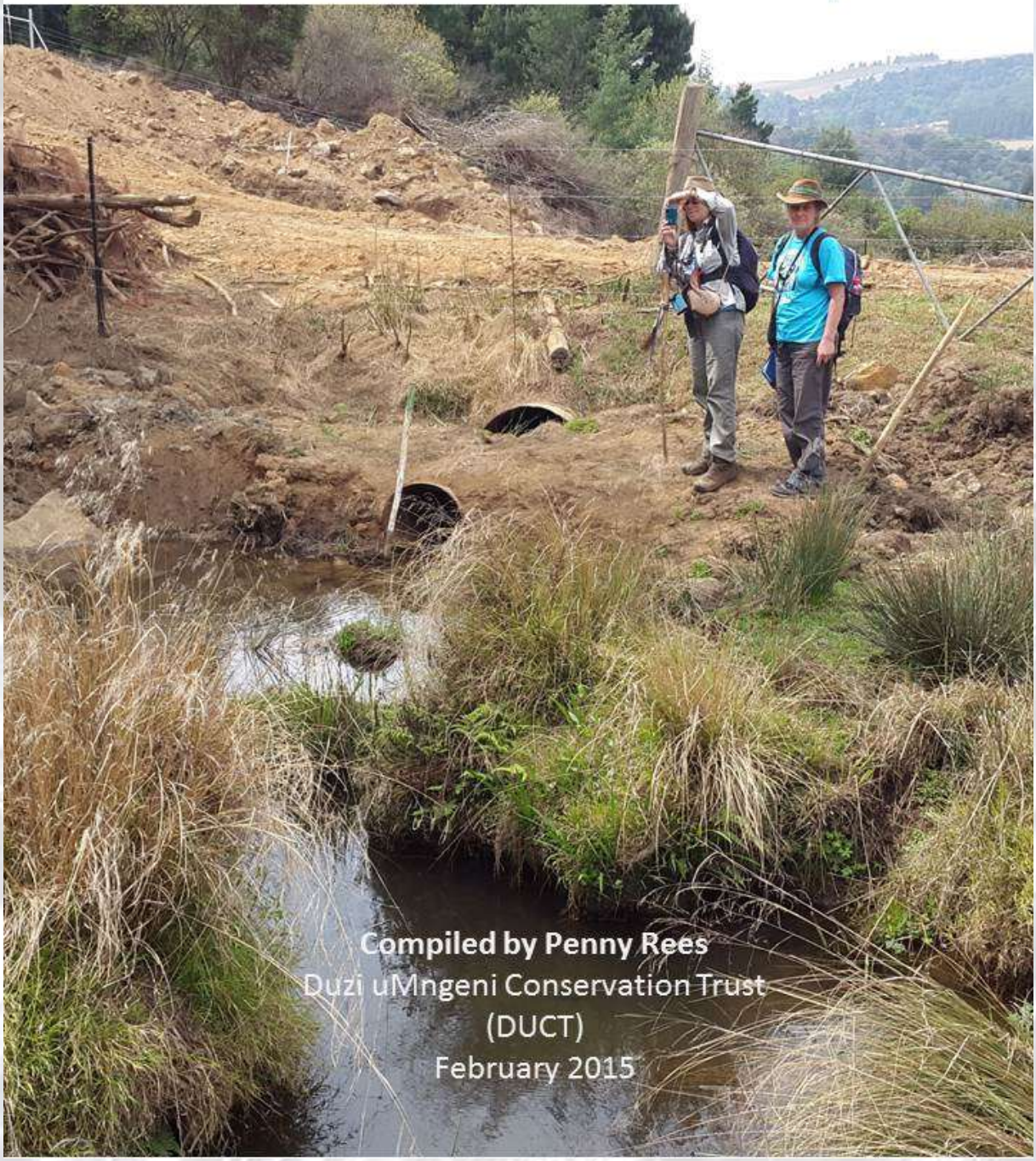
Mpofana River Walk Report

23rd to 25th September 2014



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(DUCT)
February 2015

Background

The Mpofana River is referred to as a "*receiving stream*" as it is part of the Mooi Mgeni Transfer Scheme (MMTS) which transfers water into the uMngeni River catchment the Mooi River which is part of the Tugela catchment. This is to ensure a constant supply of water to over five million downstream users as far away as Durban.

I approached Mr Alistair Hunter from Umgeni Water for assistance with information pertaining to the history of the MMTS as he conducted an in depth study in 2009 on the fluvial geomorphology monitoring of the receiving streams. He was kind enough to email me additional information and with his permission I have included his text in this background as follows (in bold):

In 1983, during a drought that affected water supply to the eThekwini Metropolitan Municipality and the Msunduzi Municipality, the Department of Water Affairs and Forestry (DWAF) constructed the Mearns Emergency Transfer Scheme. The Mearns Emergency Transfer Scheme enabled the transfer of raw water from the Mooi River into the Mgeni catchment. The scheme consisted of a 3m high weir, a pump station on the Mooi River (a tributary of the uThukela River), and a steel pipeline. The steel pipeline is divided into two sections: the first section is 1.4m in diameter and 13.3km in length, and the second then divides into two 0.9m diameter steel gravity pipes, 8.3km in length (Umgeni Water, 1996). The pipeline outfall is located on the Mpofana stream close to Balgowan). The Mpofana stream is a tributary of the Mgeni River, upstream of Midmar Dam. The scheme was limited due to the following:

- ***The supply of water from the donor system was limited by the volume impounded, and***
- ***A maximum of 1.6 m3/s could be transferred, as greater flow rates inundated sections of stream banks, thus limiting access by landowners (Henderson, 1995: a).***

During 1994, the Mgeni River system was the subject of a water supply study undertaken by consulting engineers, BKS, who provided water resource development plans aimed at ensuring water supply to the eThekwini Metropolitan and Msunduzi Municipalities until 2025 (Umgeni Water, 1996). This study concluded that the most feasible option to augmenting the water supply and increase security of supply to Midmar Dam was the upgrading of the Mearns Emergency Transfer Scheme. The upgrade consisted of the construction of a dam at the existing Mooi River weir site, utilising the existing pumps and pipeline infrastructure and the purchasing by DWAF, of the servitude along the receiving streams, which would allow the increased volume from the donor supply (Huggins, et al., 2002). The Mearns Emergency Transfer Scheme upgrade became known as the Mooi-Mgeni Interbasin Transfer Scheme Phase 1 (MMTS-1).

In the planning for the upgrade, DWAF and Umgeni Water commissioned several studies to consider the impacts of the proposed upgrade of MMTS-1 on

the geomorphology of the receiving streams. The studies made recommendations, which were incorporated into the Environmental Management Plan (EMP) as per requirements of the Environmental Conservation Act (ECA) (73 of 1989). This EMP formed the framework for the implementation of a monitoring programme to monitor change in the geomorphology of the receiving streams. The Mpofana stream is a relatively small stream that drains predominantly into extensive agricultural land, and is considered a minor tributary in the Mgeni River catchment. The total natural length of the receiving stream is 39.9 km (Huggins, et al., 2002), which includes the Lions River reach, which feeds into the Mgeni upstream of Midmar dam (Figure 1.1) (Hunter., 2009).

From the outfall, the water has flowed and eroded its way down the Mpofana to its confluence with the Lions River near Caversham Mill and thence on to the uMngeni River just upstream of Midmar Dam.

As mentioned above, some research was previously conducted in order to glean an idea of how the increased amounts of water would impact the receiving stream. Of particular concern of landowners along the Mpofana, is that the increased flows, almost simulating constant flood conditions on the small river, would increase erosion of the banks. This will change the ecology, health and route of the river and the resultant silt could end up in Midmar Dam, in addition to impacts to landowners along the river such as the flooding of their causeways across the river.

These concerns seem to have become a reality. We have already seen the result of the erosion during previous river walks: in 2012, walking along the uMngeni River floodplain, despite a singular lack of recent rain, we were stunned at seeing a chocolate brown Lions River pouring silt into the uMngeni just 3 kilometres upstream of Midmar dam. It was then that we began discussing the possibility of walking the tributaries in order to see where impacts originate. Eighteen months after the uMngeni Walk, Preven Chetty and I set off to walk the Lions River – and saw once again the chocolate brown waters, this time being carried by the Mpofana into the Lions at the confluence of the two rivers.

And so of course the next logical step was to walk the Mpofana to see where the silt was originating – was the siltation due to soil erosion from poor land care / agricultural practices, the Mooi uMngeni Transfer Scheme or something else? Was it fate, coincidence or just the cogs of the universe turning that found us strolling, wading and hacking our way down the Mpofana during the time that there had been no transfer of water for many months, and the Mpofana was thus at natural levels for the time of year.

This was due to Phase 2 of the MMTS which includes construction of the new Springrove Dam on the Mooi River (now complete) and the installation of a larger outfall point and a larger transfer pipeline (4.5 cumecs / second) in order to increase the amount of water transferred from Springrove / Mooi River to the uMngeni River. Whilst the new pipeline and outfall were under construction, transfers from the Mooi River were halted, hence the Mpofana's "natural" September flows.

Thus, on the 23rd September 2014, Moraig Peden, Pandora Long, Preven Chetty, Siyabonga Ndlovu and I set off from the source of the Mpofana River, on our 21

kilometre walk along the course of the river, arriving at its confluence with the Lions River on the afternoon of the 25th September 2014.

At all times we stayed beside or in the river, in order never to lose sight of it. All impacts were recorded by GPS, dictaphone and photograph and Mini SASS river health assessment tests were done as often as possible. This report is the record of these observations.

Reference to left or right bank: a very un-technical, easy to understand direction, especially considering the meanderings of the river whose banks can be on all four of the cardinal points umpteen times in the space of a kilometre! Left bank refers to the left bank of the river as if going downstream, and right bank refers to the right bank as if going downstream.

Acknowledgements

Our thanks to:

- N3TC toll concession for making the funds available to walk the Mpofana River.
- Yvonne Thompson of Caversham Hall for the stupendous accommodation, meals and company
- Balgowan Conservancy for all the planning assistance
- Nikki Brighton for ensuring that the blog is posted each night
- All the landowners along the Mpofana for their participation and passion
- Alistair Hunter for the information on the MMTS
- Peter Thomson, Chairman of the Upper uMngeni Catchment Management Forum who so kindly proof read this report for me

I'd also like to thank my team: Pandora, Preven, Moraig and our long suffering support crew member John Fourie who always has a quick joke and a smile and who will always find us at the end of the day – or at lunch time for a water resupply (or a donut delivery!!!!!). Its always a huge comfort to know that you are out there John, not far away in case of an emergency. Thank you.

Please feel free to use the information contained herein – we only ask that you credit the DUCT Mayday for Rivers Team and quote the report: *DUCT Mpofana River Walk Report, December 2014; P.S Rees (author)*

Penny Rees
February 2015

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1 Area description

GPS Co-Ordinates
Start: -29.349026
30.015174
Finish: -29.414265
20.096017

Altitude drop
352m: 1,501 to 1,149 altitude

General Description
The source of the Mpofana is situated in the KwaZulu-Natal Midlands adjacent to the village of Nottingham Road. The main road leading from Nottingham Road to the N3 highway lies on a ridge which is the watershed of the Mpofana, resulting in The Junction and Gowrie Estate being situated in the Mpofana's source area. The actual source could be any one of over eleven different springs and seeps situated in the crescent of hills that wrap around a small plateau on which Gowrie Estate lies. Some of these seeps seem to be fed with runoff from The Junction and the main road's storm water systems

The plateau apparently originally comprised a mass of wetlands fed by all these streams, however the streams were dammed decades ago and there are now 7 large and small earthen walled dams across three distinct water courses with long narrow wetlands extending between some of the dams. The property was for many decades a dairy farm, which now operates on a drastically reduced scale as a result of the sub division of the land to create a golf course and housing estate, with some of the houses constructed on the operational part of the dairy farm in order to provide the owners with pastoral surroundings.

