Scott Wilson

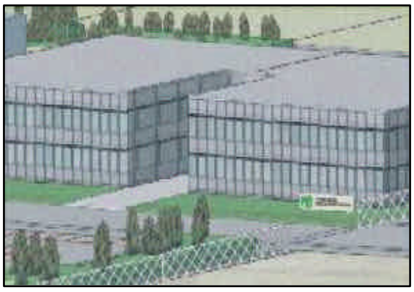
in association with

BMT

Environmental Impact Assessment for Development of an EcoPark in Tuen Mun Area 38

Final EIA Report

Volume 1 – Main Text and Appendices A to C



環境保護署

Environmental Protection Department

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1 INTRODUCTION

1.1 General

1.1.1 The Chief Executive announced in his 2005 Policy Address that the Government will formulate a policy to provide concessions to assist the development of the environmental industry. He has pledged to build an EcoPark in Tuen Mun for exclusive use by recycling industries. The first phase of EcoPark will be commissioned in late-2006.

1.1.2 Prior to this announcement, in October 2003, Scott Wilson Limited, in association with BMT Asia Pacific, and supported by The Dougherty Group, David C Lee Surveyors Limited and Cheung Macpherson Consultants Limited, was appointed by the Waste Facilities Business Unit (WFBU) of the Environmental Protection Department (EPD) to conduct further studies into the development of EcoPark (formerly the Recovery Park) in Tuen Mun Area 38.

1.1.3 The EcoPark is a Designated Project (DP) under G.4(b) of Part 1, Schedule 2 of the EIAO. As a DP under Schedule 2, EcoPark requires an Environmental Permit (EP) to allow a range of recycling processes to be undertaken within the facility.

1.1.4 The further studies under the current agreement include conducting an Environmental Impact Assessment (EIA) Study to obtain the EP and a zoning amendment submission that includes a Road Traffic Impact Assessment (RTIA) and Marine Traffic Impact Assessment (MTIA) to secure approval for the necessary zoning amendment.

1.1.5 This Report presents the approach to and findings of the EIA study for EcoPark, and follows the requirements of the EIA Study Brief (ESB) No. ESB-104/2002.

1.2 Background of the Project

1.2.1 Hong Kong's landfills are filling up faster than expected and society is producing much more waste now than 15 years ago, when the landfills were being planned. Government provides facilities for collecting waste plastic bottles, aluminium cans, paper and mobile 'phone batteries. These materials, together with electronics, glass, food waste, ferrous metals, textiles, rubber tyres and wood can be recycled into new products. These recycling operations not only reduce the amount of waste to be disposed of in landfills but also provide employment and stimulate the economy.

1.2.2 Government has devoted considerable effort to encouraging people to reduce waste. A Waste Reduction Committee was formed in 1999 to introduce new initiatives and in May 2001 the Chief Secretary Committee endorsed a package of measures to further promote the prevention, separation and recycling of municipal solid waste. Recycling programmes have been set up in housing estates, schools, hospitals, hotels, the airport, public transport facilities and public places and venues. Short-term land has been set aside for use by recyclers and businesses have been encouraged to initiate waste reduction activities through the Wastewi$e scheme, which recognises their efforts.

1.2.3 The challenge facing Hong Kong is similar to that in many developed cities. Increasing wealth has brought increasing wastage. Over the past 15 years, municipal waste has increased by about 50% while the population has increased by just 20%, and by the end of 2003 although Hong Kong was recycling 41% of municipal waste, less than 4% was being recycled locally. Thus, further measures need to be taken to improve the level of recycling.

1.2.4 The long-term availability of affordable land provided with basic infrastructure has been identified as one such measure to promote the growth of the waste recycling industry in Hong Kong. To this end, EcoPark in Tuen Mun Area 38 is to be established, and in his 2005 Policy Address the Chief Executive committed to its commissioning in late-2006.

1.2.5 A Preliminary Study on the Development of a Recovery Park in Tuen Mun Area 38 (the *Preliminary Study*) was completed by Scott Wilson in October 2002 and presented an outline master plan for developing EcoPark in two phases, including provision of basic infrastructure and common facilities. The site also includes 460m of marine frontage for transporting recyclable materials and goods into and out of EcoPark by barge.

1.2.6 It should be noted that during the course of this Study the boundary of EcoPark was modified from that in the *Preliminary Study.* This Study now uses the new boundary that was provided by PlanD in late-2004, and a new conceptual layout (see Section 2.5).

1.3 Purpose of the EIA Study

1.3.1 The purpose of this EIA Study is to provide information on the nature and extent of environmental impacts arising from the Project and other concurrent works. This information will contribute to decisions by the Director of EPD on :

- The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed Project.
- The conditions and requirements for the detailed design, construction and operation of the proposed Project to mitigate against adverse environmental consequences wherever practicable.
- The acceptability of residual impacts after implementation of proposed mitigation measures.

1.3.2 Satisfying the aims of the EIA Study has been managed by achieving a number of more specific objectives as listed in the ESB. The objectives of the EIA study are to :

(i) Describe the Project and associated works together with the requirements for carrying out the Project;

(ii) Identify and describe elements of community and environment likely to be affected by the Project and/or likely to cause adverse impacts on the Project, including natural and man-made environment and the associated environmental constraints;

(iii) Describe the considerations given in selecting the proposed site, layout design (including recycling processes to be adopted for the recycling plants), and to provide reasons for selecting the preferred option and to describe the part environmental factors played in the selection process;

(iv) Identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(v) Identify and quantify waste management requirements and propose measures to mitigate or prevent impacts, and measures to be adopted to avoid introducing land contamination at the Project site;

(vi) Identify and quantify water quality impact on nearby sensitive waters arising from the construction and operation of the Project and requirements for a contingency plan to deal with accidental spillage of chemicals into nearby waters;

(vii) Identify any negative impacts and propose the provision of mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;

(viii) Investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;

(ix) Identify, predict and evaluate the residual environmental impacts (i.e. after practicable mitigation) and the cumulative effects expected to arise during the construction and operation phases of the Project in relation to sensitive receivers and potential affected users;

(x) Identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate the identified environmental impacts and cumulative effects and reduce them to acceptable levels;

(xi) Identify constraints associated with the mitigation measures recommended in the EIA Study, as well as the provision of any necessary modifications; and

(xii) Design and specify environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

1.4 Approach to the EIA Study

1.4.1 The environmental impacts arising at EcoPark from the operation of the various recycling businesses will be directly related to :

- The type of materials processed.
- The recycling processes used.
- The throughput of each process.
- The transportation of materials into and out of EcoPark.

1.4.2 This EIA for EcoPark is unique in that the future scope of operation of EcoPark cannot be determined at this stage. While the *Preliminary Study* identified an initial mix of tenants (and corresponding processes), these will not remain static but will change in response to market demands of the recycling industry. Thus, the EIA will need to demonstrate that the environmental impacts of all future recycling processes have been fully considered. Furthermore, it is intended that the EP for EcoPark should be all-encompassing and that individual tenants will not normally need to apply for their own EP.

1.4.3 To achieve this, three key approaches have been incorporated into this EIA, and are described in the following sub-sections :

- The Umbrella Approach to include as wide a range of processes as possible, based on the best available information available at this time.
- The Process Review Approach to allow for inclusion within EcoPark any future processes not covered by this EIA.
- Continuous Public Involvement to ensure that the community and stakeholders are fully aware of the proposals for EcoPark and can make positive contributions to its development.

The Umbrella Approach

1.4.4 To address the requirements of ESB Section 3.3, a comprehensive range of recycling methods and throughputs has been assessed, such that whatever EcoPark configuration is adopted in the future, and whatever types of processes are used, the EIA has already taken these into consideration – this has been termed the "umbrella" approach.

1.4.5 To ensure that this approach is comprehensive, it needs to address the "worst case" scenario of possible recycling activities. Therefore, we have adopted "buffered" throughputs in which the original throughputs determined in the *Preliminary Study* have been increased by a growth factor (see Section 2.5) and have assessed these as the "worst case".

1.4.6 It should also be noted that, based on the Phase II utilisation rates (i.e. throughput per unit area – see Table 1.1, below) the area required to accommodate the "worst case" buffered throughputs can be calculated.

1.4.7 The physical area required to achieve the "buffered" throughputs is shown in Table 1.2, below. From this table, it can be seen that to accommodate all of the "buffered" throughput within EcoPark would require an area of some 206,000m^2 to be allocated to tenants, compared to the 141,300m^2 that is actually available for recycling activities (see Section 2.5), and so the "worst case" is not physically achievable within EcoPark.

