

Environmental Management Programme (EMPr) for Conducting Maintenance Work on the Braamfontein Spruit: Phase 2

Report Prepared for
Johannesburg Roads Agency SOC (JRA)



Report Number 490243



Report Prepared by



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Table of Contents

Disclaimer.....	v
List of Abbreviations	vi
1 Introduction	1
1.1 Background	1
1.2 Purpose of the Environmental Management Programme (EMPr)	2
1.3 Project Team	3
1.3.1 Details and Expertise of the Environmental Assessment Practitioner (EAP)	3
1.4 Structure of the EMP	4
2 Project Details	4
2.1 Project Description	4
2.2 Construction Methodology	14
2.2.1 Site Establishment.....	14
2.2.2 Typical protection structure 1 (Riprap and vegetated berm).....	15
2.2.3 Typical protection structure 2 (Riprap & vertical wall)	15
2.2.4 Typical protection structure 3 (Vertical wall)	16
2.2.5 Concrete stilling basin (site 2)	17
2.2.6 Proposed new bridge (site 8)	17
2.2.7 Rehabilitation of existing canal (site 5).....	18
2.3 Services	19
2.3.1 Water for Construction Purposes	19
2.3.2 Power	19
2.3.3 Sanitation	19
2.3.4 Contractors Camp and Laydown Area	19
2.3.5 Access Roads.	19
2.3.6 Stockpiles of Raw Materials	19
2.4 Fuel Storage.....	19
2.5 Construction Materials	19
2.6 Employment	20
2.7 Occupational Health and Safety	20
3 Roles, Responsibility and Compliance Monitoring Requirements	20
3.1 Gauteng Department of Agriculture and Rural Development (GDARD).....	20
3.2 Johannesburg Roads Agency SOC (JRA).....	20
3.3 Environmental Control Officer (ECO).....	23
3.4 Contractor Management	23
4 Guidelines for the Environmental Management Plan.....	23
4.1 General Guidelines	23
4.2 Environmental Principles	24
4.3 Incidents and Non-Conformances	24

4.4	Penalties and Liabilities	25
4.5	Compliance with Legislation and Regulations	26
4.6	Required Environmental Permits, Licences and Authorisations	27
4.7	Required Documentation before Commencement of Construction Activities	27
4.7.1	Environmental Method Statements	27
4.7.2	Pro-Forma Documentation	28
5	Quantitative Impact Assessment	28
5.1	Methodology	29
5.2	Results	32
5.2.1	Potential Impacts Associated with the Planning Phase	32
5.2.2	Potential Impacts Associated with the Construction Phase	32
5.2.3	Potential Impacts Associated with the Operation Phase	42
5.2.4	Potential Impacts Associated with the Decommissioning and Closure Phase	50
6	Environmental Management Programme	50
6.1	Planning Phase	51
6.2	Construction Phase	55
6.3	Operation and Rehabilitation Phase	89
7	Monitoring and compliance	93
7.1	Site Documentation	93
7.2	Monitoring Programme	93
7.3	Photographic Record	94
7.4	Environmental Monitoring	94
8	Awareness Training	97
APPENDIX 1: PHASE 1 CONCEPTUAL DRAWINGS		99
APPENDIX 2: CONSTRUCTION METHOD STATEMENT		100

List of Tables

Table 2-1:	Proposed erosion protection measure types and remedial measures	6
Table 2-2:	Proposed erosion protection measures along Braamfontein Spruit based on hydrodynamic modelling with the mitigation measures in place	9
Table 2-3:	Proposed priorities based on flood hazard and erosion on properties	14
Table 3-1:	Roles and Responsibilities of JRA Personnel and Contractor	21
Table 4-1:	Classification of Environmental Incident	25
Table 5-1:	Criteria for Assessing Significance of Impacts	31
Table 5-2:	Interpretation of Impact Rating	31
Table 5-4:	Summary of the potential impacts that can be expected during the construction phase	35
Table 5-5:	Summary of the potential impacts that can be expected during the operation phase	46
Table 6-1:	Planning Phase EMPr	51
Table 6-2:	EMPr for the Construction Phase	55
Table 6-3:	Rehabilitation Phase	89
Table 7-1:	Environmental monitoring programme	95

List of Figures

Figure 1-1:	Location of the Remedial Measures	2
Figure 2-1:	Designed typical protection structure -1	6
Figure 2-2:	Designed typical protection structure -2	6
Figure 2-3:	Designed typical protection structure -3	6
Figure 2-4:	Details of proposed stilling basin at site 2 (downstream of the Barry Hertzog Avenue culvert) 7	
Figure 2-5:	Cross section and layout of the proposed new bridge at site 8 (2nd Street, Parkhurst)	7
Figure 2-6:	Rehabilitation of existing canal in Parkview Golf Club required at site 5	8
Figure 5-1:	Bank Shaping and Planting	43
Figure 5-2:	Example of bio engineering techniques in combination with riprap	44

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by Johannesburg Roads Agency SOC (JRA). The opinions in this Report are provided in response to a specific request from JRA to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

List of Abbreviations

AMI	Assistant Manager: Implementation
AMO	Assistant Manager: Operations
AMP	Assistant Manager: Planning
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
DM	Depot Manager
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act, 1989 (Act 73 of 1989)
ECO	Environmental Control Office
EMP	Environmental Management Plan
F	Foreperson
GDACE	Department of Agriculture, Conservation and Environment
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographic Information Systems
GN	Government Notice
HAS	Hazardous Substances Act 1993 (Act 85 of 1993)
HSEO	Health Safety Environmental Officer
I	Inspector
JRA	Johannesburg Roads Agency
LTO	Liaison Transport Officer
MS	Method Statement
MSDS	Material Safety Data Sheets
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMWA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NHRA	National Heritage Resources Act 1999 (Act 25 of 1999)
NWA	National Water Act, 1998 (Act 36 of 1998)
OHSA	Occupational Health and Safety Act 1993 (Act 85 of 1993)
PPE	Personal Protective Equipment
ROM	Regional Operations Manager
SANS	South African National Standards
SOC	State Owned Company
TLS	Team Leader/ Supervisor
WAR	Water Allocation Reform
WUL	Water Use Licence
WULA	Water Use Licence Application

1 Introduction

1.1 Background

The Johannesburg Roads Agency (JRA) is responsible for the construction and maintenance of the road and stormwater networks in the City of Johannesburg Municipality (CoJ) and has identified a need to initiate a project that will attend to the current challenges experienced by residents and other stakeholders in the area. Some of these challenges include excessive water flow and environmental degradation along the Spruit to the point where properties along the river are at risk.

The JRA commissioned a study on the state of the Braamfontein Spruit and the steps required to improve the natural habitat and surrounding infrastructure. SRK Consulting (Pty) Ltd was appointed as a specialist engineering company to conduct the study and come up with required recommendations on remediation measures. The study took into account various environmental considerations to identify the sources of the problem and propose actions the COJ can take to restore the habitat and introduce further safety measures.

The rehabilitation plan was split into two phases. Phase 1 involved the identification and implementation of emergency measures. In this phase, seven priority areas were identified and remediation measures were put in place from December 2016 to June 2018.

Phase 2 (subject to this Environmental Management Programme (EMPr)) involved assessment of the complete catchment area and river morphology. The specific objective of phase 2 is the identification of zones with high erosion potential, which consisted of the following activities:

- to identify erosion prone areas;
- to identify new erosion protection measures required to protect these areas;
- conceptual remedial measures of the infrastructure required.

After investigation and 2D modelling of various flood events routed through the compiled model of the Braamfontein Spruit, fifty areas (Figure 1-1) were identified that were erosion prone and where severe flooding could occur during, specifically a 1 in 50 year flood event. Conceptual erosion protection measures were designed for the identified locations and the model re-run to ensure the preservation and protection of the identified areas and to ensure the surrounding properties are not negatively affected during a 1 in 50 year storm event.

The construction of the protection measures will trigger activities listed in Listing Notices 1 and 3, and will require an Environmental Authorisation from the Gauteng Department of Agriculture and Rural Development (GDARD), Competent Authority. This EMPr has been compiled as part of the application for an EA, as required in terms of GNR 982 of the NEMA.

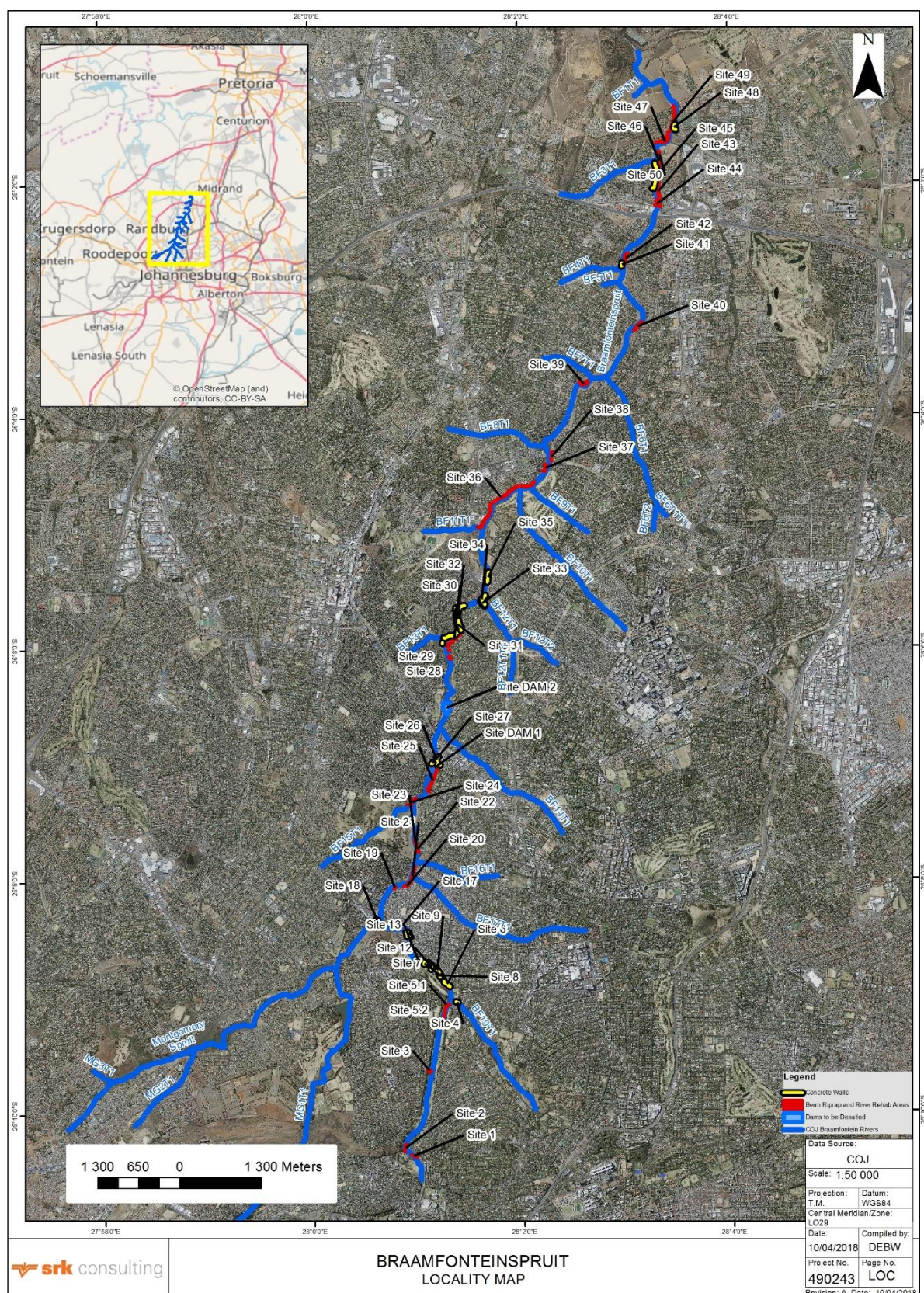


Figure 1-1: Location of the Remedial Measures

1.2 Purpose of the Environmental Management Programme (EMPr)

The purpose of this Environmental Management Programme (EMPr) is to ensure that the impacts of the proposed project are kept to the minimum. This EMPr is based on the principles of the NEMA, which include:

- To avoid, minimise, or correct pollution and degradation of the environment;
- To avoid or minimise waste and to re-use or re-cycle waste where possible;
- To apply a risk averse and cautious approach;
- To anticipate and prevent negative impacts on the environment (physical, biological, social, economic, and cultural). Where these impacts cannot be prevented, such impacts must be minimized or remedied;
- That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimized and remedied;
- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option; and
- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.

The NEMA stipulates that anyone who causes pollution or degradation of the environment is responsible for preventing impacts occurring, continuing or recurring and for the costs of repair of the environment. Other legislation that contain requirements which were taken into consideration in drafting the EMP, include:

- National Environmental Management Act No. 107 of 1998;
- National Water Act, 1998 Act No. 36 of 1998; and
- Occupational Health and Safety Act No. 85 of 1993.

This EMP among other things:

- Presents an action plan for the implementation of mitigation measures with the purpose of regulating the Contractor's conduct or method of working;
- Provides specific environmental guidance for construction and operation activities;
- Incorporates measures to manage and mitigate construction activities so that negative environmental impacts are avoided or reduced;
- Identifies and allocates responsibilities for specific actions associated with the management of construction activities to mitigate negative environmental impacts; and
- Provides an outline of the activities which require monitoring and the assessment thereof.

1.3 Project Team

The SRK team responsible for compiling the EMPr consists on Ms Ndomupei Masawi (Senior Environmental Scientist) and Ms Manda Hinsch (Partner/Principal Environmental Scientist). The expertise of the team members is included in **Section 1.3.1**.

1.3.1 Details and Expertise of the Environmental Assessment Practitioner (EAP)

Ndomupei Masawi is a registered SACNASP (Reg Number: 400045/14) Professional Environmental Scientist who has more than 12 years of Integrated Environmental Management experience. Her experience includes compiling Environmental Management Programmes, undertaking Public Participation Processes, providing Geographic Information System (GIS) Services and undertaking the processes and assessments to support applications for Environmental Authorisations, Water Use Licences, Waste Management Licences and Air Emission Licences, for roads, railway lines, power stations, airports, dams, housing developments, schools in South Africa, Zimbabwe and Uganda.

Manda Hinsch has been involved in the water sector field for the past 34 years. Her expertise includes:

- Conducting processes to obtain water and environmental authorisations, including the associated public participation processes
- thorough and in depth understanding of the South African water legislation; National Water Act (1998) associated with links to the Water Act of 1956;
- water reform strategies and reallocation. development of policies for Implementing Water Allocation Reform (WAR) in South Africa with associated pilot implementation;
- implementation of WAR in selected catchments the implementation of validation;
- evaluation of impacts and management through the issuing of Water Use Authorisations and the management of hazardous and solid waste for industrial, mining water and waste water systems;
- implementation and policy development in water and related fields particular focus on water quality management and management of water quality in urban and informal areas;
- waste management strategies;
- institutional development in the water sector- establishment of Catchment Management Agency member of various steering Committees, e.g Development of Classification System, 2010 Water Quality Standards, Development of Catchment Management Strategy guidelines etc;
- extensive experience in the environmental and water legislation both in policy development and implementation and environmental (hydrology and water quality) investigation for nuclear sites;
- surface water, water quality, specialist studies including monitoring protocols and plans;
- annual water monitoring studies and small towns water reconciliation studies;
- steering and guiding of research projects in the water field through the Water Research Commission; and
- development and implementation of policy and strategy on pollution from urban areas.

1.4 Structure of the EMP

The EMP has been structured to include the following aspects:

- **Chapter 1** provides project background and team details;
- **Chapter 2** provides the summary of the project description;
- **Chapter 3** specifies roles, responsibilities and compliance monitoring requirements;
- **Chapter 4** provides a description of the EMP, including all relevant legislative requirements and principles;
- **Chapter 5** provides mitigation and management plans for the pre-maintenance, maintenance and rehabilitation phases of the maintenance works;
- **Chapter 6** provides the Monitoring programme; and
- **Chapter 7** provides the Environmental Awareness Plan.

2 Project Details

2.1 Project Description

The Braamfontein Rehabilitation project was divided into two phases (Phase 1, which entailed the construction of gabions at 7 identified priority areas, and Phase 2, which will address the rehabilitation of the rest of the Spruit and is subject to this EMPr).

To identify the appropriate remedial measures along the Spruit, a hydrodynamic modelling of the fluvial morphology of the Braamfontein Spruit was conducted. Based on the hydrodynamics, the river bed and bank sediment characteristics, and the scour patterns simulated by the mathematical model, hydraulic designs were carried out of river bank protection measures which considered riprap, groynes, bed arrestors, streamlined bridge flow patterns, energy dissipaters, etc. In locations where the river is constricted unnaturally, rehabilitation of the main

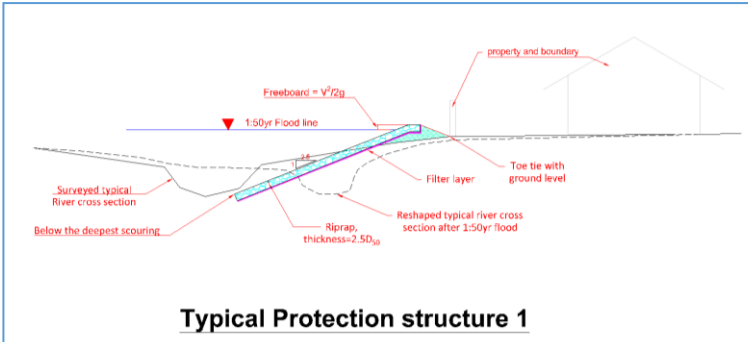
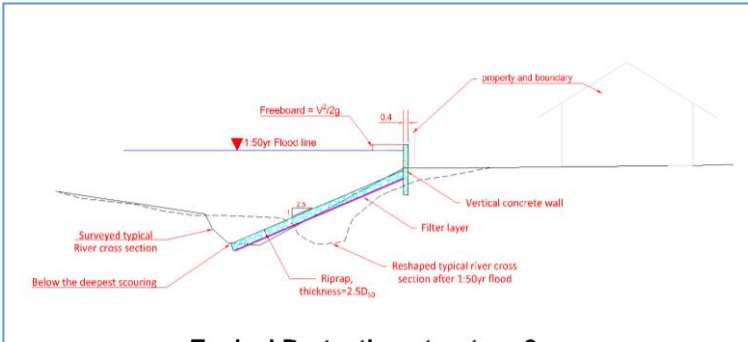
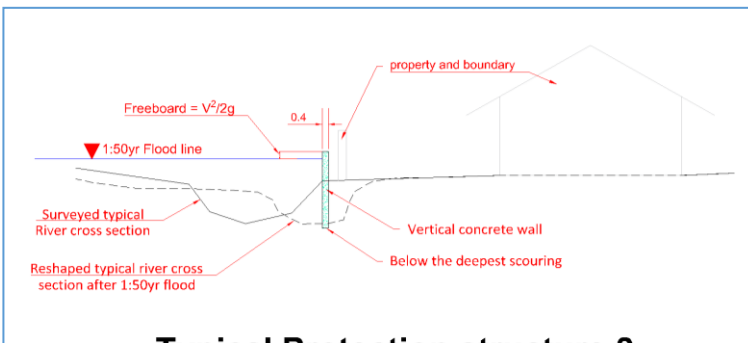
channel and floodplains were considered, based on regime theory and hydrodynamic modelling. The areas earmarked for remediation are shown in Figure 1-1.