Top: Depression in centre of photo hides spring chosen as source for Mpofana Walk
Upper Centre: Spring nestled in the hillside depression
Lower Centre: Home in the Residential / Dairy farm development
Bottom: Watering the astro-turf putting area at the Golf Course clubhouse

The stream we chose as a starting point begins life as a tiny seep on a hillside blanketed in natural grasslands which rapidly becomes a small stream which after a mere 500 metres suddenly dries up due to an on-stream dam that does not release any water. Further downstream, a wetland fed by other streams revives the watercourse which after a few more hundred metres is farther impacted by an additional dam and part of the construction site for the new pipeline of the Mooi uMngeni Transfer Scheme. In order to construct the pipeline, the Mpofana is channelled through a pipe suspended temporarily across the new pipeline whilst the latter is being constructed.

Prior to dropping off this small plateau the water in the stream disappeared once again leaving us to find and follow the dry water course smothered in pine needles. The rocks of a dry cascade on the plateau edge reminded us how beautiful this place would have been with a flow of water.

At the foot of the plateau, the stream is rejuvenated by a tributary that comes through the abovementioned golf course, and for the next +-18 kilometres the Mpofana alternates between shallow and fast flows burbling over black dolerite rocks; high vertical banks channelling a deep river lazily meandering across flood plains and long wide wetlands spread out across the flatlands. There is a small waterfall at another drop off at a second plateau and a small gorge where the river has carved its way down through the bedrock before reaching the Lions River.

The journey takes the Mpofana past and through small residential properties, guest houses, small holdings, commercial livestock farms (sheep, cattle, poultry and equine) and timber plantations, before the Mpofana meets with the Lions River a couple of hundred metres downstream of Caversham Mill, approximately 13 kilometres north west of Howick and Midmar Dam as the crow flies.

Top: Wetland on the housing estate
Middle: Dry cascade downstream of housing estate, golf course & timber plantation
Bottom: Rejuvenated stream

On the upper reaches of the Mpofana there are few areas with intact, natural vegetation on the river banks, whilst the river itself has very low water levels, with predominantly clear water and a silt free river bed where every rock on the river bed is visible. As we moved downstream the last few kilometres lifted our spirits. Incoming water from various tributaries resulted in a stronger stream of flowing water. Not only were the buffer areas intact and blanketed in indigenous vegetation, but this even extended inland away from the river in some areas.

The norm here would be that as the riparian area (the river banks) improves, so the river health will improve – we have seen this so often on our river walks. However, there is always an exception to the rule, and the Mpofana is that exception. Despite an increase in water quantity as well as intact riparian areas, river health declined downstream of the Mooi uMngeni Transfer outfall. All signs point to the cause as being the constant layer of silt on the river bed as well as on all the submerged rocks downstream of the outfall. (Appendix 1)

2 Wild Animals

In the few areas with indigenous bush, the prevalence of bird calls increased dramatically. The following were either seen or heard or their sign was noted during the walk:

Animals
- Antbear – diggings
- Bushbuck – visual
- Caracal – scats
- Duiker – visual
- Gerbil (Tatera spp) - burrows
- Jackal - scats
- Otter – midden and spoor
- Porcupine – scats & quills
- Reedbuck – visual of males and females, spoor
- Scrub Hare or Natal Red Rock Rabbit (Lepus saxatilis or Pronolagus crassicaudatus) – visual and droppings
- Water Mongoose – spoor and scats

Birds
- Barn Owl
- Crowned Cranes
- Guinea Fowl
- Long Crested Eagle

Top: Impacted riparian area – after clearing of bramble and wattle
Bottom: Indigenous riparian area

3 Vegetation

Due to the agricultural and residential use along the length of the river for many decades, there are few sections along the Mpofana River that still have indigenous vegetation.

By law, all water courses and wetlands should have a buffer zone in which disturbance to the river banks is prohibited for a distance of 32 metres from the edge of the river (and 20 metres for wetlands). This is due to the fact that the two ecosystems – the river and the adjacent land known as the riparian zone, do not function in isolation of each other as impacts on one can and often do affect the other. Often, as the riparian area improves, so the health of the actual river will improve.

Indigenous habitats along the Mpofana comprise Mistbelt grasslands, thicket, wetland and some Valley Bushveld shrubs and trees. There were only two reasonably intact riparian areas on the Mpofana as follows:

Area 1: Source area

Length: 700m
Vegetation:
Both banks: 1st 500 metres - predominantly indigenous grassland with small wetland.
Last 200 metres – grassland with 5% indigenous bush, the latter including Leucocidea (Ouhout), Celtis africana (White Stinkwood), Maytenus (Fire thorn) and Scadoxus (Natal Paint Brush). Bramble is unfortunately invading the right bank of the last 100 metres

Area 2: Lower reaches upstream of confluence

Length: 6.4km (3.2km per bank)
Vegetation:
Both banks: a mixture of indigenous grassland, thicket & forest

Top: Area 1 - Intact grassland at source. Note fenced off water course
Middle: Area 1 - lower reaches of source area. Note bramble in foreground
Bottom: Area 2 - Indigenous grassland and thicket upstream of confluence

In addition, there are a few areas with small amounts of indigenous vegetation and / or where some clearing of invasive plants have taken place. These were as follows:

Area 3: 2.5km from source as the crow flies
Length: 200 metres
Vegetation
Right bank: 80% Indigenous grass and bush
Left bank: +-5% indigenous bush

Area 4: 600 metres downstream of Area 3
Length: 1km (both banks)
Vegetation
Right bank: 400 metres - 95% indigenous grassland & wetland
Left bank: 600 metres - 95% indigenous bush, grassland and wetland

Area 5: Downstream of Zenzanani Village
Length: 1.4 km (both banks @700m)
Vegetation
Left Bank: 80% grassland and indigenous bush. Wattle trees on edge of bank have been recently ring barked and treated with herbicide
Right bank: 40% grassland, edge of river banks lined with wattle trees, most of which have been ring barked and treated with herbicide. Kikuyu pastures intruding into buffer

Top: Area 3
Middle: Area 4
Bottom: Area 5

Area 6: 500metres downstream of Area 5
Length: 800 metres (both banks)
Vegetation
Right bank: 20% indigenous grasses. Kikuyu invading into buffer & ring barked wattles on river bank
Left bank: 5% indigenous grasses, remaining area under felled wattle saplings

Area 7: Immediately upstream of Beaconsvlei Dam inlet
Length: 2kilometres (both banks)
Vegetation: Wetland area.
Left bank: 100% wetland
Right bank: 90% wetland. Road and bramble situated in buffer zone

Area 8: 400 metres downstream of Beaconsvlei Dam wall
Length: 500m (left bank)
Vegetation:
Right bank: Pasture
Left bank: Indigenous grassed hillside

Top: Area 6
Middle: Area 7
Bottom: Area 8

Area 9: Immediately upstream of the Mearns outlet
Length: 1km (both banks)
Vegetation
Both banks: Floodplain – 95% indigenous. 5% bramble

Area 10: Immediately downstream of Mearns outfall
Length: 600m (left bank)
Vegetation
Right bank: grassland in poplar plantation
Left bank: floodplain 100% indigenous grassland

Area 11: 1.6km downstream of Mearns outlet
Length: 300m (left bank)
Vegetation:
Right bank: garden lawn
Left bank: 100% indigenous bush

Top: Area 9
Middle: Area 10
Bottom: Area 11

List of indigenous plants recorded

This list is by no means a complete list of all species occurring along the Mpofana

Acacia ataxacantha	Fire Thorn
Acacia siberiana	Paperbark acacia
Asparagus spp	Wild asparagus
Aster bakeranus	Star flower
Buddleja	Wild Sage
Canthium inerme	Turkey Berry
Celtis africana	White stinkwood
Crinum spp	Crinum Lilly
Combretum	River Willow
Cussonia	Cabbage Tree
Cyathea dregei	Tree Fern
Dalbergia armata	Thorny Flat Bean
Dias cotinifolia	Pom Pom tree
Dietes spp	Wild Iris
Grewia	Cross Berry
Halleria	Tree Fuschia
Kniphoifia	Red Hot Poker
Leucocidia	Ouhout
Maytenus	Fire Thorn
Phragmites	Reeds
Podocarpus	Yellowwood
Ptaeroxylon obliquum	Sneeze Wood
Searsia (Rhus) dentate	Nana Berry
Scadoxus	Natal Paintbrush
Widdringtonia	Wild Erica bush
Zanthoxylum capense	Knobwood

Isolated clumps of mixed indigenous bush included some of the above plus other unidentified species

4 Wetlands

Wetlands are natures water storage and purification works and they are an integral part of natural systems. They slow down the flow of water, thus providing flood prevention; they supply downstream areas with water due to the fact that they store water and slowly release it; wetland plants remove contaminants from water, thus "polishing" or purifying the water, and of course wetlands provide an extensive habitat for a large variety of birds, mammals and amphibians. Historically, wetlands were not seen in such a positive light, and farmers were encouraged to drain them in order to increase arable land acreage.

Although some of the larger wetlands on the plateau immediately below the source are naturally occurring, it is not always easy to ascertain whether wetlands along the Mpofana area are as a result of the construction of earth dams or not.

On the plateau immediately below the source spring where we began our walk, besides numerous small wetlands, there seem to be three main wetlands which all run parallel to each other in a roughly north west to south east direction. The third largest of these on the eastern side of the plateau was on the route we walked, and has all but dried up due to a dam wall that does not release any water into the stream.

The two largest wetlands lie approximately 500 metres apart, and they extend for between 1.5 and 2 kilometres in length. Earth dam walls were constructed across them in the historical past, and thus there are three dam walls on the south western wetland and two walls on the north eastern wetland. This has most likely resulted in reducing the size of the wetlands.

Besides the wetlands on the source plateau, there seem to be only three other naturally occurring wetlands on the Mpofana, both upstream of the Mearns Outfall. One drains towards the river near Zenzanani Village and the other is situated upstream of the Beaconsvlei Dam draining from beyond Michaelhouse School. Two additional wetlands are situated on the Mpofana in the headwaters of large constructed earth dams

Top: Historical Dam on Gowrie Golf Course, with Gowrie Village in background
Middle: Zenzanani Wetland - construction road for Springrove transfer pipe bisecting wetland
Bottom: Beaconsvlei Dam wetland

5 Negative Impacts

The majority of the negative impacts seen along the Mpofana are in fact illegal.

The place where the Mooi River water exits the pipeline and enters the Mpofana is known as the Outfall Point. During our walk down the Mpofana we realised that the Mpofana comprises two distinct areas – the area upstream and the area downstream of the outfall point, and there is a clear difference in the types of impact and the condition and health of the Mpofana upstream and downstream of the outfall point.

Upstream of the Mooi outfall point the main impacts are reduced flows; construction work for the installation of the Mooi uMngeni transfer pipe line; the Gowrie Housing Development and golf course. River banks are impacted by the removal of indigenous vegetation either physically or by the invasion of invasive plant species such as wattle and by erosion gullys where cattle access the river to drink. Apart from the immediate areas around these cattle points, there is a distinct lack of silt on the bed and rocks of the river, and the water is clear, indicating a lack of suspended solids.

Downstream of the Mooi outfall although the water remained clear, the river bed and rocks on the bed were often invisible under a thick layer of silt, whist the river banks showed distinct signs of scouring and erosion that was not evident upstream of the outfall. Damage to the riparian areas lessened with distance from the outfall and shortly before the confluence with the Lions River, a stretch of +-6 kilometres comprised mostly entirely natural vegetation on the banks.

