



**TONGAAT HULETT DEVELOPMENTS (PTY) LTD**

**Compensation Flats Industrial Park, Umhlali**

**Wetland Rehabilitation & Management Plan**

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## Specialist Report Details

This report has been prepared as per the requirements of Section 32 of GNR 543 - Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998)

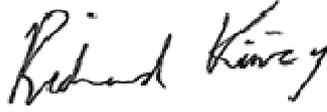
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I, ...**Robert Gregory Mullins**..... declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Agriculture and Environmental Affairs.

Signed:..........

Date:.....22/5/2012.....

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**TONGAAT HULETT DEVELOPMENTS (PTY) LTD**  
**COMPENSATION FLATS INDUSTRIAL PARK - UMHLALI**  
**WETLAND REHABILITATION AND MANAGEMENT REPORT**

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**WETLAND REHABILITATION AND MANAGEMENT REPORT**

## **1 INTRODUCTION**

SiVEST has been appointed by Tongaat Hulett Developments (Pty) Ltd to compile a wetland rehabilitation and management plan for the Compensation Flats Industrial Park near Umhlali on the KZN North Coast. The study will form part of the mitigation documentation included in the Environmental Impact Assessment (EIA) to be submitted to the Department of Agriculture and Environmental Affairs.

This rehabilitation and management plan focuses on the three separate wetland portions as identified in the delineation and impact assessment studies.

## **2 TERMS OF REFERENCE**

SiVEST was required to develop a wetland rehabilitation and management plan for the three wetland units on the Compensation Flats Industrial Park site.

The wetland rehabilitation plan should include:

- Details for structures proposed within the drainage lines to prevent further erosion and improve flooding;
- Methods for the removal and control of alien invasive plant species within the wetland;
- Suitable plant species to be replanted in the wetland; and
- Various monitoring steps to assess the success of the rehabilitation.