1.4.8 The benefit of the "umbrella" approach, however, means that all combinations of recovery processes that can be accommodated within EcoPark (within "buffered" throughputs) have therefore been assessed, even though the exact configuration is not known (and cannot be known) at this time.

Table 1.1 : Utilisation Rates

Material Type	Hong Kong Utilisation Rates (Generally Lower) (tpa/m^2)	International Utilisation Rates (Generally Higher) (tpa/m^2)	Hong Kong Rates as a %age of International Rates	Phase I Utilisation Rates (Tending to Lower Hong Kong Rates) (tpa/m^2)	Phase II Utilisation Rates (Tending to Higher International Rates) (tpa/m^2)
Batteries	-	0.07	-	-	0.1
Electronics / Appliances	-	4.05	-	-	4.1
Glass	0.35	33.91	1%	0.4	33.9
Organic Food Waste	-	1.89	-	-	1.9
Ferrous Metals	12.86	-	-	12.9	12.9
Non-ferrous Metals	2.15	-	-	2.2	2.2
Paper	8.0	17.2	47%	8.0	17.2
Plastics	0.28	3	9%	0.3	3.0
Textiles	9.6	9.29	103%	9.6	9.6
Rubber Tyres	0.38	1.79	22%	0.4	1.8
Wood	4.0	4.11	97%	4.0	4.1
Spent Copper Etchant*					10.0

Source : Table 8.3 from the Final Report of the *Preliminary Study.*

Note : * The *Preliminary Study* did not include Spent Copper Etchant as a material type. The utilisation rate shown is based on a very conservative estimate (i.e. a relatively small area required for a large throughput, hence, a larger throughput resulting in potentially greater impacts to be assessed).

Table 1.2 : Area Required for Buffered Material Throughputs

Material Type	Buffered Material Throughput[1] (tpa)	Utilisation Rate[2] (tpa/m^2)	Area[3] Required for Buffered Material (m^2)
Batteries	2,240	0.1	22,400
Electronics	25,100	4.1	6,122
Glass	42,680	33.9	1,259
Organic Food Waste	82,180	1.9	43,253
Ferrous Metals	270,380	12.9	20,960
Non-ferrous Metals	57,100	2.2	25,955
Paper	507,590	17.2	29,511
Plastics	102,740	3.0	34,247
Textiles	8,010	9.6	834
Rubber Tyres	20,020	1.8	11,122
Wood	41,260	4.1	10,063
Spent Copper Etchant	3,290	10.0	329
Totals	**1,162,590**		**206,055**

Notes :
1. From Table 2.2.
2. From Table 1.1 (for Phase II).
3. From "Shape and Design of the Project" in Section 2.5, the area within Phase I is 83,316m^2 and within Phase II is 111,904m^2, giving a total of 195,220m^2, i.e. just under 20ha – this site area is not finalised and is subject to further discussion with PlanD and LandsD. Subtracting the areas required for infrastructure the areas remaining for allocation to tenants are 47,000m^2 in Phase I and 94,300m^2 in Phase II, giving a total of 141,300m^2, which represents a utilisation rate of 72.4% of the total EcoPark area. This is considerably less (just over two-thirds) than the 206,055m^2 required to accommodate all of the buffered material throughput.

The Process Review Approach

1.4.9 To ensure that this EIA and the EP remain valid for new processes or greater throughputs that have not been included within the "umbrella" assessment, it is recommended that a review of all recycling processes is carried out so as to ensure compliance with the EIA Report and EP. This is an important safeguard to ensure that the conditions of the EP will be met in the future and is discussed in detail in Section 12.2 of this report.

1.4.10 As the Process Review will be implemented through the EM&A programme, this is also discussed in the EM&A Manual.

Continuous Public Involvement

1.4.11 EPD is keen to promote Continuous Public Involvement (CPI), a concept that allows on-going public participation in the EIA process. Through CPI, people can see how information is gathered, how different models of prediction are chosen and what alternatives are considered. Most importantly, they can contribute their knowledge and views at any stage in the process, thereby helping to ensure that the outcome is acceptable.

1.4.12 WFBU is fully aware of the expectations of the local community in Tuen Mun with regard to the development of EcoPark and CPI has been implemented (as per ETWB TC No. 13/2003) to ensure that the views of key stakeholders have been considered from the earliest stage of the EIA process.

1.4.13 Through initial, formal public consultation with key stakeholders, such as the Tuen Mun District Council (TMDC), the benefits of developing EcoPark, including job creation, have been acknowledged by the local community. As the EIA has progressed, TMDC has again been formally consulted on other issues, such as the appearance of EcoPark.

1.4.14 Informal discussions have also been held with the Hong Kong Waste Management Association (HKWMA), Hong Kong's premier professional organisation representing waste management professionals. The HKWMA are very supportive of the development of EcoPark and may provide more formal support during the public consultation stage.

1.4.15 In terms of more formal consultation, EPD provided a progress paper to TMDC in September 2003, and in November 2001, November 2004 and March 2005 ETWB and EPD gave further briefings to TMDC on the development of the Project.

1.4.16 Based on the CPI, the scope of processes and layout of EcoPark have been examined with this in mind and have resulted in a number of changes to the design so as to meet the expectations of the public. These are discussed in Section 11.2.

1.5 Report Structure

1.5.1 Following this introductory section, this EIA Report is organised as follows :

- Section 2 – Description of the Project.
- Section 3 – Air Quality Impact Assessment.
- Section 4 – Noise Issues.
- Section 5 – Water Quality Impact Assessment.
- Section 6 – Waste Management Implications.
- Section 7 – Contaminated Land Impact Assessment.
- Section 8 – Landfill Gas Hazard Assessment.
- Section 9 – Landscape and Visual Issues.
- Section 10 – Hazard to Life Assessment.
- Section 11 – Summary of Environmental Outcomes.
- Section 12 – Environmental Monitoring and Audit.
- Section 13 – Operational Design Assumptions For "Base Case" Assessment.
- Section 14 – Conclusions.

2 DESCRIPTION OF THE PROJECT

2.1 Key Project Requirements

2.1.1 As referred under Clause 1.2 of the EIA Study Brief, the development and operation of the proposed EcoPark will comprise the following :

- Provision of infrastructure including marine loading/unloading areas, roads, drains, sewers, utilities, etc.
- Construction of buildings and facilities for accommodating office and recycling operations.
- Provision of on-site wastewater treatment facility or pumping facility for transmitting wastewater to other government facilities for treatment.
- Allocation of lots to tenants for construction of their facilities.
- Delivery and unloading of recyclable materials, recycling operations and loading and transportation of finished products by road and sea.
- Maintenance of infrastructure, office buildings, recycling facilities, etc.
- Environmental monitoring and audit as well as implementation of mitigation measures.

2.2 Consideration of Alternatives

2.2.1 Section 1.2 has described the background to EcoPark project, i.e., why EcoPark is needed in Hong Kong, in terms of it helping to meet policy objectives and to provide appropriate incentives to the local recycling industry. The alternatives considered under this sub-section, however, relate to the different locations within Hong Kong that have been examined in terms of their availability and suitability for development as EcoPark. This addresses *"the considerations given in selecting the proposed site"* required under item 3.3 of the ESB (see para.1.3.2(iii)).

2.2.2 Please note that *"the considerations given in selecting the … recycling processes to be adopted for the recycling plants"* together with the *"reasons for selecting the preferred option"* required under item 3.3 of the ESB (see para.1.3.2(iii)) are discussed in Section 3 on air quality. The reason for this is that air quality issues, rather than other environmental issues, are considered to be the limiting factor in terms of developing EcoPark. The preferred option, in terms of the range of recycling processes and proposed throughputs, will be determined by the conclusions and recommendations of the air quality impact assessment. As such, environmental factors (predominantly air quality) dominate the option selection process for EcoPark.

2.2.3 The idea for an EcoPark was first raised in the late-1990s as one of the means for helping achieve the targets in the *Waste Reduction Framework Plan*. In subsequent years, EPD carried out extensive site searches for the preferred location for an EcoPark and these focused on utilising the restored closed landfill sites in Hong Kong.