Top: Reduced stream flow
Upper Middle: Pipeline construction
Lower Middle: Clear water above the Mooi outfall
Bottom: Silted rocks below the Mooi outfall

In-stream impacts

Extraction / Water Demand:

Upstream of outfall = reduced flows

The first water extraction point on the Mpofana is approximately 100 metres below the source spring on the stream. Water is also extracted for Gowrie Village from aquifers by means of borehole pumping – the previous maximum pumping yield of 20,000 litres per hour has dropped to 13,000 l/hr due to the consumption by Gowrie Village and the dairy farm lowering the aquifer level. According to Mr Duncan Price, manager of the dairy farm, the Gowrie village houses and farm consume 300,000 litres a day. This will be lowering the water table which in turn will be depriving the wetlands in the area of water resulting in smaller wetlands which as a result release less water into the stream. Additionally, the golf course is irrigated from an on stream dam at a rate of 100,000 litres per day. This latter is water that would otherwise have entered the Mpofana river.

The farm dams in the source area also release minimum amounts of water, lowering the stream level and in at least one case a dam is not releasing any water at all resulting in the river bed below the dam being dry. Of a further five dams on the Mpofana, two are releasing minimum amounts of water which exacerbates the reduced flows.

These impacts are made worse by timber planted in the buffer, often to the waters edge, water extraction pumps and extraction for the pipeline construction resulting in a dry watercourse.

Top: Dry stream below earth dam
Upper centre: Timber in stream bed
Lower Centre: Extraction pump
Bottom: Extraction from wetland

Finally, a small non-permanent irrigation furrow for subsistence vegetable farming, is the last of many extraction points all of which, combined with the lack of rainfall over the last few months, have caused the river level to be either non–existent in places or very low.

Downstream of outfall = increased flows

At the time of our walk, due to the new pipeline construction, no transfers were taking place from the Mooi River, and thus it was easy to see how the amount of water slowly increases downstream as water from tributaries enters the Mpofana and the number of dams and timber plantations become fewer. It was also easy to see the "high water level" indicating how much more water is usually in stream due to the transfer scheme.

Pump Stations

Domestic, commercial and agricultural water extraction pumps were observed on the Mpofana and these no doubt contribute to reduced flows.

Erosion

Elevated, unnaturally high levels of silt in a river blocks sunlight, which impacts negatively on aquatic plants and animals. Plants need sunlight to produce their food and silt levels block the visibility of aquatic creatures, effecting hunting and fleeing behaviour. Fish and many other aquatic insects have gills which can be clogged by silt. All this have a profound impact on the health of a river.

Top: Low flows upstream of Mooi outfall
Upper Middle: Improved flows downstream of Mooi outfall
Lower Middle: Localised erosion from cattle trampling
Bottom: Bank erosion from high flows of Mooi Outfall

Natural erosion takes place in the meandering incised river channels. Erosion from livestock accessing the river caused localised turbidity and siltation on the bed of the Mpofana , however river bank collapse from the abnormal constant high flows of the Mooi uMngeni Transfer Scheme is a far greater impact

Siltation of the Mpofana

The erosion of the Mpofana river banks has resulted in increased sediment loads in the river. At the time of the walk, the water level in the river was extremely low as the area had experienced a long dry winter which had not yet been broken by the summer rains. Additionally, there were no artificially high water levels from the Mooi outfall.

Siltation Upstream of outfall

Upstream of the Mooi outfall, apart from extremely localised cattle access points and the areas where the river meanders through level floodplains and the water is naturally turbid, there was little sign of suspended silt in the water which was consistently crystal clear to the extent that all the rocks on the river bed as well as the bed itself, were visible.

Siltation Downstream of outfall

Thirteen kilometres from its source, having meandered for +-2,5 kilometres across a floodplain, the Mpofana reaches the Mooi outfall which is situated at a right angle to the water course and is a mere 600 metres upstream of the end of the floodplain. The banks on the floodplain upstream of the outfall have vegetative cover and lack signs of excess erosion.

Top: (left) Turbid water downstream of outfall; (right) clear water upstream of outfall
Upper Middle: MMTS outfall point
Lower Middle: Pipeline construction
Bottom: Vegetated banks immediately upstream of outfall

Immediately opposite and downstream of the outfall however, the banks are clearly eroded, and it is evident that the river is eroding and changing course as the waters cut a straighter channel. Some of the meanders are such tight switchbacks that it seems highly possible that they will disappear.

Farther downstream of the outfall point we saw constant evidence of erosion that we had not seen upstream of the outfall: predominantly collapsed river banks with fences suspended over thin air and water and silt consistently smothering the river bed and submerged rocks. This was in contrast with the situation upstream of the outfall point, where the river bed and submerged rocks were visible for most of the +-13km.

Siltation - summary

Of four test sites upstream of the outfall site there was no silt visible at three sites and only a light concentration at the fourth. However downstream of the outfall point, there was a slightly elevated silt level at one site, and high levels at three sites.

There is no doubt in our minds that the erosion of the Mpofana banks has been accelerated by the waters of the transfer scheme.

Top: Eroded banks downstream of outfall
Upper Middle: Fence over eroded bank
Lower Middle: Typical silted river downstream of outfall
Bottom: Typical clear water upstream of outfall

As mentioned earlier, at the inception of Phase 1 of the scheme, attempts were made to monitor the impacts of the transferred water. This was done by placing metal stakes on the edge of the river bank. Unfortunately it seems as though most of these stakes have fallen into the river as the banks have eroded and collapsed – we only saw one stake along the river. Being unpainted, they are also difficult to spot.

The aforementioned burial ground site has resulted in a large area of earth being cleared of all vegetative cover which will wash into the river with hard rain and could collapse / wash away with the future increased flows.

Nutrification

Nutrification is the process whereby excess loads of nutrients enter a river. Sources include agricultural fertilisers, human and livestock faeces, industrial waste, insecticides and herbicides involving a variety of elements such as ammonia, nitrites, nitrates, phosphates, organic carbon and nitrogen. This can occur via effluent, incorrect application, dumping, leaks and spills.

Aquatic plants flourish in nutrient enriched water, however on the Mpofana only a few localised points were seen where livestock have access to the river and defecate in the water.

Upstream of outfall:
Algal blooms - 5 sites:
4 on livestock farms, 1 residential
Oxygen weed – 10 sites:
2 in dams, 2 near residential, 6 at livestock watering points
Pickerel Weed – 2 sites: dams
Downstream of outfall:
None noted

Top: Erosion monitoring peg (circled)
Upper Middle: Burial ground site
Lower Middle: Oxygen Weed & algal bloom
Bottom: Elevated level of silt

Aquatic Invasive Vegetation

Aquatic invasive vegetation flourishes in water with unnaturally high nutrient loads, and thus the presence of such plants is an indicator of elevated nutrient levels. Upstream of the outfall signs of nutrification were far more prevalent than downstream and the abovementioned Oxygen Weed indicated the presence of such increased nutrient levels

Additionally, the highly invasive Pickerel Weed was seen in the shallows at two dams

Riparian Buffer Zone

Riparian Buffer

The riparian buffer zone comprises 32 metres of the river bank extending outwards from the edge of the river (both banks). Rivers and the land beside them do not function as single entities, and impacts on one have a direct effect on the other. Thus if the buffer zone is in good condition, this will have positive impacts on the health of the adjacent river. It is for this reason that disturbance in the buffer zone is illegal.

Exemptions to this are historical activities such as pastures planted to the rivers edge.

The Mpofana is 20.5 kilometres long, resulting in a total of 41 kilometres of river bank of which:

22km are impacted (12km upstream of the outfall & 10km downstream)

19km are un-impacted (14km upstream of outfall & 5km downstream)

Top: Invasive Pickerel Weed
Upper Middle: Buffer (natural), with indigenous vegetation and stable river banks
Bottom Middle: Buffer (rehabilitated)
Bottom: Buffer choked by invasive Wattles, trampled by livestock, and with collapsing river banks

Terrestrial Invasive Alien Vegetation

Pine and Wattle trees are allelopathic - they release chemicals which change the composition of the soil. Therefore they dominate by harming or killing any other plant that grows under the tree.

Clumps of large invasive trees shade out the land and river, changing the water temperature and depositing excess detritus on the river bed all of which have negative impacts on the rivers health.

It was encouraging to see that the Balgowan Conservancy and some landowners have been clearing invasive plants in the 32 metre buffer. A total of 6 kilometres (both sides of the river for three km length) have been cleared of Bugweed, Wattle and some Bramble. Well done to all concerned.

The dominant invasive and or alien plant species along the Mpofana in the riparian buffer are:

- Wattles (self seeded) : +- 5.5 kilometres covering 100% of the 32 metre buffer need clearing
- Saw Tooth Oak: +- 1.2 kilometres planted into the buffer to within 5 metres of the waters edge
- Pine: +- one kilometre planted into the riparian buffer
- Bramble: difficult to quantify as much has been burnt, some sprayed and some frosted. Sprouting in many areas
- Bug weed: occasional patches. Hard to tell if they had been frosted or treated with herbicide

Other invasives observed are: Wandering Jew, Bug weed, Honey Locust, Syringa & Catsclaw

Appendix 2 contains maps and lists of recorded invasive and alien plants

Top: Ring barked Wattle
Upper Middle: Treated Bramble
Lower Middle: Self seeded Wattle in buffer
Bottom: Saw Tooth Oak planted in buffer

Construction

MMTS pipeline construction at river and wetland crossings. At these points, the meagre mitigation measures seen during the walk did not raise our hopes that enough care was being taken to minimise impacts on the Mpofana. Mpofana banks are extremely vulnerable to water or wind erosion at pipeline construction points due to insufficient remedial / protective cover on river banks exposed during construction.

Of concern is thus the potential lack of post pipeline construction rehabilitation and monitoring which could lead to silt loads entering the Mpofana in places where up to now there have been no siltation impacts. Additionally, the disturbed soils will be an ideal sprouting ground for invasive species such as wattle and bug weed.

The Gowrie housing estate at the source has thus far placed houses and gardens outside of the riparian buffer except when adjacent to the dams where gardens have been established to the waters edge

The following were observed inside the 32 metre buffer of the Mpofana:

Water extraction pump houses
Burial ground under construction
Residential Gardens
Historical Pastures (these are legal as they were in existence prior to legislation that established riparian buffer zones)
Haybale storage area
Rubbish Pit
MMTS pipe storage area inside wetland buffer
Roads: alongside wetland & on pipeline servitude

Top: Pipeline construction in buffer
Upper Middle: Pipeline construction in buffer
Lower Middle: Historical pastures in buffer
Bottom: Haybale storage in buffer

Erosion

Three types of river bank erosion were observed:
Gully erosion where livestock have access to the river for drinking purposes
Sheet erosion from overgrazing
River bank collapse from the abnormal high flows of the Mooi uMngeni Transfer Scheme

Drainage Ditches

Two historical wetland drainage ditches were noted, both large enough that we were unable to jump across them.

Sand Mining

None observed

Litter / Dumping

One rubbish pit approximately 10 metres from the river

Wetlands

The water consumption of the Gowrie Village and Golf course seems to have deprived the source wetlands of water leading to a reduction in their size and their capacity to hold and slowly release water into the Mpofana.

The remaining three natural wetlands that we observed were impacted as follows:
Wetland adjacent to Zenzanani Village: crossed by a a rock "causeway" road (pipeline servitude)
Wetland close to Zenzanani Village: part of the wetland buffer was levelled to stack pipe sections for the pipeline construction
Wetland upstream of Beaconsvlei Dam: Left bank: timber planted into buffer; right bank: cattle trampling in wetland, road in buffer. Historically either this wetland extended far to the south or there was a second wetland which is now drained by a large drainage ditch that feeds the water into the existing wetland situated to the north.

Top: Sheet erosion
Upper Middle: Wetland Drainage Ditch
Lower Middle: Rubbish Pit in buffer
Bottom: Cattle trampling of wetland buffer

6 River Health and Water Quality

One needs to keep in mind the difference between water quality and river health. Water quality is defined as "*to describe the physical, chemical, biological and aesthetic properties of water that determines its fitness for a variety of uses and for the protection of the health and integrity of aquatic systems*" (SA Water Quality Guidelines). Water quality can be determined by sending a sample of river water to a laboratory for testing

River health on the other hand, comprises a far broader range taking in the entire ecological system of the river and interconnected land; of not only the water, but also the physical river (river bed and river banks) as well as flora and fauna communities in the river and occurring on the banks. The level of River Health can obtained by a test called Mini SASS which can be done by laymen.