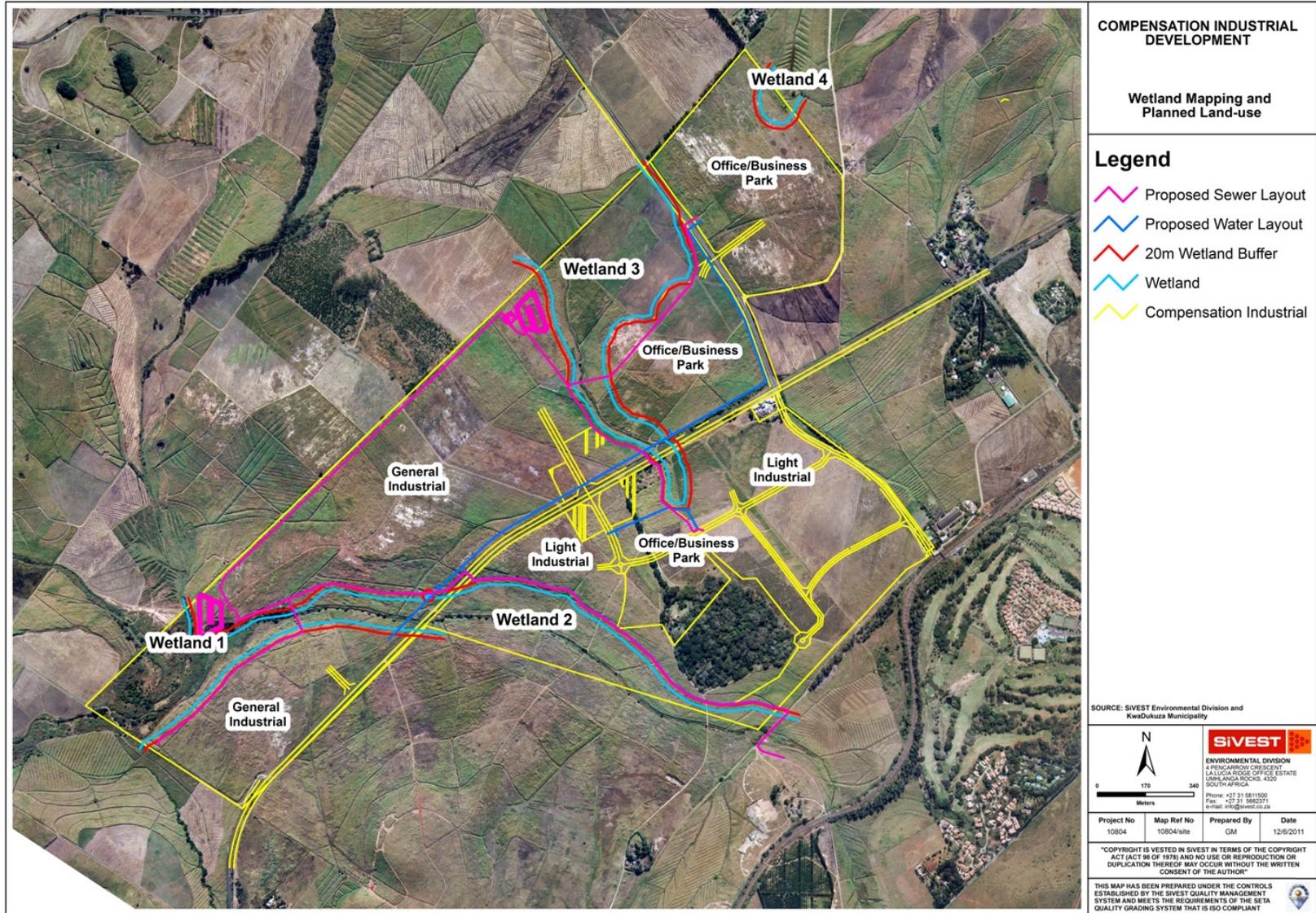
## **3 BACKGROUND**

Tongaatt Hulett Developments (Pty) Ltd proposes the development of an industrial complex on the Compensation Flats site near Umhlali.

Delineation of the wetlands in 2006 identified the presence of three wetland units across the properties either side of the R102 (Figure 1). Wetland units 1 and 2 are linked systems separated by the road. Wetland unit three lies predominantly on the western portion of the site with a tiny portion crossing the road to the east.

Past landuse practices have resulted in the systems being highly modified. Central drains and farming activities have resulted in much of the wetlands having dried out and being converted to farmland. The drains have incised and minor nick points have developed in these watercourses.

Part of the management recommendations specified in the impact assessment included the rehabilitation of the wetland systems on site and the ongoing maintenance of these areas..



## 4 WETLAND REHABILITATION AND MANAGEMENT

### 4.1 Rehabilitation Principles

Successful rehabilitation depends upon conceptual planning, research and design flexibility. Wetlands are ever-changing systems that have adapted to local conditions over many decades. It is not only important that a rehabilitated wetland looks like a wetland, it must also function as one (Canadian Wildlife Service, 2005).

There are many things to consider, including:

- The ability of the local catchment has to allow rainwater to infiltrate the ground water system and subsequently, to slowly release this water subterraneously into the wetland.
- The wetland should have capacity to receive both catchment and incident water without being eroded, hold excess water and release it slowly into the downstream system. Erosion from surface runoff reduced to the barest minimum.
- The wetland needs to be able to receive and accommodate soil and solute eroded from the surrounding catchment, and prevent the scouring and gulying, reducing siltation in the stream.
- The presence and/or quality of a seedbank, or a natural source in the area that allows for recolonisation of vegetation;
- The wetland must have capacity to accumulate organic matter.
- The critical balance between inputs and outputs; water, nutrients and soil has to be maintained.

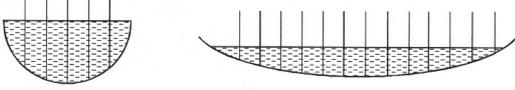
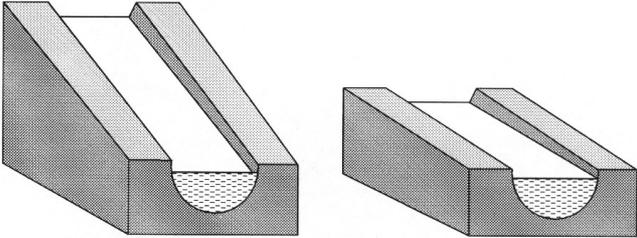
**Table 1: Benefits that may arise from wetland rehabilitation:**

<b>Indirect:</b>	<b>Direct:</b>
Biodiversity support	Grazing for livestock
Water quality enhancement	Fibre plants for crafts and construction
Flood attenuation	Medicinal plants
Erosion control	Tourism
Streamflow regulation	Areas for cultivation
Groundwater recharge/discharge	Wood

Key to the rehabilitation of wetlands is the re-establishment of an environment that is as close to the natural hydraulic regime (depth, duration and intensity of flooding) as possible. This is achieved through reducing the velocity of water through the system and promoting the spreading of flow across the wetland.