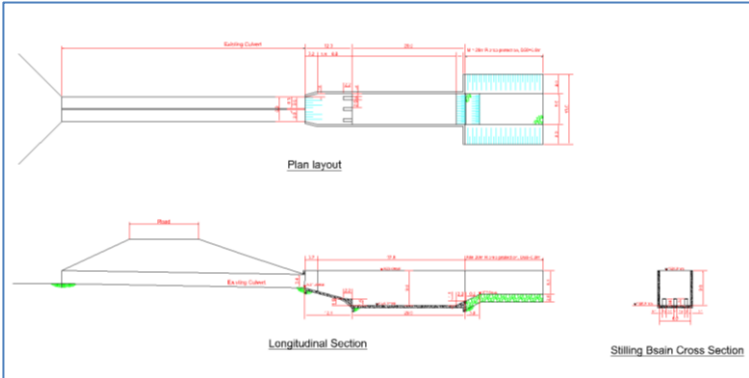
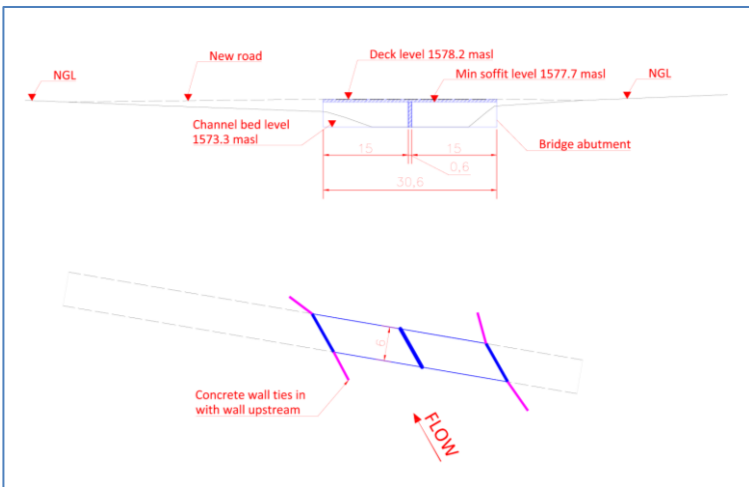
The study identified three (3) alternatives that will be used at different sections of the Spruit (Table 2-1). It must be noted that the identified alternatives will be applied at different sections of the Braamfontein Spruit, depending on the state of the river bank. Where the floodplain are wide berms with riprap protection are proposed. In constricted reaches due to existing development, concrete walls on bedrock or with riprap protection are proposed. The proposed designs above require no maintenance, unlike Reno mattresses or gabion boxes. The existing concrete canal on the golf course should be rehabilitated and slightly realigned near the heritage bridge.




In addition, three site-specific conceptual remedial measures were required for the following areas:

- Stilling basin at site 2 (downstream of the Barry Hertzog Avenue culvert).
- Proposed new bridge at site 8 (2nd Street, Parkhurst) that will replace the existing bridge.
- Damaged canal at site 5 (Parkview Golf Club) requires refurbishment.
- Desilting of two existing dams located in the Braamfontein Spruit, which have become silted over time.

Table 2-1: Proposed erosion protection measure types and remedial measures

Description of river bank erosion protection	Reference drawing
Wide floodplains: Berm with 1:2.5 side slope on both sides, Riprap protection on one side face to river, riprap toe below 50years flood erosion level	 <p style="text-align: center;">Typical Protection structure 1</p> <p>Figure 2-1: Designed typical protection structure -1</p>
Limited space and deep alluvial material: Concrete wall with 1:2.5 bank slope and Riprap protection on one side, riprap toe below 50 year flood erosion level	 <p style="text-align: center;">Typical Protection structure 2</p> <p>Figure 2-2: Designed typical protection structure -2</p>
Limited space and shallow bedrock: Concrete wall without side slope, toe below 1:50 years flood erosion level or to bedrock	 <p style="text-align: center;">Typical Protection structure 3</p> <p>Figure 2-3: Designed typical protection structure -3</p>

Description of river bank erosion protection	Reference drawing
<p>Stilling basin at site 2 (downstream of the Barry Hertzog Avenue culvert). A concrete stilling basin is proposed downstream of the Barry Hertzog culverts at the upper end of the golf course reach. A standard USBR stilling basin was designed. The stilling basin has to be a concrete structure due to the high stream power. The chute leaving the culverts diverge slightly as it enters the stilling basin. Downstream of the stilling basin riprap on a suitable filter is required in the high-energy zone near the stilling basin.</p>	 <p>Figure 2-4: Details of proposed stilling basin at site 2 (downstream of the Barry Hertzog Avenue culvert)</p>
<p>Proposed new bridge at site 8 (2nd Street, Parkhurst) that will replace the existing bridge</p>	 <p>Figure 2-5: Cross section and layout of the proposed new bridge at site 8 (2nd Street, Parkhurst)</p>

Description of river bank erosion protection	Reference drawing
<p>Damaged canal at site 5 (Parkview Golf Club) requires reinstatement</p>	 <p>Figure 2-6: Rehabilitation of existing canal in Parkview Golf Club required at site 5</p>
<p>Dam 1: The dam has a capacity of 30 000 m³ and is not lined. The maximum wall height is 6m, with a crest length of wall of 100 m. The dam basin measures 120 m (length) by 80 m (width at the widest part). The dam has an overflow weir.</p>	
<p>Dam 2: Dam 2 has a capacity of 50 000 m³ and is also not lined. The maximum wall height is approximately 4 m, with a crest length of wall of 130 m. The dam basin measures 160 m (length) by 120 m (width at the widest part). The dam also has an overflow weir.</p>	

The designs are based on the 50 year scour depths and flood. The identified remediation measures will be constructed at different sections of the Spruit as provided in Table 2-2.

Table 2-2: Proposed erosion protection measures along Braamfontein Spruit based on hydrodynamic modelling with the mitigation measures in place

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
1	In hazard and erosion zone	4	Berm** with Riprap	1	102	2.1	
2	No	-	No				Flood won't reach this site when upstream berm built at site 1
2	In hazard and erosion zone	1	Stilling basin				Stilling basin downstream of Barry Hertzog Avenue culvert designed
3	In hazard and erosion zone	4	Riprap	2	65	5.5	Approach road downstream side erosion protection
4	In hazard and erosion zone	4	No				Site 4 was numbered initially but is now considered out of the study area.
5	In hazard and erosion zone	4	Riprap	2	40	5	Approach road downstream side erosion protection
5	In hazard zone	4	New canal	3	246	±3	Canal realignment to straighten the flow through heritage bridge
6	In hazard and erosion zone	1	High Concrete wall with riprap***	2	126	3	River rehabilitation*; Typical protection structure 3 (vertical concrete wall) is an alternative.
7	In hazard and erosion zone	1	High Concrete wall	3	101	4.5	River rehabilitation, the bridge downstream of site 7 recommend removal
8	In hazard and erosion zone	1	High Concrete wall	3	148	4.5	River rehabilitation; New bridge with higher soffit level and/or wider channel

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
							was evaluated in the hydrodynamic model to limit damming.
9	In hazard and erosion zone	2	High Concrete wall	3	98	4	River rehabilitation
10	In hazard zone	1	High Concrete wall	3	129	4.6	River rehabilitation
11	In hazard and erosion zone	2	High Concrete wall	3	147	4.3	River rehabilitation
12	In hazard zone	2	High Concrete wall	3	53	4.5	River rehabilitation
13	No	-	No				Flood does not reach building
14	No	-	No				Flood does not reach building
15	In hazard zone	1	High Concrete wall	3	82	3.5	The weir upstream of site 15 should be removed
16	In hazard zone	1	High Concrete wall	3	120	3.5	The weir upstream of site 16 should be removed; The weir and sedimentation cause additional damming and flooding upstream of the weir and it is proposed that it is removed.
17	In hazard and erosion zone	2	Berm with Riprap	1	48	3.1	Vertical concrete wall is an alternative
18	In hazard and erosion zone	4	Stilling basin				Energy dissipation and erosion protection needed downstream of the bridge. Detail cannot be designed since the river upstream of the bridge has not

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
							been surveyed. At this stage this is considered to be outside the study area but could be included if a survey is carried out upstream of the bridge over a distance of 300 m.
19	In hazard zone	2	Berm with Riprap	1	35	2.6	Property boundary located in middle of the river and the berm cannot be constructed in the river.
20	In hazard zone	2	Berm with Riprap	1	61	2.8	
21	In hazard zone	1	Berm with Riprap	1	343	4.7	
22	In hazard zone	2	Berm with Riprap	1	67	4.6	
23	In hazard and erosion zone	2	Berm with Riprap	1	195	5.7	
24	In hazard and erosion zone	2	Berm with Riprap	1	227	2.9	
25	In hazard and erosion zone	3	Berm with Riprap	1	424	5.3	
26	In hazard zone	1	High Concrete wall with riprap	2	177	6.5	Riprap max D50=3.05m, suggest use concrete face
27	In hazard and erosion zone	2	High Concrete wall with riprap	2	32	1.5	
28	In hazard and erosion zone	1	Berm with Riprap	1	73	6.4	Or consider remove the structures and buildings
29	In erosion zone	4					Recommend remove the buildings and structures

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
30	In hazard and erosion zone	3	Berm with Riprap***	1	429	4.5	Site 30 only indicates protection at the RHS of the river. Vertical concrete wall is an alternative. Large riprap construction (dumped rock) should not be a problem with an experienced contractor.
31	In hazard and erosion zone	1	High Concrete wall with riprap	2 and 3	653	5.8	River rehabilitation
32	In hazard zone	1	High Concrete wall	3	465	8.2	River rehabilitation
33	In hazard and erosion zone	2	High Concrete wall	3	109	6.5	No protection needed between 32 and 33. Hazard stops short of the buildings.
34	In hazard and erosion zone	2	High Concrete wall with riprap	2 and 3	186	7.9	
35	In erosion zone	3	High Concrete wall with riprap	2	157	7.4	Generally scour is outside the flood hazard zone
36	In hazard zone	1	Berm with Riprap	1	1285	6.3	This is a long reach to protect. Alternative is to replace the berm with a vertical concrete wall. Costing to be done during detail design.
37	In hazard and erosion zone	3	Berm with Riprap	1	153	3.2	
38	In hazard and erosion zone	2	Berm with Riprap	1	159	3.2	
39	In hazard and erosion zone	1	Berm with Riprap***	1	140	5.6	Remove the buildings or replace the berm with

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
							vertical concrete wall as alternative.
40	In hazard and erosion zone	2	Berm with Riprap	2	200	4.8	Remove the weir at downstream of site 40, Inverted syphon or pipe below bed to be designed if energy head is sufficient. If not, then the pipe has to be surveyed locally in the field to assess in detail what its impact is on damming and flow patterns if it is left as is.
41	In hazard and erosion zone	1					Recommend remove the buildings and structures
42	In hazard zone	1	Berm with Riprap	1	187	7.2	
43	In hazard and erosion zone	1	Berm with Riprap	1	498	6.1	Berm designed with toe line outside of cadastral line. Or else, the typical protection structure 2 (Riprap plus vertical concrete wall) can be used as alternative.
44	In erosion zone	3	Berm with Riprap	1	101	5.7	
45	In hazard and erosion zone	2	High Concrete wall with riprap***	2	451	5.1	Typical protection structure 3 (vertical concrete wall) is an alternative.
46	In hazard and erosion zone	3	Berm with Riprap	1	104	4	
47	In hazard and erosion zone	1	Berm with Riprap***	1	277	5.4	Typical protection structure 3 (vertical

Protection site no. Figure 1-1)	Motivation	Priority level (Table 2-3)	Structure description	Cross section type (Table 2-1)	Crest length (m)	Structure maximum height (m)	Comment
							concrete wall) is an alternative.
48	In hazard and erosion zone	1	High Concrete wall with riprap	2	115	6.8	
49	In hazard and erosion zone	2	Berm with Riprap	1 and 2	460	3.7	Last 78m of structure change to high concrete wall to tie in with downstream bridge abutment
50	In hazard zone	1	Berm with Riprap	1	75	3.1	Or consider remove the buildings and structures in high hazard zone

Table 2-3: Proposed priorities based on flood hazard and erosion on properties

Priority level	Recommend phasing*
1. Building in hazard zone: damage to light structures possible	1*
2. Building in hazard map zone: wading unsafe	2
3. Property in both erosion zone and hazard map damage to light structures possible zone, excluding golf course	3
4. Road or golf course in both erosion zone and hazard map zone	4

Note: * 1 = highest priority

2.2 Construction Methodology

2.2.1 Site Establishment

The construction sites will be located on previously disturbed areas as all the areas identified are within a built up environment. These areas will make provision for closed civil systems such as water tanks and conservancy tanks for sewerage containment. All waste products will be removed from the construction sites to an approved and licensed disposal site. Rehabilitation of the construction sites will be to the same level as to prior establishment. The construction site camps will be located above the 1:100 year flood line with hazard free accessibility from the main roads for delivery and access to the construction areas. Access to the respective construction sites would be possible via pre-existing roads. All additives to be used are to be non-poisonous and environmentally friendly. Batching of concrete for all purposes is to be done

at the construction site camps in a regulated environmentally friendly way. No batching will be allowed to happen inside river servitude area of the 1:100 year flood line. All construction equipment and material also to be stored at the site camps and above the 1:100 year flood line where required. All material will be imported thus no quarries will be established in the vicinity.

2.2.2 Typical protection structure 1 (Riprap and vegetated berm)

1. Site Clearance and establishment.
2. All necessary traffic accommodation and construction warning signage will be erected as necessary.
3. River diversion and dewatering where required.
4. Surveying and setting out.
5. All existing failed gabion structures and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
6. Importing and placement of appropriate fill material.
7. Preparation and compaction of the river bank.
8. Riprap installation:
 - Ensure correct gradient.
 - Provide specified fabric.
 - Fabric shall be securely stapled to the ground.
 - Provide the specified type and size of riprap.
 - A rock bucket should be used during the installation of the riprap.
 - Place riprap according to engineering specifications and guidelines provided during detailed design.
9. Berm:
 - Provide enough material to construct berm to required height.
 - Place and compact material according to engineering specifications and guidelines provided during detailed design.
 - Ensure that the berm ties in with the riprap to form one structure.
10. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
11. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
12. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

2.2.3 Typical protection structure 2 (Riprap & vertical wall)

1. Site Clearance and establishment.
2. All necessary traffic accommodation and construction warning signage will be erected as necessary.
3. River diversion and dewatering where required.
4. Surveying and setting out.

5. All existing failed gabion structures and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
6. Importing and placement of appropriate fill material.
7. Preparation and compaction of the river bank.
8. Riprap installation:
 - Ensure correct gradient.
 - Provide specified fabric.
 - Fabric shall be securely stapled to the ground.
 - Provide the specified type and size of riprap.
 - A rock bucket should be used during the installation of the riprap.
 - Place riprap according to engineering specifications and guidelines provided during detailed design.
9. Concrete wall:
 - Excavation into river bank.
 - Erect formwork and steel fixing.
 - Cast concrete.
 - Curing.
 - Stripping of shutters.
 - Backfill and compact.
10. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
11. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
12. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

2.2.4 Typical protection structure 3 (Vertical wall)

1. Site Clearance and establishment.
2. All necessary traffic accommodation and construction warning signage will be erected as necessary.
3. River diversion and dewatering where required.
4. Surveying and setting out.
5. All existing failed gabion structures and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
6. Importing and placement of appropriate fill material.
7. Preparation and stabilisation of the river bank.
8. Concrete wall:
 - Excavation into river bank.
 - Erect formwork and steel fixing.
 - Cast concrete.
 - Curing.

- Stripping of shutters.
 - Backfill and compact.
9. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
 10. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
 11. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

2.2.5 Concrete stilling basin (site 2)

1. Site Clearance and establishment.
2. All necessary traffic accommodation and construction warning signage will be erected as necessary.
3. River diversion and dewatering where required.
4. Surveying and setting out.
5. All existing failed gabion structures and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
6. Importing and placement of appropriate fill material.
7. Preparation and stabilisation of the river banks.
8. Concrete stilling basin:
 - Excavation into river bank up to bedrock.
 - Prepare base with proper compaction of the soil and to the correct level.
 - Erect formwork and steel fixing.
 - Tie into existing upstream culverts and downstream canal.
 - Cast concrete.
 - Curing.
 - Stripping of shutters.
 - Backfill and compact where necessary.
9. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
10. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
11. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

2.2.6 Proposed new bridge (site 8)

1. Site Clearance and establishment.
2. All necessary traffic accommodation and construction warning signage will be erected as necessary. This will include temporary access for residents to cross the river.
3. River diversion and dewatering where required.
4. Surveying and setting out.

5. All existing failed gabion structures and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
6. Importing and placement of appropriate fill material.
7. Preparation and stabilisation of the river banks.
8. Erection of bridge (ensure strict quality control throughout entire process):
 - Excavation into river bank and river bed for foundation work.
 - Erect formwork and steel fixing.
 - Cast concrete columns and supporting beams/structures.
 - Curing.
 - Stripping of shutters.
 - Erect formwork and steel fixing for bridge causeway.
 - Cast bridge causeway.
 - Curing.
 - Stripping of shutters.
 - Provide asphalt pavement and tie into existing road.
 - Provide appropriate road markings.
 - Erect needed signage and safety barriers.
9. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
10. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
11. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

2.2.7 Rehabilitation of existing canal (site 5)

1. Site Clearance and establishment.
2. River diversion and dewatering where required.
3. Surveying and setting out with new alignment.
4. All existing failed canal sections and other debris will be removed down to the founding rock embankment with the use of an excavator where possible or by hand.
5. Importing and placement of appropriate fill material.
6. Preparation and stabilisation of the side embankments if required.
7. Concrete canal:
 - Excavation into riverbank and base.
 - Prepare base with proper compaction of the soil and to the correct level.
 - Erect formwork and steel fixing to tie in with existing canal walls and base.
 - Cast concrete canal base and then walls as one structure.
 - Curing.
 - Stripping of shutters.
 - Backfill and compact.

8. Landscaping, shaping of ground, planting of vegetation where required and consideration of green engineering around all structures.
9. Rehabilitation and site de-establishment including the removal of all debris and waste products off the site to an approved and licensed disposal site.
10. Maintenance of the rehabilitated areas should be carried out to ensure that the newly planted vegetation does not die.

The conceptual design drawings are included in **Appendix 1** of the EMP and the Method Statement in **Appendix 2**.

2.3 Services

2.3.1 Water for Construction Purposes

The water required for maintenance purposes will be supplied by the City of Johannesburg Metro Municipality.