2.2.4 Whilst most of the closed old landfills are being restored for recreational uses, materials recycling is another way of making good use of these restored landfills. As compared to the current short term tenancy sites for accommodating recycling activities, the closed old landfill sites provide suitable land with potentially longer tenure to meet the demand of the recycling industry and hence give the tenants an added incentive to invest in their operations. Also, recycling activities are compatible with the engineering nature and the inherent development constraints of restored landfill sites.

2.2.5 An assessment of the potential use of the restored landfill sites for accommodating materials recycling activities was conducted by EPD. The factors considered in the assessment included location of the site, programme of the restoration work, committed afteruse, progress in determining the afteruse and implementation programme, potential usable area for recycling activities and compatibility with the neighbouring land use.

2.2.6 The results of that assessment indicated that Pillar Point Valley Landfill (PPVL), Ma Yau Tong Central Landfill (MYTCL), Tseung Kwan O Stage II/III Landfill (TKOL-II/III) and Siu Lang Shui Landfill (SLSL) had potential for accommodating materials recycling activities. The appropriateness of these sites for an EcoPark will be considered briefly below.

2.2.7 The construction and operation of materials recycling facilities at PPVL, MYTCL, TKOL-II/III and SLSL sites was not anticipated to have unacceptable environmental impacts to neighbouring developments. The existing road network provides good access to the sites and the traffic generated by the recycling operations at these sites was not expected to put significant extra burden on the existing roads. Through appropriate layout and architectural design, it was anticipated that the materials recycling activities would not cause adverse visual impact to the surroundings.

Pillar Point Valley Landfill

2.2.8 The location of PPVL, in relation to the industrial and residential areas in Tuen Mun (sources of recyclable materials), West New Territories (WENT) Landfill (a major waste disposal site) and the border with the Mainland (an outlet for recovered materials), made this site suitable for recycling operations. The materials recycling activities at the PPVL site would also be compatible with neighbouring industrial and non-residential developments.

2.2.9 PPVL is currently being restored under a Design-Build-Operate (DBO) contract, which includes a 30-year aftercare period. The management of the materials recycling activities and the provision of related infrastructure and installations was included in PPVL DBO Contract albeit subject to excision. In the event, this option was excised from the Contract and restoration works are proceeding without the provision for an EcoPark.

2.2.10 The PPVL site is currently zoned “GB” (Green Belt). Rezoning a platform identified as a potential area for materials recycling activities within PPVL, to “OU” (Other Specified Uses) would be required due to the specific nature of EcoPark activities. The PPVL site at its southern end also encroaches partly onto site zoned "OU" annotated "Crematorium, Columbarium, Funeral Services Centre and Open Space” which, being at a distance from the platform of PPVL, would not be affected by EcoPark development.

2.2.11 As no serious interest had been shown in developing PPVL for recreational use, the Home Affairs Bureau (HAB) had no objection to the use of PPVL. However, the Housing, Planning and Lands Bureau (HPLB) expressed the view that recycling activities deviated from the original planning intention and pointed out that there would be a shortfall of open space in the locality. In this regard, rezoning of the site would require a cautious decision.

Ma Yau Tong Central Landfill

2.2.12 The location of MYTCL, in relation to the industrial and residential areas in Kwun Tong (sources of recyclable materials), South East New Territories (SENT) Landfill (a major waste disposal site) and the Kwun Tong Public Cargo Handling Area (KTPCHA) (a major point for export of recovered materials), made this site very suitable for materials recycling. It was understood that the KTPCHA may be relocated under the "South East Kowloon Development" to Tseung Kwan O Area 131, which is also considered a suitable point for export of the recovered materials.

2.2.13 MYTCL has been restored and is being monitored and maintained by the landfill restoration contractors for up to 30 years. The potential area considered suitable for materials recycling activities was an area of 0.4ha on the lower platform and which is zoned "O" (Open Space). Rezoning of this area from "O" to "OU" would be required.

2.2.14 HAB did not support the proposed EcoPark at the MYTCL site because there is a shortage of open space provision in the Kwun Tong District and the proposal could have affected the “Lam Tin Park Phase II” project, which was then under planning. They were also concerned about the compatibility of recycling activities with the Lam Tin Park. HPLB expressed similar concerns as for PPVL stating that rezoning of the site would require a cautious decision.

Tseung Kwan O Stage II/III Landfill

2.2.15 The TKOL II/III site is very suitable for materials recycling activities. It is close to the sources of recyclable materials, i.e. the industrial and residential areas in Kwun Tong and the residential area in Tseung Kwan O. The site is also close to SENT Landfill and the KTPCHA. The proposed reprovisioning site at Tseung Kwan O Area 131 for the KTPCHA could continue to be a point for export of the recovered materials.

2.2.16 TKOL II/III has been restored and is being monitored and maintained by the landfill restoration contractor for up to 30 years. The potential area considered suitable for materials recycling activities was an area of 0.7ha on the lower platform and is zoned "O". Rezoning of this area from "O" to "OU" would be required.

2.2.17 As no serious interest had been shown in developing TKOL II/III for recreational use, HAB had no objection to the use of TKOL II/III. HPLB expressed similar concerns as for PPVL, stating that rezoning of the site would require a cautious decision.

Siu Lang Shui Landfill

2.2.18 The location of SLSL, in relation to the industrial and residential areas in Tuen Mun (sources of recyclable materials), WENT Landfill and the border with the Mainland (an outlet for recovered materials), made this site suitable for recycling operations. The materials recycling activities at the SLSL site would also be compatible with the neighbouring industrial and non-residential developments.

2.2.19 SLSL has been restored and is being monitored and maintained by the landfill restoration contractor for up to 30 years. The potential area considered suitable for materials recycling activities was an area of 0.6ha on three platforms and are zoned "GB". Rezoning of these area from "GB" to "OU" would be required.

2.2.20 HPLB expressed similar concerns as for PPVL, stated that rezoning of the site would require a cautious decision.

Tuen Mun Area 38

2.2.21 Tuen Mun Area 38 is currently zoned as "Other Specified Uses" annotated "Special Industries Area" on the outline zoning plan and was previously earmarked for the development of the 4th Industrial Estate (4IE) following ExCo's in principle approval to the establishment of the 4IE in 1996. However, it is now considered more attractive to develop 4IE at Tseung Kwan O Area 137 as an extension to the existing 3rd Industrial Estate already located there.

2.2.22 With the relocation of the 4IE to Tseung Kwan O, a large piece of land thus became available at Tuen Mun Area 38. Compared to the use of the old restored landfill sites, the 21ha of land at Tuen Mun Area 38 provided a much larger area for the development of EcoPark. It also avoided the difficult road-only access, especially at PPVL and SLSL, both of which had steep, narrow access roads that would make bulk transport of materials difficult. Furthermore, Area 38 had direct marine access, unlike the landfill sites, and this would facilitate the bulk marine transport of materials, especially to the more accessible Pearl River Delta Region. Finally, Tuen Mun Area 38 was already zoned as "OU" annotated "Special Industries Area" and it would therefore only require an amendment to the Column 1 description – this would be in keeping with the planning intent of the already industrialised area, thus alleviating some of the concerns expressed by HPLB on locating EcoPark at the restored landfill sites.

2.2.23 Based on the above considerations, it was very clear that the site in Tuen Mun Area 38 possessed all of the advantages of the restored landfill sites but had few of the limitations. Thus, Tuen Mun Area 38 was considered to be the preferred location for EcoPark and was identified as such by Government prior to commencement of the Preliminary Study.

2.2.24 In summary, the advantages of developing Tuen Mun Area 38 for EcoPark are :

- Remote from existing residential developments and environmental impacts to local residents will be further reduced by the distance to EcoPark from built-up areas.
- Planning constraints are minimal as the site is already zoned as "OU" annotated "Special Industries Area" and would therefore only require an amendment to the Column 1 description.
- Close to areas that are already used informally by the recycling trade therefore tenants will not need to move a great distance to enjoy the benefits offered by EcoPark and will still be able to maintain their existing recycling network in the locality.
- Synergy with existing and planned developments in Area 38, such as Shiu Wing Steel, Castle Peak Power Station, CEDD's C&D Materials facilities, etc. – EcoPark will be able to integrate with adjacent waste management and/or industrial facilities, which will reduce the need to transport materials over long distances. Further integration of recycling activities for the recycling of "waste products" from the adjacent users may also be possible.
- Proximity to Siu Lang Shui Landfill (which has already been restored) and Pillar Point Valley Landfill (which is currently being restored) both generate usable quantities of landfill gas, which could provide an alternative eco-friendly source of power for tenants within EcoPark. The feasibility of this option may be examined in the future.
- Proximity to Tuen Mun Sewage Pumping Station and Pillar Point Sewage Treatment Works, both of which have sufficient capacity to deal with the effluents (domestic sewage + treated effluent from the on-site industrial wastewater treatment facility) from EcoPark.
- Location on the main haulage route to the West New Territories (WENT) landfill will allow waste vehicles to drop off recyclable materials and pick-up un-recyclable waste from EcoPark en route to WENT landfill and so will not result in additional vehicle trips through Tuen Mun or Yuen Long.
- The provision of adequate (460m) marine frontage will allow recyclable materials to be brought on-site in bulk allowing the re-manufactured products to be taken off-site in bulk without increasing traffic flows on the local road network. The location of EcoPark in proximity to the River Trade Terminal and the Pearl River allows materials to be transported to and from the Pearl River Delta region by barge, thereby enhancing the value of the site to tenants and so benefiting the recycling industry as a whole.