Water velocity through a wetland is controlled by three factors:

- hydraulic radius (R) – shallow, wide flow moves slower than canalised, deep flow;
- slope of the wetland (S) – steeper the wetland gradient, the faster the flow; and
- roughness of the channel (n) – greater resistance offered in the channel, the slower the flow.

Constant variables	High velocity	Low velocity
Slope, Roughness, Cross-sectional area.	(a) Variable wetted perimeter 	
Roughness, Hydraulic radius.	(b) Variable slope 	
Hydraulic radius, Slope.	(c) Variable roughness 	

**Figure 1 - Relationship between current velocity and the variables hydraulic radius, slope and bed roughness (from Kotze *et al*, 2001).**

With these principles and goals in mind, a vision for the rehabilitation program has been developed to improve functionality of the wetland and raise the overall value of the system at both a local and broader landscape level.

## 4.2 Rehabilitation Vision

Primary impacts to the systems involved include notable canalisation of flows within the central drains, sub-surface agricultural drains, removal of indigenous vegetation and alien plant encroachment.

Little can be done about the impact of the R102 and fragmentation of the systems. However by focusing the rehabilitation efforts on the individual wetland units the overall value and functioning of the systems will improve. This goal is easily achieved through :

- Plugging and deactivation of the central channels draining each of the systems;
- Deactivation of the agricultural drains;
- Re-vegetation and the control of alien vegetation; and
- Correct management of runoff and stormwater entering the wetland from the site and well as surrounding areas. The focus of the management must be towards both volume and quality control

The installation of a series of gabion weirs within each of the wetland units will promote backflooding and the re-establishment of a more natural wetness regime. With a cessation of farming within the wetlands and the increased soil moisture levels, indigenous wetland vegetation will rapidly return to these systems. Careful control of alien plants will be required but if managed early and effectively these species should not become a problem and minimal ongoing maintenance will be required.

## **4.3 Implementation and Management**

### **4.3.1 Structures**

Assessment of the watercourses, the size of the catchments and the predicted flow volumes was carried out to determine the best approach for the rehabilitation. Current and future runoff volumes excluded the use of earth plugs or rock weirs as these structures would not withstand the likely flows.

Concrete or mass-gravity weirs were also excluded as these structures are usually only installed for high energy or larger interventions. These systems are too small to justify the impact and expense of such structures.

It was concluded that the use of gabion weirs would be the best solution for the various systems. The structures are robust enough to withstand the flows in these systems, while being easy enough to install with lower cost and impact to the local systems.

#### **4.3.1.1 Wetland 1**

This system lies on the south western portion of the site and is fed via an incised channel from beneath the R102. The system drains into a small river system lying along the western boundary of the property. Rehabilitation will focus on the wetland draining into the stream, with activities within the riparian portion limited to alien plant control.

##### **4.3.1.1.1 Gabion Weirs**

It is proposed that two gabion weir structures be installed within this portion of the wetland. The lower structure will be placed just upstream of a portion of backflooded wetland linked with the stream floodplain (Fig 3). The weir will be positioned at a point where the channel merges with the system. The second weir is positioned higher up the system at a point where the slope on the system between the lower weir and upper weir is between 1%-2%. The upper weir has been positioned such that the predicted backflooding will not influence the R102. Each weir should have a Reno Mattress base plinth and stilling-basin. The weir should not be higher than two metres.

#### **4.3.1.2 Wetland 2**

This system lies on the south eastern portion of the site (east of the R102) and drains into wetland 1. The system is characterised by an incised central drain and a series of agricultural drains directing flows into the channel. Rehabilitation will focus on plugging the central drain and deactivation of the sub-surface drains. .

##### **4.3.1.2.1 Gabion Weirs**

It is proposed that three gabion weirs be installed within this portion of the wetland. The lower structure will be placed just upstream of the R102 and will flood back to to the second weir at a 1%-2% grade (Fig 4). The second weir in turn will flood back to the third weir. The third weir will make use of an existing farm road crossing and culvert. This final structure will backflood to the property boundary, where the system inters the site.

As above, the weirs must be built on a Reno Mattress with stilling basin and should not be higher than two metres.

#### 4.3.1.3 Wetland 3

This system lies on the north western portion of the site and drains in a north westerly direction off of the site via a well defined central channel and smaller herringbone drains. Deactivation of the channel and drains will help return this system to a more natural hydraulic regime.

