Wastewater Risk Abatement Plan of

CITY OF CAPE TOWN

This document should be read in conjunction with WRC Report TT 489/11 (Wastewater Risk Abatement Plan – A W_2RAP guideline to plan and manage towards safe and complying municipal wastewater collection and treatment in South Africa.

WRC Report No. SP 22/11

June 2011

CITY OF CAPE TOWN

WATER AND SANITATION DEPARTMENT

WASTEWATER BRANCH

WASTEWATER RISK ABATEMENT PLAN

for the Operations and Maintenance of the

WASTEWATER COLLECTION AND TREATMENT WORKS

'We clean your wastewater'

February 2011

Revision History

Revision No.	Prepared by	Description	Date
Draft A	KA Samson	draft of W2RAP	21 February 2011

Document Acceptance

Action	Name	Signed	Date
Prepared by	KA Samson		
Reviewed by	Alf Moll/RM/RB		
Approved by	KA Samson		

EXECUTIVE SUMMARY

The primary objective of collection and wastewater treatment is to ensure that the effluent discharged to the environment does not pose unacceptable risks to the human health and the ecosystem.

Wastewater Treatment Works operate 24/7, 365 days of the year and there is limited control over the quantity and quality of the incoming raw wastewater. The environment in which the Wastewater Treatment Works (WWTW) operates is aggressive, corrosive and with an ageing infrastructure. More importantly the discharge of substandard effluent quality or untreated wastewater degrades the receiving water catchments and poses significant risks to public health and the environment

To mitigate potential risks, the Wastewater Branch of the City of Cape Town developed a risk mitigation plan for its WWTW designs and Operation and Maintenance. This plan, in line with the approach adopted by the Department of Water Affairs (DWA), will hereafter be called the City's Wastewater Risk Abatement Plan (W2RAP)

The City's W2RAP is based on the scope of our business, identifying, analysing and evaluating these risks and defining the appropriate risk treatment strategies and controls.

The Wastewater Branch's W2RAP is underpinned by the legislative and business requirements such as the IDP, the WSDP, the City's Risk Register, the Water and Sanitation Department's and the Wastewater Branch's Risk Register, the Quality Management System based on ISO 9001, the Branch's plans annual Operational & Maintenance Plan and the Infrastructure Asset Management Plan .

To ensure that our objectives are achieved, the Wastewater Branch is commitment to

- Continually improving its core business performance by means of integrated environmental programmes that are regularly assessed and monitored;
- Responsible stewardship and a high standard of plant management;
- Meeting the requirements of relevant legislation pertaining to the operation and maintenance of the Wastewater Treatment Works;
- Preventing pollution by implementing the Best Practical Environment Option at all times;
- Educating and motivating employees to conduct their work activities in an environmentally responsible manner;
- Minimising the amount of sludge disposed to landfill by extending the off-site composting and other beneficial re-use options;
- Staying abreast of the latest wastewater treatment technology;
- Minimising environmental incidents by means of risk management and a preventative maintenance programme;
- Improving efficiency with regard to energy consumption;
- Minimising the use of hazardous substances and strict control of the use of those that are necessary;
- Promoting the re-use of treated effluent;

- Implementing an environmental management system using the internationally recognised ISO 14001 as a guideline;
- On-going implementation, auditing and reporting on the performance of the ISO management system;
- Communicating this policy to relevant stakeholders.

  (*an extract from our Quality Policy*)

In addition, it is committed to ensuring that its 10 year Master Plan for capital financing of its replacement, refurbishment and upgrading of the Works is implemented

In terms of the City's W2RAP, all decisions, including the daily operations and maintenance, the outsourcing of services contract management and design parameters are based on a risk management. To this end, prior to design and construction for an upgrading or capacity extension to a WWTW, a Hazard and Operability Study (HAZOP) is performed to ensure that all the risks, its likelihood and consequences and the risk treatment strategies/control measures are taken into account.

This W2RAP is designed to assist the WWTW Operators to identify the key risks on their WWTW and to implement appropriate risk controls measures.

This is a living document and is required to be updated on an annual basis or after an incident where risk control strategy may require a revision

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Manager: Wastewater

KA Samson

March 2011

TABLE OF CONTENTS

1 INTRODUCTION

The City of Cape Town's Wastewater Treatment Branch provides wastewater treatment to approximately 3.2 million residents. Inclusive of the organic load from the industries, commercial and retail establishments, the City's 20 Wastewater Treatment Works (WWTW), 3 Marine Outfalls and 2 oxidation ponds treat in total wastewater from a population equivalent (pe) of approximately 6 million people on a daily basis. The 21^{st} WWTP, namely the Fisantekraal WWTP, is scheduled to be fully operational by June 2011.

Presently (year 2011), the Branch still experiences significant challenges with regard to the operations and maintenance at the WWTPs. Among these are:

- a historically low base budget allocation for R&M,
- Aging infrastructure
- the current 'catch-up' mode to ensure optimal operation and maintenance planning with regard to the installation of new infrastructure and technologies
- the annual parameterised percentage budget increase going forward for each financial year i.e., it is not a needs-based budget allocation,
- the low skills base and the low number of adequately skilled or experienced staff required to operate and maintain these complex and technologically advanced multi-million rand installations.
- the need to rapidly upgrade and extend the WWTP for the housing developments

Therefore, due either to inadequate previous designs, ineffective operation, lack of maintenance and planning, Wastewater Treatment Works potentially poses a significant negative impact on the public and the environment. Incidents such as sludge lagoons walls rupturing, overtopping of maturation ponds, power outages, mechanical/electrical/process control system breakdowns and the discharge of substandard or partially treated sewage to the environment have highlighted the fact that managing risk is an integral part of the overall management of the WWTW.

The City of Cape Town's Wastewater Branch therefore adopted a risk-based approach for the designs of its WWTW, its daily operations and maintenance and management of the WWTW. This is a relatively new approach for the wastewater industry in general. While this approach has been used with varying success before, the documenting and rating of the risks has been a shortcoming.

The main drivers for this approach were the mechanical/electrical/process control systems (PCS) breakdowns, the reactive mode of maintenance, the rapid growth of housing development impacting on the treatment capacity of the WWTW, the under-investment in infrastructure for the wastewater collection system and Treatment Works and the resultant the discharge of raw sewage or a non-compliant effluent to the environment.

Essentially the drivers were the need to ensure (i) the safety of the staff and the public at large, (ii) the protection of the existing assets, (iv) the protection of the downstream wastewater treatment processes (v) the need to increase treatment capacity in a short time period and (vi) the need to discharge a compliant effluent for possible reuse.

For the past 4 years, the Wastewater Branch has spent approximately R200 million per annum to upgrade and extend the capacity of the WWTW. This is a significant increase over the previous 4 years were the budget allocation was unsustainable. Since the present projects involve a considerable capital budget and expenditure, hence it is imperative that a proper risk assessment is undertaken.

While the operational and maintenance risks for the WWTW have been identified and form part of this W2RAP, the higher level risk register for the Wastewater Branch and for the Water and Sanitation Department is not overly emphasized in this document.

The scope of this document is limited to providing guidance to our WWTW managers and the staff to identify the wastewater treatment process risks, assess and implement the risk controls required to ensure the Branch's objectives are achieved.

It is vital to remember, **risk management starts with the on-site WWTW staff**.

This is a living document and is required to be updated on an annual basis or after an incident where risk control strategy may require a revision.

2 DESCRIPTION OF THE WASTEWATER TREATMENT BRANCH'S SCOPE OF WORK

Aside from the two oxidation ponds, the City's Wastewater Treatment Plants are generally sophisticated, complex, largely automated and highly mechanised installations. Each WWTP has various unit processes in order to achieve the wastewater effluent quality required. The final effluent quality has to meet the requirements stipulated in the licence (permit) issued by the regulatory authority, the Department of Water Affairs (DWA).