2.3.2 Power

All machinery used during the construction will be diesel/petrol driven.

2.3.3 Sanitation

Chemical ablution facilities will be made available to the maintenance staff at all times during the maintenance period. These facilities will be serviced regularly, and the waste will be transported to a treatment facility off-site. The facilities will be removed from the site once the maintenance phase is completed.

2.3.4 Contractors Camp and Laydown Area

The contractor's camp and laydown areas shall be located outside the 1:100 year floodlines of the Braamfontein Spruit, any drainage areas and the wetland buffer zone.

2.3.5 Access Roads.

The existing access roads will be used throughout the construction phase. It is expected that access to the respective construction sites will be open spaces, golf course and park areas.

2.3.6 Stockpiles of Raw Materials

The stockpiles will be placed in such a way that they will not impact on the Braamfontein Spruit and drainage areas and will be located outside the 1:100 year floodlines.

2.4 Fuel Storage

To prevent earthmoving machinery moving in and out of the site and disrupting traffic in the area diesel will be stored on site. Diesel will be required primarily for the earth moving equipment. The demand for diesel is estimated at 10 000 litres per month. On-site storage of about 5 000 litres in above ground storage tanks will be required to ensure the continuation of the construction activities.

2.5 Construction Materials

Suitable excavated material will be stockpiled adjacent outside the 1:100 year floodlines of the Braamfontein Spruit or outside of the wetland buffer zone, or whichever is great, and used as backfill where required. Material not suitable for backfilling and all excess excavated material that is not required for backfilling will be disposed of at a registered Landfill Site. Batching of concrete for all purposes will be done at the construction site camps in a regulated

environmentally friendly way. No batching will be allowed within the 1:100 floodlines of the Braamfontein Spruit.

2.6 Employment

It is anticipated that the contractor (s) who will be appointed to do the work will be responsible for recruiting people, including those from the surrounding area. Employment will only be generated during the construction phase of the project.

2.7 Occupational Health and Safety

As a basic, all contractor employees and visitors will undergo induction training with regard to health, safety and the environment. This training will be required prior to entering the site for the first time and will be required each time the conditions on-site change such that additional training is required.

Personal Protective Equipment (PPE) will be issued to all persons entering the construction site. PPE includes safety shoes, goggles, earplugs, gloves, hard hats, masks, etc. The PPE required will be dependent on the area that the person is working in, as well as the activity he/she is undertaking. The Contractor will conduct continuous rainfall projection monitoring to ensure the safety of the construction workers.

3 Roles, Responsibility and Compliance Monitoring Requirements

The purpose of this section is to define roles for personnel and allocate responsibilities in the implementation and monitoring of the EMPr.

3.1 Gauteng Department of Agriculture and Rural Development (GDARD)

The GDARD plays a lead role in the implementation of environmental policies, legislation and regulations. Their role is to ensure that the construction of the maintenance works on the Braamfontein Spruit is implemented in a sustainable manner, in compliance with the relevant environmental legislation. GDARD is responsible for approving the EMPr for the project and any revisions and amendments thereto.

3.2 Johannesburg Roads Agency SOC (JRA)

The Roles and Responsibilities of the Maintenance, JRA and its representatives are summarised in Table 3-1. The JRA is the applicant, the developer of the project and the Client of the Maintenance Contractor. Under the NEMA, applicants are accountable for the potential impacts of activities being undertaken as well as managing these impacts. JRA therefore has the overall environmental responsibility to ensure that the implementation of this EMPr complies with the national, provincial and condition of the authorisation from the GDARD.

Table 3-1: Roles and Responsibilities of JRA Personnel and Contractor

Key	Function	Responsibility
MC	Maintenance Contractor	<ul style="list-style-type: none"> A person or firm appointed by the JRA to undertake a contract to provide materials or labour to perform a service or do a job. The Maintenance Contractor is responsible for the implementation of this EMPr and ensuring that the works on site are conducted in an environmentally sensitive manner and fully in accordance with the requirements of this EMPr at all times.
ROM	Regional Operations Manager.	<ul style="list-style-type: none"> Proponent ultimately accountable for ensuring compliance to the EMPr and any other conditions.
DM	Depot Manager	<ul style="list-style-type: none"> Oversee and ensure compliance with the EMPr and other relevant legislation. Ensure the continual relevance of the Environmental Method statements through constantly evaluating and considering new techniques in order that improved work techniques are strived for. This must be reflected in the updated Environmental Method statements (MS). Amended MS must be communicated to the relevant parties by the DM at the various forums available. The DM must maintain records of attendance at these forums. Manage, advise and monitor maintenance contractors in order that they comply with contractual agreements relating to this EMPr.
AMP	Assistant Manager: Planning	<ul style="list-style-type: none"> Initiates the EMPr and related documentation. Assists the Depot Manager develop Method Statements and ensure continuous improvements to the environmental management practices and procedures. Assist with effective dissemination of any environmental management related information via the various forums available.
AMO	Assistant Manager: Operations	<ul style="list-style-type: none"> Will manage the signoff and handover process where maintenance contractors have been appointed to undertake maintenance work. The environmental checklist must be sought from the maintenance contractor and attached to the completion certificate for inclusion in the job card handover. In the case of maintenance contractors undertaking maintenance work, inspections are to be carried out prior to the job card being closed.
AMI	Assistant Manager: Implementation	<ul style="list-style-type: none"> Monitor compliance with the EMPr and other relevant legislation so that the legislative requirements within the Depot's jurisdiction are met. This will be achieved through the review of reports submitted.
I	Inspector	<ul style="list-style-type: none"> Carry out inspections on work done and determine this in line with the EMPr and MS. Complete inspection report for submission to the Assistant Manager: Planning and Technical.

Key	Function	Responsibility
TLS	Team Leader/ Supervisor	<ul style="list-style-type: none"> Will ensure that team are trained in the necessary environmental emergency response procedures (Oil spills, breakdowns, waste management etc.). Monitor compliance with the EMPr on site. Report on compliance with the EMPr. This will be done to the foreperson. The Environmental checklist must be completed for issue to the Foreperson.
F	Foreperson	<ul style="list-style-type: none"> The foreperson will hold similar responsibility with regard to environmental management matters assisting the team leader achieve the required measurable targets. When collecting job cards from supervisors the completed environmental checklists must also be sought.
LTO	Liaison Transport Officer	<ul style="list-style-type: none"> Ensure that maintenance vehicles/machinery do not pose any risk to the environment prior to being deployed to the maintenance site. (Risks include: Hydrocarbon leaks, Excessive fumes, potential for hydrocarbon leaks due to perished pipes, poor hydraulic seals etc.) Refuse the use of maintenance vehicles/machinery on site that poses the above risks. Checklists to be completed daily and copies attached to the report completed by the inspector.
HSEO	Health Safety Environmental Officer	<ul style="list-style-type: none"> The HSEO forms part of the JRA management team. Ensure that the EMPr is applied and adhered to. Undertake internal audits using the EMPr as the Audit standard. Do site assessments. Draw up emergency procedures Draw up emergency reporting procedures

3.3 Environmental Control Officer (ECO)

The JRA will appoint a suitably qualified ECO who will be responsible for monitoring and auditing the implementation of the EMP and EA during the construction and decommissioning phases. The designation of the ECO is reserved for suitably qualified environmental personnel, with adequate environmental knowledge to understand and implement the EMP. Once appointed, the name and contact details of the ECO must be submitted to the Director: Compliance Monitoring of the GDARD.

The duties of the ECO during construction phase will include but are not limited to:

- Evaluation of the EIA documents and verify the environmental condition of the project footprint.
- Prior to the commencement of construction activities, the ECO and Contractor will conduct a pre-construction survey of site. The Contractor for the ECO's review must document the findings of the pre-construction survey in a report with photographic reference. The construction procedure, designated no go areas and activity zones must be confirmed at this time by the Contractor and JRA and agreed with by the ECO.
- Bi-weekly (i.e. every two weeks) site inspections during construction must take place to ensure adherence to environmental laws and the conditions contained in the EMP.
- Monthly reports and relevant checklists on the findings of the monitoring sessions must be compiled and submitted to JRA.
- Provide independent compliance reporting to the GDARD.
- Conduct monthly audits and compile report on audit findings for submission to JRA and the GDARD.
- Reporting of any non-conformances within 48 hours of identification of such non-conformance to the relevant authorities.
- Ensure that the requisite remedial action is implemented in the event of noncompliance.
- Maintain a non-conformance register.
- Ensure the proactive and effective implementation and management of environmental protection measures.
- Ensure that a register of public complaints is maintained by the Contractor and that all public comments or issues are appropriately reported and addressed.
- Act as a Liaison between JRA, the Contractor and GDARD.

3.4 Contractor Management

Contractor management will be affected through specific activities as listed below:

- Environmental management expectations during the project shall be highlighted.
- The EMP shall be included with the contract documents.
- The appointed Contractor shall be instructed to develop a document that should indicate how they plan to ensure compliance with the EMP.

4 Guidelines for the Environmental Management Plan

4.1 General Guidelines

In terms of Section 28 of the NEMA, the prevention of any site degradation due to non-compliance, administrative or financial problems, and inactivity during the maintenance phase, illegal activities, delays caused by archaeological finds, etc. is ultimately the responsibility of the JRA.

The works site must be clearly defined and surveyed according to the project authorisation. The existing access roads will be used throughout the construction period. It is expected that access to the respective construction sites will be via the Parkview golf course, park areas and

open spaces. No workforce members and other personnel shall be allowed to access areas beyond the defined site onto adjacent private property, unless is necessary and the property owner has given prior approval. This will ensure that no unnecessary delays in the process are caused.

No camping shall be allowed on any private property and damage to private or public property such as fences, gates and other infrastructure that occurs shall be repaired to the satisfaction of the owner in line with the Public Liability Claims procedure.

Relevant landowners and businesses must be informed of the maintenance work as well as the phases in which the work shall take place via adequate signage at strategic points on site. JRA Customer Contact Centre number to be included on the signage is Tel: 0860562874 and e mails: hotline@jra.org.za).

The Maintenance Contractor must adhere to all conditions of the contract including this EMP. Proper planning of the maintenance works must be undertaken to allow for disruptions due to rain and very wet conditions.

Proper site management and regular monitoring of site works must take place. Proper documentation and record keeping of all complaints and actions taken (as per the Incidents Register and Environmental Checklist) must be issued with the completed job cards. Regular site inspections and good control over the maintenance process must be kept throughout the maintenance period.

4.2 Environmental Principles

The following environmental principles should be considered at all times during the pre-construction and the construction phase:

- The footprint of the construction activities must be kept as small as possible;
- As a minimum requirement, all relevant standards relating to international, national; provincial and local legislation will be adhered to; and
- Every effort will be made to implement the waste hierarchy of reduce, reuse, and/or recycle waste material generated on site.

4.3 Incidents and Non-Conformances

According to Section 30 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA): *“Incident” means an unexpected sudden occurrence including a major emission, fire or explosion leading to serious danger to the public or potential serious pollution of or detriment to the environment, whether immediate or delayed.*

In terms of the above definition:

- The Emergency response plan/method statement should be initiated in response to an incident as classified in Table 4-1. The incident must be reported to the ECO and GDARD as per Section 30 (3) of NEMA. An emergency incident report required in terms of Section 30(5) of NEMA must be submitted to GDARD’s Environmental Management Inspectorate for processing.
- A chemical spill is defined as a potential liquid hydrocarbon or chemical spill or other release, which can create a hazard to life or property or create environmental damage. Examples include liquid hydrocarbons, compressor or other equipment lube oil, evaporative cooler acid water, liquid odorant, or other substances that contain controlled or hazardous substances. Spills and other environmental incidents have been classified according to the risk to the environment and appropriate responses are indicated in Table 4-1.

Table 4-1: Classification of Environmental Incident

Level	Definition	Response Required
Level 1	A Minor Emergency, which can be controlled, entirely by the personnel and facilities located within the immediate vicinity of the accident/incident site. These include events which cause minor property or equipment damage that are non-disruptive to operations, and do not pose a safety risk to personnel or property outside of the boundaries of the development footprint.	Record in the incidents register and managed accordingly
Level 2	A Level 2 Incident is defined as a Moderate Emergency, which is disruptive, but not extensive, and forces <u>a portion</u> of the employer operation to be temporarily suspended or shut down. A Level 2 Incident is a spill or hazardous product release which has the potential to cause harm to personnel, the public, or the environment and includes a chemical spill of more than 35 l to land; or any chemical spill to water resources.	Record in the incidents register and managed accordingly
Level 3 to 5 Incidents	A Level 3 to 5 Incident is defined as a Serious (3), Major (4) to Catastrophic (5) alert requiring the intervention of external support services and that can have serious impacts on ecology, humans and on the overall Project.	Report the incident to the ECO immediately. The ECO will submit an emergency incident report to GDARD. The incident must also be recorded in the incidents register

In the above cases, it will be the decision of the site management as to whether work stoppage must be implemented. In most cases, work in the area where the incident occurred will be stopped until all safety clearances have been given. Unless, there is a fatal accident, then the whole site will stop.

4.4 Penalties and Liabilities

Section 24F of NEMA deals with prohibitions relating to commencement or continuation of listed activities. It provides that:

- 1) *Notwithstanding any other Act, no person may-*
 - a) *Commence an activity listed or specified in terms of Section 24(2)(a) or (b) unless the competent authority or the Minister responsible for mineral resources, as the case may be, has granted an environmental authorisation for the activity; or*
 - b) *Commence and continue an activity listed in terms of Section 24(2) (d) unless it is done in terms of an applicable norm or standard.*

Section 49A of the Act deals with relevant offences. It provides that:

- (1) *A person is guilty of an offence if that person-*
 - a) *Commences with an activity in contravention of Section 24F (1)*

Section 49A of the Act deals with the penalties and provides that:

- 1) *A person convicted of an offence in terms of Section 49A(1)(a) is liable to a fine not exceeding R10 million or to imprisonment for a period not exceeding 10 years, or to both such fine or such imprisonment.*

Further to the above the JRA internal policies are in place dealing with consequences for non-compliance, these remain enforceable should it be found that all or part of this EMPr has not been complied with.

4.5 Compliance with Legislation and Regulations

The contractor is required to comply with all relevant national and provincial legislation and regulations including:

- Atmospheric Pollution Prevention Act No. 45 of 1965 for the Control of noxious and offensive gases, smoke, dust and vehicular emissions;
- National Environmental Management: Air Quality Act 39 of 2004, List of Activities which result in Atmospheric Emissions which may have a Significant Detrimental Effect on the Environment – GN R893/2013
 - Listed activities and associated minimum emission standards identified in terms of Section 21 of the National Environmental Management: Air Quality Act 39 of 2004;
- National Dust Control Regulations, 2013 GN R827/2013;
- City of Johannesburg Metropolitan Municipality: Air Pollution Control By-Laws;
- Gauteng Noise Control Regulations GN R5479/99, Regulations 8, 9, 10, 12 and 16;
- National Environmental Management Act No. 107 of 1998;
 - Section 30 Environmental Emergency Reporting Requirements; and
 - Environmental Impact Assessment Regulations, 2014 GN R982/2014;
- National Environmental Management: Waste Act, 59 of 2008;
- NEM: WA Section 19 – Listed Waste Management Activities that may require licensing
 - Waste Classification and Management Regulations, 2013 – GN R634/2013;
 - List of Waste Management Activities that have, or are likely to have a Detrimental Effect on the Environment GN R921/2013;
 - National Norms and Standards for Disposal of Waste to Landfill – GN R636/2013
 - Gauteng Waste Information Regulations, 2004; and
 - City of Johannesburg Metropolitan Municipality: Waste Management By-Laws, 2013
- National Water Act 1998 (No. 36 of 1998)
 - Section 20 Environmental Emergency Reporting Requirements;
 - Section 145 Flood risk information; and
 - City of Johannesburg Metropolitan Municipality Public Health By-Laws, Chapter 6 regarding Water;
- Water Services Act No. 108 of 1997
 - Regulations relating to the Compulsory National Standards and Measures to Conserve Water GN R509/2001; and
 - Diversion or impoundment of rivers. Conservation and use of water. Treatment and disposal of waste, wastewater and effluent. Pollution and pollution emergencies. Water Users & Associations;
- Occupational Health and Safety Act No. 85 of 1993: Controls the exposure of employees and the public to dangerous and toxic substances or activities. Department of Labour;
- National Environmental Management Biodiversity Act 10 of 2004;
 - Alien and Invasive Species Lists, 2014; and
 - Alien and Invasive Species Regulations, 2014;
- Conservation of Agricultural Resources Act 42 of 1983;
 - Conservation of Agricultural Resources Regulations GNR 1048/84;
- National Forest Act 30 of 1998 – Section 15 (Effect of declaration of protected trees); and
- City of Johannesburg Metropolitan Municipality: By-Laws for the Protection of Wild Animals and Birds, 2006

4.6 Required Environmental Permits, Licences and Authorisations

Waste disposal – All hazardous waste generated during the construction phase on site will only be disposed of to an appropriate licensed landfill site in terms of the National Environmental Management: Waste Act 2008 (Act 59 of 2008) (NEMWA). Copies of the permits or licences of the landfill sites to be used must be obtained and kept on site before the commencement of construction. All general and hazardous waste generated on site shall be separated and disposed of at the permitted waste disposal site in such a manner as not to cause any nuisance conditions or secondary pollution.

Storage of hazardous substances – Hazardous substances must be stored and handled in accordance with the appropriate legislation and standards. This may include the Hazardous Substances Act 1993 (Act 85 of 1993) (HAS), the Occupational Health and Safety Act 1993 (Act 85 of 1993) (OHSA), relevant associated Regulations and applicable SANS standards. The Contractor must ensure that all the relevant Material Safety Data Sheets (MSDS) are present on site at all times.

Alien Invasive Species – The removal of the alien and weed species encountered on the construction area must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (CARA) and Section 28 of the NEMA.

Health and Safety – The necessary health and safety measures shall be implemented as required in terms of the OHSA.

Heritage Resources – The National Heritage Resources Act 1999 (Act 25 of 1999) (NHRA) requires permits for the removal of structures or elements of cultural significance on site.

Water Use licence (WUL) – Prior to construction taking place in any watercourses, authorisation is required from the Department of Water and Sanitation (DWS). The construction of the remedial measures on the Spruit will trigger the following water uses:

- Section 21 (c) Impeding or diverting the flow of water in a watercourse; and
- Section 21 (i) Altering the bed, banks, course or characteristics of a watercourse.

The rehabilitation activities will therefore require authorisation from the Department of Water and Sanitation (DWS) Gauteng Regional Office. An aquatic and wetlands specialist was appointed to conduct an impact assessment using the DWS risk assessment matrix published in GN R509 of the National Water Act, 1998 (Act 36 of 1998) (NWA). The impact assessment results show that the impacts will be of medium significance, a Water Use Licence Application (WULA) will therefore be required.

4.7 Required Documentation before Commencement of Construction Activities

4.7.1 Environmental Method Statements

The Maintenance Contractors shall compile Environmental Method Statements, which will set out the maintenance vehicles and machinery, materials, labour and method that the maintenance contractor proposes using to carry out the maintenance work. The maintenance contractor must sign each Method Statement along with the Environmental representative and Depot manager to formalise the approved Method Statement.