During the walk, all impacts were recorded and photographed, and regular Mini SASS, Methylene Blue, Turbidity & Index of Habitat Integrity (IHI) tests were undertaken. Mini SASS is a general indicator of river health, Meth Blue indicates levels of bacterial infection & oxygen, turbidity indicates levels of suspended solids in the water and IHI indicates the percentage of disturbance to river and buffer.

Mini SASS

Mini SASS is a very simple and enjoyable way of determining the health of the river, and the results give an overall picture of river health that is often missed by laboratory tests, for the pure and simple reason that a lab test, if taken say a week after a chemical contamination, may not reveal any chemicals as they could have been washed downstream. The Mini SASS however gives an overall picture of the rivers health at any time as for example, a week after the chemical spill, although the chemicals have washed away, their impacts / damage will still be in evidence. With Mini SASS, aquatic insects are caught, identified and classed according to tolerance levels of pollution and a simple scoring method results in an accurate picture of river health.

Mini SASS scores are broken down as follows:
Under 5.1 = Seriously / critically modified, very poor condition
5.1 – 6.1 = Largely modified / poor condition
6.1 – 6.8 = Moderately modified / fair condition
6.8 – 7.9 = Largely Natural / few modification GOOD condition
+7.9 = Unmodified / Natural condition

The Mpofana River conditions are not always suitable for Mini SASS due to the prevalence of some deep pools and river channels resulting in a lack of rocks and riffles needed to Mini SASS and we were thus able to carry out only eight Mini SASS tests, the results of which are as follows:

- *Largely modified / poor condition:* four sites (scoring 6, 5.9, 6.2, 5.4)
- *Moderately modified / fair condition:* three sites (all scoring 6.3)
- *Largely Natural / few modification GOOD condition* one site (scoring 7.1)

The highest score on the Mpofana was upstream of the outfall where one site was largely natural / few modifications (good condition); two sites were moderately modified (fair condition) and the remaining site was largely modified (poor condition); Downstream of the outfall, two sites were moderately modified (fair condition) and

three sites were largely modified (poor condition).
Appendix 3 shows the locations of the Mini SASS test sites

Tuesday 23 September 2014:

Site 1: Meth Blue

Site description: Approximately 800m from source
Stream @ headwaters of dam – algal bloom in stream and shallows of dam
Upstream of MMTS outfall.
Surrounding Land use: Dairy farm / residential estate
Surrounding Vegetation: Kikuyu pastures
Index of Habitat Integrity: 60% - Seriously impacted habitat
Meth Blue Score: sample faded within three days, indicating a level of around 60% bacteria (and conversely 40% oxygen - the bacteria "eat" the oxygen).
River Health negatively impacted due to:
Excessively high nutrient loads in the Mpofana due to cattle accessibility to the dam and stream, at which times their faeces are creating the over nutrification problems. The tell-tale algal bloom observed in the water is additional evidence of the over nutrification.

Site 2: Mini SASS

Site description: Approximately 3 kilometres from source.
Downstream of timber plantations.
Upstream of MMTS outfall.
Surrounding Land use: Left bank: timber into buffer edge; right bank grazed veld grass.
Surrounding Vegetation: Buffer reasonably intact and indigenous
Invasive clearing has been undertaken immediately upstream of test site
Index of Habitat Integrity: 28% - moderately impacted
Turbidity: 100% clear, no suspended solids - acceptable
Siltation on river bed and rocks: None - acceptable
Mini SASS Score: 6.3 Moderately modified, fair condition
River Health negatively impacted due to:

- Lack of water – upstream extraction & timber planted in watercourse has led to two sections drying out and a third section reduced to a trickle
- Timber upstream of test site
- Timber planted into buffer on one bank
- Bramble upstream of test site
- Signs of occasional cattle access to Mpofana at test site

Positive Impacts:

- Upstream ring barking of large invasive wattle trees as well as clearing of smaller wattle trees allowing regeneration of indigenous grasses and sunlight penetration
- Regeneration of indigenous vegetation for +-200 metres along the buffer
- Approximately 50% of the buffer comprising indigenous vegetation

Site 3: Mini SASS & Meth Blue

Site description: Approximately 6.5km from source and +-1.15km downstream of dam restricting flows.
Upstream of MMTS outfall.
Surrounding Land use: Abandoned & self-seeded Wattle
Surrounding Vegetation: 95% Wattle; 4% Bug Weed; 1% Grass
Index of Habitat Integrity: 45% - Moderately impacted
Turbidity: 100% clear, no suspended solids – acceptable
Siltation on river bed and rocks: light concentration
Mini SASS Score: 6 Largely Modified, poor condition
Meth Blue Score: sample remained un-faded after 5 days indicating a lack of bacteria
River Health negatively impacted due to:

- Upstream dam not releasing sufficient water
- 95% of river buffer up to waters edge under wattle with 5% bugweed
- Light concentration of siltation on river bed & rocks as well as detritus from wattles (leaves, bark etc) which changes the [pH (acidity) of the water

Positive Impacts: None

Wednesday 24 September 2014:

Site 4: Turbidity

Site description: Approximately 8.5km from source.
River channel on an ex-wetland / floodplain, naturally deeply eroded and canalised. Upstream of MMTS outfall.
Surrounding Land use: Cattle pastures
Surrounding Vegetation: Grazed kikuyu and veld grass. Occasional Wattle – all ring barked

Index of Habitat Integrity: 28% Moderately impacted
Turbidity: Very poor visibility due to a high concentration of suspended solids
River Health negatively impacted due to the following impacts immediately upstream:

- Low level bridge forming small cascade which is eroding downstream side of the bridge
- Large quarry adjacent to road +-700m uphill of river
- Intense cattle and sheep trampling of river banks
- Road in buffer zone (+-5metres from river bank)

Positive Impacts: None

Site 5: Mini SASS
Site description: Approximately 9km from source.
Downstream end of floodplain channel.
Upstream of MMTS outfall.
Surrounding Land use: Livestock grazed wetland / floodplain, young timber
Surrounding Vegetation: Right bank natural wetland plants & veld grasses; left bank +-10m of riparian grass, balance of buffer is cleared wattle with minimal veld grass
Index of Habitat Integrity: 10% Little Impact
Turbidity: Clear on arrival. 75% post Mini SASS
Siltation on river bed and rocks: None
Mini SASS Score: 7.1 - Largely Natural / few modification GOOD condition
River Health negatively impacted due to:

- location at the downstream end of a floodplain channel where the river enters a rocky area, there is a small amount of residual silt from the naturally canalised river upstream.

Positive impacts:

- Intact riparian vegetation in buffer on right bank (wetland and grassland)
- Intact grassland for +-10 metres of left bank buffer
- Wattle clearing in buffer and beyond on left bank for +-100m length

Site 6: Meth Blue (2 samples)

Site description: Approximately 11.5km from source
Mpofana a small channel meandering across floodplain at confluence with smaller stream.
Upstream of MMTS outfall.
One sample taken on Mpofana upstream of confluence (S5); second sample taken on confluence stream which seems to originate near livestock and poultry infrastructure (S4).
Surrounding Land use: Intense beef and poultry.
Surrounding Vegetation: Left bank veld grass; right bank pasture with bramble in the buffer zone
Index of Habitat Integrity: 40% Moderately impacted
Meth Blue Score: sample 4 faded within three days, indicating a level of around 60% bacteria (and conversely 40% oxygen), whilst sample 5 barely faded, indicating minimal bacteria levels.
River Health negatively impacted due to:

- Increased nutrient loads entering the Mpofana from tributary
- Bramble infestation on right river bank for +-5 metre width of buffer zone
- Pasture to rivers edge on both banks

Positive impact

- Left bank slightly upstream comprises indigenous grassland

Site 7: Mini SASS

Site description: Approximately 12.5km from source.
Immediately downstream of road bridge and poultry farm boundary.
Upstream of MMTS outfall.
Surrounding Land use: Un-utilised floodplain
Surrounding Vegetation: Indigenous floodplain grasses and sedges
Index of Habitat Integrity: 6% Little impact
Turbidity: 4 - acceptable levels of suspended solids
Siltation on river bed and rocks: None
Mini SASS Score: 6.3 Moderately Modified, Fair condition
A Mini SASS conducted in October 2013 with Michaelhouse Grade 11's produced a similar score of 6.14
River Health negatively impacted due to:

- Road bridge crossing Mofana at test site
- Upstream signs of erosion of river banks where roads are in extremely close proximity to river edge.
- Aquatic invasive Oxygen Weed upstream of test site indicating increased nutrient loads

Positive Impacts:

- Intact riparian buffer
- Intact floodplain beyond buffer

Thursday 25 September 2014

Site 8: Mini SASS

Site description: Approximately 14km from source
+- 1km downstream of MMTS outfall.
Residential smallholding.
Surrounding Land use: Left bank timber into buffer; right bank – lawn to waters edge
Surrounding Vegetation: Lawn & timber
Index of Habitat Integrity: 32.5% Moderately impacted
Turbidity: 90% clear, few suspended solids – acceptable level
Siltation on river bed and rocks: High concentration, river bed and rock surfaces under thick layer of silt.
Also elevated levels of Diatoms (sludge) on rocks indicating increased nutrient loads
Mini SASS Score: 6.3 Moderately Modified, Fair Condition
River Health negatively impacted due to:

- Immediately upstream of the test site for approximately half a kilometre is timber planted to the river edge on both banks, followed by timber on the left bank and lawn planted to the rivers edge on the right bank.
- Siltation on river bed for the first time at unacceptably high levels, such that many pebbles are invisible under the silt layer. As this is the first test site downstream of the MMTS outfall, and is only +- 1 kilometre from the outfall, we attribute the silt to a combination of the scouring, eroding impact of the outfall combined with the naturally sedimented incised channel downstream of the outfall.

Site 9: Mini SASS

Site description: Approximately 15km from source.
Approximately 1.7km from the MMTS outfall.
Surrounding Land use: Residential small holding - lawn, gardens, timber
Surrounding Vegetation: Right bank lawn to river edge, left bank indigenous bush
Index of Habitat Integrity: 27.5% Moderately impacted
Turbidity: 100% clear, few suspended solids – acceptable
Siltation on river bed and rocks: High concentration, river bed and rock surfaces not visible under thick layer
Mini SASS Score: 5.9 Largely Modified, Poor Condition
River Health *negatively impacted* due to:

- Major earthworks on river bank less than 1km upstream of test site
- Rock causeway obstructing water flow +- 200 metres upstream of test site
- Timber into buffer less than 200 metres upstream of test site and
- Lawn to rivers edge at test site
- Siltation on river bed at unacceptably high levels, such that the rocks and pebbles are invisible under the silt layer

Positive Impacts

- Left bank buffer and beyond is indigenous bush for almost 1km upstream

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Site 10: Mini SASS

Site description: Approximately 18km from source.
+-10km downstream of MMTS outfall
Surrounding Land use: Agricultural; residential with new gardens
Surrounding Vegetation: Timber, pastures, indigenous bush. Left bank cleared of invasives
Index of Habitat Integrity: 22.5% Little impact
Turbidity: 100% clear, few suspended solids – acceptable
*Siltation on river bed and rocks****:*** Elevated concentration, river bed and rock surfaces not visible under thin layer
Mini SASS Score: 6.2 Moderately modified Fair condition
A Mini SASS conducted in May 2014 during a Balgowan Conservancy Water Workshop produced a score indicating Natural / Unmodified condition
River Health negatively impacted due to:

- Right bank upstream of site planted to pasture to rivers edge
- Left bank upstream of site comprises gardens in buffer (newly cleared buffer)
- Buffer upstream used to store hay bales to within +-5 metres of river
- Invasive wattle into buffer on right bank
- Elevated siltation on river bed

Positive impact:

- Invasive clearing on left bank has allowed for indigenous vegetation to recover

Site 11: Mini SASS

Site description: Approximately 19.5 km from source. Agricultural area. Downstream of MMTS outfall.