2.3 Site Location and Site History

Site Location

2.3.1 The proposed EcoPark is situated on the outskirts of Tuen Mun, adjacent to a number of industrial premises and existing industrial uses (see Figure 2.1). The site is remote from existing residential developments, with the nearest being village houses at Lung Kwu Tan (>2km to the west) and Melody Gardens (>2km to the east).

2.3.2 The site is bounded to the north by Lung Mun Road, north of which is the restored Siu Lang Shui Landfill. To the southeast is the Tuen Mun Fill Bank and River Trade Terminal and to the northwest is Shiu Wing Steel Mill. To the south are coastal waters. The site is currently zoned "Other Specified Uses" ("OU") and annotated "Special Industries Area" ("SIA") on the latest approved Tuen Mun OZP No. S/TM/20, gazetted on 21 January 2005.

2.3.3 In addition to the uses described above, other existing uses of Tuen Mun Area 38 include a C&D Material Fill Bank (including tipping halls for East Sha Chau and Penny's Bay Stage 2) and a Pilot C&D Material Recycling Facility, all of which are managed by the Civil Engineering and Development Department (CEDD). The Tuen Mun Sewage Pumping Station (TMSPS) is located to the north of the Fill Bank.

2.3.4 Planned uses of Tuen Mun Area 38 include the PAFF, to be constructed adjacent to the northwest boundary of EcoPark, the Fill Bank Expansion, a Crushing Facility, a Temporary Mixed Construction Waste Sorting Facility and a C&D Materials Handling Facility. A "holiday camp" to the north of the site, on the other side of Lung Mun Road is also planned. All existing and planned uses are shown on Figure 2.1.

2.3.5 This EIA is required to consider relevant existing, committed and planned projects, such as those described above. Proposed future uses (post-2009) for Area 38 will likely include additional facilities related to waste management, but no approved projects, programmes or site particulars are available for these uses at this time.

Site History

2.3.6 The site for EcoPark is land recently reclaimed under the Tuen Mun Area 38 Reclamation project. Other than a tipping hall for East Sha Chau associated with CEDD's Area 38 Fill Bank, the land for Phase I has not been used since reclamation. The land for Phase II is currently occupied by the Fill Bank (and its planned extension) and by the Pilot C&D Material Recycling Facility (soon to be replaced by a proposed Crushing Facility).

2.4 Nature, Scope and Benefits of the Project

Nature

2.4.1 In simple terms an EcoPark is an area of land set aside for use by the recycling industry in general, within which individual recycling operators can acquire an area of land suitable for their particular recycling operation at an affordable price and with a length of tenure sufficient to fully justify their investment in the buildings, plant and machinery necessary for their operations to be carried out in an efficient, effective and sustainable manner.

2.4.2 A follow-on D&C consultancy will prepare the detailed design of EcoPark and its infrastructure and this will be constructed as a Public Works project by a Works Contractor. Under a Management Contract the Operator will then take possession of EcoPark and manage the facility on behalf of EPD. Thus, each individual tenant will need capital investment only for the provision of his own particular requirements. Although each tenant will need to pay for use of common facilities, this approach will ensure that costs are kept to a minimum and should make EcoPark more financially attractive to tenants than the alternative of having to meet the full costs of providing facilities themselves.

2.4.3 In order to gain public acceptance of EcoPark, the facility will be developed along the lines of a business park or retail park, hence the designation of Eco*Park*. The EcoPark will make extensive use of landscaping to provide an "oasis of green" in an otherwise industrial setting and thereby provide a more aesthetically pleasing environment in which tenants can work. Furthermore, by requiring tenants to adopt appropriate measures to control and mitigate the environmental effects of their activities, environmental impacts can be minimised such that statutory environmental protection objectives can be met.

Scope

2.4.4 The land on which EcoPark is proposed to be developed is already formed and already has a seawall in place, therefore further reclamation works are not necessary. Although a conceptual layout for EcoPark has been developed (see Section 2.5), the detailed design of EcoPark will be developed by under the follow-on D&C consultancy.

2.4.5 Construction of EcoPark (by the Works Contractor) will involve the following activities :

- Construction of basic infrastructure, including roads, drainage, sewers, utilities, etc.
- Provision of empty, serviced lots (initially grassed, open ground) to be developed by qualifying tenants for their own use.

- Construction of an Administration Building containing management offices, a visitor centre, etc., and facilities for management of the marine frontage.
- On-site Wastewater Treatment Facility (WTF) and waste collection/storage facilities.
- Berthing facilities (e.g. bollards) for loading/unloading at the marine frontage.
- Environmental Monitoring and Audit (EM&A) and implementation of necessary mitigation measures to meet any EP conditions.

2.4.6 Operation of EcoPark (by the Operator) will comprise the following activities :

- Development of promotional and advertising materials.
- Preparation of contractual/leasing arrangements with individual tenants and allocation of lots to tenants for construction of their facilities.
- Preparation and implementation of management procedures/emergency procedures.
- Management of the marine frontage allocated to EcoPark.
- Maintenance of common infrastructure, plant, management office, etc.
- EM&A and implementation of necessary mitigation measures to meet any EP conditions.

Benefits

2.4.7 Organised recycling is a relatively new industry in Hong Kong and is one which is growing rapidly and demonstrating that it is capable of producing benefits to the community at large, not just in economic terms but also in environmental terms. Some recycling activities, such as the collection and recycling of waste paper and scrap metal, have been carried out in Hong Kong for many years. But in recent years the range of waste and used materials that are collected for recycling and which are capable of being processed for reuse on an economically viable basis has grown considerably.

2.4.8 Given the comparative costs of the Hong Kong and Guangdong Province economies, and the low profit margins that generally prevail within the sector, most of the value-added processing to-date has taken place on the Mainland rather than locally in Hong Kong. Of the 41% of Hong Kong's waste that was recycled in 2003, less than 4% was recycled locally, compared to more than 37% that was exported for recycling. The purpose of EcoPark, therefore, is to provide the necessary environment to encourage the growth of Hong Kong's recycling and environmental industry and to promote value-added recycling in Hong Kong, and within EcoPark in particular.

2.4.9 The continuing development of new technologies to make recycling viable (when in the past it was not) will ensure that the recycling industry in Hong Kong has a viable future and that it will make an increasingly important contribution to the economic life and environmental well-being of the community.

2.4.10 At present, recycling generally takes place in premises built primarily for other purposes, on parcels of government land that have been let under short term tenancy, or on parcels of undeveloped land in the New Territories where there is a little or no means of imposing effective measures to control the environmental impact of recycling activities.

2.4.11 Where recycling takes place in existing developments in the urban area, it can be generally considered as an unacceptable use because the premises in which these operations are housed were not originally built for such purposes and their use for recycling activities is generally not welcomed by adjoining owners and occupiers who regard such uses as "bad neighbours".

2.4.12 In the New Territories, in particular, the uncontrolled spread of recycling activities has led to many areas being degraded, both visually and environmentally, because the processes that are undertaken are not properly controlled and premises often do not have the basic infrastructure needed to ensure that the work is carried out in a clean and efficient manner. This is an undesirable situation and one that generally detracts from the environmental aspirations of Hong Kong.

2.4.13 It is also important to note that with the more advanced techniques and processes that are now available, a greater investment is required in terms of plant and machinery and for handling waste products in greater bulk. These developments in the recycling industry generally mean that the type of premises that have been used for recycling in the past would no longer be appropriate or acceptable.