All Method Statements including, those, which, may be required as ad hoc or emergency maintenance method statements, must be submitted to the Depot Manager for approval prior to the commencement of the activity. Any changes to the method of works must be reflected by amendments to the original approved Method Statement. Any changes in this regard must be approved by the Depot Manager on the understanding that such changes are environmentally acceptable and in line with the requirements of this EMP.

The JRA pro forma Method Statements shall be used and method statements for the following activities must be submitted for approval before maintenance works commence:

- Solid waste management;
- Lay down areas;
- Workshop and maintenance/cleaning of plant;
- Concrete works;
- Dust control;
- Storm water management plan during construction;
- Hydrocarbon and emergency spills procedures;
- Plant refuelling procedures;
- Sourcing, excavating, transporting and dumping of fill and spoil material; and
- Emergencies, non-compliance and communication.

The Method statements must be signed off by the Depot manager.

4.7.2 Pro-Forma Documentation

Prior to the commencement of maintenance activities by the maintenance contractors the JRA pro forma documentation is to be filled out by the contractors and is binding to the EMP and project contract. The proformas documents includes *inter alia*:

- Declaration of understanding by the Depot Manager;
- Declaration of understanding by the Maintenance Contractor;
- Approved Environmental Method statements (updated if required);
- Environmental awareness training records;
- Signed attendance registers of environmental induction; and
- Signed attendance registers of environmental toolbox talks.

5 Quantitative Impact Assessment

The Braamfontein Spruit river system is severely modified due to the canalisation of some sections of the Spruit, which has altered the natural flow patterns and potentially increasing water velocity through the channel, which contributes to the increased incidence of incision and erosion in non-canalised portions. Additionally, impermeable surfaces associated with ongoing urbanisation in the catchment, as well as possible sewage overflows, will result in increased water volumes entering the river especially during storm events. During the aquatic ecological assessment the following observations were made:

- Severe impacts as a result of erosion, incision and embedding;
- Severe impacts in terms of exotic alien vegetation encroachment;
- Some impacts in terms of inundation under high flow conditions;
- Flow modification as a result of weirs and impoundments along the length of the system;
- Litter instream as well as in the riparian area;
- Large pieces of rubble and collapsed infrastructure instream; and

- Significant sedimentation affecting the instream substrates at sections of the river.

It is expected that the construction phase of the project will have the following impacts:

- Changes to instream habitat and biota,
- Deterioration of surface water quality due to sedimentation,
- Contamination of soils,
- Loss of sensitive aquatic taxa;
- Loss of terrestrial biodiversity;
- Deterioration in air quality, and
- Increase in ambient noise levels.

The majority of the identified impacts for the construction phase will be of **moderate** and **low** significance without the implementation of mitigation measures. The implementation of mitigation measures will reduce the significance of the impacts to **low**.

The operational phase of the preferred alternative may result in the following potential impacts:

- Changes to instream habitat and biota,
- Loss of sensitive aquatic taxa;]
- Changes in the hydrology (flow velocity) of the Braamfontein Spruit,
- Proliferation of alien invasive species; and
- Loss of biodiversity.

The flow velocity of the river will be changed due to the use of stream diversion during construction and /or maintenance and repair during the operation phase. The potential alteration of the stream flow characterisation will result in changes to the hydrological function and sediment balance.

The ineffective rehabilitation of the disturbed area will likely result in the transformation of the instream biota and habitat, which will result in the loss of biodiversity and the inability of the river system to support biodiversity. Impacts identified for the operational phase are expected to be of **medium** and **low** significance without the implementation of the mitigation measures included in the EMPr. The implementation of the mitigation measures will reduce the significance of the impacts to **low**.

It is not foreseen that the protection measures and the erosion protection measures will be removed. However, should this happen for some or other reason the potential impacts will be similar to that during construction of the measures. The implementation of the project itself is considered a form of mitigation in terms of arresting erosion that is currently posing a threat to private property as well as residents along the Braamfontein Spruit. The aquatic ecological assessment states that although the watercourse is not necessarily especially sensitive to further negative impacts, the ecology thereof may respond positively to intervention measures thus leading to an overall improvement of the system. For this reason, further degradation to the system should not be permitted, whether it be through direct impacts arising from the implementation of rehabilitation/intervention measures, or indirect impacts associated with the edge effects of increasing urbanisation. Therefore, whilst rehabilitation/intervention is deemed essential in order to prevent further degradation of the system, it is equally essential that such activities do not impact negatively.

5.1 Methodology

All specialists were required to assess each identified potential impact according to the Impact Assessment Methodology as described below. This methodology has been utilised for the assessment of environmental impacts where the consequence (severity of impact, spatial

scope of impact and duration of impact) and likelihood (frequency of activity and frequency of impact) have been considered in parallel to provide an impact rating and hence an interpretation in terms of the level of environmental management required for each impact.

The first stage of any impact assessment is the identification of potential environmental activities¹, aspects² and impacts, which may occur during the commencement and implementation of a project. This is supported by the identification of receptors³ and resources⁴, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Environmental impacts⁵ (social and biophysical) are then identified based on the potential interaction between the aspects and the receptors/resources.

The significance of the impact is then assessed by rating each variable numerically according to defined criteria as outlined in Table 5-1. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity⁶, spatial scope⁷ and duration⁸ of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity⁹ and the frequency of the impact¹⁰ together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix table as shown in Table 5-2.

This matrix thus provides a rating on a scale of 1 to 150 (low, medium low, medium high or high) based on the consequence and likelihood of an environmental impact occurring.

Natural and existing mitigation measures, including built-in engineering designs, are included in the pre-mitigation assessment of significance. Measures such as demolishing of infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

¹An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation.

²An **environmental aspect** is an 'element of an organisations activities, products and services which can interact with the environment'. The interaction of an aspect with the environment may result in an impact.

³**Receptors** comprise, but are not limited to people or man-made structures.

⁴**Resources** include components of the biophysical environment.

⁵**Environmental impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. Receptors can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as aquifers, flora and paleontology. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.

⁶**Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.

⁷**Spatial scope** refers to the geographical scale of the impact.

⁸**Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

⁹**Frequency of activity** refers to how often the proposed activity will take place.

¹⁰**Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.

Table 5-1: Criteria for Assessing Significance of Impacts

SEVERITY OF IMPACT Insignificant / non-harmful Small / potentially harmful Significant / slightly harmful Great / harmful Disastrous / extremely harmful	RATING 1 2 3 4 5	CONSEQUENCE
SPATIAL SCOPE OF IMPACT Activity specific Site specific Local area (within 5 km of the project) Regional National	RATING 1 2 3 4 5	
DURATION OF IMPACT One day to one month One month to one year One year to ten years Life of operation Post closure / permanent	RATING 1 2 3 4 5	
FREQUENCY OF ACTIVITY / DURATION OF ASPECT Annually or less / low 6 monthly / temporary Monthly / infrequent Weekly / life of operation / regularly / likely Daily / permanent / high	RATING 1 2 3 4 5	LIKELIHOOD
FREQUENCY OF IMPACT Almost never / almost impossible Very seldom / highly unlikely Infrequent / unlikely / seldom Often / regularly / likely / possible Daily / highly likely / definitely	RATING 1 2 3 4 5	

Table 5-2: Interpretation of Impact Rating

Likelihood	Consequence														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

High	76 to 150	Improve current management
Medium High	40 to 75	Maintain current management
Medium Low	26 to 39	
Low	1 to 25	No management required

SIGNIFICANCE = CONSEQUENCE x LIKELIHOOD

5.2 Results

5.2.1 Potential Impacts Associated with the Planning Phase

The potential impacts associated with the planning stage (pre-construction phase) of the project included:

- Poor planning leading to an increased footprint in the vicinity of the channel;
- Inadequate design of infrastructure leading to changes in riparian habitat; and
- Inadequate design of infrastructure leading to changes in instream habitat and hydrological patterns.

5.2.2 Potential Impacts Associated with the Construction Phase

Movement of earth moving equipment within the project area will be required for the removal of any existing structures. The removal of any existing infrastructure from the riverbed will potentially result in the loss of and/or changes to the instream habitat and instream biota.

Site clearance for construction result in removal of the riparian habitat. Although the vegetation within this habitat unit has been disturbed as a result of surrounding urban and anthropogenic activities as well as severe alien and invasive plant infestation, the affected areas still provide habitat to support a number of indigenous faunal species. The extensive alien plant growth has however resulted in a significant loss of indigenous floral species.

The terrestrial ecology within this habitat unit is considered largely disturbed and as such, the rectification of areas of erosion and bank instability, current instream infrastructure failure points, as well as the removal of alien invasive plant, will have a *medium significance* level. With the implementation of mitigation measures, the impact significance may be reduced further.

The impact will be localised since it may not be contained to the project site and will last for the duration of the construction phase. The probability that the impact may occur is most likely and will result in an impact with a **medium** significance prior to the implementation of any mitigation measures. With the implementation of mitigation measures, the impact will be reduced to a **low** significance.

It is expected that construction activities will be conducted during the dry months and this will likely result in an increase in nuisance dust. The impact will occur for the duration of the construction phase but will be localised and have a medium severity. The impact will thus have a **medium** significance but will be mitigated with the implementation of dust suppression measures to an impact with **low** significance.

Earth moving equipment and construction vehicles may potentially increase ambient noise levels. The duration of the impact will be throughout the construction phase while construction activities are underway. Once the construction activities stop the ambient noise, levels will return to what it was prior to the construction activities. The impact will have an overall **medium** significance.

Due to the nature of construction activities hydrocarbon spillages is likely to occur. This will result in the deterioration of the water quality and contamination of soils and changes to the instream biota. The impact may occur throughout the construction phase but will be of local importance since the water may not be contained to the immediate site. The impact will reduce the functionality of the receiving environment but it will still continue to function in a modified way. Thus, the impact will have a **medium** significance prior to the implementation of any

mitigation measures. The implementation of mitigation measures will reduce the probability that an incident may occur and should the necessary materials be available the impact will be contained to the immediate site thus reducing the significance of the impact to **low**.

The removal of the existing structures and movement of construction vehicles and personnel will result in the disturbance of the soil, which may result in the erosion of the riverbeds and banks. The erosion will result in an increase in suspended solids and the loss of soil. This impact will be localised, but will have a high severity due to the loss of soils, which cannot be recovered without difficulty. The impact will have a **medium** significance prior to the implementation of mitigation measures. With the implementation of mitigation measures the impact will be mitigated to a **low** significance.

Material removed from the river will be stockpiled outside the 1:100 year floodlines. Uncontrolled runoff from the stockpiles will result in erosion of the stockpiles and the sedimentation of the Braamfontein Spruit. It is expected that the impact will have a **medium** significance prior to the implementation of any mitigation measures, which will be reduced to a **low** significance with the implementation of mitigation measures.

Temporary earth berms will be constructed on both sides of the construction areas to divert the flow of water through the area and create a dry area for the construction equipment to operate in. The water will be transferred through a pipe from the one side to the other. The cofferdams will result in the change in flow of the river. These coffer dams will be in place for the duration of the construction phase and will have a medium severity, but the receiving environment will continue to function in a modified way. The impact will be of a **medium** significance without the implementation of the mitigation measures set out in this document. The significance of the impact will be reduced to a **low** with the implementation of mitigation measures.

The construction of the cofferdams can also result in the loss of habitat and aquatic integrity. The impact will have a short duration during the construction phase and will be contained locally. The impact will be of a **medium** significance without the implementation of the mitigation measures as detailed in the accompanying EMPr. The significance of the impact will be reduced to a **low** with the implementation of mitigation measures.

Water accumulating in the cofferdam or between the two earth berms needs to be removed to ensure that construction can continue and the concrete foundations can be constructed to the necessary standards. It is expected that the water will be high in suspended solids and will result in the deterioration of the receiving water environment if this water is discharged to the Braamfontein Spruit. This will have a medium severity and the impact will be contained to the local area. Water will likely be disposed of for the duration of the construction period and therefore will have an impact with a **medium** significance prior to the implementation of mitigation measures. This significance can be reduced to **low** when construction takes place during the dry season or when sedimentation ponds are used to settle out the suspended solids.

Construction of the gabions, the bridge and stilling dam will include setting up of foundations for the structures in the riverbed. A medium probability exists that concrete can be poured in such a way that it will contaminate the Braamfontein Spruit. The risk will be of short duration and will only pose a risk while concrete is placed on the foundation. The impact will be contained to the site within the cofferdams resulting in an impact with a **medium** significance prior to the implementation of mitigation measures. The implementation of mitigation measures will reduce the significance of the impact to **low**.

The storing and placing of construction materials and stockpiles in the riparian area or within the 1:50 year floodline will result in the destruction of instream habitat and biota and increase

in the silt load into the Braamfontein Spruit. This impact will be of short duration, as the dump rock will be used during the construction phase. The probability of the impact occurring is most likely and will have an impact with a **medium** significance without the implementation of mitigation measures. The impact will be mitigated to a **low** significance through the implementation of mitigation measures.

The lack of waste management will result in the deterioration of surface water, loss of instream habitat and an increase in general and hazardous waste to be managed. This will have a high severity should it occur but will have a short duration. Without the implementation of mitigation measures, the impact will have a **medium** significance. The implementation of mitigation measures set out in the EMPr will reduce the significance of the impact to a **low**.

Laydown areas will be provided for the construction equipment in agreement with the landowners. Surface water can be contaminated due to insufficient bunding of hydrocarbon fuels or provision of maintenance areas for the construction equipment. This impact will be for the duration of the construction phase. The probability of the impact occurring is likely and will be of **medium** significance without the implementation of mitigation measures. The implementation of mitigation measures will reduce the significance of the impact to **low**.

Provision of poor sanitation and poor housekeeping during the construction phase will result in the contamination of the surface water, which will result in a high severity. The impact will be for the duration of the construction phase. The probability that this might occur is most likely and will result in an impact with a **medium** significance, which could be mitigated to a **low** significance.

The probability that proliferation of alien and weed species in any of the disturbed areas will lead to the altered vegetation communities within the river system is likely. This will have a high severity, as this will change the receiving environment and functioning of the river system largely or significantly. Active rehabilitation will be required to address the impact and will continue throughout the medium term if rehabilitation was not successful. The impact will be of **medium** significance.

The results from the quantification of the identified potential impacts associated with the construction of flood remedial measures are summarised in Table 5-3.

Table 5-3: Summary of the potential impacts that can be expected during the construction phase

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Social	Ineffective communication with affected property owners and property occupiers leading to conflict	2	1	1	2	3	20	Low	2	1	1	2	2	16	Low
	Construction activities may result in an increase in petty crimes in the area	3	3	2	2	3	40	Medium High	2	2	2	1	2	18	Low
	Unauthorised access to private property may result in conflict with the property owners and occupiers	2	2	2	2	2	24	Low	2	2	2	1	2	18	Low
	Poor housekeeping will result in the deterioration of water quality, increase in <i>E coli</i> resulting in potential health effects	4	3	2	2	2	36	Medium Low	2	2	2	2	2	24	Low
	Irresponsible disposal of contents of chemical toilets may cause the deterioration of surface water quality, increase in <i>E coli</i> resulting in potential health effects	4	3	2	2	2	36	Medium Low	2	2	2	2	2	24	Low
	Possible boost in short-term local small business opportunities.	N/A					0		N/A					0	Low
Groundwater	Local spillages of oils from vehicles and machinery leaching to groundwater contamination.	3	2	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
Surface Water Quality	Increase in silt load in runoff due to site clearing, grubbing and the removal of topsoil from the construction footprint area.	3	3	2	3	2	40	Medium High	2	2	2	3	2	30	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	Disturbance of the area may release suspended solids into the river during the construction of the temporary earth berm	3	3	2	3	2	40	Medium High	2	2	2	2	2	24	Low
	Lack of or poor sanitation will result in the contamination of surface runoff	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
	Potential deterioration in water quality due to the potential accidental spillages of hazardous substances such as hydrocarbons from construction vehicles and machinery.	3	3	3	2	2	36	Medium Low	2	2	2	2	2	24	Low
	Deterioration of water quality due to the disposal of water that accumulated in the cofferdam.	3	3	3	3	2	45	Medium High	2	2	2	2	2	24	Low
	Deterioration of water quality as a result of concrete that is poured in such a way that it will end up in the Spruit	3	3	3	3	2	45	Medium High	2	2	2	2	2	24	Low
	Poor stormwater management leading to runoff from stockpiled material removed from the river resulting in the erosion of the stockpiles causing sedimentation of the Braamfontein Spruit	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
	Diversion of the river resulting in the change in flow and an increase in sedimentation	3	3	3	3	2	45	Medium High	2	2	2	2	2	24	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	Construction of temporary earth berms may result in changes to instream biota	3	3	3	3	2	45	Medium High	2	2	2	2	2	24	Low
	Construction of temporary earth berms may result in changes to instream habitat	3	3	3	3	2	45	Medium High	2	2	2	1	2	18	Low
	Debris from poor handling of materials and/or waste blocking watercourses, resulting in flow impediment and pollution.	3	2	2	2	2	28	Medium Low	2	2	2	1	2	18	Low
	Contaminated dirty water runoff to surrounding areas resulting in the impact on local surface water quality	3	3	2	3	2	40	Medium High	2	2	2	2	2	24	Low
	Increase of surface runoff and potentially contaminated water that needs to be maintained in the areas where site clearing occurred.	3	2	2	2	2	28	Medium Low	2	2	2	1	2	18	Low
Riparian Zone and Aquatic Ecosystems	Localised changes to the riparian areas because of vegetation clearing.	3	2	2	2	3	35	Medium Low	2	2	2	2	2	24	Low
	Possible incision in the vicinity of the diversion as a result of the temporary formation of a concentrated flow path	3	2	2	2	3	35	Medium Low	2	2	2	2	2	24	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	Temporary river diversion may result in altered flow regime leading to possible loss of recharge downstream, impacting on downstream biota.	3	2	2	2	3	35	Medium Low	2	2	2	2	2	24	Low
	Loss of habitat and riparian zone ecological structure as a result of site clearance activities and uncontrolled riparian zone degradation	3	2	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
	Impact on the riparian systems as a result of changes to the sociocultural service provisions	3	2	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
	Increased runoff due to topsoil removal and vegetation clearance leading to possible erosion and sedimentation of riparian resources	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
	Soil compaction and levelling as a result of construction activities and vehicle movement leading to loss of riparian habitat	3	2	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
	Impact on the hydrological functioning of the riparian systems	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
Heritage Resources	Although the heritage study found no resources of cultural and/or heritage importance that will be affected by the project, a possibility remains that, there may be some resources that may be affected.	2	1	2	2	1	15	Low	2	1	2	1	1	10	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Palaeontological Resources	Site clearance in the river has potential to impact on palaeontological resources	2	1	2	2	1	15	Low	2	1	2	1	1	10	Low
Flora	Loss of localised riparian biodiversity habitats within sensitive areas due to site clearance and establishment of drill sites.	3	2	2	2	3	35	Medium Low	2	2	2	2	1	18	Low
	Sedimentation of riparian resources leading to smothering of flora	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
	Loss of localised riparian floral species diversity including Species of Conservation Concern (SCC) and medicinal protected species due to site clearance	2	2	2	2	2	24	Low	2	2	2	2	1	18	Low
	Potential spreading of alien invasive species as indigenous vegetation is removed and pioneer alien species are provided with a chance to flourish.	3	3	2	3	2	40	Medium High	2	2	2	2	2	24	Low
Fauna	Vegetation clearance may result in loss of faunal habitat ecological structure, species diversity and loss of species of conservation concern.	2	3	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
	Habitat fragmentation as a result of construction activities of the access roads leading to loss of floral diversity.	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	Loss of faunal diversity and ecological integrity as a result of construction activities, erosion, poaching and faunal species trapping	3	2	2	2	2	28	Medium Low	3	2	2	2	1	21	Low
	Movement of construction vehicles and machinery may result in collision with fauna, resulting in loss of fauna.	2	2	2	2	2	24	Low	2	2	2	2	1	18	Low
Air Quality	Possible increase in dust generation, PM10 and PM2.5 as a result of bulk earthworks, operation of heavy machinery, and material movement.	3	2	2	2	3	35	Medium Low	2	2	2	2	2	24	Low
	Increase in carbon emissions and ambient air pollutants (NO2 and SO2) as a result of movement of vehicles and operation of machinery/equipment.	3	2	2	2	2	28	Medium Low	2	2	2	2	1	18	Low
Visual	Visual intrusion as a result of the movement of machinery and the establishment of the required infrastructure.	2	1	2	2	2	20	Low	1	1	2	2	1	12	Low
	Indirect visual impact due to dust generation as a result of the movement of vehicles and materials, to and from the site area.	2	1	2	2	2	20	Low	1	1	2	2	1	12	Low
Noise	The use of vehicles and machinery during the construction phase may generate noise in the immediate vicinity	2	2	2	2	2	24	Low	2	2	2	2	2	24	Low

