Environmental Review of Parkietenbos landfill extension

Chamber of Commerce & Industry (KvK),
Mr Alan Riley, President
Aruba Trade & Industry Assoication (ATIA),
Mr Greg Peterson, President
Aruba Hotel & Tourism Assoication
(AHATA), Mr Horace Nord, President
San Nicolas Business Asosication (SNBA),
Mr Hubert Redhead, President
Aruba Retial Merchants Association
(ARMA) Mr Albert Warren, Presdient
9 July

Final

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A COMPANY OF

ROYAL HASKONING

HASKONING NEDERLAND BV
MILIEU

Hoofdweg 490
Postbus 8520
3009 AM Rotterdam
+31 (0)10 286 54 32 Telefoon
010 2865220 Fax
info@rotterdam.royalhaskoning.com E-mail
www.royalhaskoning.com Internet
Arnhem 09122561 KvK

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Author (s)	V. Ingram, H. Jumelet, E. van den Oever
Client	Chamber of Commerce & Industry (KvK), Mr Alan Riley, President Aruba Trade & Industry Assoication (ATIA), Mr Greg Peterson, President Aruba Hotel & Tourism Assoication (AHATA), Mr Horace Nord, President San Nicolas Business Asosication (SNBA), Mr Hubert Redhead, President Aruba Retial Merchants Association (ARMA) Mr Albert Warren, Presdient
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APPENDIX 3: MAPS

1) Map of Aruba
2.1) Sampling locations, large scale map, 2002
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3) Map of planned landfill extension CIWS (with annotations, Royal Haskoning)
4) Sampling locations and results of analyses,1996
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1. Arial view of landfill. Note dead mangrove area in south-west and north-westerly wind direction, June 2002
2. Arial view of Landfill. Note creek to east of landfill and dam, and lagoon, including seagrass beds (lighter colour) and reefs (darker area to south), June 2002
3. Arial view of landfill. Note proximity to reefs, height of existing dike walls and waste falling over walls, June 2002
4. Arial view of landfill. Note smoke direction ,also proximity to industrial area, June 2002
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9. Arial view of landfill. Note smoke direction and dead mangrove area in south-west and north-westerly wind direction, April 2002
10. Arial view of landfill. Note proximity to Parkietenbos village and coastal road, April 2002
11. Underwater photo, coral reefs near Bucati Island

APPENDIX 1: INTERVIEWS

Interviews were held with represetnatives from following organisations between 9 and 14 june 2002.

- Directie Volkshuisvesting, Ruimteljik Ontwikkleling en Milieu
- Environmental Adviser to the Minister
- Caribbean Integrated Waste Systems N.V.
- Local residents in the Parkietenbos area
- Non-governmental organisations
  - ATIA
  - ARMA
  - AHATA
  - SNBA
- Environmental non-government organisations
- FAMA
- Rainbow Warriors International
- FANAPA
- StimAruba
- Local diving companies

Haskoning 1998, Saneeringsplan omgeving stortplaats Parkietenbos, Uitgevoerd in opdracht van Directie VROM

Ministerie van Publieke Werken en Volksgezondhied in Aruba, 1992, Bestek F4400 voor het afwerken van stortplaats Parkietenbos, DHV

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Government Aruba, 2002, Oproeping ter bijwoning van een Central Commissie van Staten van Aruba op Vrijdag 22 Febuari 2002 : Enig Agenda Punt mbt het Emergency Action Project in relatie met vuilstortplaats te Parkietenbos

Haskoning 1996, Bodemkwalitietsonderzoek ter plaats van stortplaats Parietenbos te Aruba, Uitgevoerd in opdracht van Directie VROM

6.9 Cumulative impacts

- Activities to reduce waste volumes under the Vision on Complete Waste Management (2002) should be implemented as soon as possible to ensure a long lifetime for the landfill and avoid the need for a new landfill in the 5 years.
- The Environmental Impact Assessment (EIA) should include ALL phases of the EAP. An integrated waste project of relevance for the whole Island should have an integrated EIA or separate integrated assessment that plans and manages long term impacts for the all waste management activities at the site.
- The Execution Plan for the EAP should include how the other priority sites described in section XI of the contract are to be managed. This is currently unknown.

6.10 Good management, transparency & communication

- There is an immediate need for extensive public information, awareness and consultation concerning the entire EAP. This should be jointly managed by the government and CIWS to ensure that the public receives an accurate understanding of the whole project. Particular information and awareness raising should focused on the greatest concerns:
  - How waste will be controlled and what will be dumped and volumes to be dumped
  - Relation between the EPA and integrated waste management plans for Aruba
  - Current pollution at the site and health risks and controls on this pollution.
- It is recommended that the EIA should cover social, particularly public health, and economic impacts of the landfill extension. This is due to the close proximity to Parkietenbos and to tourist areas.
- It is recommended that the EAP is objectively evaluated as to how far it meets the Vision for waste management for Aruba. This is particularly important given the environmental and social sensitivity of the location, and given the dependence of the longevity of the landfill on meeting recycling and waste separation targets.
- Information should be published or disseminated to local community groups, concerned NGO's and other stakeholders about when the EIA will be presented, and what and when public consultations and public participation in the process is planned.
- Justification for process that allows for construction to commence when the EIA and final design is not completed or approved.
- Information on permits and licenses required for the construction and operation of the landfill extension
- The process for checking compliance of executing the EAP against the contract, responsibility for checking (such as Ministry of Public Works and Directorate VROM) and sanctions be clarified.
- The EAP and a Project Execution Plan should be monitored by a competent authority that is not party to the project. As the Management Team includes representatives of the contractor, they are not in a position to independently evaluate compliance.

6.6 Ecology

- Ensure compliance with the Structurnota Natuur en Landschap (1996) requirement for compensation for the loss of mangroves in the extension area and damage to mangroves during construction, and those destroyed by pollution from the current landfills. These losses should be at least compensated with equivalent hectares of mangrove re-vegetation, where possible in Parkietenbos, and if not possible, in other suitable, relevant locations (decided by government, in consultation with soon as NGOs and interest groups). Phase 3 is recommended to start as soon as possible to allow for monitoring and supervision of the (re)-vegetation given their slow growing time by the Management Team
- Ensure design measures made to maintain health of mangroves in Northeast corner of current vegetation remain (e.g. through channel excavated)
- Investigate seawater pollution levels and the risk to human health and environment in the lagoon in the Parkietenbos area.
- Implement remediation plans for current surface water (small lagoon) and soil pollution and methods to be used to ensure regular flushing and reduction of hyper-saline surface water. Dead mangroves removed and area re-vegetated
- Remove all waste currently in the sea by the landfill and recycle or reuse where possible, or if necessary, landfill it.

6.7 Landuse

- Using the current Parkietenbos landfill location for the EAP means sacrificing environmentally valuable mangrove and marine ecosystem. It is not clear if this balance has been clearly evaluated and other alternative sites evaluated on economic, social and environmental criteria. An evaluation is recommended to include alternative sites for landfills, with realistic scenarios of waste volumes and waste management practices on Aruba in the future.
- Research other suitable locations for compensation of mangroves. Set up a monitoring and management programme for vegetation scheme as part of the Project Execution Plan.

6.8 Nuisance

- Implement traffic control measures (e.g. signs warning of the entrance and of heavy traffic, mirrors for vehicles exiting site) to ensure safety for local traffic and pedestrians in the area, particularly at the Junction close to the landfill entrance, should be put in place immediately. This should continue during the lifetime of the landfill.
- Landscaping and vegetation of old landfill are necessary. Closure details in Phase 4 are unknown. It is recommended to improve the visual impact for the local community and tourists, particularly also to the high dependence of Aruba on tourism and the landfills proximity and visibility to major tourist areas in Oranjestad and the reef islands.
- Measures to control birds, vermin and insects should be specified in Execution Plan to minimise occupational and public health risks. For example, daily covering of wastes with locally obtained materials such as sand.

a) Evaluate design of landfill extension dike walls to withstand flooding and seawater inundation and protect against leachate of pollution.
b) Analysis of the waste material used for dike walls is published and the suitability of material evaluated to ensure compliance with IBC norms. If above Dutch Norms (set in the Building Materials Decree 1999) or more polluted than the extension site, need to find either (a) alternative sources of suitable wall material (b) cover extension walls with suitable liner, or (c) worst case scenario to excavate materials back into dump.
b) Feasibility of the "no geological barrier and no leachate collection system design" to be evaluated and tests on impermeability of compressed peat & clay/granito layer conducted and evaluated to ensure compliance with IBC norms. As compression of peat to a suitable impermeability to prevent percolation of leachate by landfilled waste is expected to take some years, there will be an undefined time period during which pollution is possible. Measures should be provided (e.g. a liner or alternative ways of reaching the required compression) to avoid pollution. The theory that the majority of pollution originates from burning of waste and is airborne needs to be proved. The results of 1996 and 2002 analyses indicate that as pollutants are found at depths of up to 2meters in the peat layer, leaching is highly probable. The results of this modelling should affect final design.
d) Evaluate practically of using extracted water from peat compression for dust control, given change of pollution, sufficiency of 4 monitoring wells for entire siteand alternative water resources if pollution is found.

- Evaluate the leachate drainage, collection and discharge system (currently none is known in the design)
- Elaboration on methods of methane gas treatment and use.
- Approach for the Phase 4 closure of the existing landfill should include reinforcement of landfill walls and stabilisation of the waste mass (e.g. levelling out on site to less steep angles), repair damage to rhino mattresses and remove waste overflowing from the site into the sea. This is particularly important if landscaping and recreational development are part of the plans.
- Methods to restrict free access to the whole site (not just the road side) should be elaborated, but are important given recent accidents and discourage continued illegal dumping
- Ensure training and setting up pragmatic procedures for management and operation of landfill in future, particularly once the EAP contract expires
- Procedures for aftercare and closing to be provided and evaluated.
- Cost implications of any potential changes to design should be evaluated
- Methods for handling and relocating asbestos waste at site
- Plan specifying methods and types of waste to be separated and recycled
- Detailed plan for design and operation of the incinerator and air quality control measures, included in the EIA
- Methods for collection and monitoring of leachate and methane at existing *and* proposed site and procedures for management of these
- Monitoring of pollution levels of leachate from compressed peat/clay layers

6.5 Radioactivity

- Verification of the level of radioactivity (an update of the situation since 1996) at the existing site is required to ensure that closure and after-care of the landfill is managed properly.