Simplified, the WWTP essentially consists of:

(i) an Inlet Works with lifting pumps, mechanical screens (hand-raked in the case of emergency), screenings washing and dewatering and grit removal;

(ii) (optional) the primary settling tanks (PSTs) with associated moving bridges and mechanical scrapers and sludge withdrawal pumps;

(iii) biological reactors with associated internal recycle pumps, pipework, diffusers, aeration system (either surface aerators or blowers) with associated motors and gearboxes;

(iv) the secondary settling tanks (SSTs) with stilling wells, moving bridges and sludge withdrawal systems and associated recycle pumps;

(v) maturation ponds – for tertiary treatment and capture of solids carry-over;

(vi) disinfection of the final effluent using either chlorination or UV disinfection. Should chlorination disinfection be installed, it is regarded as a major hazardous installation (MHI);

(vii) sludge thickening/dewatering, at most of the City's WWTPs, is by mechanical means. This is done either by belt presses or centrifuges. The dewatered sludge is stored in sludge hoppers/silo's before being transported off-site. The thickened sludge is transported to the hoppers by means of screw conveyors and positive displacement pumps;

(viii) odour control with bio(media) trickling filters completed with fans and internal ducting or in certain instances simply by using masking agents

These installations require specialised skills for operating and maintaining of the Works.

The competence of personnel (mechanical, electrical and process control systems maintenance) required to operate and maintain these installations are sometimes generally difficult to assemble.

Owing to the aggressive and corrosive environment under which the infrastructure and equipment has to operate, maintenance requirements are very high and presently the maintenance is largely reactive and on an emergency basis. While recent initiatives, such as the Operational and Maintenance Plan have been implemented, proactive maintenance is limited by the lack of capacity of the current maintenance complement.

Under these conditions, risk management is paramount in the management strategy of the Branch.

3 Legislative, Policy and Operational requirements

The business of wastewater collection and treatment operates in a highly regulated environment. In this regard, the following Acts have particular reference viz., Basic Conditions of Employment Act (BCEA), Labour Relations Act (LRA), Occupational Health Safety Act (OSHA) and especially the machinery regulations, National Water Act (NWA), Skills Development, National Environmental Management Act (NEMA) etc.

While the City and the Water and Sanitation Department complies with the abovementioned Acts, it should be noted that the following requirements highlights the necessity for a risk management approach:

3.1 Department of Water Affairs: Green Drop Audit requirements

The requirements are:

(a) Operations (Process Control), Maintenance and Management Skills;

(b) Wastewater Monitoring Programme which requires Operational and Compliance Monitoring;

(c) Credibility of Wastewater Sample Analysis;

(d) Submission of Waste Water Quality Results;

(e) Effluent Quality Compliance;

(f) Wastewater Quality Failure-Response Management;

(g) Wastewater Asset Management;

(h) Publication of Wastewater Management Performance;

(i) Wastewater Treatment Facility Capacity;

(j) Storm water and Water Demand Management;

(k) Proof of Bylaws.

All of the above relates to managing the risks.

3.2 Integrated Development Plan (IDP)/Water Services Development Plan (WSDP)

The IDP and WSDP are the City's strategic plan for the provision of municipal services. These Plans provide the obligations to which the City commits itself for a 5-year period. It is imperative that the Wastewater Branch's obligations envisaged in its Business Plans, including the risks register are reasonably reflected in the WSDP and the IDP.

3.3 Municipal Financial Management Act: Supply Chain Management Regulations

It is imperative that we comply with the MFMA and specifically, the SCM regulations. Taking into account the backlogs/constraints experienced by WWTW operators, its procedures tends to be cumbersome and delays the effective and efficient response to wastewater collection and treatment's operational and maintenance needs. Notwithstanding our engagements with the City's SCM Department to relax the stringent regulations, it is unlikely to change as these are legislative requirements to which the SCM department has to comply. Although, our Risk Abatement Plan and O&M plan takes into account these stringent regulations, it remains a challenge to effectively anticipate and plan for all emergencies, breakdowns, reactive repairs and associated costs.

3.4 Quality Management System (QMS): (ISO 9001/14001)

A QMS, such as ISO 9001, is an important guide for our O&M plan's successful implementation and risk management.

To this end, the Wastewater Branch has made reasonable progress with the implementation of proper documenting of operating procedures and capturing of the data. In addition, the Potsdam WWTP has already developed the ISO 14001 system documentation and its implementation is in progress.

The QMS system is designed to have adequate documentation and reporting, training, operational procedures, equipment malfunction reports, preventative and mitigation and verification of the input data.

In this regard, the Aspects and Impact Register and the legal register has already been developed

4 RISK MANAGEMENT

Simply stated risk management address the question '*What (the event/incident) could go wrong (the Risk) the probability (the likelihood) that will it occur, what are the results (the consequences) of the incident, what do we have in place to prevent 'the incident' from occurring (contingency measures or risk control strategy), and if the event/incident does happen, how do we deal with it (emergency procedures)'*

Risks are potential dangers, hazards, threats that will impact on the Branch's business objectives. The risks are considered in terms of its consequences and likelihood.

- The likelihood is the probability (or chance) that the event (or incident) will occur.
- The consequence is the result of the incident; for example, that may include (i) the discharge of a non-compliant effluent, (ii) the treatment unit processes are negatively affected so that it does not operate effectively, (iii) financial losses, (iv) the environment is compromised or (v) the worst case scenario, that of fatal injury or death

In the wastewater treatment environment, some of causes of not adequately managing the risks are the limited knowledge, experience and information of the Works' infrastructure and the operation and maintenance thereof.

This document provides guidance on a structured approach of identifying and analysing potential risks, devising and implementing control measures to mitigate the risks.

In the process of developing the Branch's W2RAP, (i) the boundaries of wastewater collection and treatment was defined, (ii) the risks were identified, assessed, (iii) appropriate mitigation/control measures developed. This general approach is graphically depicted in Figure 1.

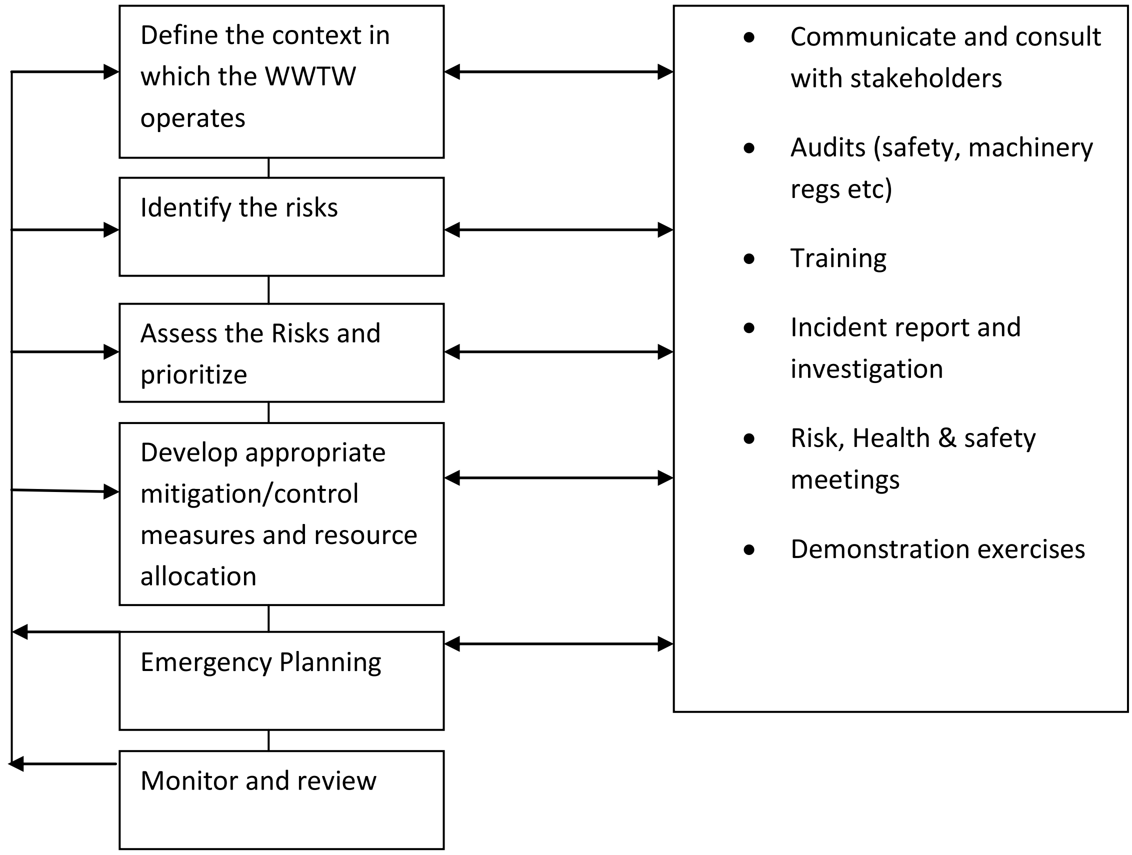

Figure 1: The risk management process

4.1 **PLANNING FOR RISK ABATEMENT**:

The first step of risk management is to know the physical boundaries of the area of jurisdiction i.e. the extent of the site and the processes to be included. This affects the information collection, including the level of detail necessary and the team requirements.

