nelson mandela bay
MUNICIPALITY
PORT ELIZABETH | UITENHAGE | DESPATCH

SEWERAGE MASTER PLAN: Phase 2 Stage 2
Urban Areas

COMMISSION No: B865

October 2009

COMMISSION No. B865

NELSON MANDELA BAY MUNICIPALITY

SEWERAGE MASTER PLAN: URBAN AREAS

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SEWERAGE MASTER PLAN: URBAN AREAS

1. INTRODUCTION

In its letter Ref. B865, dated 12 September 2005, the Office of the Infrastructure and Engineering Business Unit of the Nelson Mandela Bay Municipality (NMBM) appointed *ILISO Consulting,* in conjunction with *Cabitech,* to provide consulting engineering services and prepare a sewerage master plan for the urban areas of the metro.

The NMBM is deemed a Water Service Authority (WSA) and incorporates the management structure of the old Port Elizabeth Municipality, Uitenhage and Despatch, which in the past was responsible for the provision of sanitation infrastructure to predominantly urban areas.

2. GOALS AND OBJECTIVES OF THE URBAN SEWERAGE MASTERPLAN

The sewerage master plan is part of a series of plans which cascade down from the Integrated Development Plan (IDP); the Water Services Development Plan (WSDP) and the Spatial Development Framework (SDF).

2.1 The Integrated Development Plan (IDP)

The Integrated Development Plan provides the basis for the managed development of the NMBM and will be used by the political, business and community leadership to determine activities and operational plans and guide the allocation of resources until and beyond 2020. It is imperative that the future of the NMBM be understood as reflected by the Vision 2020. The IDP is the initial plan in pursuance of the long term transformation agenda.

2.2 The Water Services Development Plan (WSDP)

This section highlights the goals and objectives of the WSDP, that relate to the sewerage master plan.

The WSDP for the Metro has to serve a number of purposes, viz.:

- It should serve as a useful communication and reference tool for councillors, when the status of water services within the various wards is under discussion.
- It should serve as proof to other spheres of government (e.g. as represented by DWAF) that the NMBM is exercising due diligence in managing its water services.

2.3 Spatial Development Framework (SDF)

The SDF has a spatial planning focus. Spatial planning is a public sector activity that creates a public investment and regulatory framework within which private sector decision making and investment occurs.

2.4 Sewer Master plan Objectives

The sewer master plan had the following objectives:

- Capture and map the existing bulk lines, 200mm diameter and larger, pump stations, flow diversions and siphons.
- Analyse of the flow capacity of the existing sewer reticulation network
- Highlight all existing network deficiencies
- Identify, with the city planners, the future potential development nodes for 2010, 2015 and 2020 scenarios.
- Determine the effect that the additional loading, as a result of these future development nodes, will have on the existing sewer network and comment on future upgrading requirements.
- Estimate capital funding requirements for the planning scenarios up until the year 2020.

3. MASTER PLAN AREA

The areas, as depicted on the Spatial Development Framework were used as the basis for master planning. All areas within the urban fence were included, with additional areas earmarked for urban sprawl, such as Greenbushes, Bushy Park and Draaifontein.

This master plan was not based on percentage linear growth but rather on future development scenarios – development time frames were determined by the NMBM town planners. Unfortunately, however, the Local Development Frame Work (LSDF) was not completed for the majority of the sewer catchment areas.

4. PLANNING METHODOLOGY

The NMBM appointed 14 consultants during September 2007 to conduct a detailed study of their respective catchment areas, as shown on drawing no B865_17

Work was broken down into the following components:

a) Existing infrastructure – Define the boundaries of the catchment area; identify infrastructure detail from record drawings; survey areas where information is lacking; update record drawings; undertake a flow analysis of the existing network; provide augmentation proposals if required; capture all information on GIS system.
b) Future developments – Identify all future developments within the urban edge; determine development time frames in consultation with the NMBM town planners; compile a preliminary layout of bulk lines required to drain future developments; Analyse entire catchment network (existing and future) for 2010, 2015 and 2020 scenarios, to determine future pipe sizes and constrictions in existing system.

Catchment assessments were completed towards the end of 2008. This took longer than was originally planned due to initial problems in obtaining the existing sewer network information from the various offices of the NMBM.

Field surveys of existing infrastructure were also extremely time consuming and in particular, the Swartkops catchment took 4 months longer than planned, as a result of to silted lines, limited access to manholes and security problems.

5. FLOW CALCULATION AND ANALYSIS

The master plan was formulated using broad brush planning principles and was focused toward the bulk collector lines, 200mm diameter and larger. Flow calculations and analyses were completed by all consultants, utilising the same criteria as indicated in the ***Table 1*** below.

TABLE 1: FLOW CALCULATION CRITERIA

Variable parameters for Fow Analysis calculations		
Flow Calculation Section		
For flow attenuation formula choose:		
Harmon = 1 or		
Red Book = 2	2	
Dry weather Peak Factor limit for :		
For sewer lines with pipe diameter (mm) (A) <=	**300**	**3.25**
For sewer lines with pipe (A) < diameter (B) <=	**500**	**3.25**
For sewer lines with pipe diameter (C) >	**500**	**3.25**
Allowance for Wet Weather flow:		
For sewer lines with pipe diameter (A) <=	**250**	**100%**
For sewer lines with pipe (A) < diameter (B) <=	**500**	**100%**
For sewer lines with pipe diameter (C) >	**500**	**100%**
Hydraulic Section		
Pipe Diameters to be true internal diameters(mm)		
Manning Coeficient (n = variable)	**0.012**	

In addition, the '*Red Book'* attenuation formula was utilised and all calculations were undertaken in accordance with the agreed NMBM Flow Categories, as shown in ***Table 2*** below and the standard NMBM excel flow calculation spread sheets.

TABLE 2: FLOW CALCULATION CRITERIA

Categories for Flow Analysis				
	ADWF/erf l/e/d	People per erf	Erf Size m^2	Socio -economic group
1	**750**	**4.8**	**850**	High
2	**625**	**4.5**	**650**	Medium
3	**550**	**5.5**	**400**	Low
4	**400**	**3.5**	**350**	Town Houses & Group Housing
5	**525**	**8.5**	**300**	Site & Service - Formal Houses
6	**400**	**6.5**	**200**	Informal Structures - Green Fields dev.
7	**3500**	**10**	**1000**	Industrial & dense Commercial
8	**1750**	**15**	**1000**	Industrial for areas > 10ha
9	Variable figures to be provided for Wet Industries			

5.1 Flows from the various Catchment Areas

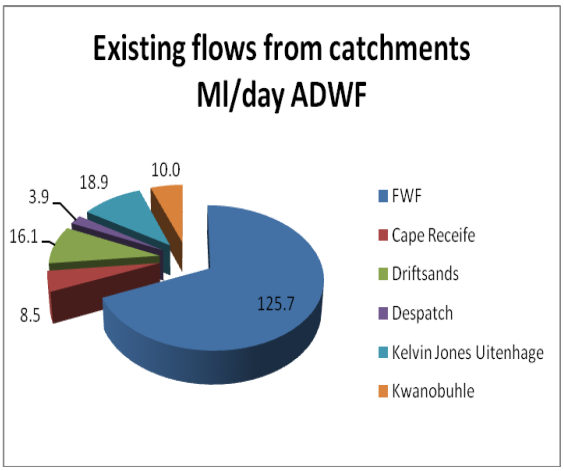
Analysis was undertaken, based on four scenarios:

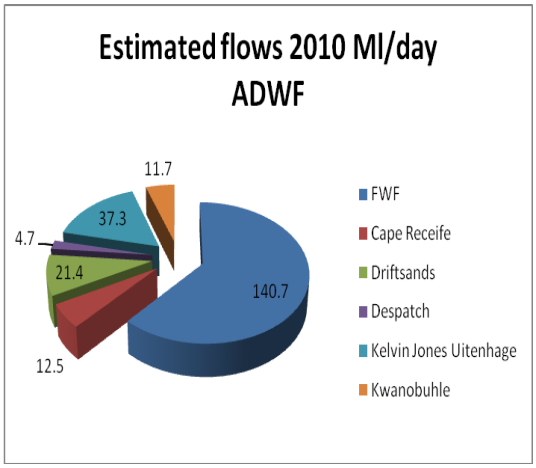
- the existing systems
- **2010**
- **2015**
- and **2020**

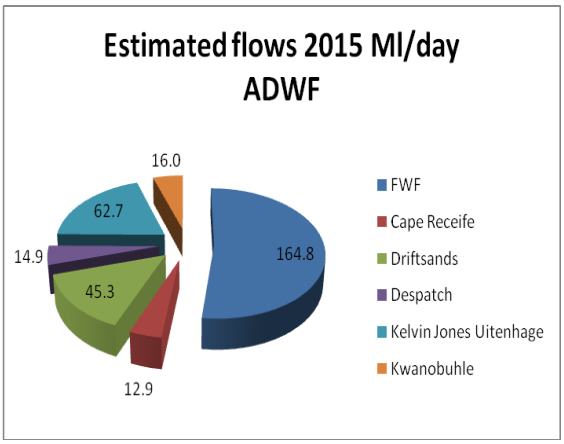
The modelling of future development scenarios was based on the Spatial Development Framework (SDF). In order to establish the ultimate incoming flows at the various waste water treatment works, the individual drainage catchments were linked in the model, to create a larger "Waste Water Treatment Catchment".

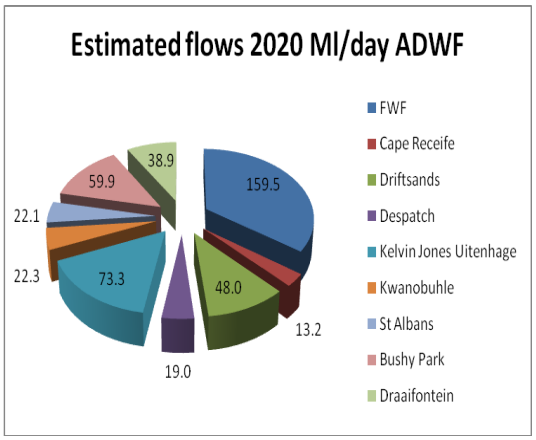
The analysis results from this exercise, when compared to actual flows measured at the various treatment works, compare well, but are generally slightly higher (in the order of 10 to 15%) than the measured flows. For master planning purposes this provides a conservative buffer.

To further refine the sewer master plan, the NMBM is currently in the process of installing around 40 flow monitoring stations throughout the various sewer catchments in the metropolitan area. Flows measured at these stations will produce valuable data for verifying actual flows and comparing these against the calculated model flows.









5.2 Analysis Summary

From the analysis results, sewer lines with capacity problems were identified and grouped into the following four planning horizons:

- the existing systems - 33km of existing pipelines to be upgraded
- **2010** - 84km of additional pipelines, to be constructed and upgraded

- **2015** - 92km of additional pipelines, to be constructed and upgraded
- **2020** - 77km of additional pipelines, to be constructed and upgraded

Thus a total of 286km of sewer pipelines are required to be constructed and upgraded from present, to the 2020 horizon.

6 PROJECTED COST ESTIMATES

Cost estimates for the upgrading of existing lines, construction of new sewer lines, siphons, pump stations, pipe bridges, pipe jacking and rising mains were prepared. These cost estimates only provide an indication of global costs, as no designs have been undertaken. More detailed cost estimates will have to be conducted on a project by project basis, as and when the required work is programmed.

Costing was grouped into the previous development scenarios, namely: existing, 2010, 2015 and 2020, as depicted in Table 3 below. Costs are all inclusive of Planning and Construction.

TABLE 3: GLOBAL COST ESTIMATES

	Existing	2010	2015	2020
Pipe Line Costing	R 67 644 612	R 190 693 069	R 306 433 807	R 1 121 742 819
Syphon		R 3 160 000		
Pipe Bridge			R 1 150 000	
Pump Station	R 4 963 000	R 56 132 803	R 27 431 616	R 10 000 000
Pumping Mains			R 4 149 410	R 4 551 595
WWTW		R 0	R 1 705 198 314	R 1 124 417 130
Total	R 72 607 612	R 249 985 871	R 2 044 363 147	R 2 260 711 544

Table 4 below indicates the estimated cost per catchment for the various scenarios.

TABLE 4: CATCHMENT COST ESTIMATES (Excluding WWTW)

Nelson Mandela Bay Municipality
Sewer Master Plan Phase 2 Stage 2
Costing

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Uitenhage	5.7	R 11 938 800	2.4	R 4 451 000	30.9	R 98 318 500	6.4	R 5 969 300
Jagtvlakte			12.2	R 24 258 197	1.7	R 5 564 805	4.4	R 21 804 656
Swartkops	1.4	R 2 115 000			5.0	R 34 000 000		
Paapenkuils	3.1	R 5 323 052	5.8	R 21 714 770	5.8	R 38 954 060		
Motherwell - North / Coega			13.0	R 37 276 659	6.9	R 37 276 659	55.0	R 1 048 745 886
Motherwell	4.4	R 6 474 386	1.8	R 4 379 119	23.5	R 35 800 275	5.3	R 29 126 725
Markman			3.6	R 1 170 000				
Lower Baakens	14.7	R 41 036 574						
Upper baakens			1.2	R 220 000	18.6	R 39 400 000	6.5	R 8 490 000
Driftsands			11.2	R 87 362 927				
Kwanobuhle			3.1	R 7 501 851	4.06	R 14 457 508.50	1.7	R 7 606 252
City	0.7	R 676 800	0.3	R 900 900				
Chatty	0.2	R 80 000	0.1	R 1 241 045				
Despatch			0.2	R 216 600	1.3	R 2 662 000		
Sub - Total	**30**	**R 67 644 612**	**55**	**R 190 693 069**	**98**	**R 306 433 807**	**79**	**R 1 121 742 819**
Syphon								
Description								
Markman			2	R 3 160 000				
Sub - Total		**R 0**		**R 3 160 000**				**R 0**
Pipe Bridge								
Description								
Uitenhage					0.2	R 1 150 000		
Sub - Total		**R 0**		**R 0**		**R 1 150 000**		**R 0**
Pump Station								
Description								
Lower Baakens	1	R 4 963 000						
Upper Baakens			2	R 13 000 000	1	5 000 000	1	R 5 000 000
Paapenkuils			1	R 12 038 910				
Motherwell - North / Coega			6	R 7 780 500			1	R 2 000 000
Markman (Amsterdamhoek)			5	R 3 270 000				
Kwanobuhle			2	R 12 000 000				
Jagtvlakte			3	R 793 393	1	R 66 116		
Driftsands			2	R 7 000 000				
Despatch			1	R 250 000				
Uitenhage					5	R 14 115 500		
Motherwell					1	R 8 250 000	1	R 3 000 000
Sub - Total		**R 4 963 000**		**R 56 132 803**		**R 27 431 616**		**R 10 000 000**
Other (Diversion weirs)								
Description								
Uitenhage pumping mains					3	R 3 433 000		
Motherwell pumping mains					0.5	R 716 410	1	R 4 551 595
Sub - Total		**R 0**		**R 0**		**R 4 149 410**		**R 4 551 595**
Total		**R 72 607 612**		**R 249 985 871**		**R 339 164 833**		**R 1 136 294 414**