6 RECOMMENDATIONS

6.1 Introduction

These recommendations indicate measures to mitigate or lessen the negative impacts of the project and ensure good environmental management practice. Whilst the "emergency" aspect of the project is understood, the environmental situation is unlikely to drastically worsen in the short term. It is important to balance short term emergency measures against possibly more significant long term impacts particularly to soil and waters.

6.2 General Recommendations

Due to a lack of information available for this Review about the Landfill extension design and project execution, it is not possible to fully or accurately predict the impacts to air, water, soil, ecology, nuisance and changes in landuse. It is recommended that:

- all this information is provided in the EIA to enable an independent assessment of the impacts and recommend ways to minimise negative environmental impact by mitigating measures.
- The EIA, in particular the mitigation measures, should be incorporated into a full "Project Execution Plan", which is recommended to be approved by the Government (for example Ministry of Public Works and Directorate VROM) and the Management Team before any works take place and the project proceeds further.
- All the recommendations below should be incorporated into the Project Execution Plan for the EAP to avoid and mitigate negative impacts and enhance the positive impacts.

6.3 Air quality

- Immediate measures should be made to commence dust control e.g. by sprinkling (sea)water on the existing landfill
- Dust control measures for the landfill extensions should be specified.
- Extinguish fires within the six month time period specified by the contract and restrict any further burning on existing landfill
- Prohibit burning at the landfill extensions.
- If fires NOT extinguished- air quality monitoring should be implemented to establish health and environmental hazards.
- Investigation of the generation potential of landfill gas, if necessary the treatment of collected methane gas and preferably, energy production, if not, controlled flaring.

6.4 Soil and water impacts

Soil and water may be significantly impacted by the landfill extension. Because of their importance, it is recommended that the design be evaluated and no further construction of the extension of Parkietenbos landfill should take place until the following measures are approved by the competent authorities and/or are included in a Project Execution Plan:

- Approval of full design, specifications and Operation Plan is provided and evaluated alongside the EIA
- Assess compliance with Dutch and EU standards and norms for the following issues:

and registration will limit this in the extension, but such activities are expected to continue until the final phase when the landfill is closed and covered.

Risks to human health are expected to decrease. This is mainly due to extinguishing of waste burning fires. Despite a lack of data on air quality, these are probably the major risk factor as well as being major contributors to ground and water pollution. Ecological and spreading risk are expected to decrease due to the extinguishing of fires. Spreading (albeit at lower rates) is expected to remain a risk due to slow leaching into soil and groundwater from the existing landfill once closed. If the integrity of landfill designs- particularly the geological barrier and use of waste material for dike walls, is not established, the ecological and spreading risks are anticipated to remain unacceptable.

5.9 Cumulative

The EIA is reported to focus only on Phase 1 of the EAP. Given the phased nature of the project and that the EAP is the major tool to implement the 'Integral Waste Management Plan' (Directie VROM 1996) and the 'Vision on Complete Waste Management' (Government of Aruba, 2002) there is a major risk that in only looking at the first phases, the cumulative impacts and benefits, and therefore effective management of Aruba's waste problem will not be possible.

The lifetime of 20 to 30 years for the landfill is strongly dependent on the implementation of the Government's Vision to reduce waste volumes. If this Vision is not quickly and fully implemented, the landfill extension is expected to have reached capacity within 5 years and further landfills or extensions would need to be constructed within 5 years. To avoid potential impacts associated with for example, further extensions or alternative landfill sites, waste volumes need to be drastically reduced.

The EAP has a positive impact on environment in Aruba in general by making the landfill part of an integrated system to introduce separation of waste and recycling. Can be further improved by making use of the energy produced by incineration and methane gas given off by the landfill.

5.10 Social impacts

Social perceptions of the impact of the landfill extension and waste management plans for the Island vary widely from opposition to support due to a lack of information and understanding about the project, lack of transparency of plans and developments and lack of knowledge about the execution of an EIA. Opposition to the EAP may endanger execution of the project.

In the short term the impacts to health are expected to be positive, mainly due to extinguishing of fires. Long term health impacts are not predictable given the scope of this report.

The track record of health and safety at the site is poor. Health and safety of employees working on the site, particularly with hazardous wastes, is critical. It is not known how health, safety and environmental management (such as an HSE management system or if one equivalent to the International Standard Organisations 14001 standards for environmental management systems) is to be implemented. The negative health impacts of uncontrolled, unregistered and open access to the existing site for the health of people illegally 'picking over' of the waste site are significant. Restrictions in access

5.5 Radioactivity

As no radioactive waste is expected to be handled or dumped at the extension, there is no health risk or increase in radioactivity expected.

5.6 Ecology

As long as waste remains overflowing into the sea from the existing dump, there is a potential permanent, major impact to the marine ecosystem in general caused by pollution directly from the uncontrolled and hazardous waste from the extension. This exacerbates the fragile condition of the reef and the lagoon. As there are no details known of how this will be managed and prevented from reoccurring in the extension under the EAP contract.

There is a significant negative impact caused by the landtake and construction of the extension. Despite that part of the extension (namely Cell 1) contains dead trees, which have most probably been affected by air, soil and groundwater pollution originating from the current landfill (which has not been remediated according to plans developed from the Government, reference to Haskoning 1998) this constitutes a significant loss of approximately percent of the mangrove forest at the Parkietenbos location. The loss of this valuable area of mangroves has knock on effects for the marine and terrestrial ecosystem, which it supports.

The current design of the extension also has a significant negative impact on the remaining mangroves and saltwater lagoon in the north-east corner of the mangroves. This is now cut off from essential contact with seawater and the essential flushing and exchange of water is restricted, which may increase already hyper-salinity in the area. This coupled with already high levels (Class II) of pollution in hotspots this may contribute to a significant deterioration in the health of this small area of mangroves.

5.7 Landuse

There is a significant negative impact on landuse as use changes from mangrove forest to landfill. Approximately 50% of the current mangroves at the Parkietenbos location will change. Given the ecological importance of the mangrove ecosystem and its status on Aruba, such a loss is of is of national importance.

5.8 Nuisance & risks

During construction, it is expected that earhthmoving and construction activities will contribute to a significant but temporary increase in noise and traffic. The increase in activities occurring at the landfill site (separation, recycling, incineration) is expected to have a minor increase in noise and traffic impacts.

Birds, vermin and insects may increase creating a major public and occupational health impact and hazard if approve control measures for daily management of waste are not implemented, Details of this are not known.

A negative visual impact for the local community and particularly tourism on the reef Islands and in Oranjestad due to the extension of the landfill size and as closure of the existing landfill takes place only in the final phase of the contract.

1) Outfall of airborne pollutants due to burning of wastes. As the landfill is uncontrolled and waste is unregistered, it is likely that most of the pollutants found in the groundwater originate from waste at the landfill.
2) Leaching and percolation of pollutants through the landfill, occurring by moisture contained in the landfill itself. Given the low levels of rainfall and high evaporation rates it is not expected that precipitation is a major factor in percolation, and that the rate of percolation is slow.

The proposed design of the landfill extension could have major environmental impacts on water quality.

The reuse of polluted waste material, with a layer of granito, for the dike retaining walls of the landfill AND the proposed method of using compressed natural peat & clay as a geological barrier in place of a liner are anticipated to cause major impacts in pollution in the existing groundwater and a major increased risk of spreading in the mangrove area. More information on the results of sampling and modelling may indicate that this does form an adequate natural geological barrier. Issues relevant are the movement and nature of peat/clay layers during initial under less than the design adjustments if adverse impacts are to be expected may also decrease the environmental impact.

5.4.3 Marine

The close proximity of the groundwater to seawater and high risk of inundation of the groundwater table by seawater, mean that there is also a significant risk of seawater pollution. However due to the fast currents, small quantities, and high dilution capacity, pollution levels in open seawater are generally expected to be low.

The results of very limited sampling in 2002 indicated that at four specific locations downstream and down current of the landfill, pollution levels above Dutch standards were found for a number of heavy metals. It is hypothesised that the landfill is the source of this pollution, caused by airborne depositions of pollution from the residues of waste fires, and possible seepage of pollutants from groundwater into the sea. If fires are extinguished, pollution levels due to air borne contamination are expected to decrease. Rates of seepage of polluted groundwater are expected to change, increasing initially as the ground is compressed, then decreasing with full compression of the peat and clay under the landfill extension cells. Further sampling of water, including analysis of lagoon and seabed sediments south-west of the landfill (in the direction of the prevailing current) is needed to confirm this hypothesis and confirm if similar pollution to that found in groundwater in 1996 (Haskoning) and 2002 (Tauw) occurs in the sea. Ongoing monitoring of levels of pollution in groundwater and the sea from the landfill extension would confirm if pollutants are entering groundwater and the sea.

The dikewalls on the seaward side of the extension do not appear adequate to avoid risks of flooding and inundation from seawater into the groundwater table, increasing the risk of spreading pollution.

As long as waste remains overflowing into the sea from the existing dump, there is a potential negative impact on to seawater quality. Potential impact on marine ecosystem due to uncontrolled waste over-flowing from the dump into the sea.

If fires are extinguished at the current landfill and prohibited at the extension, there will be no airborne pollutants, and therefore no possibility of airborne outfall of pollutants to soils, as had occurred in the mangroves to the west of the landfill.