Surrounding Land use: Veld grazing for cattle

Surrounding Vegetation: Indigenous grasslands & bush

Index of Habitat Integrity: 9% Little impact

Turbidity: 100% clear, few suspended solids - acceptable

Siltation on river bed and rocks: Elevated concentration, river bed and rock surfaces under thin layer of silt

Mini SASS Score: 5.4 Largely modified, Poor Condition

River Health negatively impacted due to:

- Bank erosion from cattle accessing river to drink
- Siltation on river bed at unacceptably high levels, such that the rocks and pebbles are invisible under the silt layer
- Increased levels of diatoms and algae indicating increased nutrient loads from cattle access

Positive Impacts:

- All invasive plants have been removed for a distance of 1.5km upstream of the site, creating an uninterrupted, intact buffer on both banks of the river for +-1.5 km upstream of site and continuing downstream of the site for 1.2 km on the left bank and a couple of hundred metres on the right bank

Summary of River Health Tests

Site	Distance: From source From outfall	Upstream Land Use	Adjacent Land Use	Vegetation	Invasive Vegetation in buffer	IHI%	Meth Blue	Turbidity	Silt on bed	Mini SASS
1	800m	Dairy / residential	Dairy / residential	Kikuyu pastures	Bamboo Kikuyu	60% - Seriously impacted habitat	60% bacteria			
2	3km	Timber Plantation – Pine & Wattle	Plantation, Veld Grazing	Pine, Wattle Bramble. Indigenous	Bramble. Recently cleared Wattle & Bugweed.	28%		100%- clear	None	6.3 FAIR
3	6.5km	D/s of dam (minimal release)	Wattle: planted & self seeded	Wattle, Bugweed	Wattle & Bugweed	45%	No bacteria	100%	Light	6 POOR
4	8.5km	Livestock, quarry	Cattle & sheep grazing	Mixed Kikuyu/ indigenous grassland.	Kikuyu	28% moderate		<25%		
5	9km	Livestock grazing	Grazing	Indigenous	Ringbarked Wattle	10		>75%	None	7.1 GOOD
6	11.5km	Livestock, Poultry	Livestock grazing	Veld & pasture	Bramble, Privet	40 moderate	60% bacteria			
7	12.5km	Livestock, Poultry	Unutilised Floodplain	Indigenous	Bramble	6 little impact		>75%	None	6.3 FAIR
8	14km 1km	Timber, Garden	Timber, Garden	Timber, Lawn	Saw Tooth Oak, Lawn	32.5 moderate impact		90% almost clear	High	6.3 FAIR
9	15km 1.7km	Garden, bush	Law, bush	Lawn, Indigenous bush	Lawn grass	27.5		100% - Clear	High	5.9 POOR
10	18km 10km	Cattle, Residential	Cattle, Timber	Timber, indigenous veld	Wattle.	22.5		100% - Clear	Elevated	6.2 POOR
11	19.5km 11.5km	Guest Farm	Grazing	Indigenous veld	Occasional Wattle	9%		100% - Clear	Elevated	5.4 POOR

Reasons for poor river health

Upstream of MMTS outfall

The upper reaches of the Mpofana are impacted by construction activities (current and completed), and buffer disturbances including invasive plants and localised bank erosion. Water extraction is of serious concern. All of these contribute to the low health scores

One site: Largely modified / poor condition (score of 6)

Two sites: Moderately modified / fair condition (both scores of 6.3)

One site: Largely Natural / few modification GOOD condition (score of 7.2)

Downstream of MMTS outfall

As we progressed downstream of the MMTS outfall, we observed the decline of the type of impacts seen upstream, at the same time observing invasive plant eradication, an unbroken ribbon of indigenous buffer vegetation in the lower section of the river (in some cases extending a distance away from the river) plus a stronger flow of water from various tributaries. All this suggested that river health should improve farther downstream – something we have often seen repeated during river walks: if impacts are reduced and riparian habitat is restored, river health can and does improve.

This is however not the case on the Mpofana, where despite intact riparian areas and a naturally increased volume of clear water, river health declined downstream of the MMTS outfall. After checking through all our photographs, records and test results, we can only come to the conclusion that the reason the Mpofana declines in health in the lower reaches is due in general to the Mooi Mngeni Transfer Scheme.

The water from the Mooi River does not seem silted (due to its origins in an impoundment, and having observed the outfall in full flow on many an occasion, the water was always silt free and clear). The question however is where does the silt that we recorded on the river bed originate? There seems no debate that the increased flows over extended periods have resulted in stream bank and bed erosion. As the general rule of stream erosion is the faster the flow the less the deposition, and usually deposition of transported material occurs when water velocity reduces. If these rules are used as a guideline, it would seem that the current levels of silt in the Mpofana may have been deposited when the transfer flows were stopped to facilitate construction of the new pipeline – as the water slowed and receded, the silt particles would have sunk to the river bed.

Conversely, when the flows increase once the water is again being transferred, the velocity will erode and collapse the banks and the resultant silt will be carried downstream by the water which will most likely also scour the river bed clean of silt rather than deposit the silt on the bottom. This suspended silt will in all likelihood be washed into the Lions and uMngeni Rivers and Midmar Dam - a supposition backed by the silt loads seen there previously.

Thus in conclusion it seems that besides the erosion, scouring and bank collapse, there are two types of silt related impact on the Mpofana which originate from the MMTS

- When MMTS flows are stopped, the negative impact is that of silt deposition which smothers everything on the river bottom whilst leaving the slow flowing water crystal clear.

- When the MMTS transfers are flowing, the Mpofana is negatively impacted by the suspended silt in the water which reduces sunlight penetration and visibility and blocks aquatic creatures gills

Additionally, historically (prior to the construction of the transfer scheme) the Mpofana would have been a small stream experiencing occasional flood levels during high rainfall events in the summer months and low flows in the winter months. With the onset of the transfer scheme, the Mpofana experienced increased and regular high flow volumes, many of which are in winter months in order to keep Midmar Dam at acceptably high levels. This is at the time of year when naturally, the river would be experiencing low flows. Thus the flow regime of the Mpofana has been completely changed, and as a result the ecology of the river is changed.

In addition, the increased flows have not allowed time for vegetation to take hold and stabilise the banks and thus there are high levels of bank erosion caused by the water. When the banks collapse, the soil gos into suspension in the water and is carried downstream. This turbidity blocks sunlight from the water thereby changing the water temperature and reducing sunlight availability to aquatic plants and thus reducing their ability to photosynthesize; silt enters gills and smothers fish and aquatic invertebrates; silt reduces visibility thus preventing aquatic prey species from hiding, predators from hunting and others from finding food. As water slows, the silt load descends and settles on the river bed and submerged rocks, smothering everything. As the water speeds up, the silt is washed downstream from the Mpofana into the Lions and thence the uMngeni – and Midmar Dam.

A 2012 report entitled Receiving Rivers Specialist Assessment was commissioned by TCTA during research for MMTS 2. The authors, Mr Bill Rowlston & Ms Lara Crous of Coastal & Environmental Services stated that a previous Environmental Impact Assessment had concluded that *the study identified erosion as the most serious threat to the ecological condition of the rivers.* This supports our conclusions.
Whether this silt is being deposited on the bed of the Lions River downstream of the Mpofana, or whether it is entering Midmar Dam seems to be under debate. From the evidence we have seen during the uMngeni, Lions and Mpofana River walks, when we witnessed large amounts of silt laden water entering the Lions from the Mpofana, and entering the uMngeni from the Lions, the river walk team is betting that the silt is being deposited in Midmar Dam.

Unfortunately the only siltation tests undertaken in Midmar Dam have been in 1963 and 1983 by the Department of Water Affairs. During the latter test, around the time Mearns Weir was built, the siltation level was measured at 0.13%. It is of concern that in the intervening 32 years no siltation tests have been undertaken in Midmar Dam and we have no knowledge of the present status of silt levels in Midmar. This despite a condition of the MMTS Record of Decision that siltation tests should be undertaken every 20 years. This would give a benchmark and data that would ascertain the siltation threat to Midmar. As far as we can ascertain, no siltation test has yet been done to comply with the ROD.

It seems ironic that the Mooi-Mngeni Transfer Scheme on the one hand brings water and life to a large part of KZN, whilst on the other hand is transforming the very stream that delivers this water, as well as potentially reducing the capacity of Midmar Dam which stores water for KZN.

Findings and Recommendations

Findings

Impacts on the Mpofana

The Mpofana River is negatively impacted almost constantly from its source to its confluence with the Lions River. The nature of the impacts can be divided into two distinct zones, being the area upstream of the MMTS outfall, and the area downstream of the MMTS outfall

Upstream of the MMTS outfall, negative impacts include lack of releases from dams, over extraction, wetland disturbances, localised nutrification with, at times proliferation of Oxygen Weed; and riparian buffer disturbances (including construction work, various invasive plant species, timber, localised erosion from livestock trampling and one rubbish pit). Notwithstanding these impacts this part of the Mpofana has the potential to be transformed and restored into a healthy river as these issues are all reversible.

Downstream of the MMTS outfall, similar impacts were observed, however they were far less frequent than upstream of the outfall. The heavily eroded river banks and high levels of sediment on the bed of the river downstream of the outfall were not seen upstream of it. Sadly, whilst the lesser impacts are reversible, the main impact of erosion seems unavoidable due to the volume of water (4.5 cumecs) that will flow almost constantly.

It is thus likely that the Mpofana downstream of the outfall will take many years, if ever, to stabilise and revert to being a healthy river. Local residents along the river, especially those who rely on causeways to access the far side of the river are understandably concerned and in attempting to make enquiries in this regard, some have been informed that if there are raised water levels due to high rainfall events, pumping will be stopped so that the flows will not include the 4.5 cumecs being pumped from the Mooi.

Thus, once again, it seems that the Mpofana will not experience natural high and low flows. The constant high water flows will continue to erode the river banks and bed until presumably, one day in the future either the banks will stabilise or will have to be braced with rock gabions. How effective these would be is questionable, as this has been attempted on the Lions River (as a result of the erosion caused by the MMTS transfers from Mearns Weir), and the gabions are clearly not being fully effective in preventing farther bank collapse.

Photo: Flooded causeway on Lions River during MMTS release, September 2013

Unfortunately the monitoring pegs erected in the banks years ago seem to have disappeared as the banks collapsed around them, so there does not seem to be much of a baseline to estimate erosion thus far. The October 2014 survey will provided some baseline figures, however due to the fact that the receiving rivers (Lions and uMngeni Rivers) were not surveyed as well, when the Mpofana is resurveyed in 2019 it may be nigh on impossible to gain an understanding of the complete picture and extent of the impacts all the way downstream to Midmar. On the floodplains, either the meanders will become more pronounced or the force of the water will break through the bends effectively straightening the channel. In other areas the water may carve down to bedrock as we noted during the walk.

Possibly somewhere in the future all this will stabilise, and it would thus be prudent to continue alien invasive clearing and maintenance of cleared areas in the hopes that when the river banks do stabilise, there will be a healthy buffer zone.

Impacts downstream of the Mpofana

The impacts on the Mpofana are carried downstream to both the Lions and the uMngeni Rivers, and possibly even Midmar Dam. On a large floodplain +- three kilometres downstream of the confluence of the Mpofana & Lions Rivers, we saw how the Lions River had eroded to such an extent that stone gabions are being used in places to shore up the banks. This is meeting only limited success, and it seems that the meandering river is eroding and many of the meanders will disappear as the water finds the easiest, most direct path, re-routing the river to a straighter course. Apart from the ill effects that this is or will have on the rivers health, such a straightening route will exacerbate downstream flooding and its dangers as the water, instead of spilling over the banks and dissipating onto the flood plain, will flood down the channel towards Midmar Dam at ever increasing speeds and force. The inlet / head waters of Midmar Dam has been identified as an important Fish Breeding site for the endemic Natal Yellowfish & we wonder if and how all this silt is impacting the breeding site.