2.4.14 Developing EcoPark with basic infrastructure, proper vehicular access, mains supplies of potable and non-potable water, connections to foul sewers and sewage treatment facilities which are capable of dealing with toilet waste together with process effluents, will ensure that any adverse environmental impact of recycling is greatly reduced. The provision of these facilities, together with long land tenure being available reasonable prices, will allow recycling operators to make the investment in plant and machinery necessary to use the most up-to-date and efficient and effective methods that not only would make recycling profitable, but would also significantly reduce their adverse impact effect on the environment of Hong Kong.

2.4.15 Where existing recycling operations move to EcoPark from previously unsuitable locations, there would be immediate benefits to the owners and occupiers of premises near those premises which have been vacated.

2.4.16 The growth of the recycling industry has also contributed, and will continue contribute to, a reduction in the amount of waste materials and discarded products that would otherwise have to be disposed of in landfills. Instead of being disposed of in this way, materials can be recycled. Not only will there be economic benefits through the sale of recycled materials and/or remanufactured products, but there will also be social benefits from increased employment and environmental benefits from waste reduction and a reduction in the amount of waste required for disposal.

2.5 Size, Scale, Shape and Design of the Project

Size and Scale of the Project

Range of Materials to be Recycled

2.5.1 Based on a review of the current recycling industry in Hong Kong and the recycling industry overseas, and taking into consideration Government's ongoing initiatives in the waste recycling industry, the *Preliminary Study* identified a number of material types within the existing waste stream that could be recycled within EcoPark :

- Batteries.
- Electronics.
- Glass.
- Organic Food Waste.
- Ferrous Metals.
- Non-ferrous Metals.
- Paper.
- Plastics.
- Textiles.
- Rubber Tyres.
- Wood.

2.5.2 Spent Copper Etchant was not identified in the *Preliminary Study* but has been included in this Study. For each of these material types, a range of processes were identified, shown in Figures A.1 to A.18 in Appendix A. Based on the anticipated throughputs of these materials and processes, Table B.1 (in Appendix B) identifies those processes and throughputs initially proposed to be included within EcoPark.

Range of Processes to be Used

2.5.3 From the process flow schematics shown in Figures A.1 to A.18 (in Appendix A) it can be seen that there are various technologies available to carry out the same or similar processes. For the purpose of this assessment, the emission, wastewater generation and waste generation rates (where available) of these technologies have been compared and evaluated to determine the "worst case" technology, which has then been taken to form the basis of the technical assessments.

Growth Factors and Buffered Throughput

2.5.4 Nominal material throughputs being diverted into EcoPark were calculated in the *Preliminary Study* on the basis of forecasted waste arisings for 2006, the expected date of commencement of operations at EcoPark – these are the figures shown in Table B.1 (in Appendix B). However, there remains the potential for waste arisings to increase over the operational life of EcoPark due to any one or a combination of the following factors :

- Changes in economical and social trends, both locally and internationally.
- Changes in Government policy in relation to waste management in Hong Kong (e.g. introduction of landfill charging for municipal solid wastes, mandating recycling of materials, implementation of producer responsibility scheme, etc.).
- Expiry of Government contracts for existing waste treatment facilities (e.g. Chemical Waste Treatment Centre (CWTC), etc.) and potential for resuming annual increases in user charges may force producers to consider other alternatives to disposal.
- Shortened lifespan of strategic landfills.

2.5.5 The forecasted waste data presented in the *Study on the Waste Management Plan - Collection and Forecast of Waste Data* ("CFWD Study") for the years 2006 and 2021 (base data), except for spent copper etchant, have been used to determine an appropriate growth factor. Table 2.1, below, presents the increase in volumes for each of the twelve main material types and their corresponding Growth Factor :

Table 2.1 : Calculation of Growth Factors

Material Type	Forecast Waste Arisings (tpa)[1]		Growth Factor (between 2006 & 2021)
	2006	2021	
Batteries	6,261	15,586	2.489
Electronics	66,767	167,609	2.510
Glass	140,614	283,120	2.013
Organic Food Waste	1,273,484	1,980,625	1.555
Ferrous Metals	823,494	1,433,896	1.741
Non-ferrous Metals	131,310	228,641	1.741
Paper	1,945,929	3,220,125	1.655
Plastics	936,269	1,440,418	1.538
Textiles	166,456	289,839	1.741
Rubber Tyres	21,989	38,287	1.741
Wood	208,386	326,882	1.569
Spent Copper Etchant[2]	12,849	17,585	1.369

Notes : 1. All waste arising values for 2006 and 2021 have been obtained from the *Study on the Waste Management Plan - Collection and Forecast of Waste Data* - Final Waste Data Report and Resource Document Volume II (BMT, 2000).

2. Volumes for spent copper etchant (from 1999 (12,849tpa) and 2007 (17,585tpa)) are based on the assumption that under the renewed CWTC contract Government will gradually divert all spent copper etchant away from the CWTC to recycling operations, including to EcoPark. Moreover, it is assumed that the industry will continue to operate under the same trend as shown between 1999 to 2007 (for the lack of any information from Government or the Industry to suggest otherwise).

2.5.6 Given the lack of information from Government and Industry (to suggest otherwise), the *CFWD Study* projected a no-growth scenario (beyond 2007) for spent copper etchant. However, with the upcoming expiry of the CWTC contract in 2007 and the potential for resuming annual increases in user charges, these factors may cause producers to consider other alternatives to disposal. Moreover, with the existing CWTC contract set to expire in 2007, it is assumed that under the renewed CWTC contract, Government will gradually divert Hong Kong's spent copper etchant from the CWTC to recycling operations elsewhere in Hong Kong, including at EcoPark. As such, to allow for a "worst case" growth in spent etchant, it has been assumed that given this combination of influencing factors, the industry will continue to operate under the same trend as shown between 1999 to 2007.

2.5.7 Table 2.2, below, shows the Growth Factor applied to the estimated material throughput (from Table B.1 in Appendix B) and the resulting "buffered" material throughput that will be used in the individual assessments :

Table 2.2 : Calculation of Buffered Material Throughputs

Material Type	Estimated Material Throughput (tpa)[1]	Growth Factor	"Buffered" Material Throughput (tpa)[2]
Batteries	900	2.489	2,240
Electronics	10,000	2.510	25,100
Glass	21,200	2.013	42,680
Organic Food Waste[3]	52,850	1.555	82,180
Ferrous Metals	155,300	1.741	270,380
Non-ferrous Metals	32,800	1.741	57,100
Paper	306,700	1.655	507,590
Plastics	66,800	1.538	102,740
Textiles	4,600	1.741	8,010
Rubber Tyres	11,500	1.741	20,020
Wood	26,300	1.569	41,260
Spent Copper Etchant[4]	2,400	1.369	3,290
Totals	**691,350**	**1.595**	**1,162,590**

Notes : 1. From Table B.1 in Appendix B.

2. Increases have been rounded to the nearest tens.

3. In the *Preliminary Study*, the estimated throughput of organics was 12,700tpa, which consisted of domestic, commercial and industrial organic food waste and organic waste from the agriculture industry. However, given that pork is a regular staple in Hong Kong people's diet, a lard refinery was included as a sub-category of organic waste processing in this Study.

4. With the CWTC contract set to expire in 2007 and the possibility of resuming annual increases in user charges, there is great uncertainty over the future operation of this facility. Spent copper etchant recycling operation is therefore included in EcoPark to provide an additional outlet for this waste material in the event of changes in the existing operational and cost structure of the CWTC.

Integration of EcoPark Activities

2.5.8 Based on the *Preliminary Study*, it was identified that the current arrangement by Government to lease out land plots to recyclers, is insufficient to provide a suitable environment to attract long-term investment by the recycling industry. This has had a significant impact on the long-term volume of materials that can be handled and processed locally, as well as the future growth of the business.

2.5.9 The purpose of EcoPark, as stated in the *Preliminary Study*, is to provide the necessary environment to encourage the growth of Hong Kong's recycling industry and to promote value-added recycling in Hong Kong. As the tenants situated in EcoPark will be handling various material types, it is intended that they are encouraged to reuse and recycle wastes that are generated by their own recycling processes such that within a business the redisual recyclable materials from one process can be used as the feedstock of another process, thereby reducing the overall quantity of waste requiring disposal.

2.5.10 It is also intended that this concept should be further expanded so that businesses form symbiotic links with each other, such that the "waste" product from one business can be used as the feedstock of another business – this is termed "vertical integration". Figure 2.2 shows the potential vertical integration between material-types within EcoPark.