Two aspects of the current design are expected to have a permanent, major, negative impact on soil quality;

1) The compression of peat to a suitable impermeability to prevent percolation of leachate from landfilled waste is expected to take some years before a natural geological barrier is formed. Therefore there will be an as yet unknown time period during which pollution by leaching from wastes deposited in the landfill extension is possible. It is expected that leaching and percolation of pollutants through the landfill will occur due to moisture contained in the waste. Because of the low levels of rainfall and high evaporation rates it is not expected that precipitation will play a major factor in percolation, and that the rate of percolation is slow. Based on the results of analyses of pollution at landfill in 1996 (Haskoning) there appears a significant risk of pollution spreading in soil and to groundwater.

2) The reuse of (highly probably) polluted waste material for the dike retaining walls is also anticipated to cause soil pollution due to percolate of pollutants to the soil. There is a major increased risk of pollution spreading into the soils in the mangrove areas, spreading to groundwater and contaminating seawater due to inundation of soils during high tide flooding.

If it is proven that a natural geological barrier is formed and effective before waste is dumped in the extension, and that the material used for the dike walls is not polluted, this impact is expected to be much less significant.

If the proposed natural geological barrier is effective, the only pollution to the soil is anticipated from pollution leaching from the existing landfill (not the new extension). Natural biodegradation processes are expected to occur in the peat and slowly decrease existing pollution levels. It is not known how compaction of the soil will alter the rate of natural attenuation. It is expected that existing pollution in the mangrove area will spread at the same rate or lower rates than at present. This hypothesis needs to be investigated and confirmed.

5.4 Water quality

5.4.1 Surface water

As surface water is absent in the area except during tropical storms, coupled with evaporation rates, the impact of the pollutants in runoff form an uncapped landfill is low. However there is a minor, short term impact of pollution runoff to the sea caused by possible inundation of the landfill during infrequent storms. This can be mitigated if the extension dike walls are sufficiently protected and lined.

5.4.2 Groundwater

It is highly likely that the groundwater pollution found in the mangrove areas in 1996 and 2002 occurs due to 2 processes:

- **Medium term:** weeks to less than a year;
- **Long term:** over one year; and
- **Very long term:** over ten years.

Descriptions of impact permanence include:
- **Transient:** a temporary effect, which will be quickly eliminated by natural forces, e.g., silt in a stream, grass re-growth.
- **Reversible:** Can be changed by intervention or natural forces, e.g., loss of local fish population, later restocked.
- **Permanent:** Cannot be reversed without major intervention; e.g., building a road to provide access.

Descriptions of impact geographic scale cover:
- **Point source:** less than 100m^2 in area;
- **Small scale local:** 100m^2 to 10,000m^2 (0.1 – 10 hectare);
- **Large scale local:** 10 hectares to 1km^2;
- **District:** 1km^2 to 100km^2;
- **Regional:** Large part or all of Aruba or its marine environment;
- **National:** Applicable to all of Aruba; and
- **Transboundary:** Applicable to more than 1 country, e.g. both Aruba and Venezuela.

Mitigation refers to the overall process of eliminating, reducing or compensating for negative impacts and risks.

5.2 Air quality

Assuming that the fires are extinguished and this practice is not continued, this will have a major positive benefit for large scale, local air quality (particularly the infrequent occasions when the wind direction affects Parkietenbos village) and it is expected that air quality in general will increase permanently.

Dust is expected to be a major transient impacts, originating from construction of the extension, particularly if material is reused from the existing site. During operation, dust from vehicle operations and odour problems are expected unless mitigating measures are implemented, such as daily covering of newly received waste, for example using sand or granito, and water spraying to reduce dust.

If the proposed incinerator is built to comply with international guidelines (for example EU or Dutch standards) and has appropriate controls, it is expected to have only an insignificant negative impact on air quality and health.

Methane gas has significant negative transboundary impacts on the global climate (known as global warming). Whilst the proposed collection of gas is a positive benefit, without treatment (such as the use of the gas for energy production, or flaring), there remain major negative impacts on global air quality.

5.3 Geology and soils

5 ENVIRONMENTAL IMPACTS

5.1 Introduction

Described below is the terminology used in the following sections describing impacts and recommendations.

- An **impact** is a notion which in the context of an EIA covers the following components:
  - Intrusion into the environment;
  - Action, leading to environmental changes;
  - Introduction (removal) of (1) polluting substances, (2) noise, (3) thermal radiation, (4) electromagnetic radiation, (5) radioactive emanation, etc.
- A **negative impact** is an expected but unwanted or adverse impact.
- An impact may be **neutral** in terms of positive or negative but still significant.
- A **direct** impact (most impacts discussed) is one connected directly to the identified activities of the company.
- An **indirect** impact is one resulting from forces outside of the direct influence of the project.
- An **effect** is a consequence of the impact.
- A **benefit** is a positive effect.
- **A residual impact** is the impact anticipated to persist after application of the proposed mitigation measures.
- A **source of impact** is an activity or an operation, which causes an impact.
- A **hazard** is a source of danger or risk.
- A **risk** is a chance or possibility of negative environmental effects (danger, loss, injury, damage, disturbance, etc.). The magnitude or rating of a particular risk is judged by a combination of the scale of the consequence and the likelihood of negative phenomena occurrence depending on the significance, permanence and scale of impact. With this approach risks can be ranked as High, Moderate, Low or Zero.

Where possible, impacts are described in the following quantitative or qualitative terms in accordance with criteria accepted in the EU. In cases where precise assessment is not possible, the significance criteria are applied based on the experts' opinions;

- **Nil**. No impact whatsoever.
- **Negligible**. An impact or risk may be present but its size is expected to be close to nil or below detection limits, not noticeable to the individuals or groups affected and well below that requiring further attention.
- **Insignificant**. An impact or risk is present but its size is below that requiring further attention.
- **Significant.** An impact or risk is present on a scale that warrants particular attention by the contractor or others. Such attention may be in the form of further assessment, quantitative analysis, mitigation, compensation or other measures.

Further qualitative descriptions include **Minor, Moderate** and **Major.**

Time scale descriptions of impact are as follows:

- **Very short term:** minutes to days;
- **Short term:** days to weeks;

Comments were made regarding the impacts of the landfill extension regarding noise disturbance, effect on health (mosquitoes) and lack of consultation. There was a willingness to be consulted about the plans.

4.9 Nuisance and Risks

Nuisance factors originate predominately from the existing landfill. They includes noise, dust, ash, traffic, birds, vermin, insects, and visual impact of the site for the local community and tourism.

Risks to human health, ecological health and the risk of pollution spreading were evaluated in 1996 (Haskoning) on the basis of pollution. Table 2 indicates the findings:

Table 5: Human, ecological and pollution spreading risks

Location	Human risk	Ecological risks	Spreading risk
A Westernmost mangroves, recreation, fishing potential	No unacceptable current risks for humans	No current risks for ecosystem	Potential unacceptable current spreading risk (Spread via sediment and surface water)
B Northeast mangroves, less accessible, fishing potential	No unacceptable current risks for humans	Unacceptable risk for ecosystem present (presence of PCBs & zinc)	Potential unacceptable current spreading risk (Spread via sediment and surface water)
C south-east mangroves, accessible little fishing potential	No unacceptable current risks for humans	Unacceptable risk for ecosystem present (presence of PCBs & zinc)	Potential unacceptable current spreading risk (possible spread via sediment and surface water, no evidence for groundwater spread)

Source: Haskoning, 1996

evidence of recent logging was found around in the Parkietenbos area or the lagoon islands.

Directly to the east of the landfill, a car wreckers company borders the creek. Car parts and tyres were noted around the creek area. 700m to the south east is the Barcadera Industrial harbour includes a cement company, sand and gravel storage, a small harbour, a tank farm and the Water en Energiebedrijf Aruba N.V. (WEB), a water desalination and co-generation electricity site. On the harbour side is a ship wreck. The industrial area emits dust, noise and airborne emissions, which travel with the prevailing wind. The Coastal (formerly Largo) Refinery is situated approximately 12km south-east of the site. Air emissions and flares from the site are clearly visible. There is no known air quality monitoring or information available for any of these sites. Directly to the west of the site along the coastal road are the residential areas of Parkietenbos and Simeon–Antonio.

Small scale fishing and shrimping occurs in the lagoon (Personal: Local residents, G Boekhoudt). It was for example observed that broken shells of the threatened Queen Conch species (*Strombas gigias*) on shore in several places directly next to the landfill (see Appendix 2, Photo 5). This lagoon area is also used recreationally (swimming, water skiing, sailing and beachside restaurants) by local residents and tourists.

Although tourism is not prevalent in the Parkietenbos area, the landfill is clearly visible from several important nearby tourist areas (airport, reef Islands, Oranjestad). Water sports (boating, sailing) and diving takes place frequently on the outer reefs of Bucuti, Palm and Sonesta Islands. Jet skis use the lagoon. These reefs are important dive sites and regularly used by at least two local dive companies. Water based sports, particularly diving, are highly dependent upon the quality of the water and of the reefs.

4.8 Social perceptions

Social perceptions of the landfill extension and waste management plans for the Island vary widely from opposition to support. There is a general lack of information and understanding about the project. A small number of residents interviewed were involved in the consultation meetings for the EAP, however the consensus was that these earlier meetings were not followed up with recent information about progress of the project. A lack of transparency concerning the plans and progress and lack of knowledge about the execution of an EIA were major concerns (Parkietenbos Residents, Rainbow Warriors, 2002). NGOs were concerned that the EAP was going to be conducted in the way that it was agreed (FAMA, 2001) and concerning health and safety risks for employees, damage to the marine environment and that waste management principles were not being applied (Personal: Rainbow Warriors).

Most concerns involved the problems caused by current practice as the landfill: burning of waste (soot, ash, dirt, health, particularly breathing problems) also the impact of waste previously dumped on the site (particularly asbestos and radioactive waste). The impact on recreational activities (swimming, sailing, fishing) was a concern, with several residents stating that their fears of pollution and risks to health had lead them to avoid using the area. Concerns on the impact of current and future operation on the mangroves, turtles, fish and birdlife in the area was expressed, particularly in relation to pollution due to waste and ash in the sea (Personal, StimAruba).

influenced by external processes. These are the supply of nutrients obtained from flooding (salt or fresh water). These processes determine the development of the ecosystem (biodiversity and productivity) and also the sensitivity for external stress factors, such as exploitation (logging), prolonged hyper salinity and soil or water pollution (inhibiting nutrient exchange) or air pollution (resulting in deposits on leaves, inhibiting breathing). Higher stress leads to lower productivity as part of the energy can not be used for recovery of the ecosystem. Less developed mangrove systems, such as Parkietenbos, are also more sensitive to negative influences than an optimally developed mangrove with higher diversity.

