phase C	Upgrading of structures in Miners Road					Repair costs		2012/13	2 800	280	462	425	3 967
Bonnievale	MP	D - Node 19	Phase D	Upgrading of stormwater drainage facilities next to Main Road outside the CBD	1</											

Region	MP Item Type	MP Item No	Project No	Project Description	Extent	Unit	Size/Settling	Unit	Task	Comment	Base Year	Constr Cost (R)	Contingencies	P&Gs	Engineering fees	Total Cost (R)
Bonnievale	MP	E-Miscellaneous	Phase E	Upgrading of access to erven over stormwater sidedrain	various				Manholes/catchpits/wingwalls		2012/13	303 000	30 300	49 995	68 993	452 288
Bonnievale	MP	E-Roads	Phase E	Upgrading of access to erven over stormwater sidedrain	2700	m ²	25	mm Ø	Premix/brickpave		2012/13	337 500	33 750	55 688	76 849	503 786
Bonnievale	MP	E-Roads	Phase E	Upgrading of access to erven over stormwater sidedrain	5200	m	1.5	m	Layer works		2012/13	1 134 545	113 455	187 200	258 336	1 693 536
Bonnievale	MP	E-Roads	Phase E	Upgrading of access to erven over stormwater sidedrain	200	m			Mountable kerb and channel		2012/13	37 000	3 700	6 105	8 425	55 230
Bonnievale	MP	E-Sewer	Phase E	Upgrading of access to erven over stormwater sidedrain	10	m	150	mm Ø	Pipe to install		2012/13	2 200	220	363	501	3 284
Bonnievale	MP	E-Sewer	Phase E	Upgrading of access to erven over stormwater sidedrain	various				Manholes/cover/erf connections		2012/13	21 000	2 100	3 465	4 782	31 347
Bonnievale	MP	E-Water	Phase E	Upgrading of access to erven over stormwater sidedrain	50	m x	110	mm Ø	Pipe to install		2012/13	9 000	900	1 485	2 049	13 434
Bonnievale	MP	E-Water	Phase E	Upgrading of access to erven over stormwater sidedrain	20	m x	160	mm Ø	Pipe to install		2012/13	4 000	400	660	911	5 971
Bonnievale	MP	E-Water	Phase E	Upgrading of access to erven over stormwater sidedrain	various				Valves/hydrants/erf connections		2012/13	2 250	225	371	512	3 359
Bonnievale	MP	E-Ducting and Electrical	Phase E	Upgrading of access to erven over stormwater sidedrain	20	m x	110	mm Ø	Telkom trench and pipe		2012/13	2 400	240	396	546	3 582
Bonnievale	MP	E-Ducting and Electrical	Phase E	Upgrading of access to erven over stormwater sidedrain	20	m x	110	mm Ø	Electrical trench and pipe		2012/13	2 400	240	396	546	3 582
Bonnievale	MP	E-Ducting and Electrical	Phase E	Upgrading of access to erven over stormwater sidedrain	20	m x	160	mm Ø	Electrical trench and pipe		2012/13	2 800	280	462	638	4 180
Bonnievale	MP	E-Ducting and Electrical	Phase E	Upgrading of access to erven over stormwater sidedrain					Repair costs		2012/13	60 000	6 000	9 900	13 662	89 562
TOTAL												9 455 431	945 543	1 560 146	1 699 729	13 660 850

Table BSW5.2: Master Plan Project Summary

Region	Project No	Project Description	Base Year	Constr Cost (R)	Contingencies (10%)	P&Gs (15%)	Engineering fees (12%)*	Total Cost (R)
Bonnievale	Phase A	Upgrading of Main Road (CBD area), Church-, Reitz- and Voortrekker Street (Including in front of the old age units and crossing the Irrigation Council channel)	2012/13	2 812 675	281 268	464 091	426 964	3 984 998
Bonnievale	Phase B	Upgrading of Forrest Street and new retention facility for future development	2012/13	1 992 875	199 288	328 824	302 518	2 823 505
Bonnievale	Phase C	Upgrading of structures in Milners Road	2012/13	1 166 415	116 642	192 458	177 062	1 652 577
Bonnievale	Phase D	Upgrading of stormwater drainage facilities next to Main Road outside the CBD	2012/13	1 135 370	113 537	187 336	258 524	1 694 767
Bonnievale	Phase E	Upgrading of access to erven over stormwater sidedrain	2012/13	2 348 095	234 810	387 436	534 661	3 505 002
TOTAL				9 455 431	945 543	1 560 146	1 435 334	13 660 850

*Engineering fees of 18% were calculated for phases D and E to account for the possible 'ad hoc' nature of the projects

CONCLUSION

The current stormwater measures in Bonnievale are insufficient and the effects are far reaching; leading to flooding of private property, contamination of irrigation water and damage to the roads at critical locations. In the CBD stormwater is being conveyed to the irrigation channels that are unsuitable and where there is dedicated stormwater drainage infrastructure it is failing due to inadequate capacity and maintenance.

The master plan proposes to address these shortcomings systematically by implementing suitable stormwater drainage infrastructure in 5 phases.

The master plan should be implemented from downstream to upstream (A1 – A8, B1 – B3, C1 – C10) in order to create capacity downstream. This phasing is proposed taking into consideration the risks associated with inadequate accommodating of stormwater namely:

- loss of life
- damage to property

and to ensure a convenient system (in terms of pedestrian and car traffic) especially in the CBD.

Phase D should be implemented in conjunction with the upgrading of Main Road by SANRAL and SANRAL should take this master plan into consideration during the planning and design phase of the upgrading of Main Road.

Phase E should be implemented when the budget allows but can start as soon as possible or on an *ad hoc* basis to address the most urgent issues.

Before detailed design is undertaken the municipality should decide whether they would want to incorporate sections of the existing irrigation channels into the stormwater system, taking cognizance of all the associated difficulties. The master plan proposes that the stormwater should be split from the irrigation channels and this should be systematically implemented as the dedicated stormwater system is constructed. The reason for this proposal is the incompatibility of the two systems with regards to:

- gradient/levels
- channel size
- channel location

The municipality should also negotiate with the Zandrif Irrigation Council regarding accepting stormwater flow into the main irrigation channel.

The total cost of implementing the proposed master plan is estimated at R 13,660,850.00