The above mentioned upgrading and construction needs to be planned and co-ordinated in conjunction with the metropolitan development requirements and then incorporated into the NMBM's capital budget programme.

7 GENERAL DESCRIPTIONS OF THE CATCHMENTS

This section provides more detailed information on each of the individual catchment areas as summarised in section 6 above.

7.1 Upper Baakens – Consultant: Goba

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Catchment	Existing	2010	2015	2020
Upper Baakens	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	84.4	126.6	112.4	112.4
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	7.3	10.9	9.7	9.7

Receiving WWTW: Pumped to Driftsands Catchment via Woodlands and Mangolds Pump stations and ultimately drains to at the **Driftsands WWTW.**

Development costing:

		Existing			2010		2015		2020
Pipe Line Costing									
Description	**Km**	**Amount**		**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Upper baakens				1.2	R 220 000	18.6	R 39 400 000	6.5	R 8 490 000
Sub - Total	**0**	**R 0**		**1**	**R 220 000**	**19**	**R 39 400 000**	**7**	**R 8 490 000**
Pump Station									
Description									
Upper Baakens				2	R 13 000 000	1	5 000 000	1	R 5 000 000
Sub - Total		**R 0**			**R 13 000 000**		**R 5 000 000**		**R 5 000 000**
Total		**R 0**			**R 13 220 000**		**R 44 400 000**		**R 13 490 000**

This catchment is due to expand drastically, with effluent flows increasing by around 300%, due to major developments planned in the west of the drainage system. The densities proposed for future developments by the planners are extremely high, up to 75 units per hectare. Once the Local Spatial Development Framework (LSDF), which is currently been prepared for this area, has been finalized, this sewer master plan will have to be amended accordingly.

Three areas bordering the Upper Baakens Catchment; namely, Bushy Park, Draaifontein and Greenbushes, have been included in the master plan study. Although these areas fall outside the current urban fence, they have been identified as future development nodes, the timeframes of which would probably extend past the 2020 planning horizon.

7.2 Lower Baakens – Consultant: SSI

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Lower baakens	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	98.4	144.8	149.0	152.7
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	8.5	12.5	12.9	13.2

Receiving WWTW: Cape Receife WWTW
(Effluent from the upper regions of this catchment is pumped, via the Mangolds Pump Station, into the Driftsands system).

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Lower Baakens	14.7	R 41 036 574						
Sub - Total	**15**	**R 41 036 574**	**0**	**R 0**	**0**	**R 0**	**0**	**R 0**
Pump Station								
Description								
Lower Baakens	1	R 4 963 000						
Sub - Total		**R 4 963 000**		**R 0**		**R 0**		**R 0**
Total		**R 45 999 574**		**R 0**		**R 0**		**R 0**

This catchment is one of the smallest catchments, with very little large scale new development taking place. The long awaited Madiba Bay Development would have a minor impact on this catchment. Flows increase by 55% up to 2020 mainly due to infill developments.

7.3 Driftsands – Consultant: Manong

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Driftsands	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	186.8	248.2	524.7	555.3
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	16.1	21.4	45.3	48.0

Receiving WWTW: Driftsands WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Driftsands			11.2	R 87 362 927				
Sub - Total	**0**	**R 0**	**11**	**R 87 362 927**	**0**	**R 0**	**0**	**R 0**
Pump Station								
Description								
Driftsands			2	R 7 000 000				
Sub - Total		**R 0**		**R 7 000 000**		**R 0**		**R 0**
Total		**R 0**		**R 94 362 927**		**R 0**		**R 0**

Effluent flow from the Upper Baakens drains into the Driftsands catchment via the Woodlands and Mangolds pump station, as well as a small portion of the effluent flow from the upper regions of the Lower Baakens Catchment.

Major developments will take place in the upper region of the Upper Baakens system – draining down into the Driftsands system via a new proposed high level collector sewer. Other than the increased flows from future developments in the Upper Baakens system, additional developments in this catchment are relatively small, with some minor development taking place around the Arlington race course.

7.4 City – Consultant: EAS

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
City combined	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	357.8	365.4	371.6	376.7
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	30.9	31.6	32.1	32.5

Receiving WWTW: Creek Pump Station – Fish Water Flats WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
City	0.7	R 676 800	0.3	R 900 900				
Sub - Total	**1**	**R 676 800**	**0**	**R 900 900**	**0**	**R 0**	**0**	**R 0**
Total		**R 676 800**		**R 900 900**		**R 0**		**R 0**

This is the oldest catchment and required substantial survey work to obtain existing data. With the exception of a few land use changes within the catchment, no new developments are anticipated. Flows increase by only 5 % by 2010, when further development is complete. This is the smallest increase to flows out of all the catchments.

7.5 Paapenkuils – Consultant: FST / Goba

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Paapenkuils	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	246.7	284.4	329.4	335.8
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	21.3	24.6	28.5	29.0

Receiving WWTW: Creek Pump station then on to Fish Water Flats WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Paapenkuils	3.1	R 5 323 052	5.8	R 21 714 770	5.8	R 38 954 060		
Sub - Total	**3**	**R 5 323 052**	**6**	**R 21 714 770**	**6**	**R 38 954 060**	**0**	**R 0**
Total		**R 5 323 052**		**R 21 714 770**		**R 38 954 060**		**R 0**

The western portion of the old Paapenkuils catchment is fully developed with new developments taking place along the western boundary of the catchment. These developments increase the flow by 36% by the year 2020. The Paapenkuils system is drained via two (2) bulk lines, one flowing to the Creek Pump Station and the other into the rising main from the Creek pump station towards the Fish Water Flats treatment works.

7.6 Chatty – Consultant: Africon

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	0.7	0.7	0.7	0.7
Total Chatty	18.1	20.2	31.0	32.0

Receiving WWTW: Via the Swartkops catchment to the Fish Water Flats WWTW.