##### 4.3.1.3.1 Gabion Weirs

Planning within this system identified the need for four gabion structures located down the length of the system. The first structure is located at a point where backflooding will stop just below the R102 – where the system enters this part of the site. Two further structures are then located at intervals down the central drain. Each set at a distance to allow for an approximate 1%-2% gradient on the wetland. The final structure is located on the property boundary – on the western edge of the site. This structure is positioned to maximise the ecosystem services from the rehabilitation efforts prior to the water leaving the property.

As above, the weirs must be built on a Reno Mattress with stilling basin and should not be higher than two metres.

#### 4.3.1.4 Re-Vegetation

##### 4.3.1.4.1 Indigenous Planting

The re-establishment of a mixed community of indigenous hydrophytic species across the wetlands is important for a number of reasons. The most obvious is the increase in habitat and biodiversity value of the wetlands. Secondly, a well established vegetation covering across the wetland greatly increase the roughness (see Fig 2 above) of the system, helping slow water moving through the wetland, trapping sediment and improving water quality. Re-establishment of the wetness regime will promote the return of hydrophytic species and wetland communities.

Limited planting of locally occurring species such as *Phragmites australis*, *Cyperus latifolius*/*Cyperus dives*, *Cyperus prolifer*, *Cyperus textilis* and *Cyperus sphaerospermus* could occur in areas of significant disturbance, especially areas exposed once alien plants are removed. Much of the material required can be selectively harvested from the site itself. Tubers and rhizomes of wetland species can be collected and replanted where required

In addition the growth of species such as *Leersia hexandra*, *Imperata cylindrica*, *Ischaemum fasciculatum*, *Dissotis canescens* and *Ludwigia octovalvis* should be encouraged (but not limited to) within the wetland areas.

##### 4.3.1.4.2 Alien Invasive plants control programme

The wetland and portion of the riparian area was noted to host a number of alien species. Although the abundance of these species was low at the time of assessment, rapid control and management will ensure they don't negatively affect the system. Species identified within the wetland and buffer include *Arundo donax*, *Melia azedarach*, *Litsea glutinosa*, *Solanum mauritianum*, *Ricinus communis*, *Lantana camara* and *Chromolaena odorata*. Removal and subsequent management of these species is very important in maintaining the biodiversity value and integrity of the wetland.

Three basic methods of controlling alien plant species exist:

- mechanical control (hand pulling, slashing and felling);
- biological control (introduction of natural predators into a system to control the plants); and
- chemical control (spraying and painting of poisons onto the plant to kill them)

In a wetland environment the use of chemical poisons is not ideal. Careless application and the non-specific nature of the toxins means that in a dynamic system, residual poison can be carried in the water to other parts of the wetland and into adjacent water courses. That said, careful application of poisons (eg. Garlon) onto the cut stumps of the *M. azedarach*, *R. communis* and *S. mauritianum* is considered the most effective way of eradicating larger individuals.

Biological control of alien plants in South Africa has had great success with a variety of species. However, limited success has thus far been achieved in the control of *Chromolaena odorata* and *Lantana camara* with bio-agents. As such, relying on natural predators to control infestations on the site will have very limited results and is more likely to fail.

During the initial clearing phase, smaller individual alien plants (and saplings) should be pulled out by hand and removed from the site. Larger plants should be ring barked, cut or slashed to just above the soil surface and the exposed cambium or stumps carefully painted with a suitable poison. Follow-up clearing should take place every two weeks for the first 3 months. The clearing activities can then be reduced to once a month after this period. It is important to note that the effective control of alien plants on the site will be an ongoing process. Provided the initial clearing process is carried out effectively, subsequent management should remain fairly minor. However these plant species are highly opportunistic and any lapse in control will see the site rapidly re-infested with these weeds.

A useful method of controlling alien plants is through fire. Burning of the wetland should be considered every second or third year. This will kill off emergent alien species as well as removing dead and moribund material from the wetland.