Top: Gabion & eroding bank – Lions River floodplain d/s of Mpofana Sept 20013
Middle: Lions River spilling over onto floodplain (Lidgetton area) December 2013
Bottom: Midmar Dam fish breeding area February 2005

A week after our walk, consultants surveyed the Mpofana in order to provide a benchmark of current conditions. This will apparently be followed by a five year monitoring program at the end of which a decision will be made on how to manage / mitigate / rehabilitate any impacts from the increased loads of water in the Mpofana. Presumably this is due to the fact that one can only attempt to predict how the Mpofana (and other receiving rivers) will be impacted; however, in the meantime, no doubt the rivers health will continue to be negatively impacted by the increased loads of silt.

As per the authorisation for the scheme, unfortunately the only section to be surveyed as part of Phase 2 is the Mpofana from outfall to Lions confluence. Thus no comparison will be made between the sections of the Mpofana upstream and downstream of the outfall which gives an indication of impacts already occurring as a result of the transfers. Nor will the Lions River be surveyed downstream of its confluence with the Mpofana, which would not only have given an indication of the impacts thus far, but could also have provided an indication of future impacts from the increased transfer.

No cognisance seems to have been taken of the fact that the Mpofana is already heavily impacted after +-30 years of unnaturally high water levels and by implication there is no concern as to the impacts. One thing is for certain: the damage has already begun, and when the new increased transfers begin, the impacts will continue and may be exacerbated

The Mpofana is not only severely impacted, it highlights peoples different (and at times indifferent) attitudes to our rivers.

Top: Silted Mpofana entering clear Lions during MMTS transfer, September 2013. No recent rains in catchment
Middle: Silted Lions entering clear uMngeni, May 2012. No recent rains in catchment
Bottom: Silted uMngeni entering Midmar Dam December 2013. After heavy rains

Water Quality / River Health

Mini SASS

Mini SASS tests are an effective means of monitoring river health and can be carried out by almost anyone if they have had basic training. Further information can be obtained on www.minisass.org

Catchment Management

Lack of adequate catchment management has meant that terrestrial invasive plants have become rampant near the river. These plants utilise ground water which would otherwise enter the river system, and in many cases block the sunlight from the river, changing the whole ecology of the river and damaging bio diversity.

We have heard comments that *"the Mpofana is trashed by the Mooi Mngeni Transfer Scheme so why waste time fixing it"*.

The Mpofana forms part of the uMngeni River Catchment and thus any efforts in improving the conditions of the Mpofana should at best, have positive consequences on the whole upper uMngeni catchment and at least, ensure a river with improved health for local adjacent land occupiers, even if this is only the section upstream of the MMTS outfall whilst the banks stabilise downstream.

If the Mpofana upstream of the MMTS outfall is in the best possible health, this may be carried downstream and may possibly mitigate the impacts of the MMTS, especially with regard to invasive plants in the riparian buffer.

Some landowners along the Mpofana have methodically cleared invasives on their properties over the years. Additionally, the Balgowan Conservancy have recently initiated an invasive plant clearing program. These parties are to be congratulated for the work they are undertaking.

Recommendations

Flow obstruction

All dams should release sufficient water in order to keep the river downstream of the dam in a healthy condition. This released water is known as the Environmental Reserve and is usually achieved by means of a pipe built into the lower section of the dam wall so that there is always a flow of water being released. These pipes sometimes block and stop functioning and need to be checked regularly.

Owners of dams releasing either very little or limited amounts of water are encouraged to either unblock the outlet pipes or allow additional water to flow into the river below the dam. Ideally, almost as much water should be going into the dam and leaving the dam. This is happening on a set of earth dams on the Mpofana, proving that it is possible to not only have the benefits of a dam, but also keep the river flowing downstream.

Of four causeways across the Mpofana, three were not causing any obstruction to the flow of the water. Although the fourth causeway did have a slight damming effect, once the high flows generated by the MMTS begin, this will not be of concern.

Invasive Alien Plants

Any disturbance of the natural riparian vegetation along the river banks will invite the presence of alien species, soil erosion, loss of soil health and biodiversity, as well as negatively impact river health.

Some recommendations to improve the health of the Mpofana include:

- Based on this Report develop a strategic plan and source funding for prioritising, implementing and coordinating the alien invasive species eradication programme along the entire length of the river
    - Priority areas:
        - Monitoring of the MMTS pipeline route to ensure that any emerging invasives are controlled before they take hold. These species are likely to include amongst others Wattle, Bugweed and Bramble
        - Removal of approximately six kilometres of Pine, Wattle & Saw Tooth Oak planted & self-seeded in the 32 metre buffer up to the edge of the watercourse as follows:
            - 2.5 kilometres (both banks) of Pine & Wattle (upstream of the MMTS outfall)
            - 1km (both banks) of Saw Tooth Oak, 100m Pine and 2.4km (both banks) Wattle downstream of the MMTS outfall
- During the Mpofana walk, the majority of Bugweed & Bramble observed and mapped were dead. We were unable to ascertain whether this was due to frost damage from the unusually cold winter prior to the walk, or whether these plants had been treated as part of an eradication program
    - The majority of the Bugweed observed was noted as undergrowth in wattle infested areas.
    - We suspect that Bramble occurs far more prolifically than we observed, as it had not begun its spring growth when we walked the Mpofana, and as there were areas along the river that had been burnt or cleared of bramble
- Tackle newly emerging alien invasive species as part of regular farm work on an on-going basis, prioritising riparian areas.
- Target particularly invasive species which are not necessarily common invaders in this catchment, for example, Privet, Syringa and Catsclaw before they become out of control.
- Prepare a long term strategy for reducing and eliminating invasive garden escapees such as; Canna/Indian Shot, Japanese Honeysuckle, Periwinkle, Wandering Jew, London Plane tree, Pyracanthus (Fire thorn) and Zimbabwe Creeper
- A very old grove of Poplars situated in the buffer zone immediately downstream of the outfall should be investigated. Under normal circumstances we would recommend they be removed, however there is the possibility that their roots are assisting in stabilising the river banks
- We observed a number of mature wattles that have been ring barked. These trees should be monitored to ensure that they do not fall into the water course once dead – this causes logjams resulting in the river bursting its banks and flooding.

Wetlands

- Where livestock have access to wetland edges in order to drink, we urge that alternate measures be taken in order to reduce the negative impact of the trampling on the wetlands.
- Should the lack of release from the dam situated on the Gowrie Estate be remedied, the partially dried out wetland downstream would possibly be rejuvenated
- Towards the end of 2012, an Environmental Impact Assessment was undertaken on the MMTS phase 2. The document stated that there were areas where *the laying of the MMTS-1 caused degradation to wetland structure and function* and that this degradation had not been rehabilitated. In order to avoid a repeat of this lack of rehabilitation, landowners are encouraged to monitor wetland crossings and report any possible problems to the MMTS Environmental Monitoring Committee.

New Developments

Ensure all new development goes through the appropriate planning process that ensure any application for development within the 32m buffer zone undergoes the necessary EIA and other planning process

Erosion

- As far as possible, limit or reduce livestock access to the river banks and into the river in order to prevent bank and bed erosion and siltation of the river.

32 m buffer - general

- Develop a plan for the withdrawal and appropriate re-siting of existing intrusions into the 32m buffer with rehabilitation plans.
- Re-site rubbish pits outside the 32m buffer to ensure that leachate and wind blown matter does not contaminate the river (consider recycling the bulk of this waste at a local recycling centre)
- Avoid mowing in the 32m buffer, allowing for the regrowth of indigenous vegetation as habitat for riverine species, including invertebrates which are key species for river health.
- Monitor the MMTS pipeline route specifically at river crossings, to ensure that all river banks are adequately stabilised to prevent soil erosion

What each landowner could do

Some recommendations for addressing the future threats of the Mooi-uMgeni transfer include:

- Monitor your stretch of your river, measure the size and depth of the channel, take regular photographic evidence.
- Be in contact with the ECO (environmental compliance officer) for the MMTS pipeline and insist on regular updates and community interaction.
- Obtain a copy of the approved EMP (Environmental Management Plan) that was part of the ROD (Record of Decision) and check that the conditions are being met.
- Request a copy of the October 2014 survey report
- Constitute a Water Users Association as legislated within the Catchment Management Agency framework to legalise and protect your water rights and to enable recognised interaction with respect to both the health of the Mpofana and the impact of the transfer scheme.

- Know and take up your rights with respect to public participation and protection of the environment and don't give up in the face of the challenges facing the Mpofana and its community as custodians of this river and its significance within the greater context of Kwazulu-Natal.

Landowner concerns regarding the MMTS phase 2 process

Landowners on the Mpofana raised a number of concerns with us. In the interest of co-operation and community involvement, we would recommend that the relevant authorities meet with the landowners to clear up some of the queries and dissatisfaction. Issues included:

- Access via causeways which will flood
- Queries as to the regularity of Midmar silt tests (ROD condition)
- Queries as to why the October 2014 survey did not include the Lions and uMngeni Rivers (why was it not part of the ROD for MMTS phase 2?)
- Landowners seem confused regarding the purchase by DWA of the servitude of the land along the river, not realising that this was apparently done decades ago. It is likely that the servitude was measured and mapped, and as it is possible that this servitude may change due to the anticipated transformation of the river course perhaps this should be revisited.
- Concerns that landowners have not been notified of regular stakeholder meetings
- Landowners have apparently received conflicting information, for example some have been told that the increased flows will be constant all the time, whilst others have been told that pumping will be cut down if heavy rain is forecast

Limitations

- This was not a scientific data collecting expedition, and thus our records, although accurate, are not complete. There were occasions where we would have to detour away from the river due to either heavy bramble infestations or terrain challenges, which restricted our ability to keep records.

- It is impossible to physically record and photograph every single negative impact seen, although the majority of impacts were recorded.

- We have attempted to compile this report for ease of reference for both laymen and those with environmental backgrounds.

- We hope that our efforts assist in not only raising awareness regarding the plight of the Mpofana River, but also inspire rehabilitation and care of this precious resource for the benefit of all those "downstream"

Conclusion

Dr Ian Player told us before the Mayday uMngeni River Walk that *rivers are the arteries of the earth, and that if we abuse our rivers nature will "kick back at us*". He believes that "*we have lost Hlonipa (Respect): for Nature, for Ourselves and for Each Other"*. This just about sums up the story of the Mpofana River.