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Chatty	0.2	R 80 000	0.1	R 1 241 045				
Sub - Total	**0**	**R 80 000**	**0**	**R 1 241 045**	**0**	**R 0**	**0**	**R 0**
Total		**R 80 000**		**R 1 241 045**		**R 0**		**R 0**

The Chatty system is relatively new and additional bulk infrastructure has been installed over the last 5 years to make provision for the proposed new developments to the north. The existing bulk infrastructure can, to a large extent, accommodate the 77 % increase in flow.

7.7 Swartkops – Consultant: Ninham Shand

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Swartkops	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
Total Swartkops	523.8	550.1	677.9	690.4
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	45.3	47.5	58.6	59.6

(Flow from Chatty included)

Receiving WWTW: Fish Water Flats WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Swartkops	1.4	R 2 115 000			5.0	R 34 000 000		
Sub - Total		**R 2 115 000**				**R 34 000 000**		
Total		**R 2 115 000**		**R 0**		**R 34 000 000**		**R 0**

The Swartkops system is one of the older systems in the metro. Flow from the Chatty Catchment area drains into the Swartkops catchment. Other than a few infill developments no major developments will take place in this catchment. The increased flows of over 30% are as a result of the developments upstream in the Chatty catchment.

7.8 Markman – Consultant: Lukhozi

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Markman / wells	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	155.4	223.2	316.2	230.7
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	13.4	19.3	27.3	19.9

Receiving WWTW: Fish Water Flats WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Markman			3.6	R 1 170 000				
Sub - Total	**0**	**R 0**	**4**	**R 1 170 000**	**0**	**R 0**	**0**	**R 0**
Syphon								
Description								
Markman			2	R 3 160 000				
Sub - Total		**R 0**		**R 3 160 000**				**R 0**
Pump Station								
Description								
Markman (Amsterdamhoek)			5	R 3 270 000				
Sub - Total		**R 0**		**R 3 270 000**		**R 0**		**R 0**
Total		**R 0**		**R 7 600 000**		**R 0**		**R 0**

Initial flows from the Coega IDZ will be pumped into this system until such time as the Coega WWTW is built. Flows will thus increase temporarily (up to 2015) by 49% due to the new developments and the low cost housing project in Wells Estate. However, these flows are expected to decrease toward 2020, when the Coega WWTW becomes operational.

7.9 Motherwell – Consultant: Izizwe

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Motherwell	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	171.0	205.8	212.5	212.5
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	14.8	17.8	18.4	18.4

Receiving WWTW: Fish Water Flats; a portion to the Despatch and Coega WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Motherwell	4.4	R 6 474 386	1.8	R 4 379 119	23.5	R 109 718 549	5.3	R 29 126 725
Sub - Total	**4**	**R 6 474 386**	**2**	**R 4 379 119**	**24**	**R 109 718 549**	**5**	**R 29 126 725**
Pump Station								
Description								
Motherwell					1	R 8 250 000	1	R 3 000 000
Sub - Total		**R 0**		**R 0**		**R 8 250 000**		**R 3 000 000**
Other (Diversion weirs)								
Description								
Motherwell pumping mains					0.5	R 716 410	1	R 4 551 595
Sub - Total		**R 0**		**R 0**		**R 716 410**		**R 4 551 595**
Total		**R 6 474 386**		**R 4 379 119**		**R 118 684 959**		**R 36 678 321**

Major portions of land have been identified to the North of Motherwell for low cost housing developments, which form part of the NMBM's 10 year housing programme.

7.10 Motherwell North/Coega – Consultant: Letsunyane

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Motherwell - Norh / Coega	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
Flow from the NMBM only	0.0	118.9	258.3	617.2
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	0.0	10.3	22.3	53.3

Receiving WWTW: Coega proposed WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Motherwell - North / Coega	2.2	R 1 778 419	13.8	R 47 190 294	16.5	R 58 264 170	21.3	R 238 196 385
Sub - Total	**2**	**R 1 778 419**	**14**	**R 47 190 294**	**16**	**R 58 264 170**	**21**	**R 238 196 385**
Pump Station								
Description								
Motherwell - North / Coega			6	R 7 780 500			1	R 44 591 725
Sub - Total		**R 0**		**R 7 780 500**		**R 0**		**R 44 591 725**
Other (Diversion weirs)								
Description								
Motherwell - North / Coega pipe jacking			3	R 10 773 000				
Sub - Total		**R 0**		**R 10 773 000**		**R 0**		**R 0**
Total		**R 1 778 419**		**R 65 743 794**		**R 58 264 170**		**R 282 788 110**

This is a proposed development area and will form part of the NMBM low cost housing programme. Flow will drain to the Coega system and will be dependent upon the construction of the new Coega WWTW.

7.11 Despatch – Consultant: KV3

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Despatch	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
Total	45.2	54.3	172.6	220.1
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	3.9	4.7	14.9	19.0

Receiving WWTW: Despatch WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Despatch			0.2	R 216 600	1.3	R 2 662 000		
Sub - Total	**0**	**R 0**	**0**	**R 216 600**	**1**	**R 2 662 000**	**0**	**R 0**
Pump Station								
Description								
Despatch			1	R 250 000				
Sub - Total		**R 0**		**R 250 000**		**R 0**		**R 0**
Total		**R 0**		**R 466 600**		**R 2 662 000**		**R 0**

This system is a small system with some minor infill developments and some new large low cost housing developments linking into the system, such as Joe

Slovo. As a result, flows increase by around 50%. It is also proposed that a portion of the development, to the north of Motherwell, drains directly to the Despatch WWTW.

7.12 Uitenhage – Consultant: SBA

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Uitenhage	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
Total	219.3	255.4	528.0	584.5
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	18.9	22.1	45.6	50.5

Receiving WWTW: Kelvin Jones WWTW

Development costing:

		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Uitenhage	5.7	R 11 938 800	2.4	R 4 451 000	30.9	R 98 318 500	6.4	R 5 969 300
Sub - Total	**6**	**R 11 938 800**	**2**	**R 4 451 000**	**31**	**R 98 318 500**	**6**	**R 5 969 300**
Pipe Bridge								
Description								
Uitenhage					0.2	R 1 150 000		
Sub - Total		**R 0**		**R 0**		**R 1 150 000**		**R 0**
Pump Station								
Description								
Uitenhage					5	R 14 115 500		
Sub - Total		**R 0**		**R 0**		**R 14 115 500**		**R 0**
Other (Diversion weirs)								
Description								
Uitenhage pumping mains					3	R 3 433 000		
Sub - Total		**R 0**		**R 0**		**R 3 433 000**		**R 0**
Total		**R 11 938 800**		**R 4 451 000**		**R 117 017 000**		**R 5 969 300**

The Uitenhage system is a relatively old system. Large residential developments are envisaged in the North East of the catchment area. These developments will increase the effluent flow by around 176%.