Marine flora are noted in literature (Beyelevelt 1999, VROM 1996) and were observed in the lagoon to the south and in the mangroves to the east Parkietenbos site and along the in the lagoon side of the Bucuti, Palm and Sonesta Islands. Seagrass and weeds are the most common species. Seagrass beds extend from the shore to the approximately 20 meters into the lagoon (see Appendix 2, Photo 2). Seagrass also forms an important ecosystem function as nursery, breeding and feeding areas for a range of crustaceans and young fish.

4.6.2 Fauna

Marine fauna noted in literature (Beyelevelt 1999, VROM 1996) and were observed at the lagoon to the south and in the mangroves to the east Parkietenbos site includes:
Lettuce Corals (*Agaricia sp.*)
Eared coral
Seastar (*Oreaster raticulatus*)
Long spined urchin (*Diadema antilliarum*)
Sea anemone (*Stichodacctyla helianthus*)
Red wall sponge (on mangrove roots)
Dolphins

Corals can be found in abundance on the seaward side of the reef, and in limited numbers in the deeper mid area of the lagoon extending sporadically to the island reefs side of the lagoon (Observation and Personal account: Dive Aruba) Appendix 2, Photo 2 shows the extent of the lagoon reefs. The reef is healthy in parts, but in a fragile conditions. Signs of stress and damage were observed on the seaward coral reefs, this is attributed mainly to damage caused by the last tropical storm four years ago. Fishing, bad anchoring practice and increased diving are also reported to add further damage the outer reef.

Additionally, the following species were observed in the lagoon side of the Bucuti, Palm and Sonesta Islands:
Bluehead wrasse (*Thalassoma bifascaicatum*)
Biclor Damsel fish (*Stegastes particus*)
Barracuda (*Sphyraena barracuda*)
Bar jack (*Caranx sp.*)
Trumpetfish (*Aulostoma maculatus*)
Mullet (*Mugil sp*)
Rainbow parrot fish (*Scarus guacamia*)
Solider Crab
Brain coral (*Copophyllia natans*)

4.5 Radioactivity

Rumours of illegal dumping of radioactive waste circulate around the island. VROM reported that possibly a broken X-ray machine may have been dumped in Parkietenbos. However, radioactivity measurements did not show high radioactivity levels, which indicates that there is no risk to human health (Directie VROM, 1996).

4.6 Ecology

4.6.1 Flora

The Aruban terrestrial flora is dominated by dry, semi-arid desert-based species. Around the southern coast are patches of mangroves and several wetlands, the most important concentrations being at Bubali and Spaans Lagoon, the only RAMSAR recognised wetland on the island.

Along on the road to the west of the landfill Divi-divi trees (*Caesalpinia coriaria*), occasional agarve (*Agave vivipara*), and cactuses, the Prickly Pear (*Opuntia wentiana),* Melocactus *(melocactus communis)* and Cadushi (*Lemaireocereus griseus*), occupy the narrow strip between road and coast on coral limestone 1 to 2m high cliff, with mangroves occupying the tidal lagoon beneath the cliff.

The mangrove distribution and species are shown on Map 5 in Appendix 3. Mangroves are common in tropical, coastal areas with sufficient tidal movement. Mangrove areas are highly productive and important in tropical coastal areas, functioning as water filters, coastal buffer protection zones, brooding, nesting and nursery areas for fish, crustaceans and birds. Mangroves are evergreen trees, which shed their leaves throughout the year, but with as maximum production during the rainy season. This organic material forms an importance food source for many animals, in particular young fish and shrimps who inhabitant these tidal zones. The approximately 15 hectare area immediately to the west of landfill contains two of the most common mangroves found in Aruba: *Rhizophora mangle (*Red mangrove*)* and *Avicennia germinans. Rhizophora* inhabits the areas regularly covered by high tides, and *Avicennia* the higher lying areas which are only occasionally covered in high tides. Both types are adapted to periodic exposure to brackish or salt water. In 1998 parts of the vegetation directly to the west of the landfill were observed dead, a swathe of approximately 100m broad and no fauna was noted in this area. Mangrove leaves were covered with a thick layer of ash, in crystalline form in 1998 (Haskoning, 1998) and also observed in 2002, particularly in the south-west corner of the mangroves, as were the trees directly downwind of the Bucuti (also known as Barcadera), Palm and Sonesta Islands. A small area of these tree directly downwind of the landfill were stunted and leafless, with thick deposits of ash (see Appendix 2, Photo 7 and Appendix 3, Map 5). Red Mangroves were also found on the Bucuti Island, Palm and Sonesta Islands, some with diameters up to 30cm. These reef islands have a dike function protecting the coast (VROM, 1996)

In general mangroves on smaller islands are lower and less diverse than on larger islands or mainland areas due to a lesser supply of freshwater from rivers and runoff. The mangrove ecosystem is an open system in which internal processes (energy fixation, increase in biomass, decay of organic material, recycling of minerals) is strongly

ROYAL HASKONING

Table 3 Results of Analyses of Water Samples, Parkietenbos area 2002 (in µg/l)

Parameter	Sampling location											
	N	O1	O2	O3	P1	P2	Q1	Q2	Q3	R	Strive Values Water	Minimum Water Quality (MTR)
Details	15 cm	Surface	15cm	200cm	Surface	200cm	surface	200cm	surface	surface		
PH	7.6	7.6	7.7	7.7	7.7	7.6	7.7	7.7	7.7	7.6		
EC (mS/m)	>2000	>2000	>2000	>2000	>2000	>2000	>2000	>2000	>2000	>2000		
Heavy metals												
Arsenic	9.3	<2	<2	<2	<2	<2	<2	<2	<2	<2	1.3	32
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.4	2
Chrome	39	10	10	4	<2.0	<2.0	3	6	18	<2	2.4	84
Copper	**120**	<20	**23**	<20	**20**	<20	<20	<20	<20	<20	1.1	3.8
Lead	0.68	<0.03	<0.03	<0.03	0.03	0.03	0.033	0.03	<0.03	<0.03	5.3	220
Nickel	**37**	<5	<5	<5	**10**	5	**8**	**8**	<5	<5	4.1	6.3
Zinc	**240**	**52**	<20	<20	<20	<20	<20	<20	<20	<20	12	40
Oil products												
Mineral oil (GC)	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	50*	1000*
Fractions C10-C40	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	-	-

Reference: Normen voor Waterbeheer Minimumkwalitiet en streefwaarde voor water en sediment, NW4, Mei 2000
* Norms for water sediments only, not for total water

Pollution exceeding the Dutch minimum water quality standards for heavy metals in surface water was found at Locations N (copper, lead and zinc), Location O (copper and zinc at surface and near surface) and Location P (copper and nickel) and Location Q (nickel). This may form a risk to the environment and human health.

There is a significant probability that pollution at these locations does originate from wind borne pollutants from residues of the waste burnt at the landfill and from water borne pollutants.

It must be noted that these results are from only very limited surface water sampling, with no water sediment samples taken. More sampling is needed to verify these results and impacts on health and environment.

	Arsenic, molybendum, barium	limited to upper clay & sand levels	Hypersalinity	
Kw			Molybendum, Arsenic	
Lw	PCBs	Possible presence due to currents, landfill may have an influence	Arsenic	
Mw			Arsenic, molybendum Zinc, Barium Hypersalinity	Presence cant be directly related to landfill
Nw			Arsenic, molybendum Zinc, Barium	Presence cant be directly related to landfill

The presence of pollutants to depths of 2m indicates that percolation and leachate from the landfill probably does occur, albeit at minimal spread and flow rates. This groundwater pollution may also due to airborne depositions on soil from burning waste which leach into groundwater.

4.4.3 Marine

The landfill borders a coastal lagoon, approximately 300m wide, fringed by a coral reef. Depth is reported to be approximately 40m. Strong currents flow in the north-westerly direction through the lagoon with speeds strongly influenced by winds. These currents converge those flowing on the north side of Aruba in a north-westerly direction, in the Palm Beach area in large circular whirlpools (Personal: StimAruba, Divers). The tidal variation is approximately 300mm. On the outer edge of the lagoon are coral reefs, with shelves at approximately 5meters and a slope down to approximately 40 meters.

A small lagoon to the north west of the landfill, bordered by the road and mangroves is filled with seawater. The 1996 study (Haskoning) indicated that this area has hyper-saline and polluted. An open, raw sewage outfall enters this lagoon. It was not observed to be in use during the field survey. If in use, it has a high potential for chemical and biological pollution of this water body.

Sea and lagoon water samples were taken at five locations in the Parkietenbos area on Bucati and Sonesta Islands and at the north-western most edge of the Parkietenbos mangrove strand (see Map 2.1) on 11 June 2002. Samples were taken at depth of surface, 15cm and where possible, 200m (allowing for shallow water depths). All locations had saline water. These locations were chosen as they are downwind (Location O) and down-current (Locations N, P, Q and R) from the prevailing currents and wind. It was hypothesised that contaminated water due to either airborne pollution from residues of the fires on the landfill falling into the water, and pollution spreading from soil and groundwater into seawater might be found at these locations directly downwind and current of the landfill. Sonesta Island was used as a reference. The results of analyses show that in the area directly downwind of the landfill, pollutants over the Dutch standards for barium and cobalt were found. Table 3 shows the levels of pollution found and the relevant Dutch standards, highlighting those levels above the Dutch standards.

4.4 Water

4.4.1 Surface water

There is very little surface freshwater in the area, due to the limited precipitation and high evaporation rates. The creek bordering the east of the landfill is reported to be mainly dry and flow only after heavy storms, approximately every 4 years (Personal: Local resident). Observations indicate that the shallow pools of heavily ionised water found in the creek were most likely caused by intruded seawater.