Activity	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Soils	Localised chemical pollution of soils as a result of vehicle hydrocarbon spillages and compaction.	3	2	2	2	2	28	Medium Low	2	2	2	2	2	24	Low
	Localised clearing of vegetation and compaction of the construction footprint will result in the soils being particularly more vulnerable to soil erosion.	3	1	2	2	2	24	Low	2	1	2	2	2	20	Low
Traffic	Increase in traffic volumes as a result of pre-construction activities, which may lead to an increase in traffic congestion on roads around the project area.	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
Climate	Emissions of Green House Gases as a result of the use of construction vehicles and machinery.	2	2	2	2	2	24	Low	2	2	2	2	1	18	Low
Waste Management	Poor waste management will result in the contamination of surface runoff resulting in the deterioration of water quality of the watercourse	3	3	2	2	2	32	Medium Low	3	3	2	2	2	32	Low
	Disposal of hazardous waste including hydrocarbon contaminated soils, rags etc. will result in the contamination of surface runoff resulting in the deterioration of water quality of the watercourse	3	3	2	2	2	32	Medium Low	2	2	2	2	2	24	Low
	Stockpiling material resulting in secondary pollution and contamination of the Spruit	3	3	2	2	2	32	Medium Low	2	2	2	2	1	18	Low

5.2.3 Potential Impacts Associated with the Operation Phase

The operational phase of the project may result in the following potential impacts:

- Changes to instream habitat and biota;
- Changes in hydrology (flow velocity);
- Loss of sensitive aquatic taxa;
- Proliferation of alien invasive species; and
- Loss of biodiversity.

The flow velocity of the river will be changed due to the additional culverts that will be constructed in the Braamfontein Spruit. The potential alteration of the stream flow characterization will result in changes to the hydrological function and sediment balance.

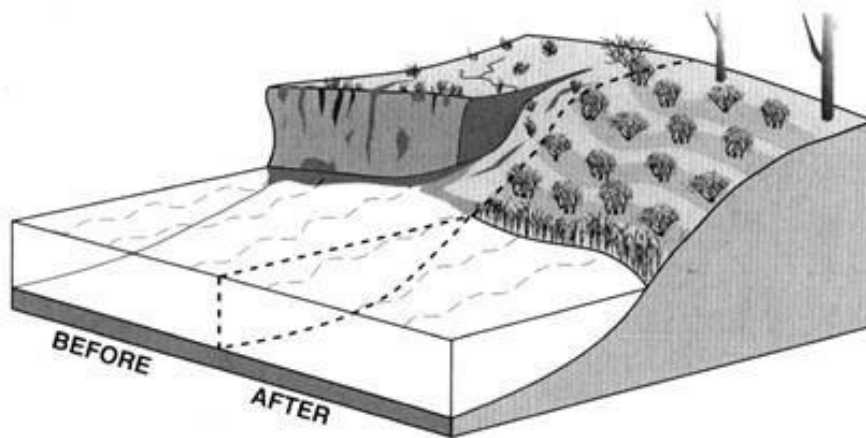
The ineffective rehabilitation of the disturbed area will likely result in the transformation of the instream biota and habitat. The transformation of the habitat will result in the loss of biodiversity and the inability to support biodiversity. This impact will have a medium severity and will be contained to the project site until such time that the rehabilitation is undertaken and is sustainable. The impact will thus have a **medium** significance but can be mitigated to a **low** significance.

The ineffective rehabilitation of the disturbed area will definitely result in the proliferation of alien and weed species in the disturbed areas. This impact will have an impact with a **medium** significance, which can be mitigated with the implementation of specific measures to an impact with a **low** significance.

It is expected that the JRA will take cognizance of the Landscape Guidelines that were developed for the Braamfontein Spruit as part of the project. The guidelines recommend the following landscape interventions to the channel design (subject to approval in terms of their hydraulic implications):

- Re-grading of eroded riverbanks to achieve flatter gradients: Flattening of the 1:2.5 side slopes of the main river channel, to an average slope of 1:4, but with allowance for variation in slope to a gradient as flat as 1:6 or 1:7 in some places, to provide a less symmetrical initial shaping.

Bank Shaping and Planting



Regrading streambanks to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate plant species.

Figure 5-1: Bank Shaping and Planting

- Encourage re-establishment of natural vegetation and improvement of species richness: Extensive initial planting of the excavated river channel, to facilitate rapid establishment of locally indigenous, appropriate vegetation in the excavated area, and thus minimise the likelihood of extensive flood damage to these areas – a list of desirable plant species are listed under Section 7 - Vegetation.
- Under the civil engineering works, coarse rock riprap is to be constructed. These will be covered by a topsoil layer. The engineering system that has been recommended has to be combined with bioengineering techniques along with Intensive planting along the length of river banks is envisaged to provide some habitat and to in time cover the rocks. Before full establishment, invasive planting is likely to inhabit the banks, and will need to be managed.

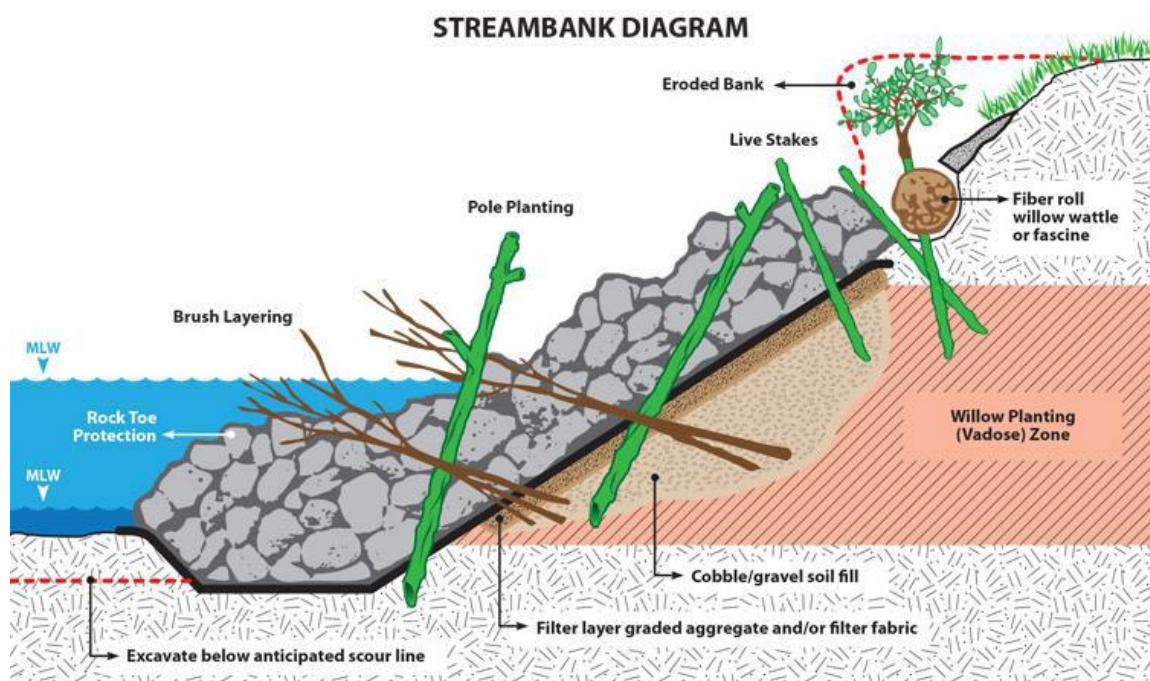


Figure 5-2: Example of bio engineering techniques in combination with riprap

- Physical removal of alien vegetation invasive and compilation of alien vegetation invasive control plan/programme. Rehabilitation measures along the river channel should include the removal of woody alien vegetation, ideally the removal of alien *Pennisetum clandestinum* (kikuyu grass), although this is probably not practical in this highly invaded area.
- Provision for energy-dissipation weirs to control vertical erosion if necessary: Provision for the implementation of small-scale rehabilitation measures within the low-flow channel, including the use of gabion weir structures, to facilitate the establishment of a stable vegetated riverine environment, particularly after excessive erosion associated with large flood events;

It is also expected that the JRA will consider the use of Bo-engineering techniques for treating the eroded stream banks and provide stability to the berms. The proposed techniques include:

- Seeding:** Seeding involves the application of grass or other plant mixes to slope areas. It can be done by hand seeding or by placing seeds into small holes. Hydro seeding can also be considered for hard to access areas.
- Container or bare root planting:** Container and bare root planting involves placing single or bunches of rooted plants into excavated holes on the slope. This method can be used for woody plants or non-woody plants which will eventually spread into a uniform root coverage.
- Live Staking:** Live stakes are sections of woody plants that are cut into lengths and placed into the slope. The plant material is installed during autumn or spring when the original plant (and consequently cuttings form it) are dormant. The plant materials used for stakes are usually hardy species which root easily and eventually grow into mature woody shrubs that reinforce the soil structure of the slope.
- Contour wattling:** Contour wattling is an erosion control planting method which can be used to stabilize very shallow soil structure against landsliding. The method involves packing lengths of woody plant material into cables or bundles (sometimes called live fascines) about 200-250mm in diameter. The bundles are laid continuously along slope contours. The cabling effect along the slope helps to intercept surface water runoff and route it laterally before it creates erosion problems. The wattling help trap sediment by creating barriers (living fences) to protect down slope areas against material falls or erosion.

The impacts that may result as a result of activities during the operation phase are summarised in Table 5-4.

Table 5-4: Summary of the potential impacts that can be expected during the operation phase

Environmental Aspect	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Socio-Economic	Uncontrolled access of private property during inspection, maintenance and/or repairs may result in conflict with affected landowners and occupiers.	2	1	1	1	2	12	Low	2	1	1	1	1	8	Low
Groundwater	Seepage of contaminated water from the use of vehicles to access structure during inspection and maintenance processes, which may result in the spillages of hydrocarbon liquids from the vehicles and machinery.	3	2	2	2	2	28	Low	2	1	1	1	1	8	Low
Surface Water	Erosion of the river beds and banks may result in siltation of the Braamfontein Spruit	2	1	1	1	2	12	Low	2	1	1	1	1	8	Low
	Change in flow of water in the river as a result of the stilling dam as well as the bridge	3	2	2	2	2	28	Medium Low	2	2	1	1	1		Low
Aquatic Ecology	Stream diversion to allow for inspection and/or maintenance and repairs may result in a temporarily altered flow regime leading to possible loss of recharge to downstream areas impacting on downstream biota	3	2	2	2	2	28	Medium Low	2	2	1	1	1	10	Low

Environmental Aspect	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	Diversion of the stream during the operation phase may result in a temporary altered flow regime, leading to loss of recharge to downstream users, impacting on downstream biota.	3	2	2	2	3	35	Medium Low							Low
	Possible incision/erosion in the vicinity of the diversion as a result of temporary formation of a concentrated flow path	3	2	2	2	3	35	Medium Low							Low
	Possible contamination of riparian soils and surface water leading to further reduced ability to support biodiversity.	2	2	2	2	2	24	Low	2	2	1	1	1	10	Low
Flora	Disturbances to or removal of vegetation whilst accessing infrastructure to carry out maintenance activities may result in potential loss to indigenous vegetation and further proliferation of alien floral species.	2	1	1	1	1	8	Low	2	1	1	1	1	8	Low
Fauna	Loss of faunal species as a result of collisions with maintenance vehicles	2	2	1	1	2	15	Low	2	2	1	1	1	10	Low
	Loss of faunal habitat and ecological structure as a result of vegetation removal whilst accessing	2	1	1	1	2	12	Low	2	1	1	1	1	8	Low

Environmental Aspect	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
	infrastructure for maintenance purposes														
Soils	Topsoil removal and movement of maintenance vehicles and personnel may result in the disruption of the soil profile.	3	2	2	2	2	28	Medium Low	2	1	1	1	1	8	Low
	Maintenance vehicle movement in the area may result in accidental hydrocarbon leakages, resulting in contamination of soil.	3	2	2	2	2	28	Medium Low	2	1	1	1	1	8	Low
Air Quality	Movement of maintenance vehicles may result in possible increase in nuisance dust generation, PM10 and PM2.5.	3	2	1	1	2	18	Low	2	2	1	1	1	10	Low
	Increase in carbon emissions and ambient air pollutants (NO2 and SO2) as a result of movement of vehicles.	3	2	1	1	2	18	Low	2	2	1	1	1	10	Low
Visual	The presence of the concrete walls on some sections of the spruit may result in visual impacts	2	1	1	1	2	12	Low	2	1	1	1	1	8	Low
Heritage Resources	Maintenance and repair activities may have an impact on cultural and heritage impacts, particularly where the heritage bridge is located	2	1	1	1	2	12		2	1	1	1	1	8	Low

Environmental Aspect	Nature of potential impact/risk	Environmental Impact Significance Before Mitigation							Environmental Impact Significance After Mitigation						
		Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating	Consequence			Probability		Significance (Degree to which impact may cause irreplaceable loss of resources/damage)	Significance Rating
		Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact			Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Noise	The use of vehicles and machinery during maintenance and/repair may generate noise in the immediate vicinity	2	1	1	1	2	12	Low	2	1	1	1	1	8	Low
Traffic	Increase in traffic volumes as a result of movement of maintenance vehicles may lead to an increase in traffic around the project area.	2	2	1	1	2	15	Low	2	2	1	1	1	10	Low
Climate	Emissions of Green House Gases as a result of the use of vehicles.	2	2	1	1	2	15	Low	2	2	1	1	1	10	Low
Waste Management	Poor waste management will result in the contamination of surface runoff resulting in the deterioration of water quality of the watercourse	2	2	2	1	2	18	Low	2	2	1	1	1	10	Low
	Disposal of hazardous waste including hydrocarbon-contaminated soils, rags etc. will result in the contamination of surface runoff resulting in the deterioration of water quality of the watercourse	2	2	2	1	2	18	Low	2	2	1	1	1	10	Low
	Stockpiling material resulting in secondary pollution and contamination of the Spruit	2	2	2	1	2	18	Low	2	2	1	1	1	10	Low

5.2.4 Potential Impacts Associated with the Decommissioning and Closure Phase

It is not foreseen that the flood mitigation measures and the erosion protection measures will be removed. But should this happen for some or other reason the potential impacts will be similar to that during construction of the measures.

6 Environmental Management Programme

Objectives were set as part of the EMPr to ensure that the EMPr is measurable. The following tables form the core mitigation measures appropriate to the pre- maintenance and maintenance phase. The tables present the objectives to be achieved and the management actions that need to be implemented in order to mitigate the negative impacts and enhance the benefits of maintenance work as set out in JRA's Standard Activity Manual.

The **planning** section of this EMPr, refers to the period of time leading up to and prior to commencement of construction activities, and is included to ensure pro-active environmental management measures with the goal of identifying avoidable environmental damage at the outset and sustain optimal environmental performance throughout the construction phase. Most impacts will occur during **the construction phase** and must be mitigated through the contingency plans identified in the pre-construction phase.

The bulk of environmental impacts will **have immediate effect during construction** (e.g. noise, dust, and water pollution). If the site is monitored on a continual basis during this phase, it is possible to identify these impacts as they occur. These impacts will then be mitigated through the measures outlined in this section, together with a commitment to sound environmental management from the project team.