7.13 Kwanobuhle – Consultant: Jeffares and Green

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Kwanobuhle	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	116.1	135.7	184.9	258.4
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	10.0	11.7	16.0	22.3

Receiving WWTW: Kwanobuhle WWTW

Development costing:

		Existing			2010		2015		2020
Pipe Line Costing									
Description	**Km**	**Amount**		**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Kwanobuhle				3.1	R 7 501 851	4.06	R 14 457 508.50	1.7	R 7 606 252
Sub - Total	**0**	**R 0**		**3**	**R 7 501 851**	**4**	**R 14 457 509**	**2**	**R 7 606 252**
Pump Station									
Description									
Kwanobuhle				2	R 12 000 000				
Sub - Total		**R 0**			**R 12 000 000**		**R 0**		**R 0**
Total		**R 0**			**R 19 501 851**		**R 14 457 509**		**R 7 606 252**

This system is relatively new. Bulk services for some of the new developments like to the south west of Kwanobuhle referred to as area 10 and area 11 have already been provided. The 123% increase in flow is due to proposed new developments to the south west of Kwanobuhle.

7.14 Jagtvlakte (Uitenhage) – Consultant: Iliso

Sewer flows extracted from analysis:

	Existing	2010	2015	2020
Jagvlakte	ADWF l/s	ADWF l/s	ADWF l/s	ADWF l/s
	0.0	176.3	197.2	263.4
	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d	ADWF Ml/d
	0.0	15.2	17.0	22.8

Receiving WWTW: Kelvin Jones WWTW

Development costing:

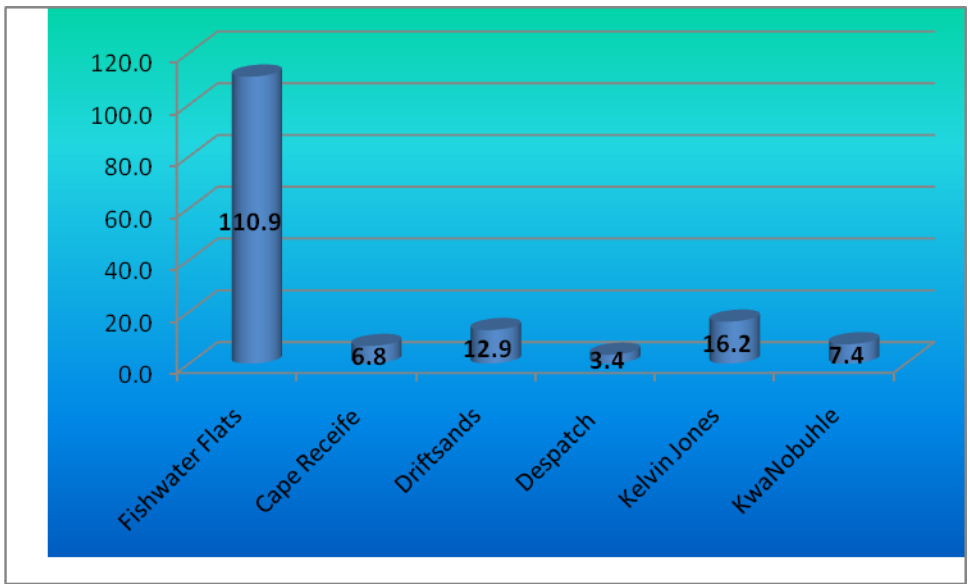
		Existing		2010		2015		2020
Pipe Line Costing								
Description	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**	**Km**	**Amount**
Jagtvlakte			12.2	R 24 258 197	1.7	R 5 564 805	4.4	R 21 804 656
Sub - Total	**0**	**R 0**	**12**	**R 24 258 197**	**2**	**R 5 564 805**	**4**	**R 21 804 656**
Pump Station								
Description								
Jagtvlakte			3	R 793 393	1	R 66 116		
Sub - Total		**R 0**		**R 793 393**		**R 66 116**		**R 0**
Total		**R 0**		**R 25 051 590**		**R 5 630 921**		**R 21 804 656**

This is a proposed development area and will form part of the NMBM's low cost housing programme. Effluent flow will drain directly to the Kelvin Jones WWTW. There is no town planning layout for this area as yet and development scenarios were obtained from the local spatial development framework.

8. WASTE WATER TREATMENT WORKS

The NMBM appointed various Civil Engineering Consultants to investigate each of the existing waste water treatment works (WWTW). The master plan does not deal with the detail of the operations and physical condition of the WWTW – but focuses more on the capacities and existing and future requirements at the respective works.

Average daily flow Ml/day at the NMBM WWTW's (2008)



The current (2008) effluent flow draining to all the WWTW in the NMBM cumulates to around 157 Ml/day, of which 111 Ml/day is treated at Fish Water Flats, 16 Ml/day at Kelvin Jones (Uitenhage) and 13 Ml/day at Driftsands. All the other works have flows less than 10 Ml/day.

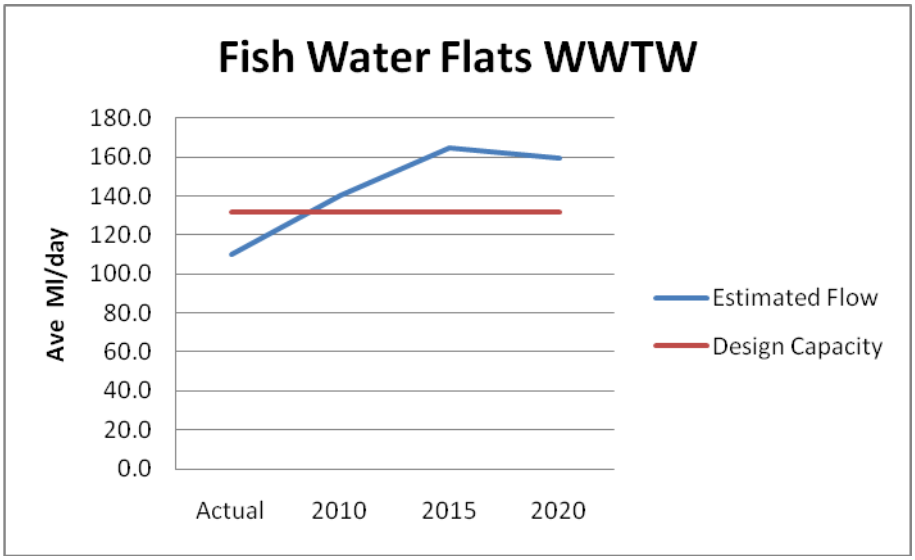
The effluent flow in the NMBM for the year 2020 is estimated at over 400 Ml/day ADWF, an increase of more than 250% over current volumes. Additional capacity of over 200 Ml/day ADWF is thus required to be provided for over the next 10 years. The lead time to implement augmentation of a WWTW would be in