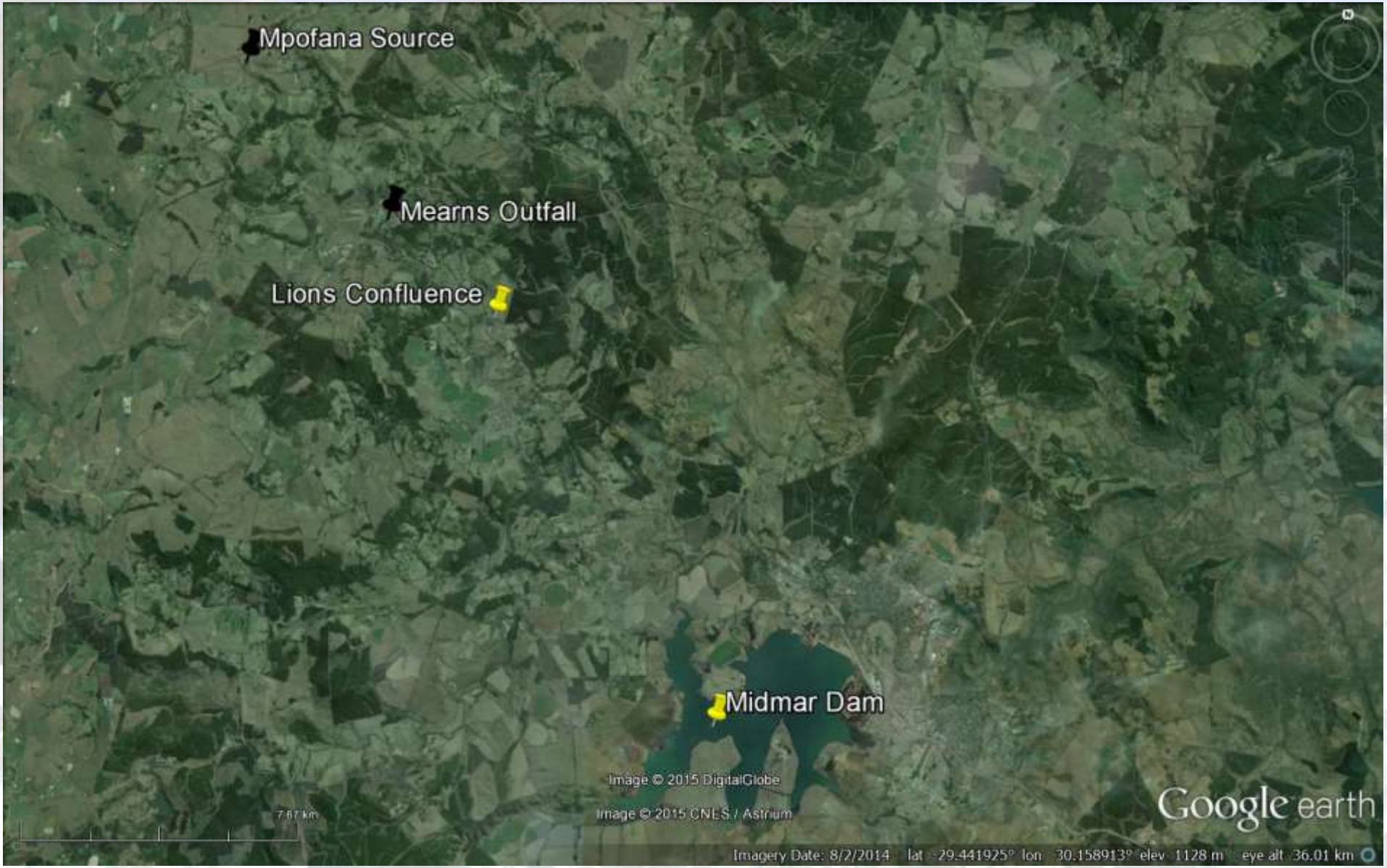
We need to regain that respect for our rivers, and the team trusts that the record of the Mpofana River in this report will not only highlight the problems experienced along the river, but will assist in remedial action and initiate a restoration of the rivers health, as well as to renew the readers Hlonipa. The journey of the Mpofana River is far from over, and it is up to each of us to take part in looking after this river.

Penny Rees
February 2015
pennyduct@vodamail.co.za River Walk Blog: uMngeni riverwalk.wordpress.com

With these hands, with this heart
and with the pure intention of God
this water is now blessed
Removing and transmuting all impurities and
returning them to the light forever.
Peace.
Kuan Yin Water Blessing

Appendix 1

Location of Mpofana River

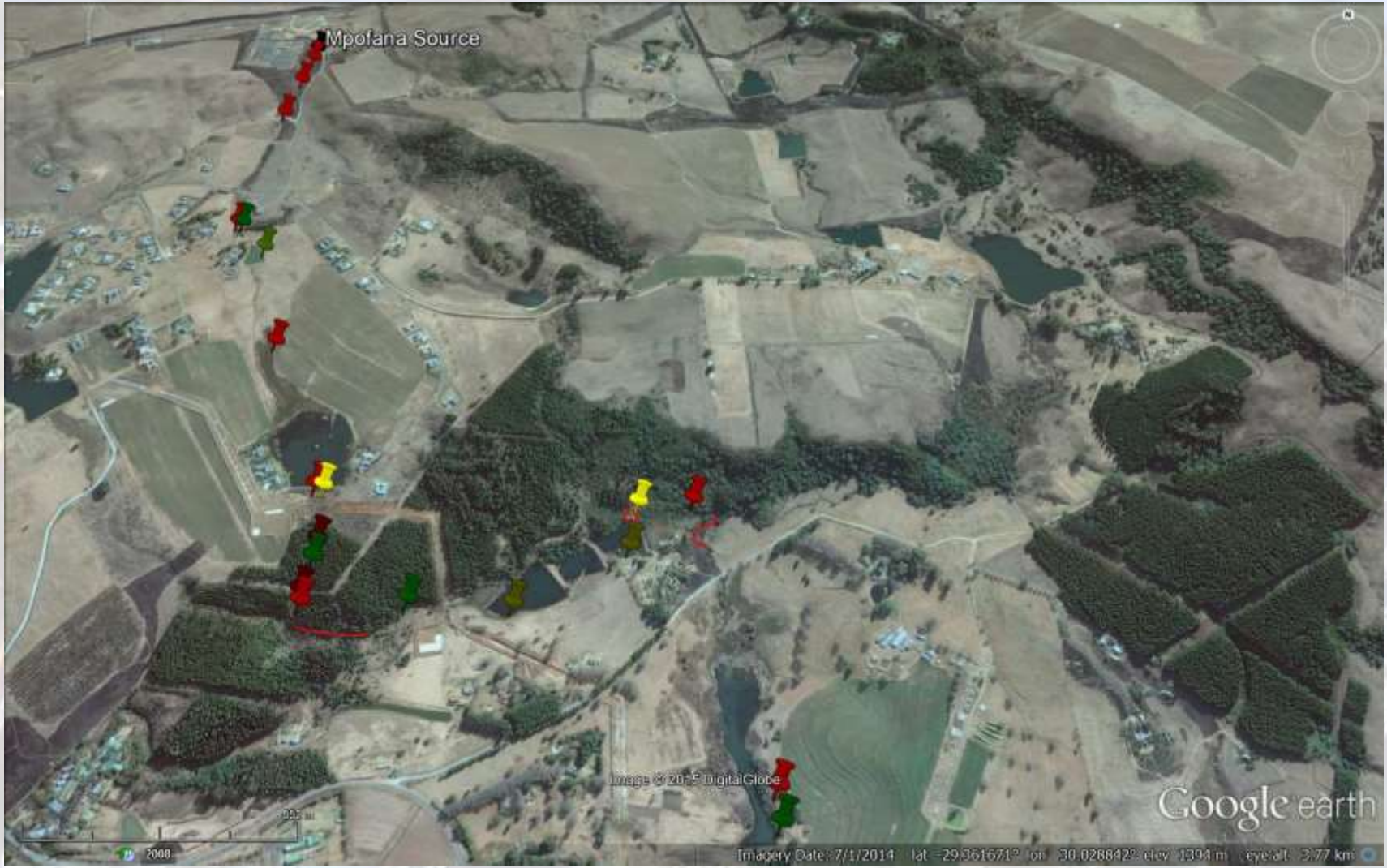

Mpofana Source
Mearns Outfall
Lions Confluence
Midmar Dam
Image © 2015 DigitalGlobe
Image © 2015 CNES / Astrium
Google earth
Imagery Date: 8/2/2014 lat -29.441925° lon 30.158913° elev 1128 m eye alt 36.01 km

Appendix 2

Invasive / Alien Vegetation in buffer

Terrestrial Invasives / Weeds Identified

Wattle	Acacia dealbata / mearnsii		
Indian shot / canna	Canna indica / generalis		
Blue Gum	Eucalyptus		
Honey Locust	Gleditsia triacanthos		
Privet	Ligustrum japonicum		
Japanese honeysuckle	Lonicera japonica		
Cats claw	Macfadyena unguis-cati		
Syringa	Melia azedarach		
Pine	Pinus spp		
Poplar	Populus		
Bramble	Rubus fruticosus		
Bug weed	Solanum mauritianum		
Wandering jew	Tradescantia spp		
Periwinkle	Vinca major		
Saw Tooth Oak			
Zimbabwe Creeper			
Aquatic Invasives Identified			
Fine Oxygen Weed	Lagarosiphon muscoided		
Pickerel Weed	Ponrederia cordata		

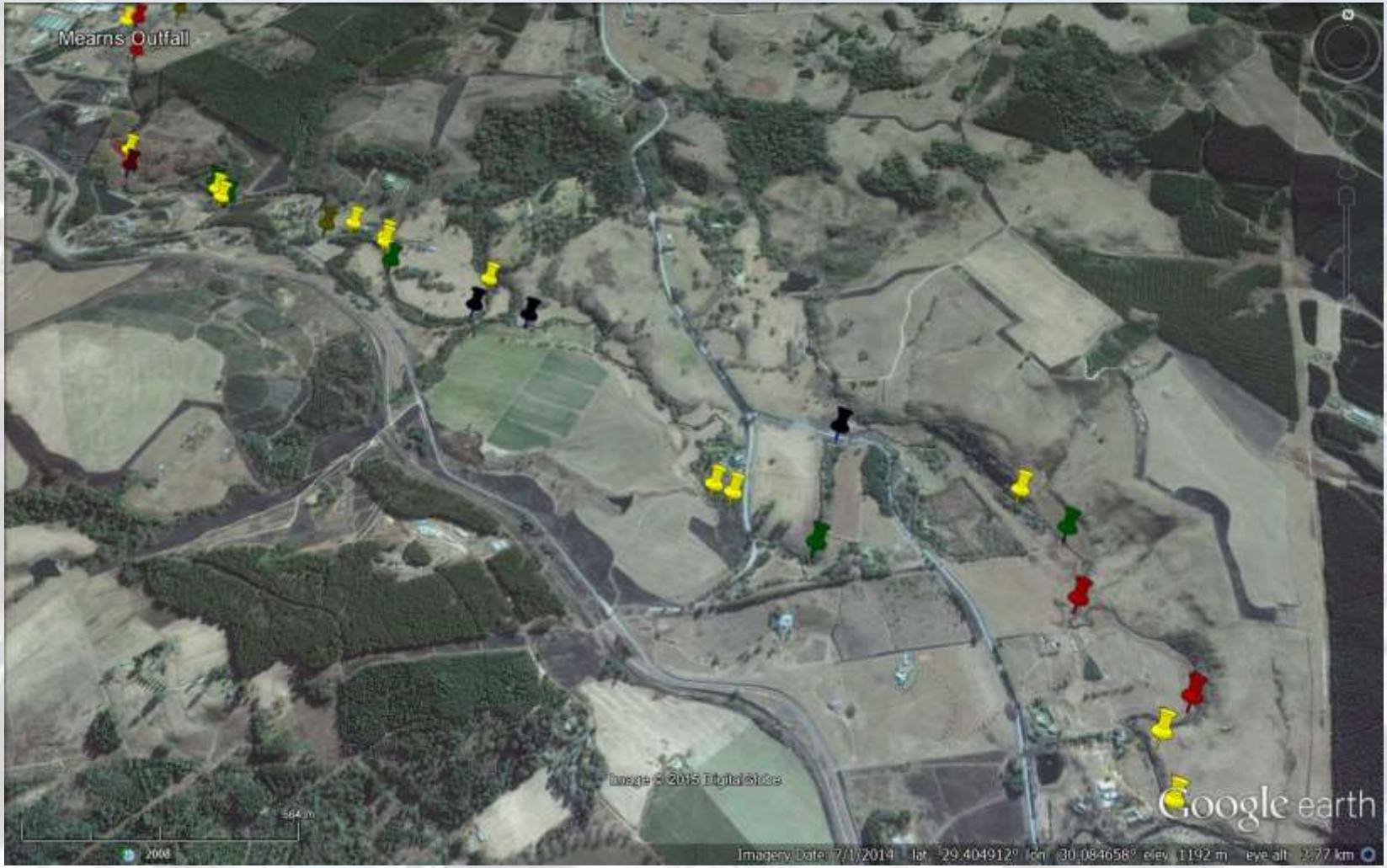


Key

Red	**Bramble**	**Red line**	Riparian zone recently cleared of invasive vegetation
Green	**Wattle**	**Olive Green**	Aquatic invasive Pickerel weed, Oxygen weed,
Purple	**Bugweed**		
Yellow	**Other alien or invasive species**: Canna, Periwinkle		