The information required for the W2RAP includes

(i) A site layout drawing;

(ii) the drawing of pipeline (routes) and instrumentation diagrams;

(iii) description of each of the unit processes (not too detailed but to identify risks);

(iv) process flow diagrams;

(v) equipment design specification;

(vi) the surrounding area, land uses and the environment that would be impacted upon;

(vii) an inventory of the hazard materials on site with MSDS;

(viii) an inventory of the equipment required and/or where it can be sourced in case of an emergency;

(ix) anecdotal evidence of near misses must be investigated, verified and documented;

(x) a list of service providers for emergency repairs;

(xi) a list of contact persons e.g. Reticulation (pump station Manager), Disaster Management etc.;

(xii) the reliability and availability of plant and equipment;

(xiii) the laboratory results for the point upstream and downstream of the water body into which the effluent discharges.

During the planning of the Risk Abatement Plan, the assumptions, perceptions and risks identified and why certain risk control measures were adopted have to be documented. These control measures must be reviewed and revised after demonstrations (role-play) of an incident

It is essential that the staff, especially the shift supervisors and WWTW staff, the process/design engineers, maintenance personnel and the line management are involved during this planning process. More importantly, that these people need to be trained to identify, assess risks and devised the necessary control measures.

The Rules

Municipal wastewater treatment plants are operated in a highly regulated environment. Compliance with the National Water Act, the Water Services Act, the Strategic Framework for Water Services, the National Environmental Management Act, the Municipal Finance Management Act, Basic Conditions of Employment Act, Labour Relations Act, Occupational Health and Safety Act and numerous other legislation is required.

The factors which the rules impact upon include the organisational context, financial, supply chain management issues, operations and maintenance effectiveness and efficiency, skills levels, political and social (especially perceptions).

The rules, and the above are only some of them, must be taken into account in the risk assessment process

4.2 IDENTIFY THE RISKS

Wastewater treatment Plants, if ineffectively operated or inadequately maintained can have serious negative impacts on the public health and the environment and which have long-term consequences. It is therefore imperative that the risks are properly identified.

This must be considered the most important step. All significant risks must be identified so that it can be assessed for its likelihood and consequences. The risks within the wastewater treatment system (collection and treatment) are varied. With respect to the collection system, pump station overflows and sewer blockages are real.

The identification and significance of the risks cannot be only a management prerogative; it must involve the operational and maintenance staff who are closely involved in the day to day processes.

In the process of identifying the risks it is essential to have all the facts available. The information collection referred to earlier must be available during this process. The Hazard and Operability Study (HAZOP) has been a recent (last 10years) inclusion in the designs of the WWTW and have been documented and designed accordingly. However, it's the risk identification of those WWTW designed before this period that needs to be done.

These Works are particularly higher risk as the information such as drawings, O&M manuals and other information mentioned above are largely missing. It is important that we engage the older and retired staff members to draw from their experience and knowledge the information required for such risk identification. This information must be documented and updated.

In addition, it is essential to keep an updated list of reliability and availability of plant and equipment. The WWTW manager needs to know how often and for what duration equipment is down. This information can be retrieved from SAP and the malfunction reports which have already been implemented at the Works.

Appendix 1 depicts the overall high level risks identified together with the risk rating as recognised by the Wastewater Treatment Branch.

4.3 ASSESS THE RISKS

Once the risks have been identified, it is important to analyse and evaluate the existing control measures so that the impact of the incident can be estimated. The assessment (analyse and evaluate) involves the likelihood and consequence of such risk events.

For this purpose of this Wastewater Risk Abatement Plan (W2RAP), the following will be applicable:

Likelihood Scale:	**Consequence Scale**
1= rare	1 = Insignificant
2 = Unlikely	2 = Minor
3 = Moderate	3 = Moderate
4= Likely	4= Major
5. = Almost certain	5 = Catastrophic

Combining the likelihood and the consequence of each risk produces a level of risk or risks rating. The Branch's risk assessment is based on the perceived significant risks and the current control measures to mitigate the risks.

In Appendix 1, the impact on public, environment, employees and the costs were assessed against the likelihood and consequences. While we have used the risk rating to assess the high level risks, the other methodology is to use a risk matrix as is currently used in the HIRA.

The rating, based on a 5 point system, assessed a mechanical/electrical/process control systems malfunction to be the highest risk. Having recognised this as a high risk, action plans have already been implemented to mitigate and reduce this risk.

4.4 DEVELOP APPROPRIATE CONTROL MEASURES

Control measures are systems to prevent, minimise, reduce and mitigate against the identified risks (consequence and likelihood) being realised.

Risk treatment strategies/control measures also include the implementation of policies, standards, procedures, training and physical changes to the infrastructure to reduce and mitigate the risks. This involves reducing the likelihood and/or consequences of an incident occurring to an acceptable level.

In order to mitigate against the risk, it is important that the WWTW staff fully understand the implications of operating the Works incorrectly e.g. pumping against a closed valve.

If the existing controls and contingency measures are not adequate, it is essential to develop the appropriate control measures to reduce the risk. After an unforeseen incident, it is necessary to re-assess the risks and the control measures.

At times the risk control measure may not be possible, impractical, the likelihood is rare or too costly to mitigate, and then the following risk control strategies should be considered;

- Accept risk: no action required;
- Reduce the level of risks i.e. either the likelihood or consequence;
- Transfer the risk;
- Avoid the risk;
- A combination of the above.

4.5 PLAN FOR THE EMERGENCY

It is necessary to have contingency plans in place in the event of an emergency. In Appendix G, a typical contingency plan is shown. The WWTW managers/superintendents must produce their Works-specific contingency plans.

4.6 MONITOR AND REVIEW

It is imperative that the control measures devised are regularly reviewed to assess the effectiveness thereof. After an incident, it is necessary to have debriefing sessions to analyse the incident and if necessary revise the control measure.

These changes must be communicated to all relevant parties, especially the staff.

As part of our monitoring and review, this W2RAP will be re-assessed on an annual basis taking into account the Action plans such as the Operations and Maintenance Plan and the Infrastructure Asset Management Plan which have already been implemented. These Plans provide a strategy for maintenance improvement, risk control, the staffing requirements and the necessary funds.

5 RISKS ASSOCIATED WITH SEWAGE PUMP STATIONS

The following points are a summary of the main risks for failures within a pump station:

(a) <u>Mechanical failure of duty pumpset(s)</u>

All pump stations have 50% standby capacity. Should one pump fail, the standby pump will come on and an alarm will be signalled and responded to.

(b) Mechanical failure of duty and standby pumpsets

In all of the City's sewage pump stations this is an extremely rare occurrence

(c) Electrical failure within the pump station

The telemetry alarm system will activate responses which will attend to the fault before significant pump station overflows can occur.

(d) Power outages

Needless to say, once there is a local power outage, electrically powered pumpset will cease to operate for the duration of the power outage. Extent of pump station overflows is dependent on the following:

- volume of sewage coming into the pump station (large volumes will rapidly cause overflow conditions).
- topographical gravity reticulation characteristics of the area served by the pump station (sewage containment by surcharging sewers can in many instances result in no overflows in power outages of several hours duration).
- considering potential sewer surcharging, duration of power outages are a factor in sewer overflows.

Once power is restored, the sewer pumpsets will pump and return the reticulation systems to their normal duty points.

(e) Screen blockages

Large pump stations are equipped with screening systems. Blockages in the screening systems, mechanically or manually cleaned, will cause sewer surcharges which could cause sewage spillage. Screens are checked on a daily basis and this mitigates this hazard.

5.1 INTERVENTIONS TO MITIGATE SEWAGE PUMP STATION OVERFLOWS

In a period of 11 months, 36 sewage overflows were recorded on the 390 sewage pump stations. These malfunctions can be categorized as follows:

(i) Malfunction due to power outages (22).
(ii) Malfunctions due to mechanical/operational problems (9).
(iii) Malfunctions due to pump station electrics (5).