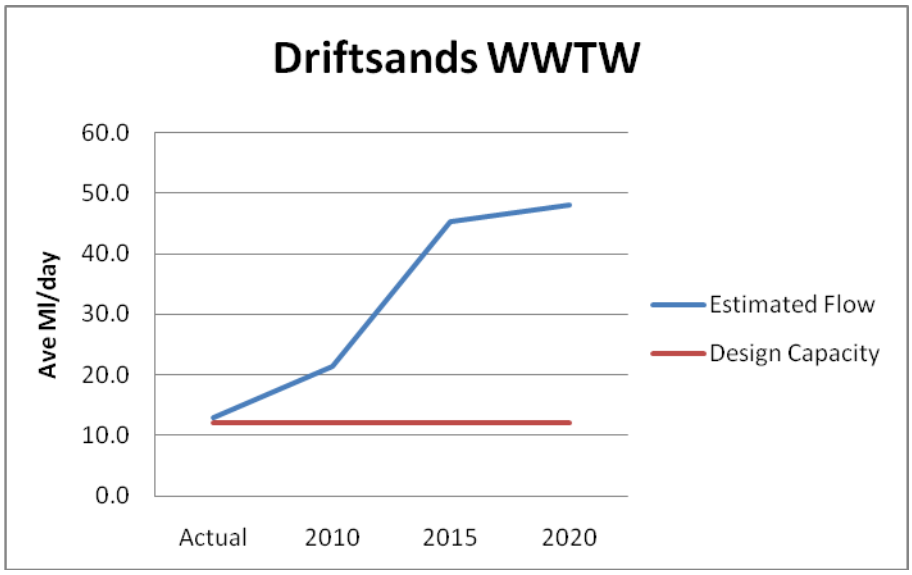
approximately 2 years from the date of the appointment of a Consulting Engineer to the start of construction. Construction periods would vary, but should not take longer than 2 years in general.

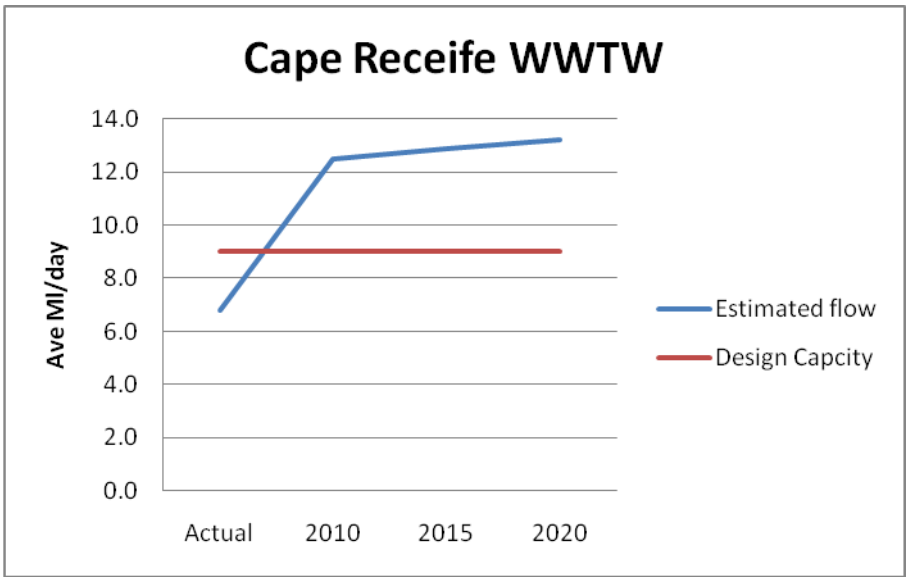
As a result of the above discussion, it can be assumed that planning needs to commence on almost all the WWTW, within the next year (2010). The exceptions are Despatch and the proposed Draaifontein and Bushy Park WWTW.

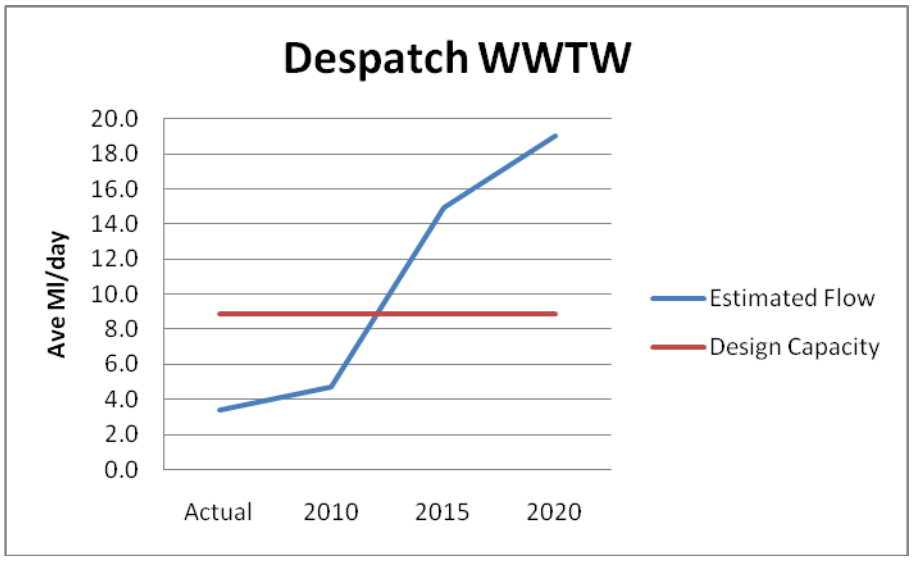
The diagrams below illustrate graphically the Design Capacity, which is the current operating capacity, of the various WWTW vs. the Estimated Flow.

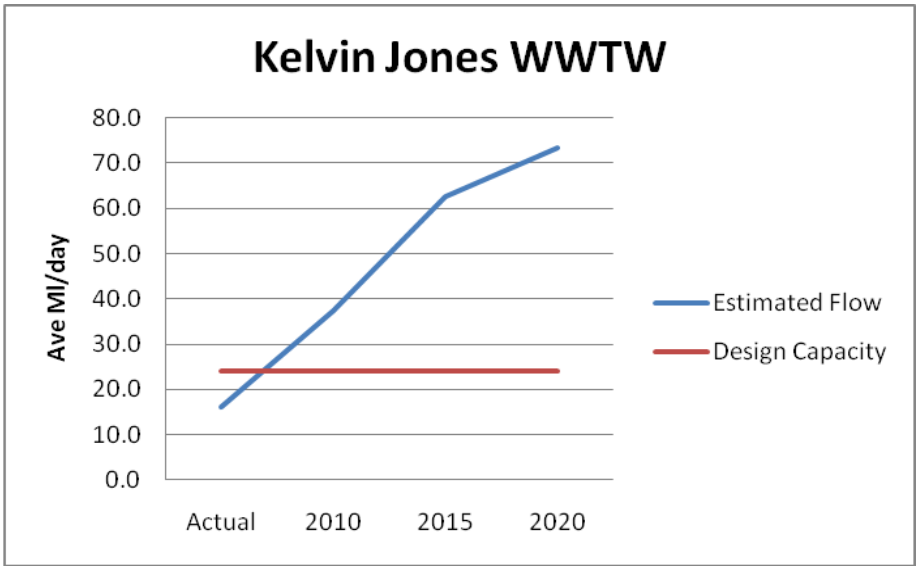
The WWTW Augmentation Schedule below is a guide to illustrate the upgrading time frames necessary to meet the calculated future demand. This schedule needs to be revised once the investigations at the various WWTW are complete.