2.5.11 It should be noted, for the purposes of this EIA, that a more conservative approach has been adopted when interpreting Tables B.1 (in Appendix B) and Figure 2.2 in the process of developing a worst-case scenario against which to assess the environmental impacts of EcoPark. In the case of lead, for example, while it is possible to fully integrate the lead recovered from battery recycling with those recovered in the non-ferrous metal recycling process, it is possible that the lead-acid battery recycler wishes to retain the lead recovery process within his own operations instead of selling it on to the non-ferrous metal (lead) recycler. This also applies to zinc recovery.

2.5.12 Furthermore, this EIA assessment does not assume that all potential vertical integration will actually occur. For example, it has been assumed that plastic from the casings of lead-acid batteries would form part of the feedstock of the various plastics processes, but it has not been assumed that textiles recovered from de-beading tyres would form part of the feedstock for textile processing (because the quality of the textiles recovered from tyres is unlikely to be suitable for the type of textile processing assumed in EcoPark at present).

Shape and Design of the Project

2.5.13 The currently proposed boundary of EcoPark is shown in Figure 2.1. Phase I occupies 83,316m^2 and Phase II occupies 111,904m^2, giving a total area of some 195,220m^2 – this site area is not finalised and is subject to further discussion with PlanD and LandsD. The dotted line in Figure 2.1 separates Phase I from Phase II and runs to the east of the drainage reserve (i.e. the drainage reserve is entirely in Phase I).

2.5.14 As discussed in Section 2.4, there are a number of constraints (from other existing and planned users in Tuen Mun Area 38) to developing EcoPark and it is intended that EcoPark will developed in stages – first Phase I and then, some time later, Phase II. As such, Phase I must be able to operate as a self-contained facility that includes all necessary components (described below) to allow EcoPark to function, but also allow seamless expansion into Phase II.

2.5.15 The rationale behind the conceptual design of EcoPark can be summarised in one word – “flexibility”. It is considered that flexibility in providing for a wide range of tenants, ranging from “sole-proprietor” operations to large companies, employing larger numbers of workers, and a wide range of processes will be paramount to the success of EcoPark.

2.5.16 In practical terms, this need for flexibility has manifested itself in the division of lots within EcoPark, which have been designed to balance the costs of providing water, sewerage and utility connections for each lot with the size of each lot and, hence, their number. Lots have therefore been allocated in a range of sizes, predominantly 800m^2 and 1,600m^2, but with some smaller lots at 400m^2 and larger lots up to 8,200m^2.

2.5.17 The benefit of this approach, combined with appropriate allocation of lots, is that tenants can rent lots in a modular fashion, and expand their presence in EcoPark by acquiring more lots (subject to availability) as their businesses expand. This approach provides maximum support to the tenants and flexibility to the Operator during the initial occupation of Phase I and Phase II.

2.5.18 Figures 2.3 and 2.4 propose a conceptual layout for EcoPark that allows for the components identified in Table 2.3, below, and described more fully in the following sub-sections. Again, it should be noted that the final boundary is subject to further discussion.

2.5.19 It should be noted that consultants to be engaged under the follow-on D&C consultancy will be responsible for developing the detailed design of EcoPark and that this suggested conceptual layout is not to be considered a constraint or binding in any way on the subsequent detailed design.

Table 2.3 : Area Allocation for EcoPark Components Within Conceptual Design

Component	Area Occupied Within Phase I + II (m^2)	%age of Total Phase I + II Area
Marine Frontage Management Office (MFMO)	240m^2	0.1%
Solid Waste Collection Point	460m^2	0.2%
Car and Coach Park	930m^2	0.5%
Wastewater Treatment Facility (WTF)	1,200m^2	0.6%
Administration Building	1,800m^2	0.9%
Landscaping (Perimeter and Internal)	11,800m^2	6.1%
Marine Frontage	12,420m^2	6.4%
Internal Road System	25,070m^2	12.8%
Empty Serviced Lots in Phase I	47,000m^2	24.1%.
Empty Serviced Lots in Phase II	94,300m^2	48.3%
Totals	**195,220m^2**	**100.0%**

Notes : Empty serviced lots in Phase I + II occupy 141,300m^2 out of 195,220m^2, giving a utilisation rate of 72.4%. This site area is not finalised and is subject to further discussion with PlanD and LandsD.

Administration Building

2.5.20 The Administration Building will be a two- or three-storey building occupying an area of some 1,800m^2. The design of the Administration Building, with a first-floor terrace area on its southern side, complies with building height restrictions recommended in Section 10, that relate to risk to life from a fire at the adjacent PAFF.

2.5.21 The landscaped area surrounding the Administration Building will include lawns and flowerbeds to provide an attractive setting as this will be the "public face" of EcoPark and will be visible from Lung Mun Road and. This will be the most prominent feature of EcoPark and therefore needs to make a positive statement, both architecturally and visually.

2.5.22 The Administration Building will contain the Management Office (for both the Operator and EPD Staff) and a Visitor Centre (including a resource/education/product display centre), toilet, canteen, etc.

Marine Frontage and Management Office

2.5.23 An integral and important part of EcoPark will be the 460m of marine frontage. The marine frontage will permit incoming materials and outgoing products (baled materials/ remanufactured goods) to be transported by sea. The marine frontage comprises a 30m deep paved area that runs east to west along the southern boundary of EcoPark. This size allows 12m containers to be stacked lengthways along the edge of the seawall. A 10m wide access road, connecting to the primary north-south road, runs east-west along the north of the marine frontage. This road permits two-way traffic and is provided with two turning circles (one at each end) to allow vehicles to change direction.

2.5.24 Located on the western side of the entrance to the marine frontage, amidst landscaped gardens, is the single-storey Marine Frontage Management Office (MFMO). Running alongside is a lay-by for waiting vehicles to park without obstructing the flow of the main road. The MFMO will be responsible for all issues relating to the use of the marine frontage by EcoPark-related users, who would be expected make arrangements with the MFMO for the trans-shipment of their incoming materials and/or outgoing products.

2.5.25 It is proposed that the marine frontage be managed through the MFMO by the Operator for use by EcoPark-related users. It is not proposed that MFMO purchase or maintain plant/equipment for use at the marine frontage, e.g., fork-lifts, cranes, etc. It is expected that users would make their own arrangements with the Operator should they require these facilities.

Internal Roads, Footpaths, Parking and Security Fencing

2.5.26 In order to provide access to each of the lots within EcoPark, an internal road network has been designed and comprises a primary dual carriageway road with central reserve, secondary roads and a number of roundabouts, all lighted as required. Each lot has one run-in (driveway) connecting it to the adjacent road network. All roads will be surfaced and provided with road markings, signage and other traffic control measures.

2.5.27 The primary road runs in a north-south direction from EcoPark entrance to the marine frontage, above the 26m-wide drainage reserve. The primary road is dual carriageway (each direction is 7.3m wide) with a central reservation comprising a median planting strip (6m wide). At either side of the primary road is a pedestrian footpath (1.3m wide), punctuated by run-ins to individual lots.

2.5.28 The secondary roads run north-south and east-west and connect to the primary road at a number of locations. The secondary roads are single carriage way (total road width is 7.4m) with road markings delineating direction. At either side of the secondary road is a pedestrian footpath (1.3m wide), punctuated by run-ins to individual lots. Within the main body of EcoPark there are three roundabouts and two turning circles (11m in diameter).

2.5.29 The primary and secondary roads intersect at a number of junctions. These junctions are either T-junctions or cross-roads. Given the low traffic flows forecast in the RTIA (see Zoning Amendment Report), none of these junctions are expected to be signalised. Instead, rights of way will be clearly indicated through signage and road markings, provided in accordance with standard Transport Department requirements.

2.5.30 A car/coach park is located adjacent to the Administration Building and provides delineated car parking spaces and for Administration Building staff and visitors. The parking area also provides delineated parking spaces for coaches and light goods vehicles. Individual tenants would be expected to park their vehicles within their own lots.

2.5.31 Fencing will be provided around the entire perimeter of EcoPark, except for the marine frontage. This fencing will be of robust construction and will form part of site security measures. The proposed boundary planting on the northern perimeter of EcoPark will be located inside the perimeter fencing.