(a) Malfunctions due to power outages

A methodology to mitigate malfunctions due to electrical outages would be to equip all pump stations with standby generators. At an estimated installed power rating of 18 000 kW, it is estimated that this cost would be in the region of R30 million.

This, however, is not a foolproof methodology as installed generators have a high maintenance requirement, which even if this is met, does not guarantee perfect functionality. Of the 22 malfunctions due to power outages, 4 pump stations that were equipped with standby generation capacity, experienced generator failure. Installed and mobile generating capacity includes 21 units from 500 kVA to 60 kVA units.

As part of the City's Disaster Risk Management plan drawn up on 2006-04-10, the vulnerability of all Water and Sanitation pump stations to prolonged power outages was recognized. It was agreed that the City's GIS database be used to assist with the identification, distribution and determination of "outage areas/blocks" using electricity sub-station footprints relative to the location of critical installations. This together with the minimizing of outage durations and usage of mobile and fixed generating plant will have a significant effect in minimizing pump station overflows. However, this co-ordination cannot guarantee that there will be any sewage pump station overflows.

(b) Malfunctions due to mechanical/operational problems

The only methodology to mitigate pump station overflows in these eventualities is to ensure quick and effective response to alarm conditions.

(c) Malfunctions due to pump station electrics problems

The only methodology to mitigate pump station overflows in these eventualities is to ensure quick and effective response to alarm conditions.

5.2 EFFICACY OF REACTIONS TO PUMP STATION MALFUNCTIONS

With the exception of some large pump stations, there is a built-in time for reaction before overflow conditions occur. This is dictated by surcharge capacities of sewers feeding the pump stations and capacity of holding ponds erected at some pump stations. The pump stations situated in congested urban areas often have very small or virtually no grounds in which to engineer containment of overflows.

This reaction time is dependent on variable sewer flows but does in most cases allow for malfunction resolution which includes the usage of mobile generating capacity.

Previously, should sewage overflows occur, bio augmentation products were used.

5.3 SUMMARY OF REACTIONS TO SEWAGE PUMP STATION MALFUNCTIONS

The primary threat to sewage pump station overflows is prolonged power outages. Equipping all sewage pump stations with standby generators is a very costly undertaking which will not guarantee an absence of overflows. Accordingly a strategy of judicious use of mobile and fixed generation plant in collaboration with the City's Electrical Undertaking has been embarked upon taking into account inherent containment capacity of the sewer and the few constructed containment dams.

In Appendix E, a graph showing the sewer pump station overflows and the reasons therefore 2010 is presented. The absence of overflows did not have noticeable effect in improving the City's waterways. It is therefore concluded that the environmental degradation of waterways can be attributed to other sources of pollution rather than sewage pump station malfunctions.

6 COMMUNICATION: ALERT LEVELS

In the event of an incident situation, the following Alert Protocol exists:

Alert Level 1:

No significant risk to health and the incident can be contained or controlled

Inform: Branch Managers of Reticulation, Wastewater, Catchment Management, Water Pollution Control (if related to Industrial effluent discharges) and Scientific Services.

Alert Level II:

Potential risk to public health and ecosystem. The root cause is identifiable but cannot be immediately contained and will last for approximately 24 hours.

Report to:

(i) Director: Water and Sanitation Services,

(ii) Executive Director: City Health,

(iii) Department of Water Affairs

(iv) Manager: Catchment Management

(v) The relevant sub-Council and

(vi) the Branch Managers of Wastewater, Reticulation, Water Pollution Control and Scientific Services

within 24 hours.

Managers: Reticulation and/or Wastewater must have initiated emergency procedures

Alert Level III:

The impact of the Environmental Incident is severe and the root cause is not easily identifiable and cannot be easily contained or controlled. The impact of the incident has significant consequences and will last longer than 24 hours.

Within 2 hours report to:

(vii) Director: Water and Sanitation Services,

(viii) Executive Director: Utility Services

(ix) Executive Director: City Health,

(x) Chief Director: Department of Water Affairs (Regional Office)

(xi) Disaster Management

(xii) Director: Road and Stormwater or Manager: Catchment Management

(xiii) the relevant sub-council and

(xiv) the Branch Managers of Wastewater, Reticulation, Water Pollution Control and Scientific Services within 24 hours.

Managers: Reticulation and/or Wastewater must have initiated emergency procedures

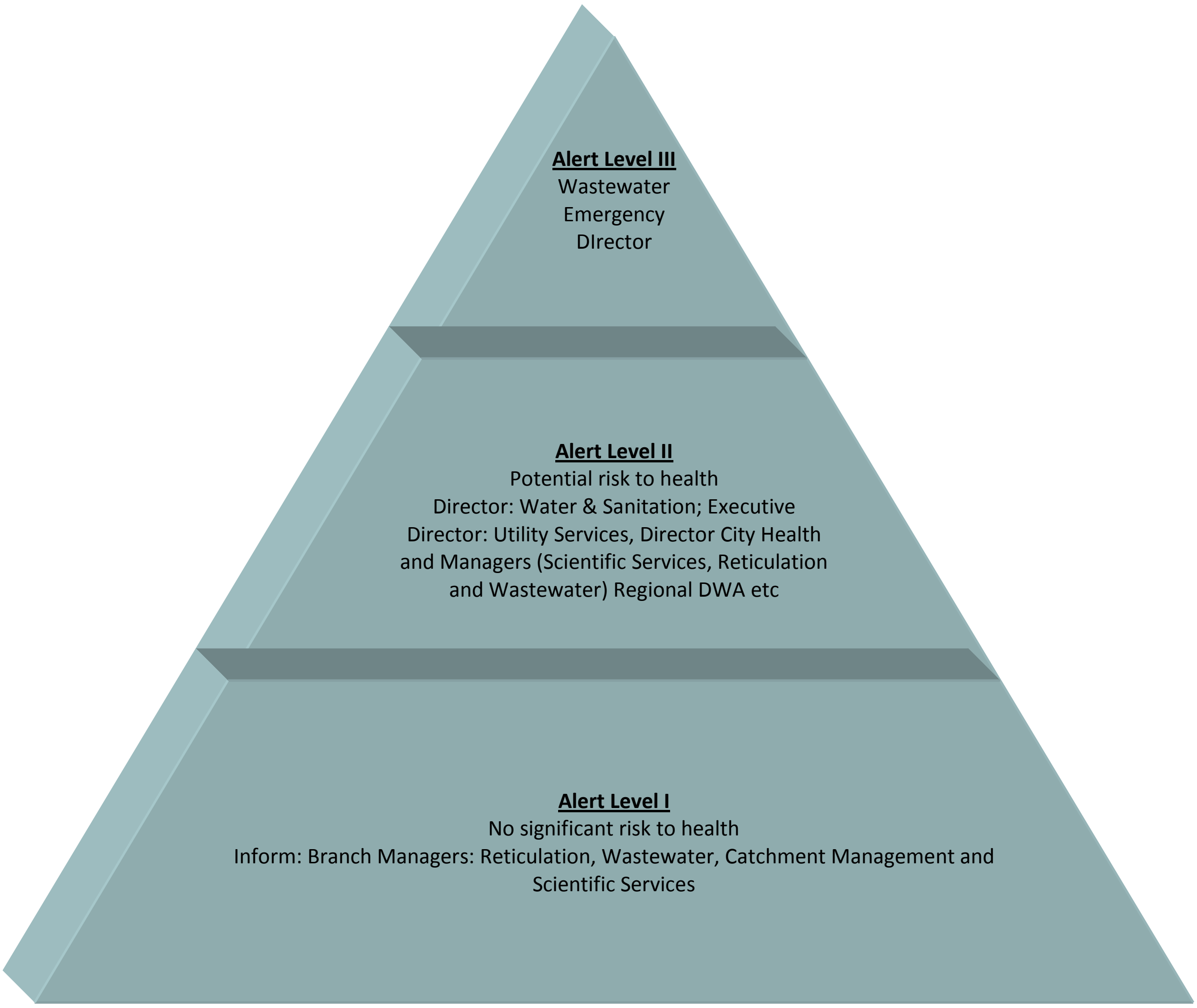

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Figure 2 Alert levels and reporting protocol

7 WAY FORWARD

Risk management is non-negotiable and each manager must ensure that the W2RAP in implemented.