4.4.2 Groundwater

Groundwater is not used as drinking water on the island. All drinking water is obtained from the WEB desalinisation plant. This is approximately 4km to the west (up-current) the landfill site.

Underneath the proposed site the groundwater is brackish and saline, in some places, hypersaline (see Appendix 3, Map 4). The upper-side of the groundwater table varies between 1m to 2m. The groundwater flow appears to north-easterly. The sea level on the coastal side of the mangroves is below the groundwater level. In high water and storms this area is inundated, causing brackish groundwater.

The groundwater in the mangrove area was sampled and tested in 1996 (Haskoning) to determine pollution. High levels (above Dutch intervention standards[2]) of heavy metals, mineral oil, PCBs and pesticides were found in some samples, particularly those located close to the landfill. It is seen as highly likely that the landfill is the cause of much of this pollution. Table 2 shows the pollution found. Map 4 shows the locations sampled.

Table 4: Groundwater Pollution levels at Parkietenbos, 1996

Sampling Location	Soil pollution (above strive & intervention values)	Comment	Groundwater Pollution (above Dutch Strive, Target & Intervention Values)	Comment
Aw			Mineral oil, zinc, Arsenic, molybendum, barium Hypersalinity	Cause: incidental oil product discharges
Cw	DDT	Possibly caused by historical mosquito extermination activities,	Arsenic, molybendum Barium Hypersalinity	Higher ground water levels of DDT may have no relation with landfill, Probably caused by historical mosquito extermination activities
Hw	Zinc, Copper,	Vertical spread of pollution	Arsenic	

[2] An Intervention value is the concentration of chemicals in soil or water at which an intervention is legally obliged under the Dutch Soil Management Act (Circular Soil Protection). This may be due to an urgent risk of spreading, risk to health or the ecology. The intervention zone, timing and method needs to be determined and agreed by competent authority.

Soil samples were taken at three locations around the landfill on Bucati and Sonesta Islands (see Map 2.1) on 11 June 2002. These areas were chosen as they are downwind (Location O) and down current (Locations N and R) from the prevailing currents and wind. It was hypothesised that contaminated soil due to airborne pollution from residues of the fires on the landfill might be deposited at in areas directly downwind of the landfill. Sonesta Island was used as a reference. The results of analyses show that in the area directly downwind of the landfill, pollutants over the Dutch standards for barium and cobalt were found. Table 2 shows the levels of pollution found and the Dutch standards, highlighting those levels above the Dutch standards. It can be hypothesised that this is due to wind borne pollutants from residues of the waste burnt at the landfill.

It must be noted that these results are from only very limited surface soil sampling and more sampling is needed to verify these results.

Table 2 Results of Analyses of Soil Samples, Parkietenbos area 2002 (in µg/l)

Sample	N	O	R	Strive Value	½ way (s+1) value	I intervention Value	Corrected Intervention value
Details	Soil	Soil	Soil				
Dry matter %		78.8					
Organic stuff %		6.1					
Lutum fraction under 0.002mm) %		3.5					
Heavy Metals							
Barium	>5.0	**6,9**	>5.0	200	412.5	625	0.790323
Cobalt	<2.0	**3.3**	<2.0	20	130	240	0.886667
Molybdenum	<1.5	<1.5	<1.5	10	105	200	3.5
Tin	<5.4	<2.0	<2.0	-	-	-	
Volatile aromatic compounds							
BTEX total		<0.2			-	-	
Benzene		<0.05		0.05	0.5	1	
Toluene		<0.05		0.05	65	130	
Ethylbenzene		<0.05		0.05	25	50	
Xylene		<0.05		0.05	12.5	25	

Reference: Circular on Soil Quality standards, Directorate VROM, 1994

It is highly likely that the soil pollution found in 1996 and recently through the Tauw work in 2002, occurs due to two processes: airborne outfall of pollution and leaching.

- Outfall of airborne pollutants probably occurs from the residues from waste burning. As the landfill is uncontrolled and waste is unregistered, it is likely that most of the pollutants found in the soil originate from this waste.
- Leaching and percolation of pollutants through the landfill, occurring through moisture contained in the landfill itself. Because of the low levels of rainfall and high evaporation rates it is not expected that precipitation is a major factor in percolation, and that the rate of percolation is slow.

Table 1: Soil Pollution levels at Parkietenbos, 1996

Sampling Location	Soil pollution (above strive & intervention values)	Comment	Groundwater Pollution (above Dutch Strive, Target & Intervention Values)	Comment
B	Copper	Vertical spread of pollution limited to upper clay & sand levels		
D	Copper, zinc, cobalt, barium, volatile hydrocarbons,			
E			Arsenic	
F	DDT Copper, PCBs	Probably caused by historical mosquito extermination activities, not landfill		
G	DDT Copper, PCBs, molybendum	Probably caused by historical mosquito extermination activities, not landfill		
I	Molybendum			
J	Copper, PCBs, Molybendum			

Source: Haskoning, 1996

Soil on the coastal side of the landfill is composed of a silty clay layer, and a coarse, silty sand layer. Under this is very fine silty clay. Topsoils are clay or sand based, with low nutrient peat of depths ranging from 500mm to over 1500mm (Haskoning, 1996). Peat layers have been reported from being up to 6000 thick in the south-west of the mangroves (Personal statement, Mr G. R. Boekhout).

Sampling from 1996 (Haskoning) indicates that under the mangroves is a peat layer that varies from not present to 6 metres. There is a clay layer beneath this, but it is not present in all places (Tauw, 2002). The presence of pollutants to depths of 2m in the peat indicates that percolation and leachate probably does occur, albeit at minimal spread and flow rates. This pollution may also due to airborne depositions from burning waste.

It is known that peat can accumulate chemical compounds present in the leachate and by the process of natural attenuation, which degrades some compounds. However, this layer has to be present for the whole surface to allow attenuation to work in the entire area. Compressing peat to a semi-impermeable layer capable of retaining pollution is only possible with a certain pressure of waste over a certain period of time. The modelling to justify this process of natural attenuation in this location and the compression theory has not been made available.

Soils on the Bucuti, Palm and Sonesta Islands are limited to thin (10-100mm layers) of sand with partly decomposed organic matter, overlaying coral limestone and some waterlogged peat (10-150mm) in the central hollows of the Islands vegetated by mangroves.

The soil in the mangrove area was sampled and tested in 1996 (Haskoning) to determine levels of pollution. High levels (above Dutch intervention standards) of heavy metals, mineral oil, PCBs and pesticides \were found in some samples, particularly those located close to the landfill. It is highly likely that the landfill is the cause of much of this pollution. Table 1 shows the pollution found. Appendix 3, Map 4 shows the locations sampled.

Observations in 1998 and 2002 indicated that sediments and soils directly downwind (prevailing north-westerly) of the landfill were polluted with a thick grey sludge, and surface water was polluted with a grey, floating, dry, ash like substance (Haskoning, 1996). These may be due to ash and deposits from the burning of wastes at the landfill.

4 BASELINE SITUATION

4.1 Introduction

This section provides a review of quantitative and qualitative data on the environment that is likely to affect and be affected by the Parkietenbos landfill extension. The objective of describing the baseline is to examine the aspects of the environment, which might:

- experience impacts as a result of the landfill extension
- influence the extent of an impact
- conflict in interest with the proposed extension
- influence the cost and logistics of construction and operation
- pose a threat to the integrity of the landfill extension
- antagonise the effect of elements of landfill extension
- present a liability for the landfill extension development.

4.2 Climate and air

The prevailing wind on the island (95% of the time) is from the north-east to south-east, averaging east, force 4 or 5 on the Beaufort scale (see appendix 2, Photo 8). The climate is tropical and sunny, with average annual temperatures of 28°c, decreasing to 26°c in the winter (January and February). Day temperatures in winter average 29°c, rising to 34°c in the summer (August and September). The average annual rainfall of 412mm, most falling as short, heavy showers in between October and March (1988-1999 CBS). Daily evaporation from open water averages 8.4mm (CBS), varying from 8 to 20 mm with the influence of the sun and wind. Periods of drought of over year are not uncommon. Approximately once in the 4 or 5 years tropical storms occur.

There is no information on local air quality available. There have been no reported studies on the island. Visual evidence indicated that air quality around Parkietenbos is strongly affected by daily burning of waste on the landfill resulting in thick, black smoke and both fine and larger particles of ash. These are carried by the prevailing winds as far as the coastal islands fringing the lagoon. Deposits of grey/black crystalline dust and ash were visually observed on mangrove leaves, stems and ground both near the landfill (Haskoning, 1998, Visual observation 2002) and on vegetation directly downwind on the lagoon Islands (see Appendix 2, Photo 9)

4.3 Geology and soils

Aruba is largely composed of 100 million year old batholite, covered with Aruba Lava formations, volcanic materials from 60 million years ago, and subsequently fringed and covered by coral reefs, creating fossil rich limestone, both massive and porous, poorly cemented and jointed limestone.

Aruba has a dry landscape dominated by its limestone geology, with thin, sparse, eroded soils (heighten by the wind and surface run off from infrequent, heavy rainfall). Soils are typified by fine grain 'terra rossa' and sandy soils.

Parkietenbos. Procedures for aftercare and closing are a requirement of the directive. It is not known how these will be managed for Parkietenbos.
It is not known if there are any coastal protection works between the lagoon and the landfill in the design, for example measures to prevent landfill collapse during a heavy storm. The EU directive requires protection of ground and surface waters.

The contract requires approval for designs within one month of contract signing (27 March 2002). It is of concern that by June 2002 final plans had not been received, however construction works had started without DOW approval and without the EIA and results of sampling (Dienst Openbaar Werken, 2002)

The fact that there is no water-bearing layer that should be protected does mean that one is free to influence the surrounding area. The fact that leachate will not occur is not proven and the quantity is not known. The presence of pollutants to depths of 2m in the indicates that percolation and leachate probably does occur, albeit at minimal spread and flow rates. The Tauw report attributes the cause of the majority of soil and groundwater pollution to airborne depositions from burning waste, and not from leachate. However this is an assumption that needs to be proved to ensure the actual need for a liner to prevent percolation of leachate and ensure compliance with EU legislation.