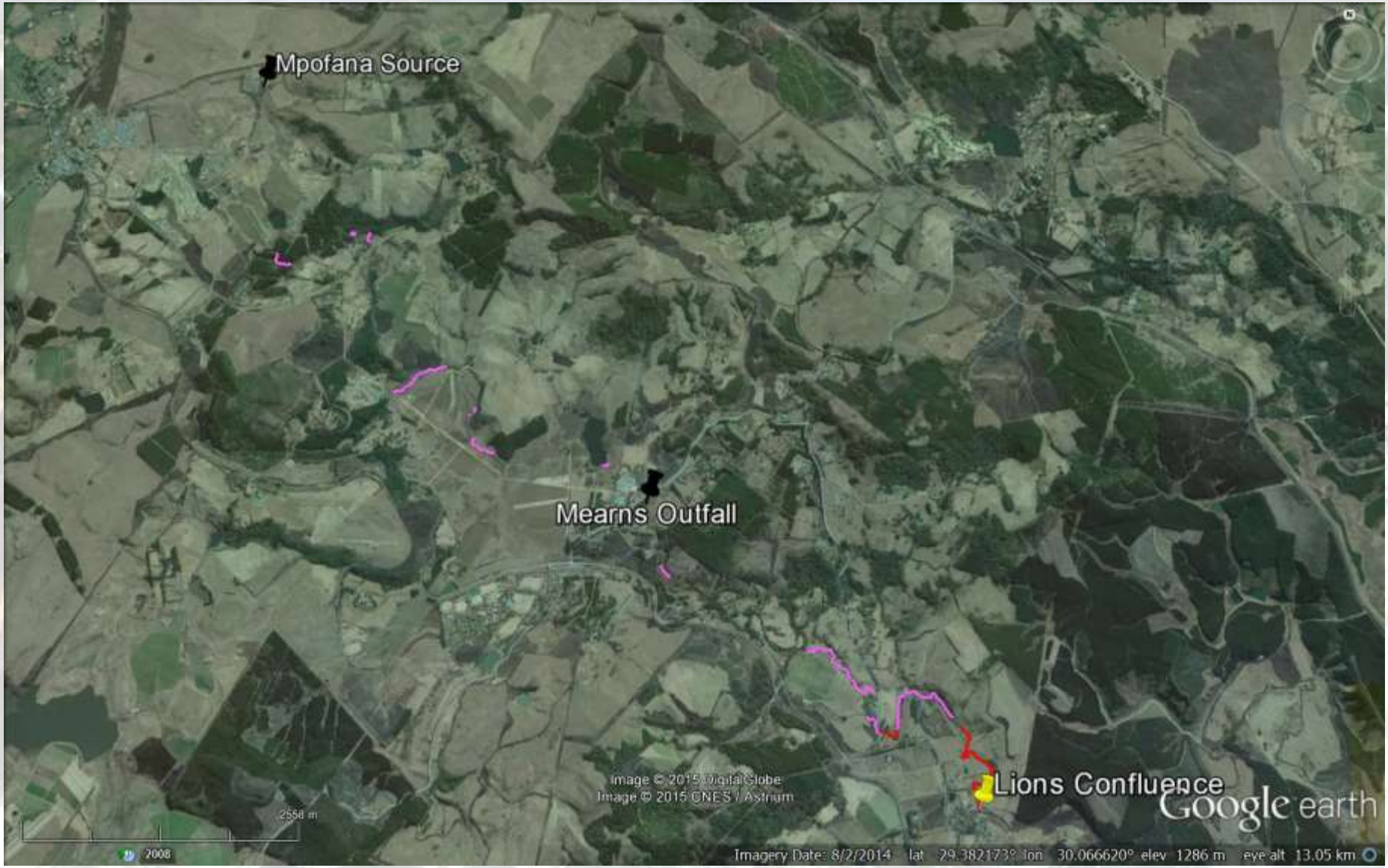
Key

Red	**Bramble**	**Red line**	Riparian zone recently cleared of invasive vegetation
Green	**Wattle**	**Olive Green**	Aquatic invasive Pickerel weed, Oxygen weed,
Purple	**Bugweed**		
Yellow	**Other alien or invasive species**: Privet, Canna, Kikuyu		



Key

Red	**Bramble**	**Red line**	Riparian zone recently cleared of invasive vegetation
Green	**Wattle**	**Olive Green**	Aquatic invasive: Pickerel weed, Oxygen weed,
Purple	**Bugweed**		
Yellow	**Other alien or invasive species:** Saw Tooth Oak, Syringa, Canna, Wandering Jew, Zimbabwe Creeper, Honey Locust, Cats Claw Creeper, Japanese Honeysuckle		



Pink lines: Both banks recently cleared of invasives
Red lines: Left bank cleared by landowner on an ongoing basis

Appendix 3

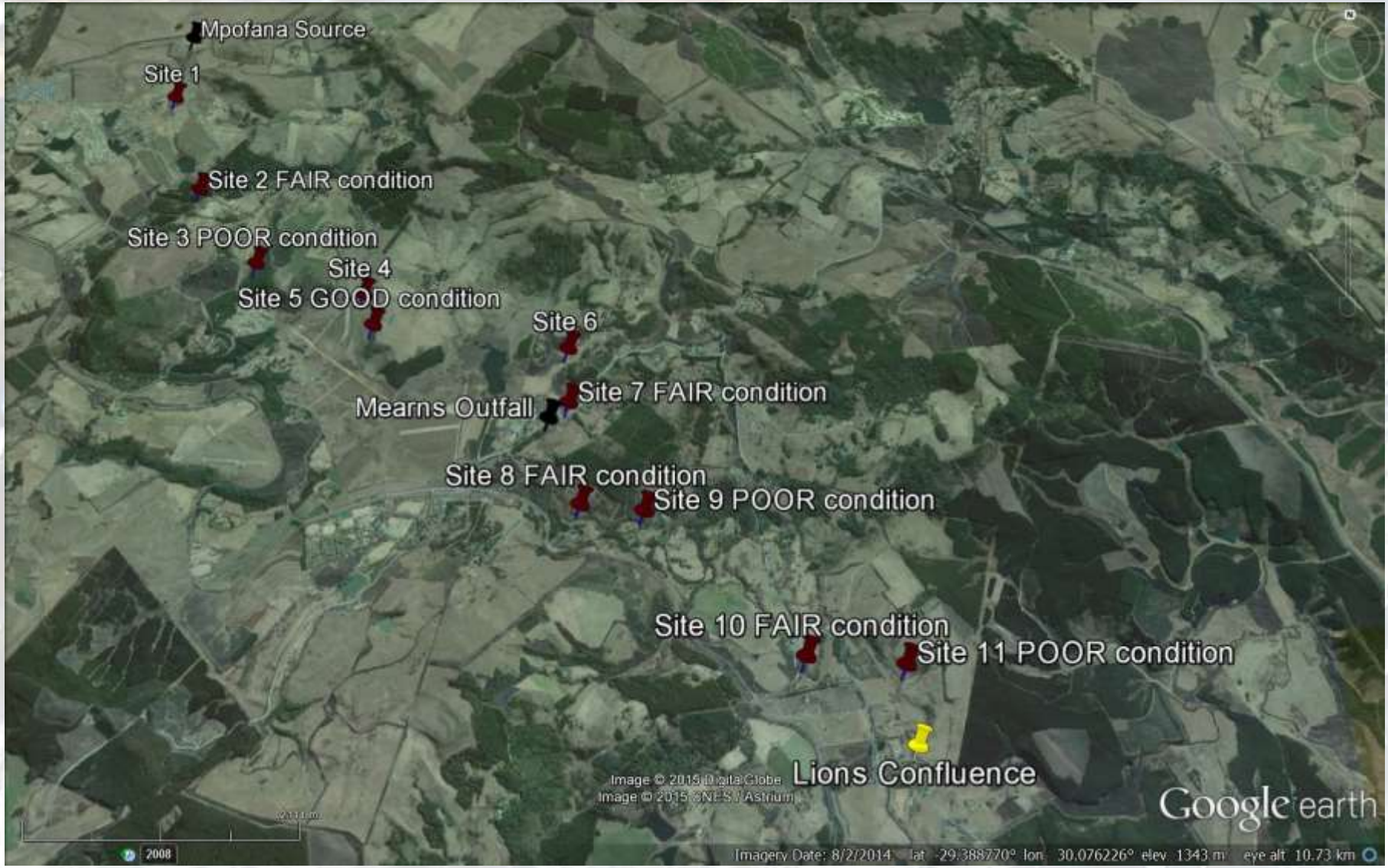
River Health Test Sites

River Health Test Sites Upstream of Outfall

River Health Test Sites Downstream of Outfall


Mpofana Source
Site 1
Site 2 FAIR condition
Site 3 POOR condition
Site 4
Site 5 GOOD condition
Site 7 FAIR condition
Mearns Outfall
Image © 2015 DigitalGlobe
Image © 2015 CNES / Astrium
1516 m
2008
Google earth
Imagery Date: 7/1/2014 lat -29.369760° lon 30.046783° elev 1318 m eye alt 8.40 km

All River Health Test Sites



Appendix 5

References

Invasive Plants:

- BROMILOW, C. 2010. **Problem Plants and Alien Weeds of South Africa.** Pretoria, Briza. Publications

- HENDERSON, L AND CILLIERS, CJ. **Invasive Aquatic Plants**. ARC

- http://www.plantzafrica.com/miscell/aliens6.htm
  Downloaded 29 December 2012

Indigenous Vegetation:

- POOLEY, E. 2005. **A Field Guide to Wild Flowers Kwazulu-Natal and the Eastern Region** Natal Flora Publications Trust

- BOON, R. 2010. **Pooleys Trees of Eastern South Africa - A complete guide**. Flora & Fauna Publications Trust

Water Quality :

- DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1996. **South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems**

- http://kywater.org/ww/ramp/rmtoc.htm Total Organic Carbon and water quality
  Downloaded March 2014

- http://www2.vernier.com/sample_labs/WQV-07-COMP-ortho_total_phosphates.pdf Phosphates (ortho- and total)
  Downloaded March 2014

- http://www.bfhd.wa.gov/info/coliform.php Benton Franklin Health District
  COLIFORM BACTERIA AND DRINKING WATER
  Downloaded March 2014

- NORRIS, R.H & THOMS, MC. 1999 **What is River Health?** Freshwater Biology (Volume 41, pages 197-209)

- MESSERS: ALISTAIR HUNTER – Umgeni Water and PETER THOMSON – Upper uMngeni Catchment Management Forum. Pers Comm

Mooi Mngeni Transfer Scheme (MMTS):

HENDERSON, C. 1996. Environmental Impact Assessment Report. Mooi-Umgeni Transfer Scheme Environmental Impact Assessment Report. Steffen, Robertson & Kirsten. Pietermaritzburg. Draft Report no. 217149/4/Draft

HUGGINS, G., ALLETSON, D. J., Institute for Cultural Resource Management (Natal Museum). Department of Water Affairs and Forestry, Department of Agriculture and Environmental Affairs and Umgeni Water. 2002. Mooi-Mgeni River Transfer Scheme. Receiving Streams, Environmental Impact Assessment. Department of Water Affairs and Forestry. Pretoria

HUNTER, A, 2009. A REVIEW OF THE FLUVIAL GEOMORPHOLOGY MONITORING OF THE RECEIVING STREAMS OF THE MOOI-MGENI RIVER TRANSFER SCHEME PHASE 1. Submitted in partial fulfilment of the academic requirements for a degree of Master of Environment and Development in the Centre for Environment, Agricultural and Development. School of Environmental Sciences. University of KwaZulu-Natal.

UMGENI WATER, 1996. Receiving Rivers Impact Management Study, Public Briefing Document, Mooi-Mgeni Transfer Scheme, Umgeni Internal Publication, February 1996.