Landscaping

2.5.32 One of the most important aspects of EcoPark is provision of landscaped area and open space. In order to provide a high lot utilisation rate, there are no large open areas of land designated within EcoPark, although individual tenants would be encouraged to provide “green” areas within their lots. Wide planting strips have been included throughout EcoPark to provide, from a user’s or visitor’s perspective, a lush, green environment. These planting strips also act as buffers between individual lots and footpaths and between lots and common infrastructure (such as the Administration Building, MFMO, WTF and refuse collection point).

2.5.33 There are four basic types of landscaping within EcoPark – Roadside Landscape Treatment (comprises a 1m wide strip between the footpath and the boundary of the adjacent lot), Boundary Planting (comprises a 2 to 5m wide strip around the perimeter of EcoPark), Median Planting Strip (comprises a 6m wide strip separating the direction of traffic flow along the primary road) and lawns and flowerbeds (comprises more formal landscaping located in the centres of the roundabouts, turning circles, around the Administration Building, etc.).

2.5.34 In the first three types, the width of planting areas (1m, 2 to 5m and 6m respectively) is sufficient to provide for the development of a ”natural woodland”, albeit linear. These landscaped areas will be vegetated with native tree and shrub species and provide a refuge for wildlife, thus improving the low ecological value of the site. Figure 2.3 provides a visualisation of these landscape types, and overall conceptual landscaping for EcoPark.

Empty Lots

2.5.35 In order to provide the optimum level of flexibility to tenants, lots within EcoPark are provided as bare lots to be developed by the tenant, at his own cost. The lease conditions will specify what type of development is not permitted but other than that, it is expected that tenants will develop their own lots in accordance with their particular needs. It is envisaged that the majority of tenants will erect some type of structure to enclose offices and workshops and will likely allocate space for vehicle parking and the storage of materials, possibly open-air or undercover, depending on the nature of the material.

2.5.36 As shown on Figure 2.4, the proposed sizes of individual lots will range from $400m^2$ to $8,200m^2$, with the majority sized at $800m^2$ and $1,600m^2$. Larger lots ($4,700m^2$ to $8,200m^2$) have been provided for known users with large land area requirements. Smaller lots can be combined to create larger lots, subject to availability.

2.5.37 Each lot will be provided as grassed open ground and a simple chain-link fence will initially separate unused lots – the tenant would be allowed to erect more sturdy fencing around the perimeter of his lot(s) if desired. Access to each lot will be provided by a run-in from the adjacent road and each lot will also be provided with a telecommunications connection point, electricity supply, potable/non-potable water supply and connections to foul sewer. A perimeter drainage system (with stop-logs to isolate contaminated liquids) will be provided and connected to the stormwater drainage system.

Wastewater Treatment Facility

2.5.38 The *Preliminary Study* recommended that a Wastewater Treatment Facility (WTF) be provided, since some processes will generate greater quantities of effluent, or effluent that is more difficult to treat. It was recommended that the WTF should have a minimum standard of influent quality that must be met. Each tenant would therefore be allowed to discharge, at a specified rate, effluent with specified maximum pollutant parameters.

2.5.39 The WTF should be of modular design, as this would prevent over-sizing during Phase I and under-sizing during Phase II – expansion should be able to match expansion of EcoPark without the need to modify sewerage infrastructure. Furthermore, the WTF should occupy a small footprint, require low maintenance, be cost effective yet be able to consistently achieve WPCO Discharge Licence conditions with a given influent standard. Further discussions on the suggested WTF are presented in Section 5.

2.5.40 The WTF building could be single-storey (subject to design requirements) and will be surrounded and isolated by a 3m wide planting area, similar to the roadside landscape treatment, to form a visual buffer between the plant and adjoining lots.

Solid Waste Collection Point

2.5.41 A solid waste collection point will be provided. This is envisaged to be a simple structure, enclosed on three sides, with a roof to prevent rainwater ingress. Various bins would be provided inside the collection point for storing waste materials prior to collection. Water drained from within this structure will be diverted to the WTF as it may be contaminated. Similar to the WTF, the solid waste collection point will be surrounded and isolated by a 3m wide planting area, similar to the roadside landscape treatment, to form a visual buffer between the collection point and adjoining lots.

2.5.42 Given that the primary function of EcoPark is to recycle materials, the quantities of waste requiring disposal are expected to be minimal, hence the simple design of the waste collection point.

2.6 Project Implementation, Timetable and Phasing

2.6.1 It has been decided that EcoPark is to be constructed as a Public Works project. The completed infrastructure would then be awarded through open tender to a Management Contractor who would be responsible for the daily operation and marketing activities. The Design and Construction (D&C) consultancy to develop the detailed design, implement the Works Contract and develop the Management Contract is due to be awarded in early-2005.

2.6.2 The construction period for Phase I will commence in early-2006 and is expected to last around 10 months, with EcoPark opening for business in late-2006, towards the end of the construction period. At the southeast portion of the Phase I site, CEDD currently operate a tipping hall for transferring public fill to East Sha Chau. It is understood that the tipping hall will be removed in late-2005, prior to commencement of Phase I construction works.

2.6.3 The construction period for Phase II is expected to last up to 12 months. The land for Phase II is currently occupied by the Fill Bank (and its planned extension) and by the Pilot C&D Material Recycling Facility (which will soon be replaced by a proposed Crushing Facility). Within the area to be occupied by Phase II, these facilities will operate until end-2008, after which Phase II of EcoPark can be developed, subject to user demand. The Fill Bank will, however, continue within the remaining area until March 2009.

2.6.4 Notwithstanding, for the purposes of assessment under this Study, a 10-month (Phase I) plus 12-month (Phase II) = up to 22-month (non-contiguous) construction period has been assumed to encompass both Phase I and Phase II construction works. Figure 2.5 shows a proposed programme for development of EcoPark and other nearby projects for which a timeframe has been established.

Figure 2.1 : Location of the Proposed EcoPark and Other Users in Tuen Mun Area 38

Key

- EcoPark
- Siu Lang Shui (SLSL) Closed Restored Landfill (Existing)
- Holiday Camp (Planned)
- PAFF (Planned)
- TMSPS (Existing)
- Pilot C&D Material Recycling Facility (Existing)
- Crushing Facility (Planned)
- Fill Bank (Existing)
- 3.2ha Fill Bank Expansion (Planned)
- Tipping Hall for East Sha Chau (Existing)
- C&D Materials Handling Facilities (indicative boundary) (Planned)
- Penny's Bay Stage 2 Sorting Facility & Barging (Existing)
- Temporary Mixed Construction Waste Sorting Facility (Planned)