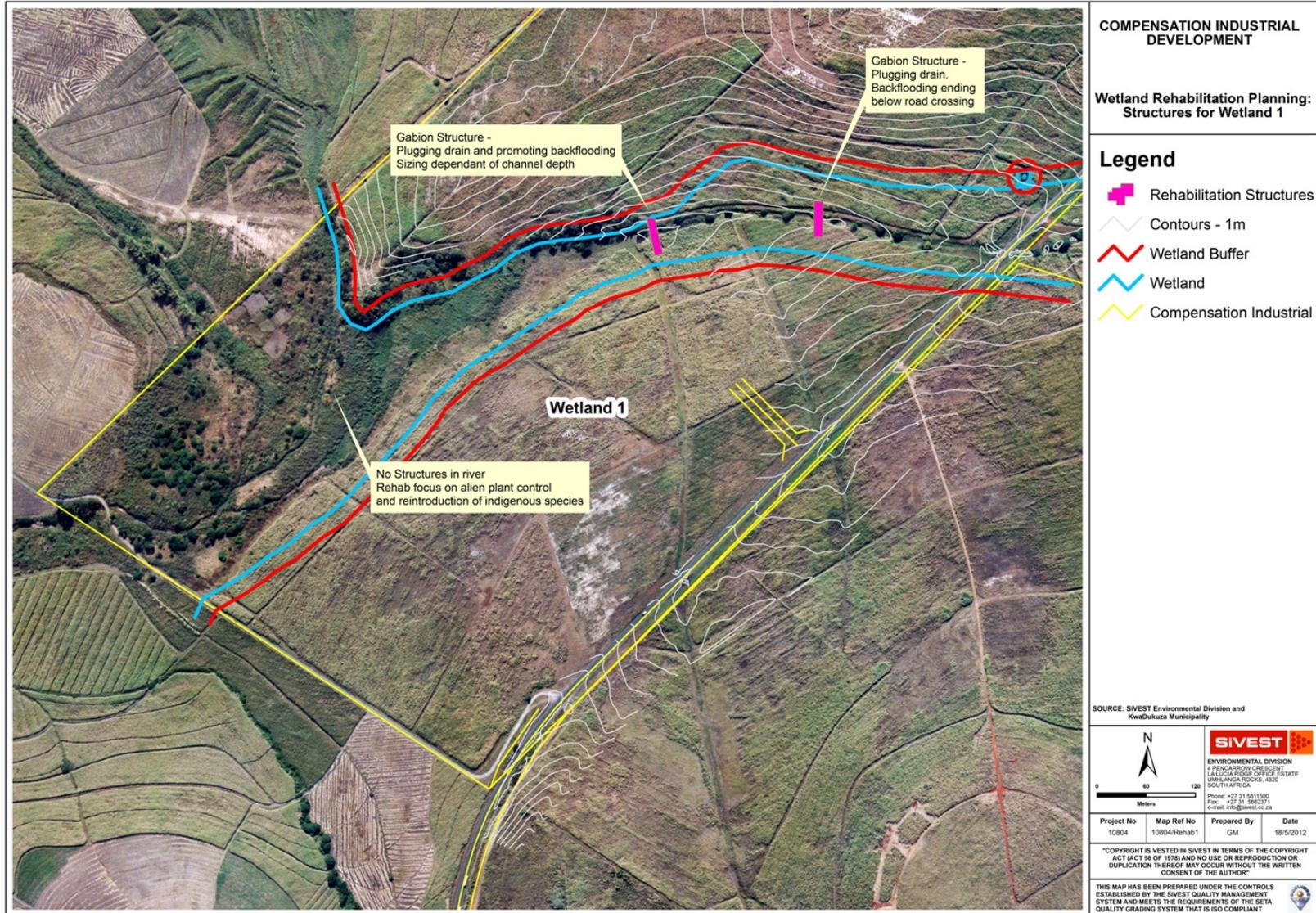
Old sugar cane lands within the wetland and buffer should be lightly ripped and all sugar cane rhizomes or ratoons must be raked up and disposed of off-site.