It is known that peat can accumulate chemical compounds present in the leachate and by the process of natural attenuation can degrade some compounds. However, this layer has to be present at the whole surface and still this is no substitute for a lining system. Compression of the peat to a semi-impermeable layer capable of retaining pollution is only possible with a certain pressure of waste over a certain period of time. The modelling to justify this has not been made available. Given that analyses in 1996 and 2002 indicate that groundwater is polluted in several areas of the site, the monitoring and reuse of extracted water for dust control, does not appear very feasible given the possibility of more extensively polluted groundwater than that known from analyses in 1996 and 2002. Confirmation that compression of the peat and clay layers, or peat and granito layer comprises a sufficient natural geological barrier, without the need to artificial sealing liners, is not clear for Parkietenbos. Proof of the movement of peat under pressure and impermeability to seawater inundation also are required This certainty is necessary to ensure compliance with EU and Dutch legislation.

The use of waste from the old landfill for construction of the retaining/dike walls of the landfill extension is possible under the Directive and the Dutch Building Materials Decree. If the material is suitable for it's purpose and the quality meets Dutch national legislation, this practice conforms with IBC norms. If the waste material is less polluted than the ground it is to be placed upon, it is possible to reuse it, according to the Dutch Building Materials Decree. Given that the waste material is derived from uncontrolled, unplanned dumping and contain unknown materials, including known hazardous wastes, it is more than likely that the construction of the landfill does not meet Dutch Regulations. The material needs to be verified by the results of laboratory analyses to ensure compliance. Reliance on assumptions about the age of the waste are not a valid method of ascertaining the quality of the waste material.

The EU Directive states that the design of the landfill should take in account the risk of flooding, protection of nature and control water from precipitation's entering the landfill body. Given the proximity to the sea, risk of tropical storms, high seawater levels and directly adjacent (and former) mangrove area, it needs to be confirmed that the design takes into account all these factors to ensure compliance.

Gas pipes will be placed in the cell extension. The Directive requires not just collection, but also treatment and use, preferably to produce energy, if not, flaring. It is not known how this will be managed for Parkietenbos.

Control and monitoring are required whilst the landfill is in operation. /the relevant authorities are responsible for determining corrective measures if adverse environmental effects are revealed by this control. It is not known how this will be managed for

during the passive phase/post closure.

The geological barrier is determined by geological and hydrogeological conditions below and in the vicinity of a landfill site providing sufficient attenuation capacity to prevent a potential risk to soil and groundwater.

The landfill base and sides shall consist of a mineral layer, which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to the one resulting from the following requirements:

- Non-hazardous waste $K \leq 1{,}0 \times 10^{-9}$ m/s, thickness ≥ 1 metre.
- Hazardous Waste: $K \leq 1{,}0 \times 10^{-9}$ m/s, thickness ≥ 5 metre
- Inert Waste: $K \leq 1{,}0 \times 10^{-7}$ m/s, thickness ≥ 1 metre.

Where the geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than 0,5 metres thick.

In addition to the geological barrier described above a leachate collection and sealing system must be added in accordance with the following principles so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum:

Leachate collection and bottom sealing

Landfill category	Non-hazardous	Hazardous
Artificial sealing liner	Required	Required
Drainage layer ≥ 0,5 metre	Required	Required

3.1 Compliance with EU directive and Dutch IBC standards

It is assumed that the extension of the landfill at Parkietenbos will only be used for non-hazardous waste. The Government's Vision of Complete Waste Management indicates that hazardous waste will be separately treated (e.g. incinerated at the Parkietenbos site) and not landfilled.

The Directive states that a landfill must be designed to prevent pollution of soil, groundwater or surface and ensure efficient collection of leachate. Unless an assessment of the location and type of waste shows that there is a hazard to the environment, an artificially established geological barrier of no less than 0,5 metres thick should be installed in combination with an artificial sealing liner. The Haskoning (1996) and Tauw (2002) sampling indicate that under the mangroves, the thickness of the peat layer varies from not present to 6 metres. It is also mentioned in the Tauw report, that the clay layer is not present in all places. Granito is proposed to be used in its place. The preliminary justification that a liner is not necessary, and that granito is a suitable substitute geological barrier is very doubtful if the properties of granito (a highly permeable, locally obtained coarse sand) are sufficient when against this requirement. Further proof of the modelling of peat movements to protect groundwater and particularly avoid the interaction of polluted groundwater and seawater.

3 LEGISLATION

The legislation of Aruba is relevant to this project in general. The contract for the EAP (Aruba & Caribbean Integrated Waste Systems N.V. 2002) states that "quality assurance is required to Netherlands Norms institute (NEN) for construction material, leakproof liners (to KIWA certification)" and landfills cells should be built accoridng to "Netherlands IBC[1] Norms or comparable norms adapted to Aruban circumstances" to be approved by Dienst Openbaar Werken.

The following Dutch and EU legislation is therefore relevant:

- EC Directive on landfill of waste 99/31/EC, dated 26 April 1999
- Establishments and licenses decree (Environmental management Act)
- Building Materials Decree (under Soil & surface Waters Protection Act) 1999
- Waste disposal at landfills (under Soil Protection Act) Decree 1993
- Waste Substances (Prohibition of landfill) Decree 1985
- Soil Protection Law.

The EU Council directive sets the standard for all European Union member countries and is the basis for the current Dutch legislation on landfills. The Dutch standards are high and are of course tailored to the Dutch environment. The EU Directive is by necessity more pragmatic and open for interpretation for the local conditions in member countries. For that reason it is more pragmatic to evaluate compliance with the IBC norms in the Directive than those in the Dutch laws.

Annex 1 of the EU directive on landfill waste sets out the general requirements relating to all classes of landfills. Below a brief summary of the requirements for non-hazardous waste is given:

Water control and leachate management

Appropriate measures shall be taken, with respect to the characteristics of the landfill and the meteorological conditions, in order to:

- control of water from precipitation entering into the landfill,
- prevent surface water and/or groundwater from entering into the landfilled waste,
- collect contaminated water and leachate; if an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential hazard to the environment, the competent authority may decide that this provision does not apply
- treated contaminated water and leachate collected from the landfill to the appropriate standard required for their discharge.

The above provisions may not apply to landfills for inert waste.

Protection of soil and water

A landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of the soil, groundwater or surface water and ensuring efficient collection of leachate. Protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier and a bottom liner during the operational/active phase and by the combination of a geological barrier and a top liner

[1] IBC stands for "Isoleren, controleren, beheeren" isloate, control and manage – which are guiding principles for Dutch landfill management.

The environmental impact assessment is subcontracted to ESC, an American company. This report is due mid July and is dependent upon the design of the landfill. The relationship between the EAP and the EIA was not mentioned in the Contract. It is not known how the EIA will be evaluated, although the Directorate of VROM and the Ministry of Public Works are understood to be the competent authorities to review EIAs on Aruba. It is not known how for example, changes recommended by the EIA would be included in the design of the landfill, construction and execution.

2.3 Location

The Parkietenbos landfill is situated on the south-west coast of Aruba, about 4km south-east of Oranjestad. See Appendix 3, Map 1.

The existing landfill is approximately 15 hectares. The landfill lies on a coastal lagoon. The landfill is bounded on the east side by a creek, which is separated from the bay by a sand dam. An outfall pipe for percolated water from the dump enters the creek. The Western side of the landfill is bordered by mangroves.

The Isla di Oro, an island with mainly recreational use, with similar mangrove vegetation to the Parkietenbos area, situated approximate 5.5km downstream of the landfill, was been used as a reference for soil and water quality in research in 1996 and 1998.

2.4 Project Status

The contract to execute the Emergency Action Plan was signed on 27 February 2002 by Aruba and Caribbean Integrated Waste systems N.V.

The Parkietenbos Landfill Extension is currently under construction. As at 13 June retaining landfill walls for the extension cell, access roads and concrete structures for waste separation including a cell for asbestos have been constructed.

Management (2002). However, at current rates of waste reception, the landfill would have a lifetime of 5 years.

The landfill extension covers an estimated 10 hectare area. The design differs from the plan presented in the Contract (see Appendix 3, Map 3) as the extension does not extend up to small lagoon by the road. The extension is divided into four cells. Cell 1 is directly adjacent to the landfill and the sea, Cell 2 is to the west. Cell 3 is above this and Cell 4 is above Cell 1.These will be filled sequentially starting with Cell 1. The outline can be clearly seen on Photos 1, 2 and 3 in Appendix 2. The EAP is to take place in four phases:

1. Construction and operation of cells 1-4 to west of existing landfill and monitoring wells, 13 outlets for methane gas and construction and operation of facilities and 4 monitoring wells, (weighbridge, storage area, hazardous and household waste cells, construction of a wall along road, asbestos holding cell.) Training of Serlimar in good waste practices. Limited recycling and separation of household waste. Weighing and registration of waste. Construction of incinerator to process animal, hospital, airplane and possibly ships waste.
2. Construction and operation of Cell to east of existing landfill
3. Mangrove revegitation along shoreline of landfill, clean up of rubbish in mangrove lagoon
4. Closure of existing landfill.

CIWS has subcontracted landfill design and geological modelling work to Tauw, H2ID and Geotron of the Netherlands. The blueprints and design are expected at the end of June. Initial reports from these contractors have not been made fully available. Interviews and observations indicated that the design is based upon reuse of older materials (over 10 years) from the existing landfill waste. Retaining walls of approximately 3 wide by 3.5 meters high, have been constructed between March and June 2002. These will be covered on all sides by a 0.5 meter layer of grantio (a permeable, locally obtained coarse sand). It was verbally reported that analyses of this material indicated that some pollutant levels were exceeded. More details are unknown. Draft reports from Tauw (2002) of chemical analyses in the mangrove area stated that pollution in the mangrove area to the west of the landfill was mainly spread by wind, and that leaching in the landfill was not expected due to an absence of percolate found. The number of pollutants had increased in 2002 as compared to the 1996 study, although they are not directly comparable as different sampling locations were used.