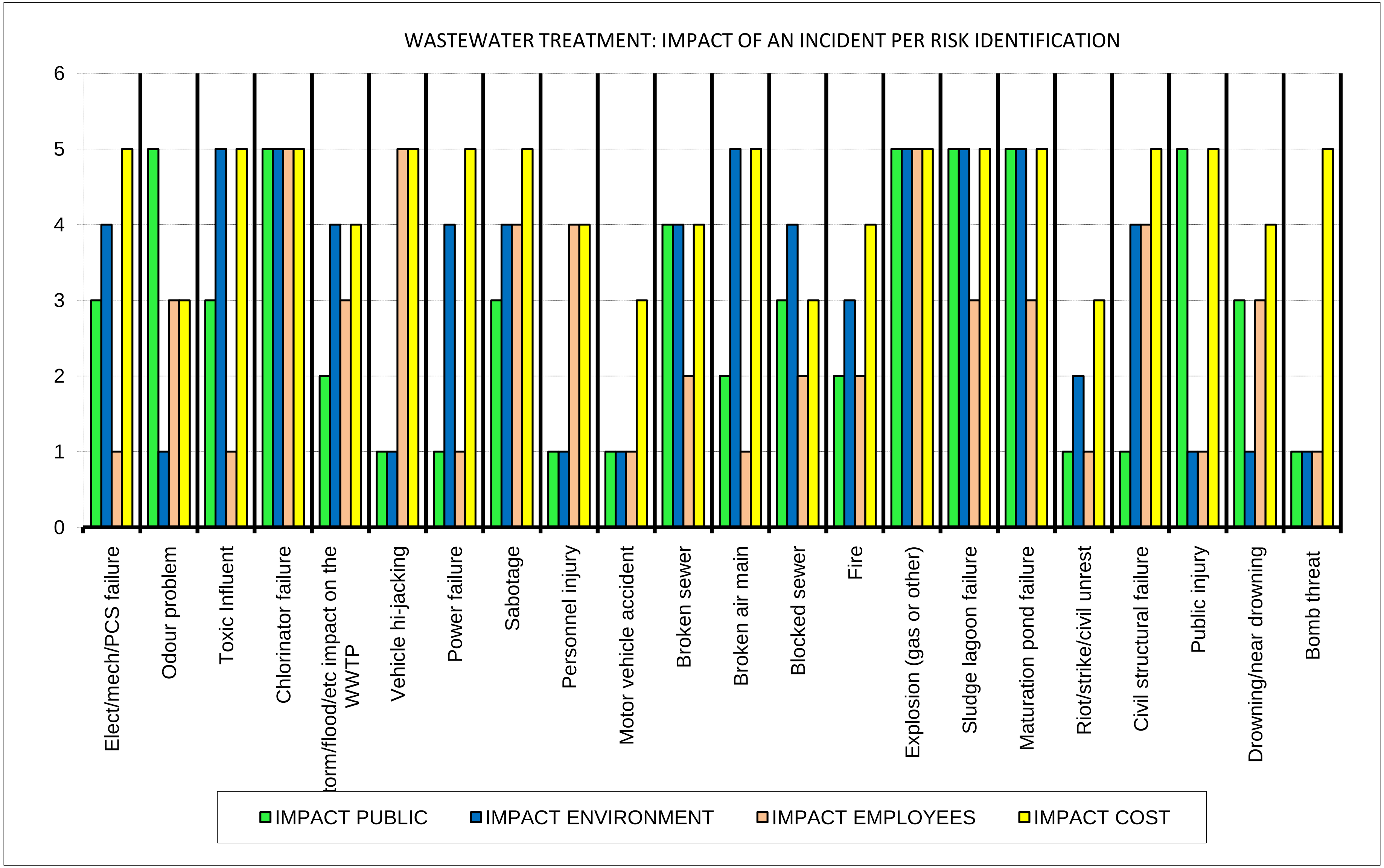
APPENDIX A
City of Cape Town: WASTEWATER BRANCH

Risk Identification, Assessment and Ratings

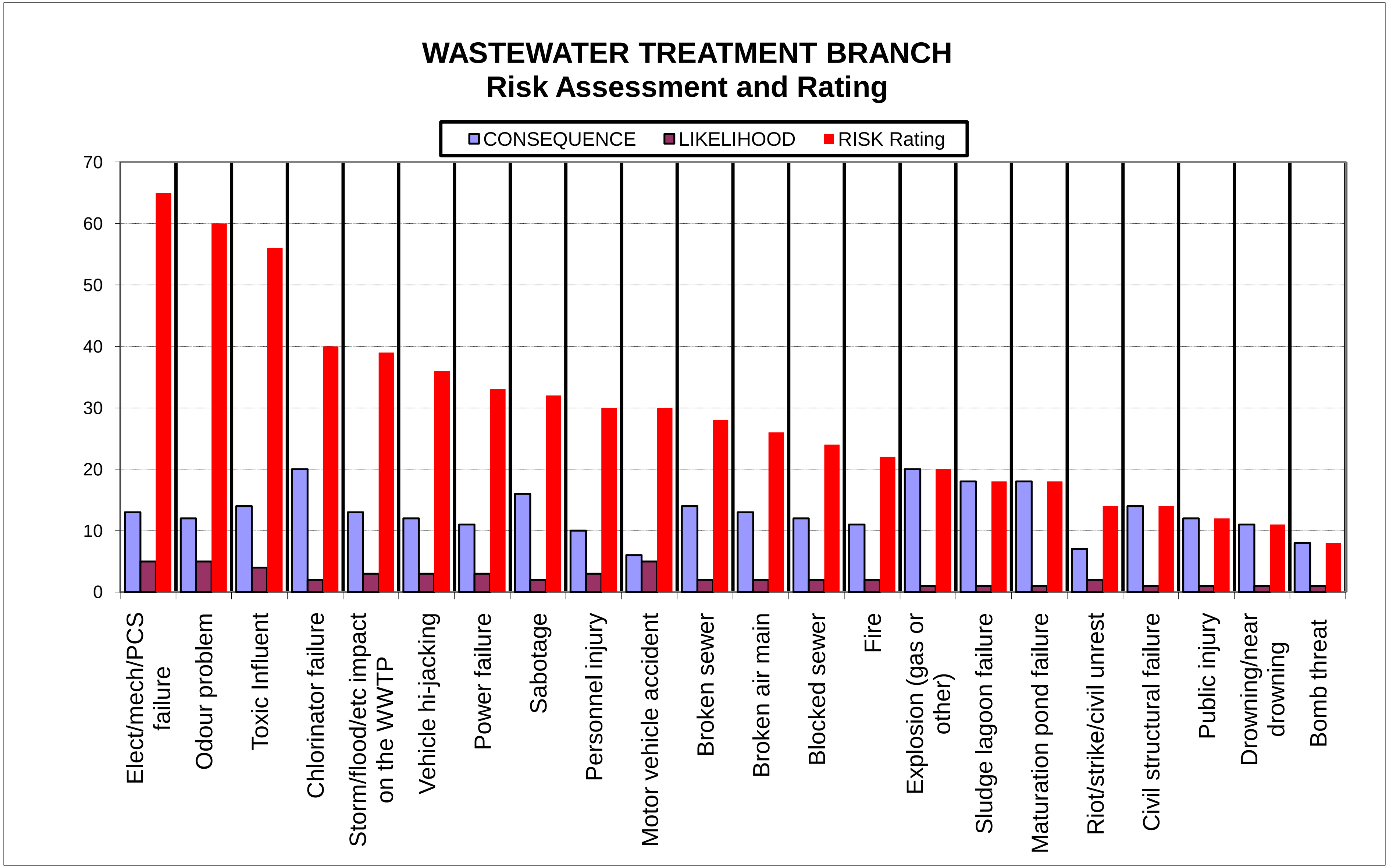
RISK ID Number	DESCRIPTION	RISK Rating	Consequence RATING	Likelihood RATING	IMPACT PUBLIC	ENVIRONMENT	EMPLOYEES	COST
WW/EMER/1	Elect/Mech/PCS failure	65	13	5	3	4	1	5
WW/EMER/3	Odour problem	60	12	5	5	1	3	3
WW/EMER/6	Toxic Influent	56	14	4	3	5	1	5
WW/EMER/16	Chlorinator failure	40	20	2	5	5	5	5
WW/EMER/20	Storm/flood/etc impact on the WWTP	39	13	3	2	4	3	4
WW/EMER/12	Vehicle hi-jacking	36	12	3	1	1	5	5
WW/EMER/15	Power failure	33	11	3	1	4	1	5
WW/EMER/4	Sabotage	32	16	2	3	4	4	5
WW/EMER/5	Personnel injury	30	10	3	1	1	4	4
WW/EMER/7	Motor vehicle accident	30	6	5	1	1	1	3
WW/EMER/11	Broken sewer	28	14	2	4	4	2	4
WW/EMER/14	Broken air main	26	13	2	2	5	1	5
WW/EMER/2	Blocked sewer	24	12	2	3	4	2	3
WW/EMER/17	Fire	22	11	2	2	3	2	4
WW/EMER/10	Explosion (gas or other)	20	20	1	5	5	5	5
WW/EMER/8	Sludge lagoon failure	18	18	1	5	5	3	5
WW/EMER/9	Maturation pond failure	18	18	1	5	5	3	5
WW/EMER/13	Riot/strike/civil unrest	14	7	2	1	2	1	3
WW/EMER/18	Civil structural failure	14	14	1	1	4	4	5
WW/EMER/21	Public injury	12	12	1	5	1	1	5
WW/EMER/19	Drowning/near drowning	11	11	1	3	1	3	4
WW/EMER/22	Bomb threat	8	8	1	1	1	1	5
	WORST CASE	100	20	5	5	5	5	5