6.1 Planning Phase

Table 6-1: Planning Phase EMPr

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
Project contract and programme <ul style="list-style-type: none"> This EMPr must be included as part of the tender documentation thereby making it part of the required scope of work. The mitigation measures as set out in this EMPr are enforceable under the general conditions of contract in the case where subcontractors are appointed to undertake maintenance work. The Contractor must ensure that all the personnel on site are familiar with and understand the specifications contained in the EMPr. The Maintenance Contractors contract must contain a clause to the effect that the disposal of all maintenance-generated refuse, must be managed, in accordance with the relevant legislation, including: <ul style="list-style-type: none"> Waste Classification and Management Regulations, 2013 – GN R634/2013; NEMWA Section 19; National Norms and Standards for Disposal of Waste to Landfill – GN R636/2013; Regulations regarding Waste Disposal Sites – GN R1196/94; and City of Johannesburg Metropolitan Municipality: Waste Management By-Laws, 2013. The Maintenance Contractor shall ensure that all waste is disposed of to an authorized waste management facility and all agreements with the service providers shall be kept on file and made available on request. 	<ul style="list-style-type: none"> Contingencies for minimising negative impacts anticipated to occur during the construction phase 	<ul style="list-style-type: none"> Records in environmental file. Signed declaration “proformas” 	<ul style="list-style-type: none"> Prior to the commencement of construction activities 	<ul style="list-style-type: none"> Contractor Depot Manager
Appointments and duties of project team and awareness training <ul style="list-style-type: none"> Before construction activities commence, the roles of the team members in the implementation of this EMP shall be communicated. 	<ul style="list-style-type: none"> Contingencies for avoiding or minimising negative impacts anticipated to occur during the construction phase. 	<ul style="list-style-type: none"> Signed environmental training attendance registers in the environmental file. 	<ul style="list-style-type: none"> Prior to the commencement of the construction activities. 	<ul style="list-style-type: none"> Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> All the relevant training and environmental induction must take place prior to the commencement of any construction activities. Environmental inductions must be undertaken to ensure that all staff are aware and have a basic level of environmental awareness training. Areas that must be covered by the inductions include: <ol style="list-style-type: none"> What is meant by the environment, Why environmental management is important How day to day activities can be altered in an effort to ensure sound environmental management. Social environmental responsibilities including: <ul style="list-style-type: none"> No use of Alcohol and drugs, Reduce noise levels. No access to areas outside of the maintenance areas footprint. Use facilities (Toilets, eating areas, waste receptacles) that have been made available. 	<ul style="list-style-type: none"> Ensure environmental awareness and formalise Environmental responsibilities and implementation 	<ul style="list-style-type: none"> Signed declaration proformas 		
Method Statements <ul style="list-style-type: none"> Method Statements must be provided by the Contractor. All activities, which require method statements, may only commence once the method statements have been approved by the Depot Manager. The Contractor will provide job-specific training on an ad hoc basis when workers are engaged in activities, which require method statements. Each job card issued must be accompanied by a mini environmental risk assessment in accordance with the JRA Risk Assessment Methodology. 	<ul style="list-style-type: none"> Contingencies for minimising negative impacts anticipated to occur during the construction phase. 	<ul style="list-style-type: none"> Approved method statements and relevant pro forma documents Training records 	<ul style="list-style-type: none"> Prior to the commencement of the maintenance works. As and when required 	<ul style="list-style-type: none"> Maintenance Contractor Depot Manager
Site Demarcation <ul style="list-style-type: none"> The overall project area must be discussed with the team prior to the commencement of the construction activities. This will take place in the form of a toolbox talk. 	<ul style="list-style-type: none"> Contingencies for minimising negative impacts anticipated to occur during the Maintenance work 	<ul style="list-style-type: none"> Demarcated areas kept to a minimal Signed attendance registers of toolbox talks related to the specific job card. 	<ul style="list-style-type: none"> Prior to the commencement of maintenance works. As and when required 	<ul style="list-style-type: none"> Maintenance Contractor Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Additional areas required for the storing of equipment and parking of vehicles must first be approved in writing should this be outside of the JRA road reserve. All site boundaries must be discussed and agreed upon before commencement of the construction phase. The Contractor shall make proposals as to the location of additional areas that may be required. Trespassing onto adjacent private properties is strictly prohibited. All environmentally sensitive features must be identified and indicated on a layout. These will be identified in the planning phase as part of the risk assessments for the specific job card. 				
<p>Emergencies, non-compliance and communication</p> <ul style="list-style-type: none"> Emergency preparedness is essential in order to ensure that incidents that may arise are adequately and timeously managed. The depot manager and their team must ensure that the workforce as well as appointed Contractors are aware of the procedures that are to be followed in the event of an emergency. This is to be done via the effective communication of method statements. It must be ensured that method statements on the protocols to be followed, and contingencies to be put in place, are available for the following potential incidents before maintenance works may commence: Contamination of the Braamfontein Spruit from spills; contamination of soils from spills; and fire. Reporting requirements as required in Section 30 of NEMA and Section 20 of NWA must be applied. Communication in emergencies must follow the lines of communication as stipulated in JRA procedures. Failure to adhere to the requirements of the EMPr by the Contractor will result in fines over and above the costs 	<ul style="list-style-type: none"> Contingencies for minimising negative impacts anticipated to occur during the construction phase 	<ul style="list-style-type: none"> Method statements 	<ul style="list-style-type: none"> As and when required 	<ul style="list-style-type: none"> Maintenance Contractor Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>incurred for any remediation required as a result of the specific non-compliance.</p> <ul style="list-style-type: none"> In terms of NEMA, fines incurred due to non-compliance may include a fine of up R10 Million and/or 10 years imprisonment. 				
<p>External Influences from adjacent properties</p> <ul style="list-style-type: none"> Prior to commencement of the construction work, all external influences that may threaten the construction activities e.g. neighbouring stormwater runoff entering the works areas must be identified and communicated to the Contractor. Contingency measures in this regard must be discussed and resolution sought between the Depot Manager and the Contractor. 	<ul style="list-style-type: none"> Contingencies for minimising negative impacts anticipated to occur during the construction phase. 	<ul style="list-style-type: none"> Records of discussions Documented management measures 	<ul style="list-style-type: none"> As and when required 	<ul style="list-style-type: none"> Contractor Depot Manager
<p>Maintenance lay down areas</p> <ul style="list-style-type: none"> Laydown areas must be selected in consultation with the Depot manager. Additional areas required for the storing of equipment and parking of vehicles must first be approved in writing should this be outside of the JRA road reserve. Laydown areas shall be located outside the 1:100 year floodlines of the Braamfontein Spruit or outside of the wetland buffer zone, or whichever is great. Where applicable, topsoil must be stripped from laydown areas. Topsoil must be stored separately for later reuse when the area is vacated. All Storage facilities must be located within the site boundaries. The maintenance team assigned per the job card is responsible for cleaning/clearing the site of all structures, equipment, residual litter and building materials at the end of the maintenance period. The job card is only to be signed off once the site has been adequately cleared. Once the area has been cleared, topsoil must be repositioned. 	<ul style="list-style-type: none"> Minimise water pollution Minimise dust fallout Minimise unwarranted environmental damage outside the footprint Maintain a clean and healthy working environment Minimise impact to surrounding environment 	<ul style="list-style-type: none"> No signs of water or soil pollution No complaints from surrounding landowners or I&APs No visible signs of litter Method statements 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor Depot Manager

6.2 Construction Phase

Table 6-2: EMPr for the Construction Phase

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
Stockpiles <ul style="list-style-type: none"> All stockpiled material (this includes crusher material, excavated material, fill material) must be easily accessible and shall be situated the outside 1:100 year floodlines of the Braamfontein Spruit or 500 m outside of the riparian zone, or whichever is great. Stockpiles must not obstruct public pathways. All temporarily stockpiling of material must be in such a way that the spread of materials is minimised. This can be done by placing sandbags at the toe of the stockpile to curb the loss of topsoil. The stockpiles may only be placed within the demarcated areas. The location of the stockpiles must be approved prior to depositing the stockpiles. Storm water run-off from stockpile sites and other related areas must only be directed into the storm water system if the necessary pollution prevention measures such as silt traps are in place and may not run freely into the immediate and surrounding environments. An appropriate storm water plan stipulating how run-off will be dealt with shall be compiled. An approved method statement on how storm water will be dealt with shall also be in place prior to commencement if construction activities. 	<ul style="list-style-type: none"> Minimise disturbance and loss of soil Minimise maintenance footprint Minimise sedimentation of nearby drainage lines and the Braamfontein Spruit. Maintain the integrity of topsoil for landscaping and rehabilitation Containment of invasive plant growth Minimise contamination of storm water run-off 	<ul style="list-style-type: none"> The footprint has not exceeded the required size. No signs of sedimentation and erosion. Relevant method statements. Signed attendance registers in the environmental file for environmental inductions and toolbox talks. 	<ul style="list-style-type: none"> Daily Monitored during wet weather and immediate actions taken. 	<ul style="list-style-type: none"> Contractor Depot Manage ECOr

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>(At minimum sand bags should be placed at inlets to trap silt and allow runoff water to filter through).</p> <ul style="list-style-type: none"> Stockpiles shall be stabilised if signs of erosion are visible. Topsoil stockpiles must be monitored for invasive exotic vegetation growth. Maintenance contractors must remediate as and when required in consultation with the ECO. Topsoil stockpiles must be clearly demarcated as no-go areas. Stockpiles shall be convex and shall not exceed 2m. 				
<p>Oil and chemicals</p> <ul style="list-style-type: none"> Method statements must be on file for the “handling and storage of oils and chemicals”, “fire”, and “emergency spills procedures”. These substances must be confined to specific and secured areas, and in a way, that does not pose a danger of pollution of the Braamfontein Spruit even during times of high rainfall. These areas must be imperviously bunded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks. Bund area must have a facility such as a valve/sump to drain or remove clean stormwater. Contaminated water shall be pumped into a container for removal by an approved service provider. Regular inspections shall be carried out to ensure the integrity of the bundwalls. 	<ul style="list-style-type: none"> Prevention of pollution of the environment Minimise chances of transgression of the acts controlling pollution 100 % compliance to national, provincial and local regulatory requirements. 	<ul style="list-style-type: none"> No pollution of the Braamfontein Spruit No litigation due to transgression of pollution control regulations No complaints from I&APs Method statements 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • All preventative servicing of earth moving equipment and construction vehicles shall be serviced off site. • Emergency areas shall be demarcated and protected with an impermeable surface. The area shall be situated outside the 1:100 year flood lines. Runoff from this area shall be contained. • Drip trays (minimum of 10cm deep) must be placed under all vehicles that stand for more than 24 hours. Vehicles suspected of leaking must not be left unattended and drip trays must be utilised. • The surface area of the drip trays will be dependent on the vehicle and must be large enough to contain any hydrocarbons that may leak from the vehicle while standing. • Spill kits must be available on site and in all vehicles that transport hydrocarbons for dispensing to other vehicles at the construction site. • All personnel shall be trained and training records shall be made available on request • All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site, (this includes contaminated soils, and drenched spill kit material). • Vehicles transporting hazardous material, including concrete, must not be washed on site. • All equipment to be washed, including concrete handling equipment must be 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>done at a suitably designed washing facility.</p> <ul style="list-style-type: none"> Waste manifests and safe disposal certificates must be filed as proof of safe disposal of any hydrocarbons removed from site. 				
<p>Cement</p> <ul style="list-style-type: none"> A standardized method statement must be available in the environmental file. The Contractor shall compile a method statement for "cement and concrete batching". The method statement must provide information on proposed storage, washing & disposal of cement, packaging, tools and plant. The mixing of concrete must only be done at specifically selected sites on mortarboards or similar structures to contain run-off into soils, Braamfontein Spruit and natural vegetation. The area must be designed to adequately contain run-off residues. Lime, cement and other powders shall not be mixed during excessively windy conditions. Cleaning of cement mixing and handling equipment must be done using proper cleaning trays. The water used for cleaning must be contained as far is possible. All empty containers must be stored in a dedicated area and later removed from the site for appropriate disposal at a licensed facility. 	<ul style="list-style-type: none"> Minimise the possibility of cement residue entering into the surrounding environment. Minimise pollution of soil, surface and ground water resources 	<ul style="list-style-type: none"> No evidence of contaminated soil on the maintenance site No evidence of contaminated water resources Method statement 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor ECO Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Concrete and cement or any solid waste materials that contain concrete and cement (including empty cement bags) must be disposed of at a licenced disposal facility in terms of the National Environmental Management: Waste Act 59 of 2008. Any spillage that may occur must be investigated and immediate remedial action must be taken. The visible remains either of concrete, solid, or from washings, must be physically removed immediately or disposed of as waste to a registered landfill site. The cement batching areas must be located in consultation with the depot manager. These must be outside the 1:100 year floodlines. Adequate storm water management measures must be implemented in order to ensure that runoff water from these areas is contained. 				
Use of dangerous and toxic materials <ul style="list-style-type: none"> No hazardous material shall be stored within 1:100 year floodlines of the Braamfontein Spruit or outside of the wetland buffer zone, or whichever is great. A spill kit must be available on site to deal with spills/ fire of the materials present should they occur. This must be done in line with the approved Method statement dealing with chemicals and chemicals handling. 	<ul style="list-style-type: none"> Prevention of pollution of soil, ground water resources and the Braamfontein Spruit in the immediate and surrounding environments Minimise chances of transgression of the acts controlling pollution 	<ul style="list-style-type: none"> No pollution of the environment No litigation due to transgression of pollution control acts 	<ul style="list-style-type: none"> As required 	<ul style="list-style-type: none"> Contractor Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> No potentially hazardous materials shall be stored within the 1:100 year floodlines of the Braamfontein Spruit or outside 500 m of the riparian zone, or whichever is great. Materials include fuel, oil, cement, bitumen etc. The foreperson must be aware of drainage channels, gullies, inlets etc. in order to ensure that chemicals are stored in such a way that runoff residues can be stopped from entering these. 				
Source of material <ul style="list-style-type: none"> The Contractor shall prepare a source statement to indicate the sources of all materials and submit these to the JRA for approval. 	<ul style="list-style-type: none"> Ensure that materials used for maintenance works are from authorised sources. 	<ul style="list-style-type: none"> Up to date source statements available 100 % record of the source of all material 	<ul style="list-style-type: none"> As required, when supplier/source changes. 	<ul style="list-style-type: none"> Contractor
Eating areas and camp followers <ul style="list-style-type: none"> Designated restricted eating areas for eating during normal working hours must be set out at construction sites. Adequate closed refuse bins must be provided, no more than 50 m from construction sites. No lighting fires are to be allowed on site. The feeding, or leaving of food, for stray or other animals in the area are strictly prohibited. Camp followers/informal traders shall not be allowed to congregate on pavements around the construction site. Litter and concrete bags, etc. must be picked up daily and put into suitably closed bins. 	<ul style="list-style-type: none"> Control potential influx of vermin and flies Neat work place and hygienic environment Minimise negative social impacts to local residents and businesses 	<ul style="list-style-type: none"> No visual sign of vermin and flies No complaints from I&APs 	<ul style="list-style-type: none"> Monitor daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>Toilets facilities on site</p> <ul style="list-style-type: none"> • A minimum of one chemical toilet must be provided per 15 persons. • The toilets must be kept in a clean, neat and hygienic condition. Toilet paper must be supplied at all toilets at all times. Toilet paper dispensers must be provided in all toilets. • Toilets must be easily accessible and a maximum of 30m from the works area to ensure they are utilised. • A reputable toilet-servicing company must be used (The company must issue proof that they are registered to handle the waste for transport to a licensed discharge facility. • The necessary agreement between the Service Provider and the Contractor for the removal of the sewage must be in place and shall be made available on request. • The necessary agreement between the Service Provider and the WWTW for the disposal of the sewage must be in place and made available on request. • Ablution facilities shall be serviced on a regular basis by an approved service provider to keep them in good, functional working order and in an acceptable state of hygiene, • Toilets must be secured to the ground to ensure they are not blown over during high winds or bumped over. 	<ul style="list-style-type: none"> • Ensure proper sanitation is achieved which will encourage the workforce to utilise toilets provided and not the surrounding habitat • Minimise potential of diseases on site • Minimise potential to pollute soils, water resources and natural habitats 	<ul style="list-style-type: none"> • Workforce use toilets provided • No complaints received from I&APs as well as members of the workforce • No visible or measurable signs of pollution of the environment (soils, ground and surface water) 	<ul style="list-style-type: none"> • As and when required • Monitor daily 	<ul style="list-style-type: none"> • Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • The Contractor shall also make available provisions for workers to wash their hands after using the toilets. • Where portable toilets are located within view of the public or neighbouring residences or places of business, efforts should be taken to screen such facilities from view. • The Contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are properly stored and removed from Site. • Discharge of waste from toilets into the environment and burial of waste is strictly prohibited and must be treated at a registered wastewater treatment works. • Portable toilets shall be placed and maintained in such a way as to prevent the potential pollution of the ground and surface water resources. • No toilets shall be located within 100 m of the Braamfontein Spruit • The contractor shall keep record, and provided such records upon request from the ECO, of the location and volumes of waste disposed. • The use of pit latrines and soak-a-ways is prohibited. • Washing, whether of the person or of personal effects and acts of excretion and urination outside the facilities provided shall be strictly prohibited. • The Contractor shall take disciplinary action and implement penalties against 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
any staff member found in contravention of this requirement.				
Waste management <ul style="list-style-type: none"> A method statement for “solid waste management” shall be compiled and kept in the environmental file. The method statement must provide information on proposed licensed facility to be utilised and details of proposed record keeping for auditing purposes. Waste must be separated into recyclable and non-recyclable waste, and must be separated as follows: <ul style="list-style-type: none"> Hazardous waste: including (but not limited to) old oil, paint, etc., General waste: including (but not limited to) construction rubble, Reusable construction material. Recyclable waste must be deposited in separate bins. Waste shall be stored in demarcated areas according to type of waste. Runoff from any area demarcated for waste will be contained, treated and reused. Hazardous waste will be removed and managed by an approved service provider. A safe disposal certificate must be provided by the approved service provider as proof of responsible disposal of hazardous waste and kept on record. All waste management facilities will be maintained in good working order. 	<ul style="list-style-type: none"> Sustainable management of waste by recycling To keep the site neat and tidy Minimise litigation and complaints by I&APs Reduce visual impact Control potential influx of vermin and flies thereby minimising the potential of diseases on site and the surrounding environment Minimise potential to pollute soils, water resources and natural habitats 	<ul style="list-style-type: none"> Disposal of rubble and refuse in an appropriate manner with no rubble and refuse lying on site Site is neat and tidy No complaints from surrounding residents and businesses Sufficient containers available on site No visible or measurable signs of pollution of the environment (soils, ground and surface water) Method statement 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • No littering shall be allowed in and around the site, a sufficient number of bins shall be provided for the disposal of waste. • Flammable substances must be kept away from sources of ignition and from oxidizing agents, • The maximum retention time for temporary storage of waste generated shall not exceed 30 days, provided the waste does not present a health hazard or risk of odour. • Any illegal dumping of waste is strictly prohibited and doing so will result in a fine and if required further legal action will be taken. Bins must be clearly marked for ease of management. All refuse bins must have a lid secured so that animals cannot gain access. • Sufficient closed containers must be strategically located around the maintenance site to handle the amount of litter, wastes, rubbish, debris, and builder's wastes generated on the site. • All solid and chemical waste generated must be removed and disposed of at a licensed waste disposal site. Proof of legal disposal must be filed in the environmental file: • Weigh bridge receipts must be sought from the waste removal contractor (if applicable) as proof of the above. • Where hazardous waste (cement, empty paint tins, solvents, oil rags, used oils, 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>hydraulic oils etc.) has been disposed of, safe disposal certificates must be sought.</p> <ul style="list-style-type: none"> • Chemical containers and packaging brought onto the site must be removed for disposal at a suitable site. • A hazardous waste bin (a drum that can contain liquids) must be transported to the construction site to be used for the containment of contaminated/hazardous waste. The bin must be adequately labelled and located in a bunded area. • All bunding areas of hazardous substances will comply with the SANS standards. • On surface bulk storage of hydrocarbons must be stored in a dedicated area, which will include a bund or a drain where necessary to contain any spillages during the use, loading and off-loading of the substances. • Bunded areas shall contain 110% of the stored volume. • Bund areas must be impermeable. • Bund area must have a facility such as a valve/sump to drain or remove clean stormwater, • Contaminated water shall be pumped into a container for removal by an approved service provider. • Regular inspections shall be carried out to ensure the integrity of the bundwalls. • The relevant safety signage must be provided to warn employees of the hazards in the area, • The necessary fire-fighting facilities will be provided. • All hazardous substances shall be stored in a secure, safe and weatherproof 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>facility. The facility shall have an impermeable floor to prevent.</p> <ul style="list-style-type: none"> • All containers must be labelled according to the substance stored, substances are not allowed to be decanted into another container without the correct labelling displayed on the container, • No combustible materials shall be stored near flammable substances; flammable substances shall be stored in a secured area. • A register of all the hazardous substances shall be kept on site. • The relevant Material Safety Data Sheets (MSDS) for all the hazardous substances shall be made available on request. • Consideration must be given to inert waste and areas for the stockpiling of this and the threshold for licensing under NEM: WA: GNR 921/2013 List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment, should be considered. • Additional legislation to be considered: NEMWA: Regulations regarding the planning and management of residue stockpiles and residue deposits – GNR 632/2015 				
<p>Noise</p> <ul style="list-style-type: none"> • Noise levels during construction must be kept within 7dB of the baseline data. • Further noise must be managed in line with the Gauteng Noise Control Regulations GN R5479/99, regulations 8, 9, 10, 12 and 16. 	<ul style="list-style-type: none"> • Maintain noise levels below “disturbing” as defined in the National Noise Regulations 	<ul style="list-style-type: none"> • No complaints from surrounding landowners or I&APs 	<ul style="list-style-type: none"> • As and when required 	<ul style="list-style-type: none"> • Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> ○ In support of the requirements of the ECA, the Gauteng Provincial Government of Environmental Affairs promulgated regulations to provide uniform minimum standards for noise regulations and create new mechanisms for effective enforcements. The regulations apply to all local authorities in Gauteng, except for regulation 10 (a), (b) and (c) and regulations 11(a) and (b) is only applicable if the local authority has in its services a noise control officer. Regulations 8 and 9 prohibit emission of disturbing and nuisance noise, whereas Regulations 10 and 11 regulate land use and operation of vehicles in the event that it may result in excessive noise generation. ○ The Local authority may inspect vehicles and attach such vehicle if the sound level exceeds the levels in (a) and (b) above by more than the 5dBA and may order the repair or modification of such vehicle and a test and inspection to be done - regulation 12 (2). The measuring instruments to be used are described in terms of regulation 16. • All construction vehicles shall be in a good working order to reduce possible noise pollution. • Work hours of 7am to 4pm must be strictly enforced unless permission is given for extended hours. Permission 	<ul style="list-style-type: none"> • Minimise the nuisance factor of the construction activity. 			