The need for a bottom sealing liner is reported as absent because of the lack of percolate found, the expectation that the compressed peat and clay layer will from a sufficient geological barrier. In areas where the clay layer is not present, additional measures, such as granito will be used to separate the waste from the ground. The effect of constructing the extension dike walls on compressing the underlying peat layer is being monitored weekly for seawater extrusion and rate of compaction. Compression will be controlled using coarse fill. Extracted water from the compressed layer will be monitored and used for dust control.

It is recognised that the geological structure of the Parkietenbos location makes placing a liner technically difficult (requiring large amounts of material (sand, gravel and a drainage layer) to level the site before an artificial sealing liner can placed. Obtaining the necessary materials and their cost have an important determinant on landfill design.

urgency to manage and remediate pollution at Parkietenbos was stated, based on two policy requirements: a separate project dossier and new financing. Private sector proposals on the basis of this policy were investigated and the costs of integrated waste management forecasted in together in the so–called Report Lacle "Waste Management Aruba 2000" of 1999. In 2000 a proposed private sector landfill and integrated facility at Palo Marga was abandoned after public consultations. Another private sector initiative ended up producing the "Emergency Action Plan voor afvalverwerking" (EAP) 2001, which was jointly developed with NGOs and local community interest groups, presenting an integrated waste solution based on the Parkietenbos landfill site.

The Government's `Vision on Complete Waste Management` (2002) sets out the a role for "an isolated, management and controlled landfill" as part of an integrated waste management for Aruba. This is in the context of changes in waste charges structure, separate treatment of hazardous waste, separation at source and mechanically recycling and reuse of economically valuable materials, educational campaigns to reach the goal and the independence and maturity of Serlimar's waste services, new waste processing facilities (e.g. composting, incineration etc) and reuse of related secondary raw materials. By October 2002 bidding for separation activities is to commence. A recycling programme is expected to be in place by 2004.

2.2 The Emergency Action Plan

In February 2002 a contract was signed between the Government of Aruba and CIWS to execute the EAP. The contract covers a 30 month period, with option to extend up to five years in total. This includes:

I. CIWS to assume responsibility for management and control of the landfill from Serlimar. A Management Team with 3 members from CWIS and 3 Government to be appointed members, shall oversee contract activities for 30 months
II. Exploit the landfill according to a plan pre agreed with the Government
III. Construct a landfill of 1,250,000m^3 to the south-west of the current landfill
IV. Contract and install equipped registration station
V. Construct concrete access road from the public to the waste platform
VI. Construct and install waste platform and reservoirs for separated waste
VII. Provide construction drawings for approval of government
VIII. Provide and install two 50 ton capacity weigh bridges of 12 by 3meters.
IX. Supply of earth moving materials (including bulldozers, grader, loader, dump and other trucks, crusher, excavator, shredder, dredger, compactors, backhoe, and bobcat) and incinerator with 20 ton per day capacity
X. Supply a draft plan specifying method for extinguishing fires, mitigating current problems and long term use of the old landfill – within 6 months of the contract i.e. by 27 August 2002.
XI. In co-ordination with the relevant named organisations, landscaping of Jaburibari and Palo Marga landfills, and identification of other dumps and setting priority and plan for landscaping and restoration.

All waste will be processed and received in the landfill extension except during a maintenance period, where the existing landfill can be used for up to 2 months after completion of the extension. The landfill extension is expected to operate for 20-30 years. This is dependent on the implementation of waste separation and recycling activities to reduce volumes of wastes drastically below the current volumes of 100-200,000 tons per year, as defined in the Government's Vision on Complete Waste

2 DESCRIPTION OF EAP

2.1 Background

Waste has been dumped on the site since the 1950s (Personal, G.R.Boekhoudt, VROM Aruba). Although the landfill reached it planned capacity in 1992, it is still accepting waste.

The landfill is currently managed by an Aruban government organisation called Serlimar (Servicio di Limpieeza di Aruba) and is open 24 hours a day, during daytime a manager is present. Waste is delivered by Serlimar and other commercial contractors on a daily basis. To reduce waste volumes burning of waste regularly occurs on the site. Access to the site is open. Waste is uncontrolled, unregistered and not separated. The landfill is reported to contain hazardous, animal, hospital, domestic, chemical and industrial waste, including asbestos Interview G. Boekhoudt, and personal observation (e.g. tyres, refrigerators, batteries, and transformers). Asbestos has been placed in concrete containers on the site. The presence of radioactive waste is rumoured but not certain. Tests in 1996 indicated no dangerous levels of radioactivity. Accidents on the site have occurred: recently in 2002 an explosion resulting from a burning oil barrel occurred, injuring three people. Dumping of untreated waste from septic tanks also occurred in 2002, which entered the coastal lagoon waters. Illegal "picking-over" of the dump is common and was observed in June 2002. Illegal waste dumping is reported as common (Personal: G. R. Boekhoudt, local residents). Odour, dust, wind blown materials, numerous birds and vermin were observed during the field survey and reported by local residents.

In 1992 a phased survey was partially implemented by DHV (Ministerie van Publieke Werken en Volksgezondhied in Aruba, 1992). This was to strengthen the outer landfill dikewalls along the creek and seaward side using "rhino mattresses" (stoned filled wire cages, covered with tarmac and material liners), and dike retaining walls using waste material from the landfill encapsulated with liners and gabions). In 1992 the landfills "useful life" was determined to end in 1996 (DHV, 1992), however it exceeded it's capacity before this date. Waste is now piled approximately 20 to 25m high on a third tier, on a slope of with an angel of approximately 62°. There appears to be a high risk of instability of the waste mass on the central and eastern seaward side of the landfill, with waste visibly spilling over into the lagoon (see Appendix 2, Photo 6).

In 1996 an investigation was made into soil and groundwater pollution around the landfill. It was determined that there was a risk to the ecology in the area and a possible risk of pollution spreading, but not a risk to human health (Haskoning, 1996). As there was pollution at levels that (according to Dutch standards) required an a plan of action, a plan for remediating (cleaning up the pollution) at the landfill was made. This did not involve any new designs or extensions for the landfill. The plan involved removing the worst affected pollution hotspots and the mangroves in the south east corner by the sea, re-vegetating this area and excavating a channel to improve flushing of the mangroves in north-western corner. This plan was not implemented.

In 1996 it was estimated that 174,802 tons of waste were produced on Aruba. Also in 1996 VROM published the Nota "Ondernemend Afvalverwerken", the first integral waste management plan for Aruba. This set the policy for a waste management concept based on the priorities of Prevention, reuse and recycling incineration and lastly landfill. The

  - Volatile aromatic hydrocarbons
  - Organic chlorinated biphenyls
  - Heavy metals
- Interviews were an important source of information about the EAP and the environmental impacts on the Parkietenbos area. Interviews also assisted in collecting data and verifying information. Interviews were conducted with representatives from the following:
  - Directie Volkshuisvesting, Ruimteljik Ontwikkleling en Milieu, and Environmental Adviser to the Minister
  - Caribbean Integrated Waste Systems N.V.
  - Local residents in the Parkietenbos area
  - Non-governmental organisations: ATIA, ARMA, AHATA, SNBA
  - Environmental non-government organisations: FAMA, Rainbow Warriors International, FANAPA, StimAruba
  - Local diving companies

1.3 Limitations

A major problem of the Environmental Review is that the accuracy and reliability of data is not optimal due to the following factors:

- Restrictions of to access to EAP relevant documents (e.g. EAP original documents), landfill designs, EIA, and results of recent Tauw and Geotron sampling and analyses;
- Not full or official access to the landfill and extension site;
- No permit for construction of the extension available
- Lack of data on the environmental baseline e.g. air quality, coral reefs, water quality
- Unfortunately the results of the sampling program cannot be used to statistically substantiate the impacts. The limited scope of the Environmental Review, short time frame and limited budget, mean that sampling was limited to provide data on critical environmental impacts and locations.

The Review only covers environmental aspects of the EAP and landfill extension. The social (including health) and economic aspects have not been included. The Review is limited to the EAP and extension. It does not assess alternatives to the landfill (e.g. alternative sites) and its roles in the national waste strategy and policy.

1.4 The role of Royal Haskoning

Royal Haskoning has been contracted as an external, independent environmental consultant to provide professional environmental advice. Royal Haskoning is an international company of environmental consultants, engineers and architects, which has specialised in providing water and environment advice for over 30 years. The company has experience in working on Aruba and in conducting numerous environmental reviews and environmental impact assessments. This Environmental Review provides impartial, third party advice on the potential environmental impacts of the landfill extension and recommends practical measures to reduce these impacts for the clients to present to the Government of Aruba.

The realisation of the Parkietenbos landfill extension and Emergency Action Project is contracted to Caribbean Integrated Waste Systems N.V. of Aruba (CIWS), a consortium of Raygar International Inc. of the USA and ARWECO, Aruba. Royal Haskoning is not connected or in anyway affiliated with CIWS or their subcontractors.

1 INTRODUCTION

1.1 Aim of the Environmental Review

In May 2002 Royal Haskoning was requested to perform an independent environmental review of the proposed landfill extension (also known as the 'Emergency Action Plan', or 'EAP') for the Parkietenbos landfill, Aruba, by the following consortium of non-government organisations:
Chamber of Commerce & Industry (KvK)
Aruba Trade & Industry Association (ATIA)
Aruba Hotel & Tourism Association (AHATA)
San Nicolas Business Association (SNBA)
Aruba Retail Merchants Association (ARMA)

The Review was commissioned by these organisations due to their concerns about the proper execution of the extension of the landfill and possible impacts on the environment, health, local communities, business and tourism. This report aims to provide constructive help in improving the EAP.