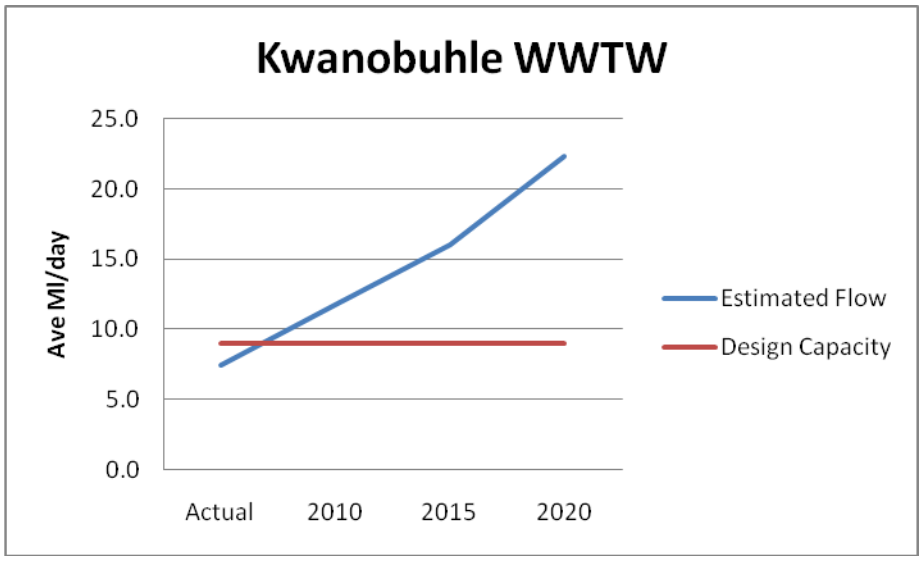



Driftsands WWTW
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ave Ml/day
Actual
2010
2015
2020
Estimated Flow
Design Capacity


Cape Receife WWTW
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Ave Ml/day
Actual
2010
2015
2020
Estimated flow
Design Capcity


Despatch WWTW
Ave Ml/day
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Actual
2010
2015
2020
Estimated Flow
Design Capacity


Kelvin Jones WWTW
Ave Ml/day
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Actual
2010
2015
2020
Estimated Flow
Design Capacity



Waste Water Treatment Works Augmentation Schedule and costing

WWTW	Current Designed Capacity	Future 2020 Capacity	Additional capacity	Estimated Augmentation cost		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2010	2015	2020
						Planning						Construction								
Fish Water Flats	132	160	28	R 1 212 000 000	Planning															
					Construction														R 609 105 470	R 602 894 530
Cape Receife	9	13	4	R 58 000 000	Planning															
					Construction														R 58 000 000	
Driftsands	12	48	36	R 107 943 243	Planning															
					Construction														R 60 296 000	
Despatch	9	19	10	R 8 000 000	Planning															
					Construction															R 8 000 000
Kelvin Jones	24	73	49	R 172 400 000	Planning															
					Construction														R 76 150 000	R 96 250 000
Kwanobuhle	9	22	13	R 184 426 000	Planning															
Proposed WWTW					Construction														R 63 500 000	R 120 926 000
St Albans	0	22	22	R 66 146 844	Planning															
					Construction														R 66 146 844	
Draaifontein	0	39	39	R 116 592 960	Planning															
					Construction															R 116 592 960
Bushy Park	0	60	60	R 179 753 640	Planning															
					Construction															R 179 753 640
Coega(NMBMM only)	0	53	53	R 159 966 000	Planning															
					Construction														R 772 000 000	
			Total	R 2 265 228 687														R 0	R 1 705 198 314	R 1 124 417 130

9. PUMP STATIONS

There are 80 existing sewer pump stations located within the sewerage network, operated by the NMBM. The majority of the pump stations are small pump stations, lifting effluent from localised low lying areas into a nearby gravity collector sewer.

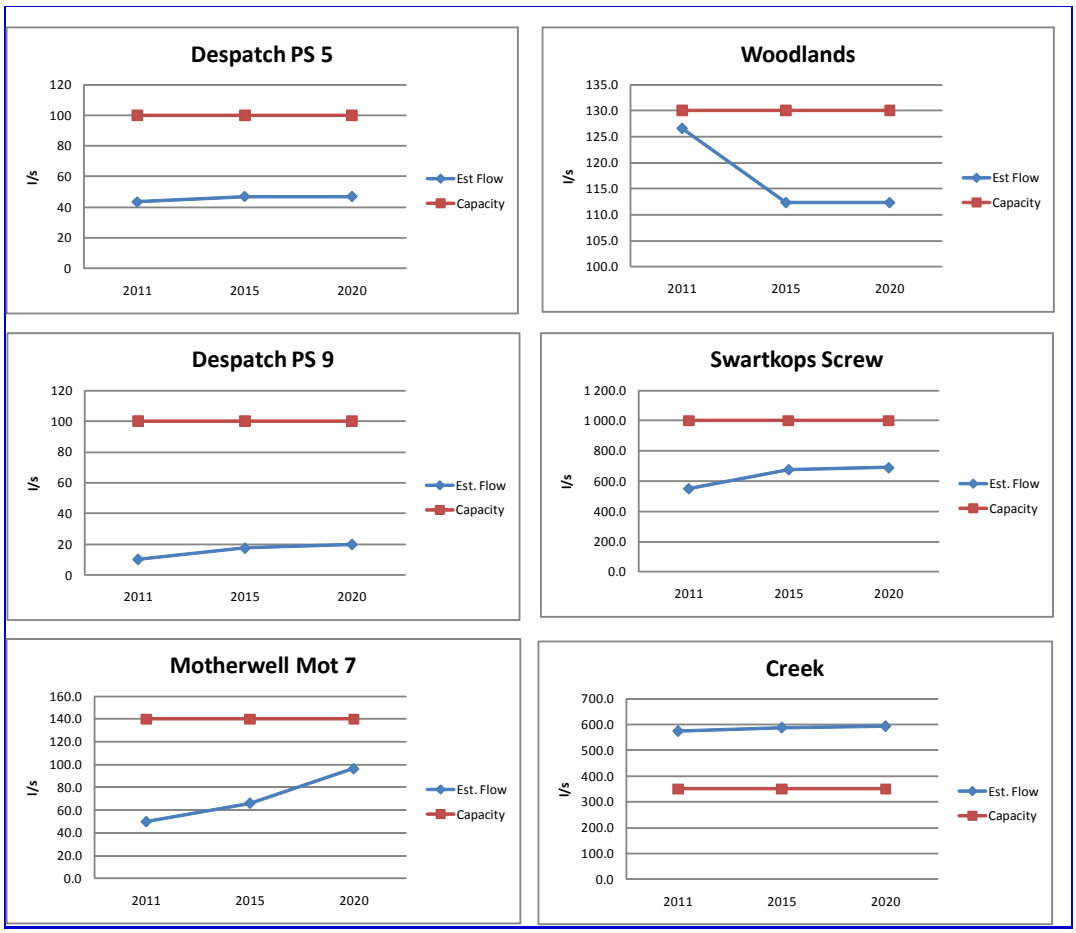
Catchment	No.	Station Name	Catchment	No.	Station Name
Chatty	44	Missionvale No.1	Markman	5	Bluewater ejector
Chatty		Bethelsdorp	Markman	6	Bluewater pumps
City	7	Boardwalk	Markman	9	Brighton Beach
City	10	Creek	Markman	61	Studebaker Street
City	21	Edgar Street	Markman	1	Aloes
City	24	Fleming Street	Motherwell	45	Motherwell No1
City	26	Hallack Road	Motherwell	46	Motherwell No2
City	30	Johnson Street	Motherwell	47	Motherwell No3
City	33	Kings Beach	Motherwell	48	Motherwell No4
City	41	Matlock Bridge	Motherwell	49	Motherwell No5
City	42	Mc Arthur Bath	Motherwell	50	Motherwell No6
City	43	Mill Park	Motherwell	51	Motherwell No7
City	52	Octagon	Paapenkuils	4	Bishops Way
City	55	Red Windmill	Paapenkuils	11	Deal Party
City	57	Rudolph Street	Paapenkuils	34	Kwaford
City	59	Strand Street	Paapenkuils	39	Malabar
City	60	Strang Street	Paapenkuils	68	Waterford Road
City	64	Swartkops Street	Swartkops	2	Baldwin Road 1
City	65	Valley Road	Swartkops	3	Baldwin Road 2
City	67	Voyle Street	Swartkops	35	Kwazakhele - Stage 7
Despatch	12	Despatch 1	Swartkops	53	Power Station
Despatch	13	Despatch 2	Swartkops	56	Redhouse
Despatch	14	Despatch 3	Swartkops	58	Schooner Crescent
Despatch	15	Despatch 4	Swartkops	66	Veeplaas
Despatch	16	Despatch 5	Swartkops		Chatty
Despatch	17	Despatch 7	Swartkops		Soweto - on - sea
Despatch	18	Despatch 8	Swartkops		Zwide 1
Despatch	19	Despatch 9	Swartkops		Zwide 2
Driftsands	8	Boundary Lane	Swarkops	63	Swartkops Stat. 4
Driftsands		Theescombe	Uitenhage	27	Hella
Driftsands		Walmer Area Q	Uitenhage	32	Kelvin
Lower Baakens	23	Essexvale	Uitenhage	37	Logistics Park
Lower Baakens	25	Fordyce Road	Uitenhage	38	Lower Magennis
Lower Baakens	40	Mangold Park	Uitenhage		Peter Searle
Lower Baakens	54	Prospect Road	Upper Baakens	31	Kabega Park
Lower Baakens	62	Summerstrand	Upper Baakens		Kuyga
Lower Baakens		Stella Londt	Upper Baakens	69	Woodlands
Lower Baakens		Wendy Ave			