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>must not be granted without consultation with the local residents and businesses.</p> <ul style="list-style-type: none"> • Unnecessary noise such as loud talking, shouting or whistling, radios, sirens or hooters, motor revving, etc. shall be strictly controlled. • Equipment must be operated with appropriate noise abatement accessories such as silencers and sound hoods, which must be correctly maintained; • All equipment must be kept in good working order, with immediate attention being paid to defective silencers, slipping fan-belts, worn bearings and other sources of noise; • Noisy activities must take place only during working hours. Residents of houses and businesses adjacent to the construction site must be informed by posting signage (informing of unusually noisy activities) prior to any planned activities that will be unusually noisy or any other activities that could reasonably have an impact on the adjacent sites this is also applicable if working hours will be exceeded. • Equipment shall be switched off when not in operation. • Equipment must be operated within specifications and capacity (e.g. no overloading of machines); • Regular maintenance of equipment must be undertaken, particularly with regard to lubrication; 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Appropriate directional and intensity settings must be maintained on all hooters and sirens. 				
Fires <ul style="list-style-type: none"> No fires shall be permitted on site. No wood is to be collected, chopped or felled for fires from private or public property within the site. 	<ul style="list-style-type: none"> Minimise risk of veldt fires Minimise destruction of natural fauna and flora Maintain safety on site 	<ul style="list-style-type: none"> No veldt fires started by the maintenance contractor's workforce No claims from landowners for damages due to veldt fires Method statement 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor
Fauna <ul style="list-style-type: none"> All activities on site must comply with the regulations of the: <ul style="list-style-type: none"> Animal Protection Act, 1962 (Act No. 71 of 1962 National Environmental Management Biodiversity Act 10 of 2004, NEMA, City of Johannesburg Metropolitan Municipality: By-Laws for the Protection of Wild Animals and birds, 2006. Sensitive fauna habitats must be identified and demarcated in the event that construction work is required to occur within or in close proximity to such areas. Disturbance to fauna and their habitats must be minimized as far is possible. Any bird nests located within the construction sites shall be reported to the depot manager and the necessary specialist advice sought from the City of Johannesburg Department of 	<ul style="list-style-type: none"> Minimise disturbance to animals Minimise interruption of breeding patterns of birds. Minimise destruction of habitat. To minimise fragmentation of habitat for flora, fauna and avifauna. 	<ul style="list-style-type: none"> No complaints from Nature Conservation No litigation concerning applicable animal protection acts No measurable or visible signs of habitat destruction 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>Environmental Planning and Management.</p> <ul style="list-style-type: none"> No hunting or trapping of animals shall be permitted. No informal fires near construction areas shall be permitted. An alien vegetation control plan must be developed and implemented in order to manage alien plant species occurring within the study area, and to prevent further faunal habitat loss. 				
<p>Flora</p> <ul style="list-style-type: none"> No uncontrolled fires shall be allowed on-site). Careful consideration and prior approval must be sought where areas are cleared for use as laydown and/or storage areas. Vegetation clearing must be done in line with the Service Level Agreement held between JRA and Joburg City Parks. The National Forest Act must be complied with in consultation with Johannesburg City Parks as some protected species may require licensing before it can be removed. Should bulbs be unearthed during maintenance work, these must be reported to the Depot manager for possible relocation to City Parks Nursery. Construction footprints shall be demarcated prior to commencement of construction activities and no construction activities shall be permitted outside of the demarcated footprint. 	<ul style="list-style-type: none"> Minimal disturbance to vegetation where such vegetation does not interfere with maintenance in terms of approvals from the relevant authority Prevent litigation concerning removal of vegetation Encourage natural habitat fauna Minimise scarring of the soil surface and land features Minimise disturbance and loss of topsoil Minimise risk of veldt fires Minimise risk of fauna and flora destruction 	<ul style="list-style-type: none"> No litigation due to removal of vegetation without necessary permission No exotic plants used for landscaping No visible erosion scars once maintenance is completed The footprint has not exceeded the agreed boundaries All damaged areas successfully rehabilitated No veldt fires started by maintenance contractors work force No claims from landowners for damages due to veldt Fires Method statement 	<ul style="list-style-type: none"> As and when required 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> The construction footprint shall remain as small as possible. Avoid disturbance of Riparian system outside of the demarcated construction areas. Access to the construction sites shall be limited to designated roadways to limit the ecological footprint of the proposed construction activities. Where required, Parks, open spaces and the golf course shall be used to access the construction sites within the Braamfontein Spruit. Should any floral or faunal SCC be located/observed, a suitably qualified specialist is to be consulted in order to advice on a way forward. The contractor shall compile an Alien and Invasive Plant (AIP) control plan be developed in order to guide the proponent on the correct removal and control techniques. Collection of plant material or medicinal purposes shall be strictly prohibited. -Rehabilitation measures must be implemented in areas where the soil surface was disturbed in order to limit alien and invasive plant recruitment and further soil erosion, which will lead to further faunal and floral habitat loss. 				
Heritage Resources <ul style="list-style-type: none"> The Contractor's team must be alert and must inform their team leader and Depot manager should they come across any findings of heritage resources. 	<ul style="list-style-type: none"> Limit the destruction of the heritage resources The preservation and appropriate management of new 	<ul style="list-style-type: none"> No destruction of or damage to known archaeological sites 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Maintenance Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> The Depot Manager must inform the local heritage agency within 24 hours should any findings be made. Should any structure of heritage significance be present at the maintenance site, work in this area must cease until the Depot manager has been issued with the go ahead, in writing, by the relevant authority (the South African Heritage Resources Agency on the appropriate provincial heritage resource agency). Under no circumstances must archaeological artefacts or graves be removed, destroyed or interfered with. 	<p>archaeological finds should these be discovered during maintenance work.</p>			
Traffic <ul style="list-style-type: none"> The Contractor shall comply with the traffic regulations. Local speed limits and traffic laws shall apply at all times to minimise the occurrences of accidents on public roads; Where possible the transportation of construction materials and rubbish shall be undertaken outside traffic peak hours to minimise inconveniencing residents. 	<ul style="list-style-type: none"> To ensure road safety along the public roads and on-site and to increase awareness of slow moving vehicles. Warn the public of construction traffic, and to manage traffic on site. 	<ul style="list-style-type: none"> Where existing public roads are used to access the construction areas, adequate construction signage is in place to inform the public of increased construction activities in the affected areas by placing adequate signage. Traffic signs should warn community road users of the presence of construction vehicles. 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor Depo Manager
Soil and Groundwater <i>Spill prevention</i> <ul style="list-style-type: none"> All earthmoving vehicles and equipment shall be on a preventative maintenance schedule to ensure that the equipment is in a good working order to prevent oil and diesel leakages; 	<ul style="list-style-type: none"> Minimise pollution of soil and ground water resources. 	<ul style="list-style-type: none"> To ensure no contamination of soil and groundwater resources. To prevent soil erosion. 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor Depot Manager

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • An inspection programme shall be implemented to ensure that all the mechanical equipment is inspected on a daily basis to ensure the optimal functioning of the equipment, and all leaks will be repaired immediately; • All containment areas shall be monitored for failures, leakages or overfilling of the bunded areas; • All bunded areas shall be designed for sufficient capacity to prevent spillages into the environment should a tank fail; • All oil and chemical drums shall be stored in an appropriately designed bunded area to contain any spillages from these drums; and • Overfilling of equipment must be prevented and all personnel be made aware of this requirement. <p><i>Refuelling</i></p> <ul style="list-style-type: none"> • Refuelling of equipment shall occur in a designated area by trained personnel; • The only permitted method of fuel transfer, will be by means of a pump/controlled valve/tap/hose/funnel; • Fuel dispensing hoses must be of approved non-electrically conductive types with automatic shut off nozzles; • All fuelling equipment will be inspected regularly and all leaks must be repaired immediately; • Absorbent spill clean-up materials shall be available at fuelling areas and should be disposed of properly after use; 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Fuelling operations shall not be left unattended; No temporary refuelling depot or point shall be located within the 1:100 year floodline, or within a horizontal distance of 100 m, whichever is the greater, of the Braamfontein f Spruit; Fuel at temporary depots shall be stored in a bunded area, or alternatively in an area underlain by heavy duty PVC sheeting and covered with 150 mm of sand. This is to include an area adjacent to the tanks upon which vehicles must park during refuelling. Sand contaminated by fuel spills must be cleaned up immediately and disposed of as hazardous waste; Fuel at long-term depots must be stored in a bunded area, underlain by a concrete slab, sloped toward a sump for spillage removal. The bund must be able to accommodate at least the full volume of one of the containers; Impervious paving must be provided adjacent to fuel tanks, upon which vehicles must park during refuelling. This will help to accommodate fuel spills during refuelling; and Spills inside the bunded area and the contents of the oil trap/sump are to be treated as hazardous waste and disposed of accordingly. Spill containment and counter measures Any effluent or hazardous spills will be contained to the smallest possible area 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>and cleaned immediately and the area rehabilitated, where necessary, as dictated by the type, size and severity of the spill;</p> <ul style="list-style-type: none"> Contaminated soil following spills should be disposed of at an appropriate licensed landfill site; Spill kits or similar equipment will be made available at the point of use to contain any hydrocarbon and chemical spills to the smallest possible area; The Service Provider will train the employees to use the spill kits. A spill response plan will be implemented and employees trained accordingly to react effectively to address any spillages; and Large spillages of hazardous substances such as oil will initially be controlled by on-site emergency response personnel, who may be aided by professional contractor. 				
<p>Air Pollution</p> <ul style="list-style-type: none"> A method statement must be available for "dust control". The method statement must provide information on the proposed source of water to be utilised for dust suppression and the details of the licenses acquired for such usage. Point sources of dust must be controlled by regular watering of roads and works area, should the need arise. NB: Concrete dust is to be considered hazardous and damages soil properties. Therefore, watering to prevent dust spread must not be done where concrete 	<ul style="list-style-type: none"> Reduce dust fall out thereby reducing nuisance factor of the construction site and potential for depleted air quality. Reduce visual impact Minimise loss of valuable soil material 	<ul style="list-style-type: none"> No visible signs of dust. No complaints from interested and Affected parties No visible evidence of dust contamination on the surrounding environment Method statement on dust control. 	<ul style="list-style-type: none"> daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>dust has fallen, as it will infiltrate into the soil.</p> <ul style="list-style-type: none"> • Dust control suppression shall be implemented on dry weather days and periods of high wind velocities; • Appropriate dust suppression measures may include limiting the extent of open areas, reducing the frequency of disturbance and spraying with water; and • Concrete bags must not be allowed to blow around the site and spread cement dust. • All vehicles transporting material that can be blown off (e.g. soil, rubble etc.) must be covered with a tarpaulin. • The construction team must monitor the site for excessive dust conditions and apply the required remedial actions. • All forms of dust pollution must be managed in terms of the: <ul style="list-style-type: none"> ◦ National Environmental Management Air Quality Act 39 of 2004. ◦ National Dust Control Regulations, 2013 GN R827/2013. ◦ City of Johannesburg Metropolitan Municipality: Air Pollution Control By-laws. • Putrescible waste must be handled, stored and disposed of before the probability of it generating odours. • Chemical toilets must be emptied / serviced on a regular basis. Proof of this must be provided to the Engineer. 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> A speed limit of 20 km/h shall apply to limit vehicle-entrained dust from the unpaved roads. Dust suppression measures shall be implemented on dry weather days and periods of high wind velocities and may include reducing the frequency of disturbance and spraying with water. All maintenance equipment must be scheduled for preventative maintenance to ensure the functioning of the exhaust systems to reduce excessive emissions and limit air pollution. 				
<p>Alien Vegetation in and along watercourses and infrastructure <i>JRA has a Service Level Agreement with Johannesburg City Parks that is required to be adhered to as part of this Construction EMPr.</i></p> <ul style="list-style-type: none"> An Alien And Invasive Plant (AIP) control plan shall be developed as a guide on the correct removal and control techniques; Where possible, the control of alien invasive plant species shall be conducted in tandem with the construction activities. The Least impact methods must be employed to remove vegetation. When removing vegetation, the stability of the watercourse and banks is not detrimentally affected. Impacted sites should be rehabilitated with suitable endemic species. This will need to be done in consultation with Johannesburg City Parks. It is expected that the JRA will take cognisance of the 	<ul style="list-style-type: none"> To minimise invasion of alien plants within the pipeline footprint. 	<ul style="list-style-type: none"> Ensure that proliferation of Alien invasive weeds does not occur No alien invasive species in the project area. 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>findings and recommendations of the Green Engineering and Landscaping Report for vegetation types that may be suitable.</p> <ul style="list-style-type: none"> • Cleared sites will need to be closely monitored and marinated as disturbed areas become vulnerable to weed infestation due to dormant seed propagation due to suitable conditions. Further this occurs due to seeds being distributed during the removal process. • The following legislation should also be considered to ensure compliance: <ul style="list-style-type: none"> ○ Alien and Invasive Species Lists, 2014 ○ Alien and Invasive Species Regulations, 2014 ○ Conservation of Agricultural Resources Regulations GNR 1048/84 ○ National Environmental Management Biodiversity Act 10 of 2004 ○ National Forest Act <p><i>Notes: Alien species spread rapidly and cause damage to water course infrastructure. They prove to be challenging to remove once established. Alien vegetation as with other vegetation may reduce the capacity of the infrastructure.</i></p>				
<p>Hydrology</p> <ul style="list-style-type: none"> • In the event of pollution caused as a result of construction activities, JRA, according to Section 20 of the National 	<ul style="list-style-type: none"> • Minimise pollution of soil, ground water resources and the Braamfontein Spruit. 	<ul style="list-style-type: none"> • No visible signs of pollution • No signs of siltation of the Braamfontein Spruit 	<ul style="list-style-type: none"> • As and when required • Monitor daily 	<ul style="list-style-type: none"> • Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>Water Act, 1998 (Act No. 36 of 1998) is to be responsible for all costs incurred by organizations called to assist in pollution control and/or to clean up polluted areas.</p> <ul style="list-style-type: none"> • No construction vehicles shall be allowed in the active channel or within 1:100 year floodlines of the Braamfontein Spruit. • Access points to the river shall be kept to a minimum. • No sand, silt and silt-laden water shall be permitted to enter the storm water system. Appropriate measures, e.g. erection of silt traps, or drainage retention areas to prevent silt and sand entering drainage or the Braamfontein Spruit must be taken. • Run-off containing high sediment loads must not be released into Braamfontein Spruit. • River diversion of the Braamfontein Spruit can only be done under exceptional circumstances and where prior approval has been sought. • During construction, erosion protection berms shall be installed to prevent gully formation. Berms every 50 m should be installed where the track has a slope of less than 2%, every 25 m where the track slopes between 2% and 10%, every 20 m where the track slopes between 10% and 15% and every 10 m where the track slope is greater than 15%. • The temporary diversion or impeding of the Braamfontein Spruit must only take place if it is essential to provide safe work 	<ul style="list-style-type: none"> • Minimise impeding the natural flow of water in the Braamfontein Spruit • Minimise the impact on natural water flow dynamics • Minimise scarring of the soil surface and land features • Minimise damage to river and stream embankments • Minimise erosion of embankments and subsequent siltation of rivers and streams • Minimise damage to riverine habitats 	<ul style="list-style-type: none"> • No visible erosion scarring of the Braamfontein Spruit once construction is completed • Minimum loss of topsoil • No access roads through river and stream banks • No erosion or siltation downstream 		