The Environmental Review provides a assessment of the possible environmental impacts arising from the proposed extension of the landfill and the EAP. First a brief description of the environmental 'baseline' of the Parkietenbos area is made. This is the starting point. The activities that are part of the EAP are then analysed, also how they comply with Dutch law (this was a requirement of the EAP contract). It is then possible to predict the impacts on the environment that may result from putting the EAP into practice. Ways to prevent, minimise or compensate for these impacts are presented as recommendations.

1.2 Activities

The following activities were part of the Environmental Review:

- Literature review: collecting relevant documents from different organisations and the Internet.
- Field survey: Observation of water, soil, air, plants and animals on land and in the sea around Parkietenbos landfill. The observations focussed on areas where risks to human health and the environment were most likely:
- Parkietenbos village;
- Mangroves to the south-west of the landfill
- Bucuti (also known as Barcadera), Palm and Sonesta Islands and their reefs on the ocean side
- Barcadera Industrial Estate
  Royal Haskoning staff took thirteen water and soil samples from around the Parkietenbos area and the Islands. See Appendix 3, Map 2 for details of the sampling locations.
- Chemical analyses of water and soil samples were preserved and transported to the Royal Haskoning certified environmental laboratory in Rotterdam, The Netherlands, where they were analysed. The samples were analysed for one or more of the following parameters, which are the most common indicators of pollution from landfills:
  - Mineral oil
  - Polycyclic aromatic hydrocarbons

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downwind has been found in 2002. It is highly probable that this pollution was partly caused by the landfill, from polluted runoff water, and from residues from burning of waste entering soil, groundwater and possibly the sea. The soil and groundwater pollution was analysed by Dutch standards not to be a risk to human health in 1996. But it was classified as a risk to the ecosystem and there is a danger of pollution spreading. The closeness to Parkietenbos village means that poor air quality (especially odour and dust) is a major issue, with local community concerns of related poor health. Although tourism is not prevalent in the Parkietenbos area, the landfill and current burning is clearly visible from several tourist areas.

Emergency Action Plan

A contract to execute the EAP was signed in February 2002 between the government of Aruba and Caribbean Integrated Waste Systems N.V. It covers 30 months and has four phases:

1) Design, construction and operation of an extension of the landfill to the south-west of Parkietenbos landfill, into the existing mangrove area, extinguishing the fires, 13 outlets for methane gas and facilities (weighbridge, storage area, hazardous and household waste cells, construction of a wall along the road, asbestos holding cell and construction of an incinerator for hazardous waste). Some recycling and separation of household waste. (2) Construction and operation of new extension to the east of existing landfill (3) Mangrove re-vegetation along shoreline of landfill, clean up of rubbish in the mangrove lagoon and (4) Closure of existing landfill, landscaping and closing Jaburibari and Palo Marga landfills.

The expected lifetime of the extended landfill is between 5 to 30 years, depending on the success of recycling and reuse of waste materials. The EAP is part of a Government Vision to better manage Aruba's waste. At the time of this study, the Environmental Impact Assessment and associated public consultations had not been finalised. The design documents were not finalised and results of the chemical analyses were not made available.

Impacts

The main environmental impacts from the putting the EAP into practice are predicted as:

- Positive impact on environment in Aruba in general, by making the landfill part of an integrated plan for separating waste and recycling. This is provided that the Government's Vision on Waste Management is implemented. This should be further improved using the energy produced from methane gas given off by the landfill.
- Positive impact on air quality due to extinguishing fires. However if methane gas is not treated and used, there is a negative impact on global climate. The incinerator, if constructed and operated according to international standards, is predicted to have an insignificant negative impact.
- Possible major increases in soil, groundwater and marine pollution, from pollutants leaking from the waste in landfill and the dike walls. This is possible if there the barrier between the landfill and the ground is inadequate or if pollution leaks through the landfill retaining walls.
- Permanent decreased air quality (dust) and nuisance (noise, vermin and odour) in Parkietenbos, if waste is not covered at the extension and capping only occurs late in the contract. These can be reduced significantly by daily covering of waste and dust control measures, such as water spraying.
- A significant loss of approximately 50% of the mangroves at Parkietenbos, due to the landfill extension. This will negatively affect the whole ecosystem in the lagoon and possibly outer reef, having indirect consequences for fishing, tourism and recreation. Mangrove loss should be compensated by equivalent re-vegetation in the area or other suitable mangrove strands. The north east corner of the mangroves near the landfill near the lagoon may be negatively impacted as it is cut off from the sea by the extension, unless it is reconnected to the sea.
- Minor, visual impact due to increase in the landfill size and facilities on the site. This is relevant for local inhabitants and for tourism.
- Minor, temporary nuisance from increased traffic and noise, during construction. This is relevant for local inhabitants and for tourism.

3. The EAP aims to improve waste management on Aruba and therefore improve the economic, environmental and social standards. Using the current Parkietenbos landfill location for the EAP means sacrificing environmentally valuable mangrove ecosystem, which can have indirect impacts on tourism and recreation. It is not clear if this balance has been clearly evaluated and other alternative sites evaluated on economic, social and environmental criteria. An evaluation is recommended.

4. The success of the EAP depends on the drastic reduction in waste volumes. To ensure that the capacity of the landfill extension extends beyond 5 years and further landfills or extensions do not need to be constructed, it is recommended as essential that the Government's Vision on Complete Waste Management is implemented immediately.

5. A number of practical good environmental management recommendations have been made to lessen the environmental impacts to air, water, radioactivity, ecology, landscape, nuisance and reduce the worst environmental impacts to acceptable levels. These are listed in Chapter 6. It is recommended to include these into a Project Execution Plan for construction and operation of the EAP. A competent authority (independent of the EAP Management Team) should monitor compliance with the EAP and a Project Execution Plan.

6. The effect of adding up all the phases of the EAP (the cumulative impact) should be looked at in one go by either the Government or the contractor, especially how it fits into long term waste management plans for the Island, instead of taking short term views.

7. It is recommended that communication and transparency between the government, the contractor, the local community and other interested parties such as NGOs is improved. Many of the current misconceptions about the EAP are due to poor communication. Information on the plans, progress and timing of the work should be provided. Opportunities for public consultation and participating in the decision making for waste management on Aruba should be made.

Activities

The following activities were part of the Environmental Review:

- Literature review
- Field survey with soil and water samples and observation of the environment, especially in sensitive areas such as Parkietenbos village, mangroves and the Reef Islands.
- Chemical analyses of water and soil samples at the Royal Haskoning certified environmental laboratory for the most common pollutants from landfills.
- Interviews with representatives from the government, the contractor, local residents, non-governmental business and environmental organisations and local diving companies.

A major problem of the Environmental Review is that the accuracy and reliability of data is not optimal because of restrictions to access to EAP documents, designs and results of recent sampling and analyses; No full or official access to the landfill; a lack of data on the environmental baseline e.g. air quality, coral reefs, water quality and Results of the sampling program cannot be used to statistically substantiate the impacts as the limited scope, short time frame and budget meant that only some environmental impacts and locations were sampled.

The baseline environment

The Parkietenbos area is sensitive. Mangroves, seagrass beds and coral reefs are all important ecosystems very close to the landfill, and although they not a protected area, they are recognised for their environmental importance. This has consequences for the quality of fishing, nearby coral reefs, recreation and tourism in the area. Some of the soil and groundwater in the mangroves next to the existing site was seriously polluted in 1996 and pollution in seawater and soils in close to the landfill and

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Summary: Environmental Review Parkietenbos landfill extension

Introduction

This is a non-technical summary of the Environmental Review. In 2002 Royal Haskoning performed an independent environmental review of the proposed Parkietenbos landfill extension (also known as the 'Emergency Action Plan' or 'EAP') by the Aruba Chamber of Commerce & Industry, Aruba Trade & Industry Association, Aruba Hotel & Tourism Association, San Nicolas Business Association and Aruba Retail Merchants Association. The Review was commissioned because of their concerns about the proper execution of the EAP and possible impacts on the environment, health, local communities, business and tourism. This report provides an independent and fair assessment of the environmental impacts of the EAP, as far as can be determined based on the information obtained.

Aim of the Environmental Review

The Environmental Review provides an assessment of the possible environmental impacts from the EAP. First a brief description of the current environmental situation of the Parkietenbos area is made. The activities of the EAP are then analysed; also to see if they comply with Dutch laws on landfills, as this is a requirement of the EAP contract. The impacts on the environment that could result from executing the EAP are then predicted. Ways to prevent, minimise or compensate for these impacts are presented as recommendations. It aims to constructively improve the EAP.

Recommendations

The unacceptable situation at the Parkietenbos landfill in its present state and the urgent need to remedy this is recognised. However the short-term measures in the Emergency Action Plan should be balanced against solving long term problems in a sustainable way and avoiding similar future problems. Royal Haskoning therefore makes the following recommendations. They measures to mitigate or lessen the negative impacts of the project and increase the positive impacts, ensure good environmental management practice during construction and operation of the EAP;

1. As construction has commenced without an EIA and without approved designs, the impacts of the design, construction and operation of the landfill extension to the environment can not be fully known or managed. Given the information known, instead of improving the situation, the EAP could lead to increased environmental impacts (particularly soil, groundwater, marine pollution and a risk of pollution spreading). It is recommended that:
   - All EAP information is provided in an independent EIA to assess the impacts and recommend ways to minimise negative environmental impact.
   - The EIA, including mitigation measures, and final approved design should be incorporated into a full "Project Execution Plan" for construction, operation and closure.
   - These to be approved by the Government (the competent authorities are understood to be the Ministry of Public Works and Directorate VROM) and the Management Team before any further works take place.

2. Based on the available information, the design does not appear to conform to Dutch or comparable (such as European Union) norms for landfills. It is recommended that these possible non-compliance's for the following issues are investigated to ensure the quality of the landfill, good environmental management and compliance of the contract
   - stability of dike wall design against pollution leakage and inundation
   - testing of waste material used for dike walls for contamination
   - integrity of the geological barrier to prevent pollution
   - unknown environmental management measures during construction and operation