The sewer master plan dealt with bulk lines, 200 mm diameter and larger and the pump stations linked to this bulk sewer system. Proposed new pump stations are also included in the catchment reports. Existing major pumps stations that are affected by proposed developments as per the sewer master plan are as follows:

- Despatch Pump station 5
- Despatch Pump station 9
- Motherwell Mot 7
- Creek Pump station
- Swartkops Screw Pump station
- Woodlands Pump station

Based on the 2010; 2015 and 2020 sewer master planning scenarios the predicted flows at the above existing pump stations are as indicated in the table and presented in the graphs below:

	Capacity	2010	2015	2020
Pump station	l/s	ADWF l/s	ADWF l/s	ADWF l/s
Despatch 5	100	43.4	47.1	47.1
Despatch 9	100	10.5	17.7	20.1
Motherwell No7	140	49.8	66.2	96.6
Creek	350	575.0	588.0	593.1
Screw	1000	550.1	677.9	690.4
Woodlands	130	126.6	112.4	112.4



The above analysis summary indicates that all the pump stations, with the exception of the Creek pump station, meet the flow requirements for the future planning horizons. In consultation with NMBM officials it was agreed that the actual measured flow at the Creek pump station is substantially lower than the calculated flow analysis for the future scenarios and that their interpretation is that no augmentation is currently needed.

It is thus determined that no augmentation is required for the pump stations for the 2020 planning horizon.

It should however be noted that in order to maintain the existing capacity at the pump stations, major repair and maintenance work is required. The NMBM appointed CA du Toit Consulting Engineers in 2010 to do a maintenance backlog report on all sewer pump stations. This report is attached for reference and also deals with the costing required for operating and maintaining the pump stations.

10. CONCLUSIONS

Generally the existing sewer network functions well and the conservative design principals adopted have served the NMBM well. The rapid development of the city over the last 5 years necessitates that additional that bulk sewerage infrastructure be installed as a matter of urgency to prevent bottlenecks and the resulting spillages.

The sewer master planning commenced in 2007, at the height of the economic boom in property development in the metro. Development at that stage was Developer driven, and the rapid rate of such development overtook the present planning horizons.

The sewer master plan aims to address this imbalance and will assist the NMBM, not only to guide future development, but also to improve service delivery. Detailed recommendations as contained in each of the attached comprehensive catchment reports are summarised blow.

11. RECOMMENDATIONS

This master plan document is a guideline document. Proposals and recommendations made, need to be investigated in more detail as development progresses. The sewer master plan is a dynamic document and should be constantly updated as and when new development takes place.

The NMBM Water and Sanitation sub directorates philosophy of "*planning should not stop", should* apply to this master plan. Planning of the recommended augmentation works should start urgently and budget provisions should be allocated over the next 10 years.

In recent years, cities have found it increasingly important to manage and control wastewater flows in their sewer reticulation systems. Normally, the first step in the process of gaining control of the drainage system is flow measurement. A

flow monitoring programme will be introduced, whereby 45 flow monitoring stations will be installed within the metro. Information obtained from these measuring stations will be used to refine the sewer master plan analysis.
High standards are applied for the design and construction of the sewer system and the same standards need to be applied to the maintenance of the system. Through the field investigations it has become evident that the system maintenance is a matter of concern. A detailed investigation of the operation and maintenance of the sewer system needs to be performed.

Another area of concern is the prevention of storm water ingress into the sewerage system. The ingress of rain water runoff into the sewer network has a major impact on the sewerage system, by drastically increasing the volume of effluent required to be treated. In rainy periods the amount of effluent can be as much as 100% more than that of dry periods.

A programme to prevent illegal connections into the sewerage network needs to be implemented urgently. The proposal is that a pilot study be conducted to determine the extent of the problem and to recommend practical solutions. Internationally cities have reduced wet weather flows by as much as 50% when such wet weather programmes have been introduced.

12. ACKNOWLEDGEMENTS

This master plan has been compiled and developed by the contributions of many. The main contribution has been from the staff of the Nelson Mandela Bay Metro Municipality, in particular we are indebted to Mr. B Martin, Miss. A Muthayan, Mr E. Julyan and Mr. S Beattie for their contributions.

The master plan document is likely to require updating at a future stage. Comments and suggestions from readers will be most welcome. Communications should be directed to: Mr. A. Crouse at cabitech@mweb.co.za or Mr A J White at tony@iliso.com.