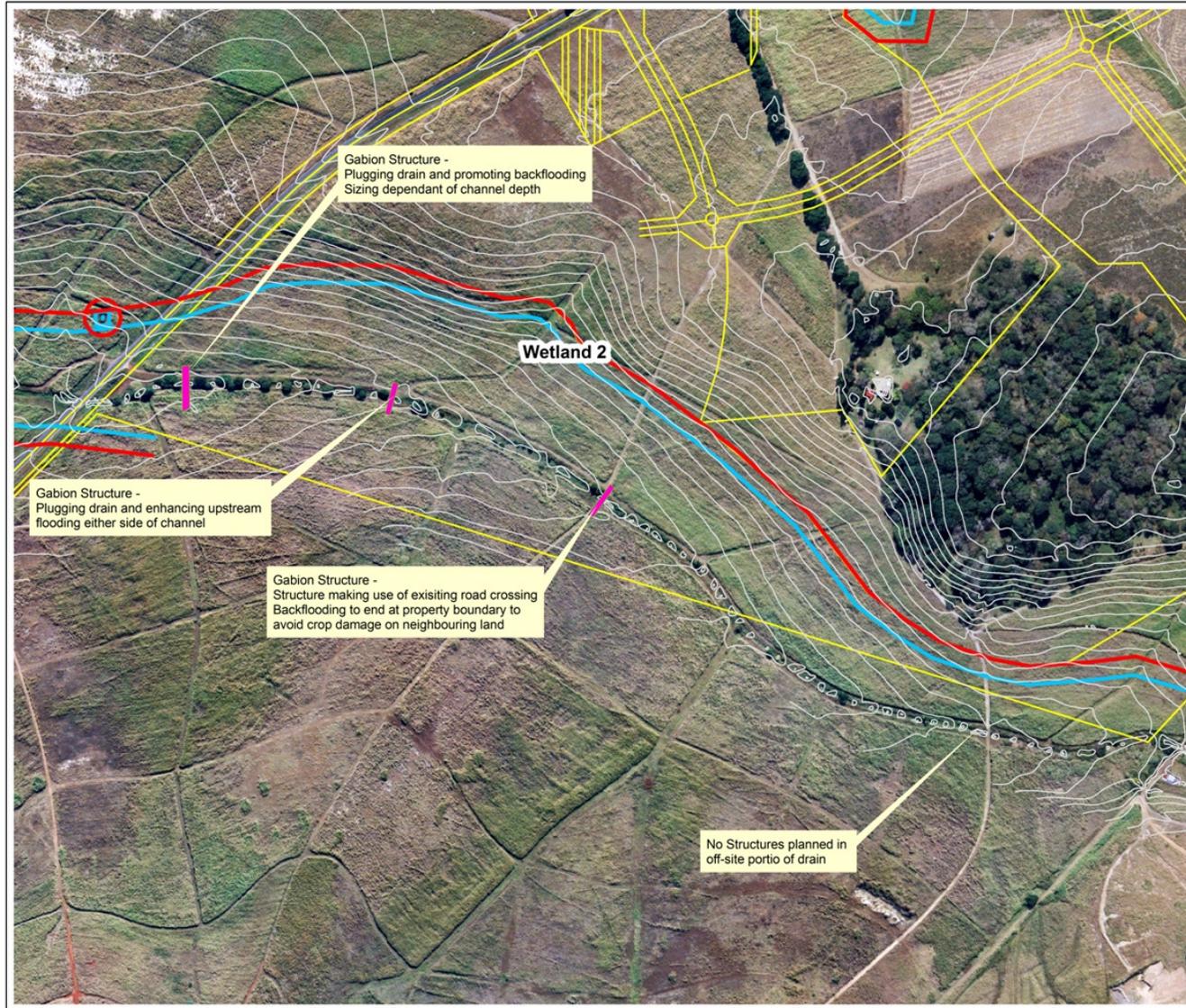
#### 4.3.1.5 Human disturbance minimisation measures

The site currently faces a variety of pressures from direct anthropogenic disturbances. These include uncontrolled access by vehicles, vagrants and squatters, illegal dumping and muti plant harvesting.

In order to mitigate and manage these threats the following steps should be followed:

- Pedestrian and vehicle access to the wetland and buffer must be prohibited. Site security staff should be aware of these requirements and if people are seen accessing the site they should be directed to leave immediately.
- The feasibility of fencing the wetland and buffer within the site should be considered as an option, however, the same rules regarding access must then apply to staff employed on the site.
- Areas of illegal dumping and soil stockpiles must be removed from the wetlands and these areas must be rehabilitated and re-planted as per the specifications listed above.





**COMPENSATION INDUSTRIAL DEVELOPMENT**

**Wetland Rehabilitation Planning: Structures for Wetland 2**

**Legend**

-  Rehabilitation Structures
-  Contours - 1m
-  Wetland Buffer
-  Wetland
-  Compensation Industrial