RISK RATING		
VERY HIGH (Catastrophic impact)		5
HIGH (Major Implications)		4
MEDIUM (Moderate impact)		3
LOW (minor impact)		2
VERY LOW (insignificant)		1

APPENDIX B


WASTEWATER TREATMENT: IMPACT OF AN INCIDENT PER RISK IDENTIFICATION
0
1
2
3
4
5
6
Elect/mech/PCS failure
Odour problem
Toxic Influent
Chlorinator failure
torm/flood/etc impact on the WWTP
Vehicle hi-jacking
Power failure
Sabotage
Personnel injury
Motor vehicle accident
Broken sewer
Broken air main
Blocked sewer
Fire
Explosion (gas or other)
Sludge lagoon failure
Maturation pond failure
Riot/strike/civil unrest
Civil structural failure
Public injury
Drowning/near drowning
Bomb threat
IMPACT PUBLIC
IMPACT ENVIRONMENT
IMPACT EMPLOYEES
IMPACT COST

APPENDIX C


WASTEWATER TREATMENT BRANCH
Risk Assessment and Rating
CONSEQUENCE
LIKELIHOOD
RISK Rating
70
60
50
40
30
20
10
0
Elect/mech/PCS failure
Odour problem
Toxic Influent
Chlorinator failure
Storm/flood/etc impact on the WWTP
Vehicle hi-jacking
Power failure
Sabotage
Personnel injury
Motor vehicle accident
Broken sewer
Broken air main
Blocked sewer
Fire
Explosion (gas or other)
Sludge lagoon failure
Maturation pond failure
Riot/strike/civil unrest
Civil structural failure
Public injury
Drowning/near drowning
Bomb threat

APPENDIX D

WASTEWATER DEPARTMENT ATHLONE WWTW

CRITICAL UNIT PROCESSES & EQUIPMENT: IDENTIFICATION OF RISKS

RISK ID Number	PROCESS and/or EQUIPMENT	Duty	S/By	Emergency situation arises if the following number of units are O/C	RISK CONTROL MEASURES	Consequence without control meansures
WW/EMER/1.1	Inlet screw pumps	1	2	1	1 standby screw + STANDBY GENSET	Overflow to Vygieskraal River - Pollution
WW/EMER/1.2	Equalisation Basins	N/A				
WW/EMER/1.3	Equalisation Basins mixers/aerators	N/A				
WW/EMER/1.4	Screens	1	2	1	standby + GENSET	No retaining coarse solids - blockages
WW/EMER/1.5	Screenings compactor	1	0	1		No dewatering of screenings- excess water will go to the landfill site
WW/EMER/1.6	Grit tanks	1	1	1	standby	Frequent digester cleaning - odours
WW/EMER/1.7	Grit classifier	1	1	1	standby	No grit removal - blockages of tanks
WW/EMER/1.8	Primary sedimentation tank	3 + 2 storm tanks	0		Able to handle wet weather flows	Blockages: Overloading of Activated sludge Plant adversely affecting the treatment process
WW/EMER/1.9	Blowers for aeration of bioreactors	3	1	1	standby	No oxygen to ASP resulting in non compliant effluent and malodours
WW/EMER/1.10	Biological reactor	6	0	1		Blocked diffusers, lack of oxygen, non-compliant effluent and malodours
WW/EMER/1.11	Return sludge pumps	3	0	1		Blocking of SST's with the resultant solids carry over to the river
WW/EMER/1.12	Internal recycle pumps per reactor	2	2	1	standby	no internal recycles which will affect the treatment process
WW/EMER/1.13	Biological reactor mixers	36	0	3		Settling - anaerobic conditions - odours

WASTEWATER DEPARTMENT ATHLONE WWTW

CRITICAL UNIT PROCESSES & EQUIPMENT: IDENTIFICATION OF RISKS

RISK ID Number	PROCESS and/or EQUIPMENT	Duty	S/By	Emergency situation arises if the following number of units are O/C	RISK CONTROL MEASURES	Consequence without control meansures
WW/EMER/1.14	Secondary sedimentation tank (Bridges)	20	0	1	Maintenance and repairs within 24 hours	Blocking of the SST; Overloading - sludge carry-overs to the river
WW/EMER/1.15	Maturation pond (sludge in)	2	0	1	Diversion around certain ponds	Non compliant effluent discharged and cause of pollution in the river
WW/EMER/1.16	Chlorination	1	0		Diversion around certain ponds	Non compliance - Ecoli count
WW/EMER/1.17	Effluent reuse pumps (IRRIGATION)	2	0	1		Excessive fresh water consumption
WW/EMER/1.18						
WW/EMER/1.19						
WW/EMER/1.20						
WW/EMER/1.21						
WW/EMER/1.22						
WW/EMER/1.23						
WW/EMER/1.24						
WW/EMER/1.25	Sludge feed pumps: WAS & PS	2+1	2+4	(1 desludge system in use)		Increase in MLSS - Bulking sludge PST's
WW/EMER/1.26	Gravity thickener	1	1	1	Operate ASP on extended aeration	Septic sludge, malodours and overloading of the ASP
WW/EMER/1.27	Dissolved Air Flotation Tanks	2	0	1		Increase MLSS
WW/EMER/1.28	Digesters	4+4	0	1	discharge sludge to Cape Flats WWTW	Primary out difficulty with loading - odours
WW/EMER/1.29	Boilers	1	1	1	standby	no heating of the digesters resulting in poorly digested sludge

WASTEWATER DEPARTMENT ATHLONE WWTW

CRITICAL UNIT PROCESSES & EQUIPMENT: IDENTIFICATION OF RISKS

RISK ID Number	PROCESS and/or EQUIPMENT	Duty	S/By	Emergency situation arises if the following number of units are O/C	RISK CONTROL MEASURES	Consequence without control meansures
WW/EMER/1.30	Gas holder	1	0	1	emission to environment	Excessive diesel usage, methane emission to air. Methane is a greenhouse gas
WW/EMER/1.31	Digester mixing compressors / pumps	2	0	1	nil	Incomplete digestion and resultant malodours
WW/EMER/1.32	Heat exchangers	4	0	1	nil	Odours (normally blocks)
WW/EMER/1.33	Sludge dewatering plant (centrifuges)	1	1	1	standby	
WW/EMER/1.34	Sludge (holding tank) silo pumps	2	1			
WW/EMER/1.35	Dewatered Sludge hopper	1	0	1	standby	
WW/EMER/1.36	Dewater Sludge conveyors	1	1		standby	