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>conditions and where construction is urgent.</p> <ul style="list-style-type: none"> • Diversions must be for the shortest possible period, not exceeding 15 days. • Methods used to divert the watercourse must be removed immediately following the completion of the construction work. • Any structures in the Braamfontein Spruit must not impact on the water quality, movement of aquatic biota; affect the velocity, pattern, or assurance of flow. • Exposed soils shall be protected by means of a suitable geotextile covering such as hessian sheeting. • Sediment control devices to be in place prior to the commencement of site preparation activities. • All construction activity within the active channel for construction of bridge pier (at 8th Ave) should take place in the low flow period of winter. • The construction of piles within cofferdams must be done as quickly as possible to reduce the duration of construction activity within the active channel of the river. • Piers must be designed in such a way as to pose the least hydraulic resistance possible. • Only essential equipment and infrastructure will be allowed within the 100 m buffer area. • Only essential construction personnel will be allowed within the 64 m buffer of the road crossing sites. 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • The boundaries of the buffer areas are to be clearly defined and all riparian areas outside the buffer area are considered to be no-go areas. • No construction activities shall be permitted outside the footprints of the construction sites. • Where possible, construction activities shall be restricted to the drier months to avoid sedimentation of the river system. • All vehicles must remain on designated roads with no indiscriminate driving through the area. • No vehicles may be allowed to indiscriminately drive through the riparian areas or within the active stream channels. • The river system shall regularly be monitored for erosion and incision. • The bed profile must be re-instated in such a way as to prevent incision and erosion in all areas that may be disturbed. • All disturbed areas shall be re-vegetated with indigenous riparian species. • Reprofiling of the banks of disturbed drainage areas to a maximum gradient of 1:3 to ensure bank stability shall be conducted; • If it is inevitable that support pillars are to be developed within the active channels, measures to ensure that the structures will cause limited turbulence must be ensured. 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> No unnecessary support structures shall be constructed within the riparian zones or active stream channels. All building materials shall be kept out of the riparian areas as well as the active stream channels. Disturbance of the vegetation and stones/boulders shall be kept to the absolute minimum, ensuring that only the areas that are necessary for access purposes are disturbed. The waste management criteria considered in this EMPr shall be implemented in order to prevent construction-related waste from entering the river. All vehicles shall be regularly inspected for leaks. Re-fuelling must take place outside the project area, on a sealed surface area to prevent ingress of hydrocarbons into topsoil. All excess rock and rubble must be removed from the active stream channel once construction has been completed. All riparian areas affected by the rehabilitation of the banks shall be desilted. 				
Visual <ul style="list-style-type: none"> The number of construction vehicles and machinery to be used shall be kept to a minimum. Movement of vehicles shall be kept to outside busy hours to minimise the visual impacts on the residents. 	<ul style="list-style-type: none"> To minimise visual intrusion 	<ul style="list-style-type: none"> To reduce visual disturbances and to minimise the loss in sense of place 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Where possible, rehabilitation of the work areas shall be undertaken in tandem with construction to ensure that areas stripped of vegetation are kept to a minimum. 				
No-go areas <ul style="list-style-type: none"> All maintenance activities must remain within the boundaries of the construction area, as discussed at the initial toolbox talk. 	<ul style="list-style-type: none"> Minimise the potential for the spread of the of the footprint Reduce loss of fauna and flora habitat Minimise the potential for loss of protected and or endangered fauna and flora species 	<ul style="list-style-type: none"> No sign of movement through "no go" areas. Containment of footprint 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor
Crime, safety and security <ul style="list-style-type: none"> PSIRA Registration of Security Personnel must be confirmed for legal operation on the site. Emergency Preparedness plans must be compiled in terms of Section 20 of National Water Act and Section 30 of NEMA. No site staff, other than security personnel and skeleton staff will be housed on site. The site and crew are to be managed in strict accordance with the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) and the National Building Regulations. It must be ensured that all emergency procedures are in place prior to commencing work. Emergency procedures must include (but not be limited to) fire, spills, contamination of the ground, accidents to employees, use of 	<ul style="list-style-type: none"> Reduce the risk of potential incidences Minimise the potential impact on the environment 	<ul style="list-style-type: none"> No incidences reported 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>hazardous substances and materials, etc.</p> <ul style="list-style-type: none"> A list of all emergency telephone numbers / contact persons must be kept up to date and all numbers and names shall be posted at relevant locations throughout the maintenance site. The nearest emergency service provider must be identified, as well as its capacity and the magnitude of accidents it will be able to handle. The contact details of this emergency centre, as well as the police and ambulance services must be available on site. Personal Protective Equipment (PPE) will be issued by all persons entering the construction site. PPE includes safety shoes, goggles, earplugs, gloves, hard hats, masks, etc. The PPE required will be dependent on the area that the person is working in, as well as the activity he/she is undertaking 				
<p>Fleet and Plant management</p> <ul style="list-style-type: none"> Construction vehicles and equipment relevant to the scale of the work to be undertaken must be sought. Only low-pressure rubber tracked plants shall be used in the Braamfontein Spruit. All construction vehicles and equipment that are leaking, noisy (above manufacturer's specifications), causing excessive fumes etc. must not be released for use on site. 	<ul style="list-style-type: none"> Prevent pollution of the environment Minimise chance of transgression of the acts controlling pollution Disposal of hazardous substances in an appropriate manner 	<ul style="list-style-type: none"> No pollution of the environment No litigation due to transgression of pollution control acts Method statement 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor Liaison Transport Officer

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> • Operators are to ensure that checklists are complete before taking plants out to site. • A method statement must be available on file to issue to subcontractors that have been appointed to undertake construction activities. • Procedures for dealing with possible emergencies that can occur, such as fire and accidental leaks and spillage must be on file. Regular training must be done with all operators and members of the maintenance team detailing emergency procedures and their application. <ul style="list-style-type: none"> ○ An emergency spill kit that is complete must be available at all times on site. Senior and other relevant members of the workforce are to be trained in dealing with spills by using the emergency spill kit. ○ All contaminated material resulting from hydrocarbon spills must be removed and disposed of as hazardous waste at a registered facility or placed in containers to be taken to the depots storage area (Bund facility) for later disposal. Safe disposal certificates must be kept in the environmental file. ○ Do not allow drip trays receiving leaks to overflow. ○ Prevent storm water channels, gullies, drains from being contaminated. 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> Do not discharge contaminants into storm water or sewage infrastructure. Prevent runoff water from being contaminated. All significant spills of hazardous substances must be reported. All significant spills of hazardous substances must be reported to the Depot on the same day of occurrence. The incidents register must be filled in detailing the spill and proof of clean up procedures flowed. Construction vehicles and equipment parked overnight at temporary parking areas close to maintenance sites must have a drip tray positioned strategically to contain any potential leaks. Drip trays must not be allowed to overflow, or fill with rain water. Drip trays are to be monitored periodically and cleared into the hazardous chemical bin as and when required. 				
Gabion and retaining wall Repair <ul style="list-style-type: none"> Where dump rock is to be replaced, stockpiles are to be placed outside of the buffer zone and carried to the works site using manual means. Repair works must only take place to existing approved structures, no additional gabions must be added as this will require the necessary environmental authorization. Entry and exit points to the gabions must first be considered to ensure that foot 	<ul style="list-style-type: none"> To ensure that the existing surface water quality in the Braamfontein Spruit will not be affected by the construction activities. 	<ul style="list-style-type: none"> No visible signs of pollution No signs of siltation of the Braamfontein Spruit. No complaints from downstream users. No visible erosion scarring of the Braamfontein Spruit once maintenance is completed Minimum loss of topsoil No access roads through river and stream banks 	<ul style="list-style-type: none"> Weekly 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>traffic in the area is not the cause of additional collapse.</p> <ul style="list-style-type: none"> Increased run-off during construction/maintenance works must be managed using berms and other suitable structures as required to ensure flow velocities are reduced; this must be done in consultation with the engineer. Storm water, wherever possible, should be allowed to soak into the land in the area on which the water fell e.g. retention ponds To reduce the loss of material by erosion, it must be ensured that disturbance on site is kept to a minimum. Size in terms of length and width of the access ramps must be limited to the minimum that is required to gain access to the Braamfontein Spruit. Earthmoving equipment and construction vehicles shall not be allowed to move outside the access ramps or demarcated areas in the rivers; The increase in suspended solids downstream of where the work is taking place shall not be more than 10 % of that of the upstream value; Monitoring shall be done on a regular basis to ensure that the impact is acceptable on the downstream users; all erosion damage must be repaired as soon as possible and in any case no later than six months after it has occurred; In general, all steep slopes steeper than 1:3 within the watercourse or where the 		No erosion or siltation downstream		

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>soils are more prone to erosion must be stabilised;</p> <ul style="list-style-type: none"> • Special care must be taken in areas susceptible to erosion, such as embankments and topsoil stockpiles; and • Silt laden water shall not be released directly downstream of the works. This water must be contained in a settlement pond and managed prior to release or through methods approved by the Engineer. Any releases from the settlement pond must comply with the discharge standards contained in the Department of Water and Sanitation (DWS) General Authorisations. 				

6.3 Operation and Rehabilitation Phase

Table 6-3: Rehabilitation Phase

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
Hydrology <ul style="list-style-type: none"> In the event of pollution caused as a result of maintenance and repair activities, JRA, according to Section 20 of the National Water Act, 1998 (Act No. 36 of 1998) is to be responsible for all costs incurred by organizations called to assist in pollution control and/or to clean up polluted areas. No maintenance vehicles shall be allowed in the active channel. Access points to the river shall be kept to a minimum. Maintenance and repair activities should not obstruct flow. Ensure sediment control devices are in place prior to diverting the stream. Ensure that the creation of the diversion does not result in a significant water level difference upstream or downstream of the installation site. The duration of impacts on the riparian areas should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised – therefore the repair/maintenance period should be kept as short as possible. It must be ensured that excessive quantities of sand, silt and silt-laden water do not enter the storm water system. Appropriate measures, e.g. erection of silt traps, or drainage retention areas to 	<ul style="list-style-type: none"> Minimise pollution of the Braamfontein Spruit. Minimise impeding the natural flow of water in the Braamfontein Spruit Minimise the impact on natural water flow dynamics Minimise scarring of the soil surface and land features Minimise damage to river and stream embankments Minimise erosion of embankments and subsequent siltation of rivers and streams Minimise damage to riverine habitats 	<ul style="list-style-type: none"> No visible signs of pollution No signs of siltation of the Braamfontein Spruit No visible erosion scarring of the Braamfontein Spruit once construction is completed Minimum loss of topsoil No access roads through river and stream banks No erosion or siltation downstream 	<ul style="list-style-type: none"> As and when required Monitor daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>prevent silt and sand entering drainage or the Braamfontein Spruit must be taken.</p> <ul style="list-style-type: none"> • During operation erosion protection berms shall be installed to prevent gully formation. Berms every 50 m should be installed where the track has a slope of less than 2%, every 25 m where the track slopes between 2% and 10%, every 20 m where the track slopes between 10% and 15% and every 10 m where the track slope is greater than 15%. • The temporary diversion or impeding of the stream must only take place if it is essential to provide safe work conditions and where construction is urgent. • Any structures in the Braamfontein Spruit must not impact on the water quality, movement of aquatic biota, affect the velocity or pattern or assurance of flow. • Where possible, maintenance and repair activities shall be restricted to the drier months to avoid sedimentation of the river system; • All vehicles must remain on designated roads with no indiscriminate driving through the area. • No vehicles may be allowed to indiscriminately drive through the riparian areas or within the active stream channels. • The river system shall regularly be monitored for erosion and incision. • The bed profile must be re-instated in such a way as to prevent incision and erosion in all areas that may be disturbed. 				

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<ul style="list-style-type: none"> All disturbed areas shall be re-vegetated with indigenous riparian species. The waste management criteria considered in this EMPr shall be implemented in order to prevent construction-related waste from entering the river; All excess rock and rubble must be removed from the active stream channel once construction has been completed. All riparian areas affected by the rehabilitation of the banks shall be desilted. 				
Visual <ul style="list-style-type: none"> The landscaping and green engineering solutions shall be utilized for rehabilitation and to minimise visual impacts. The number of construction vehicles and trips shall be kept to a minimum All the maintenance vehicles shall undergo maintenance on a regular basis to improve on the combustion engine vehicle efficiency and minimise emissions. 	<ul style="list-style-type: none"> To minimise visual intrusion 	<ul style="list-style-type: none"> To reduce visual disturbances and to minimise the loss in sense of place 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor
Rehabilitation <ul style="list-style-type: none"> Once construction work has been completed and approved and prior to the signoff of the job card the entire works site including laydown areas must be completely cleared of: <ul style="list-style-type: none"> Plant; Waste (rubble, containers, empty cement pockets etc); and Excess material. The laydown area and where construction vehicles and machinery was parked must be assessed for any contamination. The 	<ul style="list-style-type: none"> Return areas affected by the construction activities to their former state To ensure that any area affected by erosion that occurred as a result of the construction work is rehabilitated. To remove all alien invasive plant species that occur in the disturbed areas. 	<ul style="list-style-type: none"> No alien invasive plants on site No waste around the site 	<ul style="list-style-type: none"> Daily 	<ul style="list-style-type: none"> Contractor

Mitigation Measures	Management Objective	Measurable Targets/Monitoring Outcome	Monitoring Frequency	Responsible Person
<p>affected soil must be removed for disposal at a registered hazardous waste facility. Verification must be sought from the facility that they hold a permit in terms of the Section 19 of the NEMWA.</p> <ul style="list-style-type: none"> • The above must be marked off on the closeout checklist and signed off by the Depot manager and attached to the job card for submission. • Restrict vehicles to travelling only on designated roadways as far as possible to limit the ecological footprint when carrying out maintenance operations; • Continue with alien and invasive plant control measures until all the alien and invasive plant species have been eradicated from the project area. • Visual inspection shall be undertaken for 3 years after construction to ensure that rehabilitation has been successful (basal and aerial cover and species diversity). 	<ul style="list-style-type: none"> • To ensure that appropriate basal cover in disturbed areas 			

7 Monitoring and compliance

An Environmental Management File must be compiled and stored on site. The Environmental Management File will contain the following as a minimum:

- The EMPr;
- Environmental Method Statements;
- Foreperson and Supervisor Environmental monitoring reports;
- Copy of Environmental Site instructions issued;
- Completed Environmental incidents registers;
- Records of Environmental inductions;
- Toolbox Talk Topics and signed attendance registers;
- Environmental Authorizations relevant to specific region; and
- Site-specific environmental risks/awareness/aspects that could cause impacts.

A part time or full time Environmental representative shall oversee the implementation of the EMPr and compliance to relevant environmental legislation and the EMPr for the project. Evidence of the following as key performance indicators, must be included in the audit Reports where required:

- Complaints received from landowners and actions taken;
- Environmental incidents, such as oil spills, concrete spills, etc. and actions taken (litigation excluded) Refer to annexure 5 (incidents and environmental log). The log is to be issued with the close out report as part of the submission of the Job Card;
- Incidents leading to litigation and legal contraventions;
- Environmental damage that needs rehabilitation measures to be taken; and
- A copy of all Supervisor and Forepersons monitoring reports, maintenance contractor method statements and pro forma documentation must be held by the HSE and be made available to the Department upon request.

Part of the monitoring process is to undertake monitoring on a daily basis. The Environmental representative must ensure that the daily environmental checklist is completed; these must be submitted with the job card on completion of the job.

7.1 Site Documentation

The following is a list of documentation that must be held on site and must be made available on request.

- Site daily diary /instruction book/ Incident reports; Copy of Environmental Authorisation (where applicable);
- Any other form of environmental instruction or directive;
- Records of all remediation/rehabilitation activities;
- EMPr;
- Complaints register;
- Environmental Method statements;
- Signed permission to enter private property;
- Incident registers etc.
- Hazardous chemical register; and
- Site specific environmental hazards

7.2 Monitoring Programme

The monitoring programme contained in this EMPr shall be used to monitor the impacts associated with the project and to ensure that the mitigation measures are effective and sustainable.

7.3 Photographic Record

Photographic records shall be kept and submitted with the audit reports. The photographic records shall include:

- Dated photographs of the sites to be impacted before construction commences,
- Dated photographs of the sites during construction on a monthly basis, and
- Dated photographs of all the sites after completion of construction seasonally.

7.4 Environmental Monitoring

The monitoring programme for the project is set out in **Table 7-1**.

Table 7-1: Environmental monitoring programme

Type of monitoring	Parameter	Location	Frequency				Start Date	Comment
			D	W	M	Y		
Soil								
Visual inspection	Soil erosion	Where vegetation is cleared and where topsoil is stockpiled.		X			Throughout maintenance and rehabilitation phases	This will continue until rehabilitation is complete and sustainable.
Flora								
Alien invasive species	Declared weeds and alien species	Disturbed areas and rehabilitated areas			X		Throughout maintenance and rehabilitation phases	This will continue until rehabilitation is complete and sustainable.
Water Quality								
Surface water quality	pH , EC, TDS, SS	100 m upstream and downstream of the maintenance works areas in the Braamfontein Spruit		X			Throughout maintenance and rehabilitation phases	Monitoring will be required at all the construction activities until such time that rehabilitation is completed and sustainability of vegetation cover is achieved.
Emergency Monitoring	pH, Ec, TDS, Ca, Mg, SO4, Na, Cl, PO4, NO3, NH4, SS, Oils & greases	Upstream and downstream of the maintenance works areas in the Braamfontein Spruit	X				As and when required	In the case of an incident that might impact on the surface water quality
Air quality								
Dust	Visual inspection - Nuisance	Disturbed areas	X				Throughout maintenance and rehabilitation phases	
Waste management								

Type of monitoring	Parameter	Location	Frequency				Start Date	Comment
			D	W	M	Y		
Waste collection and disposal	Maintain a waste manifest book to record volumes of waste leaving the site, including recyclables. Keep safe disposal certificates on file on site for Hazardous waste. Way Bridge slips must be obtained for all other waste streams and kept on file on site	Maintenance works	X				Throughout maintenance and rehabilitation phases	Landfill site permits to be kept on file on site.
Storm water management								
Storm water management	Visual monitoring based on sediment	Construction site	X				Throughout construction and rehabilitation	
Rehabilitation								
Visual inspection where areas have been rehabilitated	Basal Cover Arial Cover Species diversity	Rehabilitated areas			X		Throughout rehabilitation	This will be undertaken for a period of three years after construction is completed or until growth is sustainable
Berms, Bridges and stilling dam								
Visual inspection	Integrity of the infrastructure	All the infrastructure including the berms, bridges and the proposed stilling dam.				X	Operation phase	Regular inspection, maintenance and repair will be required.

D – Daily; W – Weekly; M – Monthly, Y - Yearly

8 Awareness Training

The Contractor will be responsible for implementing an environmental awareness training programme to ensure that all the employees are acquainted with the requirements of this EMPr.

“Environmental awareness involves communication campaigns for reaching various audiences, developing messages and selecting and/or producing the appropriate resources and media to reach these audiences. The aim of environmental awareness is to make people from all walks of life aware of specific issues related to their surroundings, including living and non-living elements, e.g. land, soil, plants, animals, air, water and other humans, as well as awareness of their built, social and economic surroundings, and the impacts of our actions on these. Awareness is a necessary but not a sufficient element of social change.

The aims of awareness raising activities are more limited in scope than environmental education and the processes should not be confused. While they cannot, on their own, achieve the required educational outcomes outlined above, awareness-raising can be a component of broader and more in-depth education processes” Environmental Awareness, education and training strategy for City Staff and councillors August 2011.

As a minimum the contractor will conduct awareness training for all new employees and subcontractors prior to commencement with construction work. All employees must be made aware of what the potential impact can be due to their work activities on the project.

Regular and frequent training which may include daily toolbox talks and safety meetings will be used to provide any additional training as and when required. The Contractor will make use of the JRA standardized Environmental induction. Toolbox talk topics should include, but are not limited to:

- Waste management (Hazardous waste and general waste management);
- Chemicals handling and storage;
- Site clearance after maintenance;
- General Environmental management/awareness; and
- Ad hoc talks based on the outcomes of Risk Assessments.

Anybody who obtains access to the site for the first time will have to undergo awareness training. This will include any sub -consultants or sub-contractors. A register of all training provided must be kept on site.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

APPENDIX 1: PHASE 1 CONCEPTUAL DRAWINGS

APPENDIX 2: CONSTRUCTION METHOD STATEMENT

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