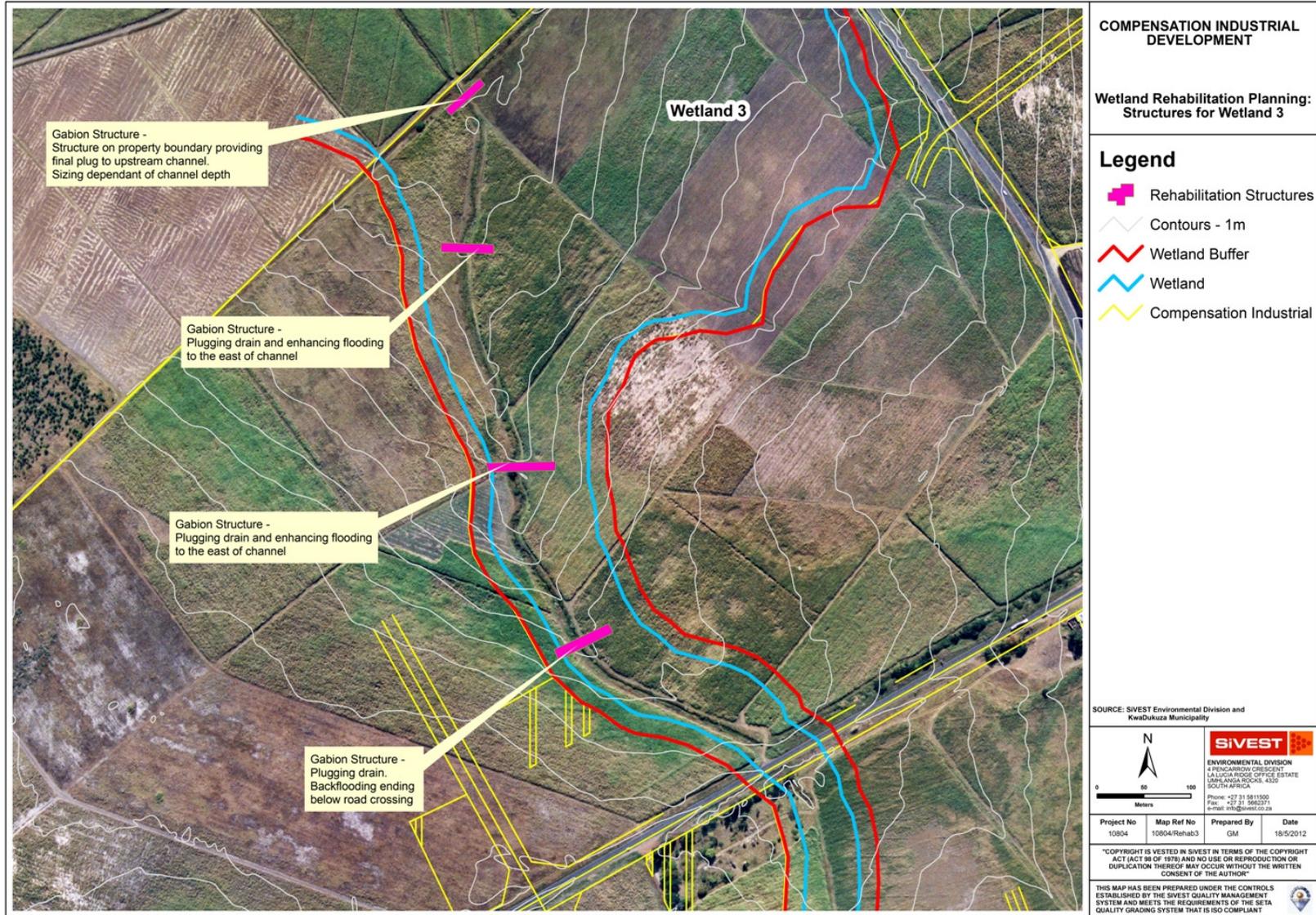
SOURCE: SiVEST Environmental Division and KwaDukuza Municipality

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#### 4.3.1.6 Stormwater Management

Management of stormwater runoff from the development is critical to maintaining the integrity of the rehabilitated system. An increase in hardened surfaces will not only increase the potential volume of water entering the wetland but also decrease the time taken for this accumulated flow to reach the system. The increase velocity and volume of water has a far greater capacity to erode and damage the wetland. The stormwater management program for the site has addressed most of these issues and runoff is reticulated to approved discharge points for controlled release (outside of the wetland system and buffer.)

##### 4.3.1.6.1 Discharge Points

Some runoff, from the road access and site edges may nevertheless end up in the wetland. These release points must:

- Be located outside of the wetland boundary and buffer (outer 10m services servitude);
- Have suitable scour protection (gabion or reno mattress) to dissipate water energy and prevent erosion;
- Should be spread along the system to prevent point-source release of runoff; and
- Should be monitored regularly (particularly after large rain events) to ensure no scour has occurred.