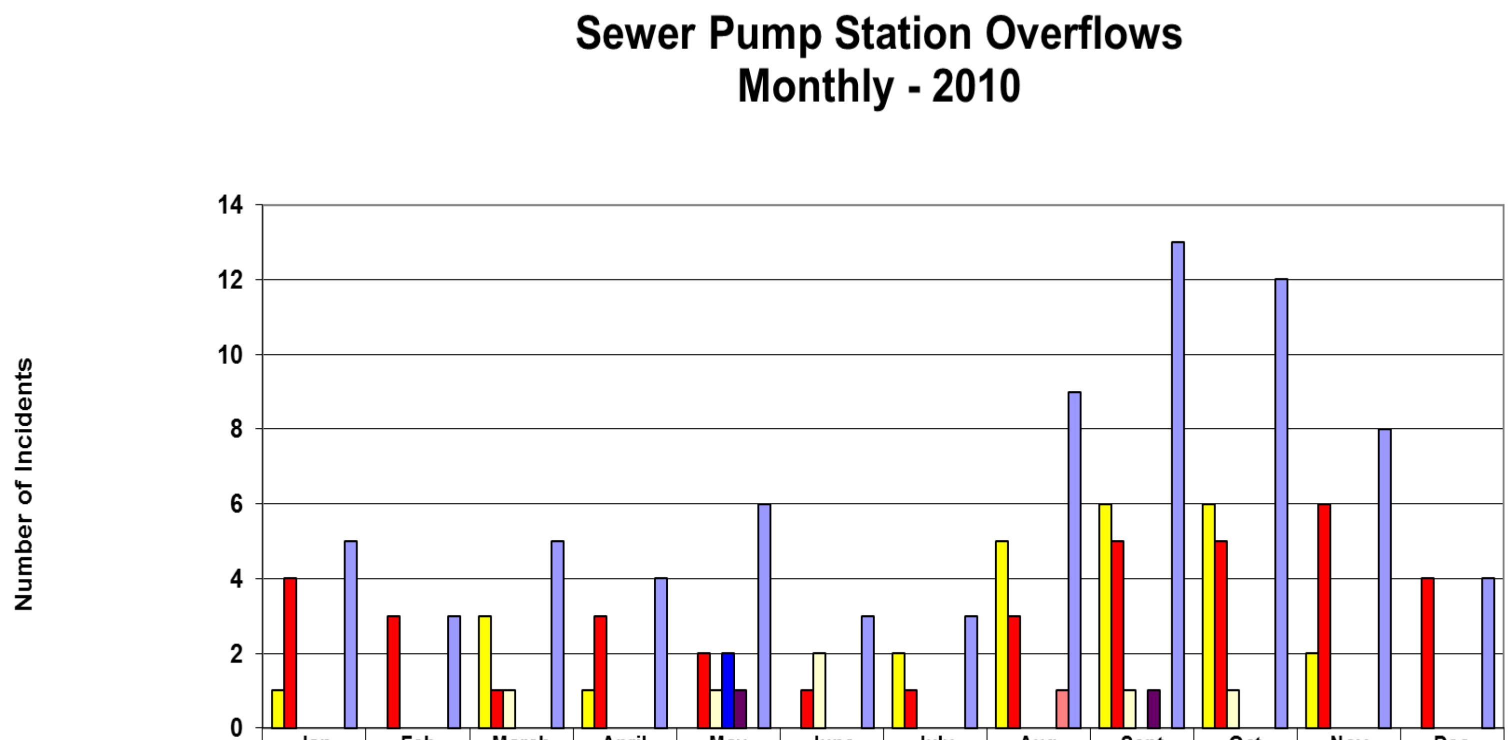
APPENDIX E

WASTEWATER DEPARTMENT: **RISKS OF POWER OUTAGES ON TREATMENT FACILITIES**							
WWTW	**Impact of Power outage**	**Consequence**	**Time for impact**	**Risk Rating #**	**Short Term Mitigating Strategy**	**Long Term Mitigating Strategy**	
Athlone	Only partial treatment can take place	Sub-standard effluent produced	2 days	Likelihood = 4, Consequence = 3	None possible	Standby generator at HOW	All Pumped
Bellville	Standby generator. Limited except in winter due to higher flows, there will be overflow of raw wastewater	Sub-standard effluent produced	1 day	Likelihood = 4, Consequence = 4	None possible	Construct maturation ponds and purchase extra generator	
Borcherds Quarry	Only partial treatment can take place	Sub-standard effluent produced	8 days	Likelihood = 4, consequence = 3	None possible	Add standby generator	All Pumped
Cape Flats	Only partial treatment can take place	Sub-standard effluent produced	7 days	Likelihood = 4, consequence = 3	None possible	Add standby generator	All gravity. Overflow into ponds
Gordons Bay	Only partial treatment can take place	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 4	Dose effluent with HTH	Add standby generator	All pump
Klipheuwel	Only partial treatment can take place	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 1	Dose effluent with HTH	Add extra septic tank	All Pumped
Kraaifontein	Only partial treatment can take place	Sub-standard effluent produced	5 days	Likelihood = 4, consequence = 3		Add standby generator	All Pumped

WASTEWATER DEPARTMENT: **RISKS OF POWER OUTAGES ON TREATMENT FACILITIES**							
WWTW	**Impact of Power outage**	**Consequence**	**Time for impact**	**Risk Rating #**	**Short Term Mitigating Strategy**	**Long Term Mitigating Strategy**	
Llandudno	Only partial treatment can take place	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 2	Dose effluent with HTH	None necessary	All pumped
Macassar	Only partial treatment can take place	Sub-standard effluent produced	5 days	Likelihood = 4, consequence = 3		Add standby generator	all pumped
Melkbosstrand	Only partial treatment can take place	Sub-standard effluent produced	2 days	Likelihood = 4, consequence = 4	Dose effluent with HTH	Add standby generator	All Pumped
Millers Point	Only partial treatment can take place	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 2	Dose effluent with HTH	Add extra septic tank	All pump
Mitchells Plain	Only partial treatment can take place	Sub-standard effluent produced	2 days	Likelihood = 4, consequence = 3	None possible	Add standby generator	All pumped. Overflow into ponds
Oudekraal	Only partial treatment can take place	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 2	Dose effluent with HTH	Add extra septic tank	All Pumped
Parow	NIL - flow will gravitate to Athlone WWTW	NIL	infinite	Likelihood = 4, consequence = 1	Divert flow to Athlone	None necessary	
Philadelphia	Nil - no electrical equipment on site	NIL	infinite	Likelihood = 1, consequence = 1	None necessary	None necessary	
Potsdam	Only partial treatment can take place	Sub-standard effluent produced	3 days	Likelihood = 4, consequence = 4	None possible	Add standby generator	Most pumped.
Scottsdene	Emergency pond will fill in 6 hours, then overflow of raw	Discharge of raw wastewater to river	6 hours	Likelihood = 4, consequence = 4	None possible	Add standby generator	All pumped

WASTEWATER DEPARTMENT: **RISKS OF POWER OUTAGES ON TREATMENT FACILITIES**							
WWTW	**Impact of Power outage**	**Consequence**	**Time for impact**	**Risk Rating #**	**Short Term Mitigating Strategy**	**Long Term Mitigating Strategy**	
	wastewater to river						
Simonstown	Limited impact as gravity flow through works	Sub-standard effluent produced	1 day	Likelihood = 4, consequence = 2	None possible	Add standby generator	All pumped
Wesfleur	Only partial treatment can take place	Sub-standard effluent produced	5 days	Likelihood = 4, consequence = 4	Divert effluents to river away from aquifer	Add additional standby generator	All pumped
Wildevoelvlei	Standy generator available. Only partial treatment can take place	Sub-standard effluent produced	10 days	Likelihood = 4, consequence = 3	None possible	None necessary	Gravity. Overflow into ponds
Zandvliet	Limited consequence as standby power runs 90% of plant except sludge handling	Sub-standard effluent produced after about 5 days	5 days	Likelihood = 1, consequence = 2	None possible	None necessary	Gravity.
Camps Bay	Standby generator. No pumping along outfall, overflows to surf zone	Contamination of surf zone	1 day	Likelihood = 4, consequence = 4	None possible	Standby generator	
Green Point	No pumping along outfall, overflows to surf zone	Contamination of surf zone	1 day	Likelihood = 4, consequence = 4	None possible	Add standby generator	

WASTEWATER DEPARTMENT: **RISKS OF POWER OUTAGES ON TREATMENT FACILITIES**							
WWTW	**Impact of Power outage**	**Consequence**	**Time for impact**	**Risk Rating #**	**Short Term Mitigating Strategy**	**Long Term Mitigating Strategy**	
Hout Bay	Limited impact as gravity only along outfall should cope or overflows to surf zone	Some contamination of surf zone	7 days	Likelihood = 4, consequence = 4	None possible	Add standby generator	

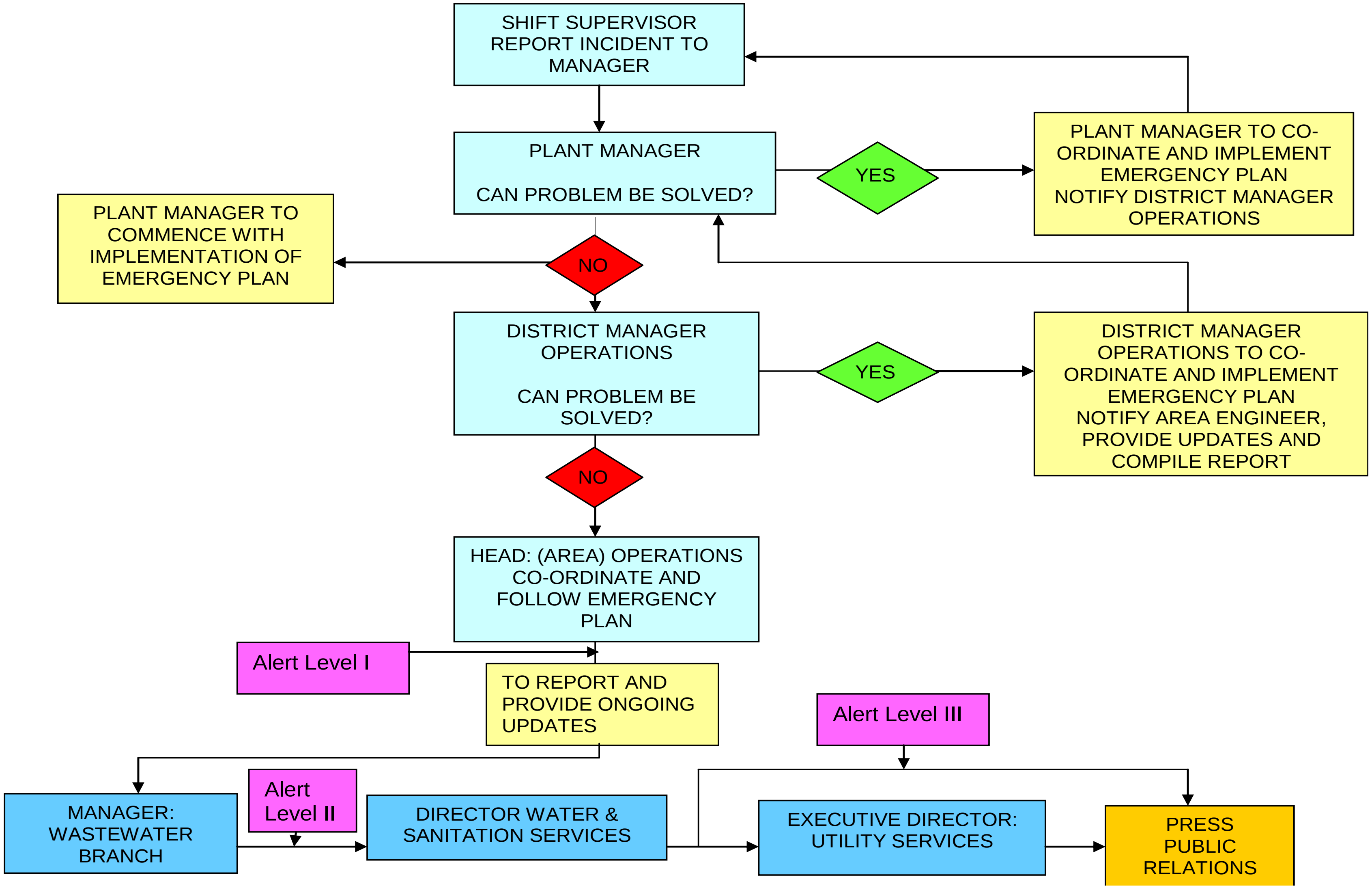


	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mechanical	1	0	3	1	0	0	2	5	6	6	2	0
Electrical	4	3	1	3	2	1	1	3	5	5	6	4
Power Outages	0	0	1	0	1	2	0	0	1	1	0	0
Stormwater Ingress	0	0	0	0	2	0	0	0	0	0	0	0
Station Vandalised	0	0	0	0	1	0	0	0	1	0	0	0
Broken Rising Main	0	0	0	0	0	0	0	1	0	0	0	0
Total for Month	5	3	5	4	6	3	3	9	13	12	8	4

Month

APPENDIX G

WASTEWATER BRANCH: EMERGENCY PLAN FLOW CHART –



APPENDIX H

CITY OF CAPE TOWN

MACASSAR WASTEWATER TREATMENT WORKS: CONTINGENCY PLAN –"WHAT IF" SCENARIO

LOCATION	PROBLEM	EFFECT	ACTION	CONTACT
Inlet works screens	Mechanical or electrical failure of one unit	Screen blocks up.	Open penstock to second mechanical screen.	Maintenance staff to effect repairs.
Inlet works screens	Mechanical or electrical failure of both units	Screens block up.	Open penstock to hand raked screen. Carry screenings and drop into screenings skip.	Maintenance staff to effect repairs.
Inlet works grit removal unit	Mechanical or electrical failure of one unit.	Grit will accumulate in failed unit. No adverse effect of operation in short term. In long term possible carryover of grit into reactor.	If possible use old grit separator.	Maintenance staff to effect repairs.
Inlet works grit removal unit	Mechanical or electrical failure of both units.	Grit will accumulate in failed unit. No adverse effect of operation in short term. In long term possible carryover of grit into reactor.	If possible use old grit separator.	Maintenance staff to effect repairs.
Activated sludge surface aerators	Mechanical or electrical failure of 1 or more units.	Each reactor has 2 aerators in aerobic selector plus 4 aerators. Reduction in aeration capacity would lead to decreased nitrification. Activated sludge may carry over into maturation pond.	Raise reactor weir for maximum aeration by remaining aerators. Adjust feed to reactor so that feed only to aerated portions of the tank. If necessary, bypass aerobic selectors if failure there.	Maintenance staff to effect repairs.

Activated sludge surface aerators	Mechanical or electrical failure of 1 or more units	Reduced treatment capacity in affected module.	Flow may be split in a ratio other than 50:50 between modules if required in addition to above action.	Maintenance staff to effect repairs.
Activated sludge return pump	Mechanical or electrical failure of 1 unit	There are two pumps of which 1 alone can handle the required pumping duty. If duty fails, standby will automatically start	Repair.	Maintenance staff to effect repairs.
Secondary sedimentation tank bridges	Mechanical or electrical failure of 1 unit.	Loss of sludge over effluent weir.	Reduce flow to disabled tank. The two inner secondary sedimentation tanks may be fed from module "A" or "B" or both.	Maintenance staff to effect repairs.
Secondary sedimentation tank bridges	Mechanical or electrical failure of 1 or more units.	Loss of sludge over effluent weir.	Can reduce flow to affected module if necessary.	Maintenance staff to effect repairs.
Incidental pumps, motors, gearboxes	Maintenance staff to effect repairs.	Usually duplicated and therefore standby available	Isolate and repair/replace.	Maintenance staff to effect repairs
Sludge dewatering equipment	Mechanical or electrical failure of 1 unit.	Build up of sludge in system.	Extend operating hours and if necessary operating days to ensure correct mass wasted.	Maintenance staff to effect repairs. Advise sludge removal contractor if working over weekend.
Sludge dewatering equipment	Mechanical or electrical failure of 2 units.	Build up of sludge in system.	Monitor MLSS and if reaches critical value then waste to on-site lagoons AS A LAST RESORT.	Maintenance staff to effect repairs

Chlorinator system	Failure of unit.	Lack of effective disinfection. Effluent E Coli will be reduced through ponds but will exceed 1000 /100ml.	None.	Maintenance staff to effect repairs
Incidental pumps, motors, gearboxes	Maintenance staff to effect repairs.	Usually duplicated and therefore standby available.	Isolate and repair/replace.	Maintenance staff to effect repairs
General on site	Odour emission.	Possible complaints from neighbours.	Call in odour control specialist Install temporary spray system.	Odour Control specialist
General power failure	All electrical equipment stops.	Potential lack of treatment. A standby generator has been transferred to the site. At the time of writing it has not been decided which equipment will be operated from this alternative power supply.	From inlet works flow through the treatment works is by gravity. Switch chlorinator over to mains water and increase dosage to maximum.	Electrical maintenance branch to determine if problem is on site or is external. If latter contact the electricity supply authority and stress need to restore power as soon as possible