##### 4.3.1.6.2 Pollution

Given the nature of the products likely to be stored in the warehouse, brought in by rail and road vehicles, as well as the necessary logistical equipment kept on site, there is a risk of contamination of runoff from the site.

The Stormwater Management System has already compensated for much of this risk and has a 'clean' and 'dirty' runoff system already planned. This system will run all potentially contaminated water through a oil/water filter and sediment trap to remove potential contaminants.

The wetland will be able to treat and process a certain level of contamination that may incidentally reach it, however the quality of runoff must be closely monitored to ensure no pollution is entering the wetland or stormwater drainage system as a whole

##### 4.3.1.6.3 Monitoring

Monitoring protocols have already been put in place to ensure water quality is maintained. The following steps will be taken to ensure compliance:

- Surfacewater monitoring will take place at both stormwater discharge points, as well as within the wetland;
- Groundwater monitoring will take place from two boreholes to be sunk immediately upstream and downstream of the site to ensure no contaminants are leaching off the property;
- Sampling will take place biannually during summer and winter months.
- A suitably qualified collection and testing company should be appointed to ensure compliance and quality of data.

## 5 OVERALL MONITORING

In any rehabilitation project it is important to know whether you are improving the value of the system. Regular monitoring also allows one to identify the need for corrective action for problems that may arise during the course of rehabilitation program (e.g. an erosion control structure begins to wash away). Monitoring therefore helps improve the focus and procedures of a project as it proceeds. Monitoring of individual wetland sites also helps us to be more successful in the future when undertaking new projects by improving our general understanding of wetland rehabilitation.

*All rehabilitation sites within a wetland, no matter how small, will require some form of monitoring for at least the lifespan of the project (Kotze et al, 2001).*

### 5.1 Key Performance Indicators

In order to determine the progress and ultimate success of the rehabilitation project monitoring of the site will be required to assess the restoration of the system.

Factors to be assessed as part of the monitoring should include (adapted from Kotze, 2001):

- Scaled or ranked measurements (e.g. level of wetness: temporary, seasonal or permanent wetness);
- Accurate measurement (e.g. distance in meters advanced by a headcut erosion site);
- Classification (e.g. plant species composition and community distribution); and
- Qualitative Assessment: descriptions, observations, perceptions, insights and attitudes.

With regards to time frames for monitoring it is important that monitoring take place during the initial construction stages of the rehabilitation project as well as operational / recovery phase. While the earth plugs are being installed and the alien plants removed, monitoring should be more regular to identified issues quickly and have them remedied. Once excavation and construction activities are complete in the wetland, and these areas have been ripped and replanted, then assessments can become less frequent as distinct changes will take longer to manifest.

**Table 2: A basic framework for monitoring of the wetland rehabilitation plan proposed for the site**

Phasing	Frequency	Assessment	Duration
Implementation and Remediation phase	Weekly	<ul style="list-style-type: none"> <li>• Alien plant removal</li> <li>• Re-vegetation</li> <li>• Fence establishment</li> </ul>	Duration of remediation activities(monthly report)
Recovery phase	Monthly	<ul style="list-style-type: none"> <li>• Alien plant re-emergence monitoring and removal</li> <li>• Re-vegetation success monitoring</li> </ul>	6 x 1 month visits (monthly report)
Operational phase	Annual	<ul style="list-style-type: none"> <li>• Alien plant re-emergence monitoring and removal</li> <li>• Fence integrity monitoring and repair</li> <li>• Human disturbance</li> </ul>	3 x annual visits (report per visit)

The frequency and nature of the monitoring will allow for accurate assessment of the various stages of the project to help guide the long term success of the rehabilitation. Frequent initial monitoring will ensure that a solid base is formed and that the wetland is given the best opportunity to improve. During the recovery phase, monitoring will make sure that the various structures are performing well and that there are no fundamental flaws in the rehabilitation process. The final, long term monitoring will assess the overall success of the rehabilitation program, once the system has had time to stabilise.

## 6 CONCLUSION

Studies have shown that through rehabilitation of the wetlands on the property the various good and services currently performed by the system can be improved. Site specific interventions and minor construction activities will go a long way to remediating the systems and improving functionality. Implementation of this plan will help to improve the quality of the systems on site as well as improving the health and water quality within the broader catchment.

Should there be any further queries regarding the details contained in this report please do not hesitate to contact SiVEST.



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