Location Map

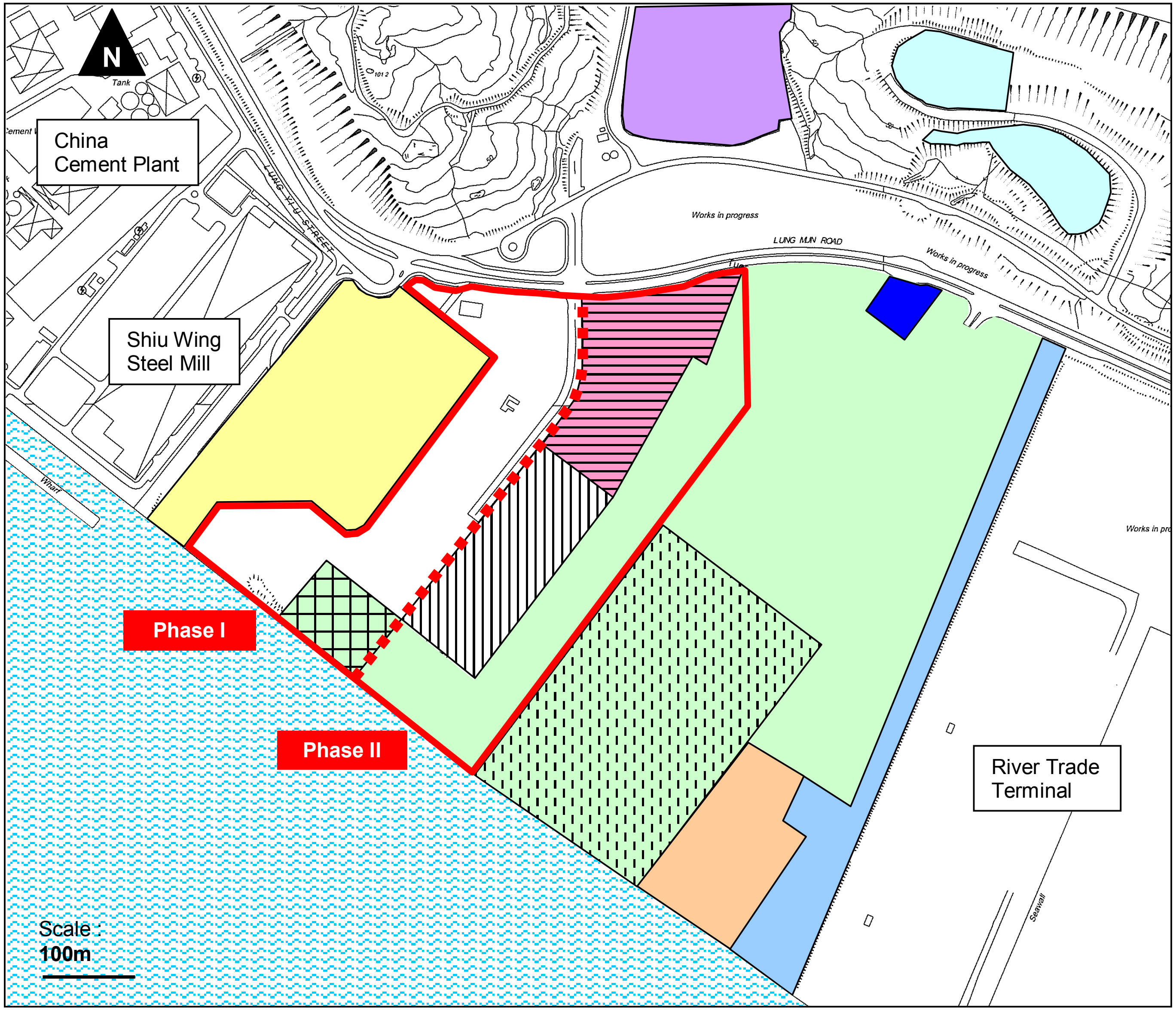


Figure 2.2 : Potential Vertical Integration within EcoPark

By-products From Processing These Material-types …	… Can Be Used As Feedstock When Processing These Material-types: Batteries	Electronics	Glass	Organic Food Waste*	Ferrous Metals	Non-Ferrous Metals	Paper	Plastics	Textiles	Rubber Tyres	Wood	Spent Copper Etchant
Batteries						♻ ◥		♻ ◥				
Electronics	♻		♻ ◥		♻ ◥	♻ ◥		♻ ◥				
Glass												
Organic Food Waste*												
Ferrous Metals						♻		♻				
Non-Ferrous Metals					♻			♻				
Paper					♻	♻		♻				
Plastics			♻				♻					
Textiles								♻				
Rubber Tyres					♻ ◥				♻			
Wood					♻ ◥	♻ ◥		♻ ◥				
Spent Copper Etchant						♻						

Notes :
- ♻ Potential vertical integration of by-products and feedstock.
- ◥ Vertical Integration of by-products and feedstock included in the assessment of waste arising from recycling activities.
- * Only the processing of Organic Food Waste does not integrate with any other material-types within EcoPark.

Figure 2.3a : Conceptual Internal Layout – Landscaping and Infrastructure

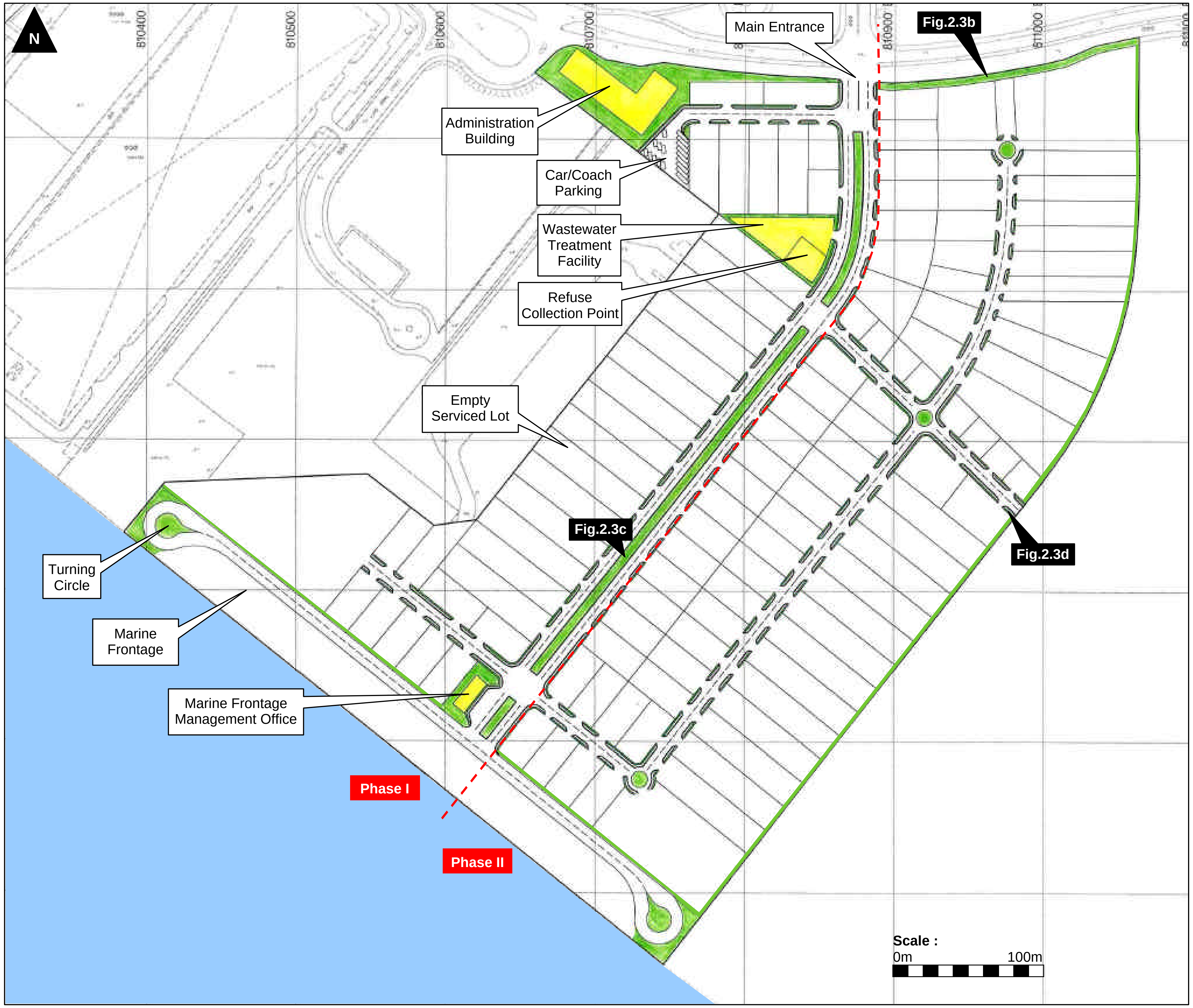


Figure 2.3b : Boundary Planting

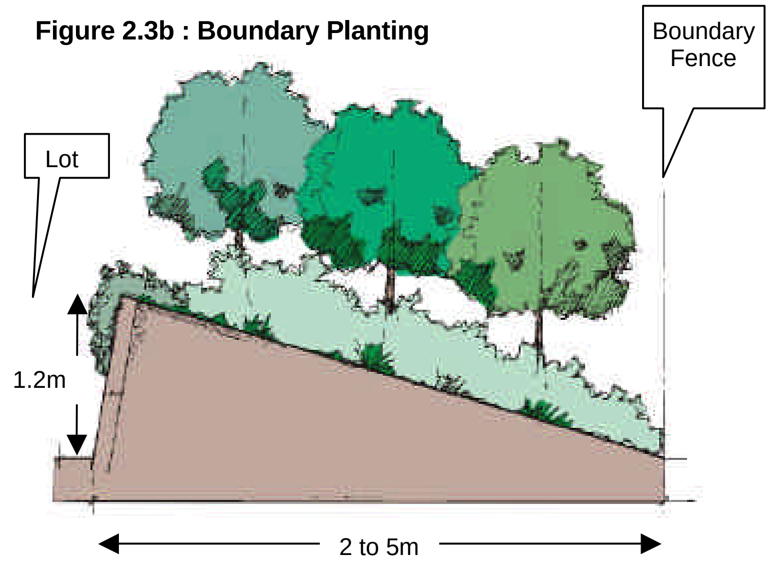


Figure 2.3c : Median Strip Planting

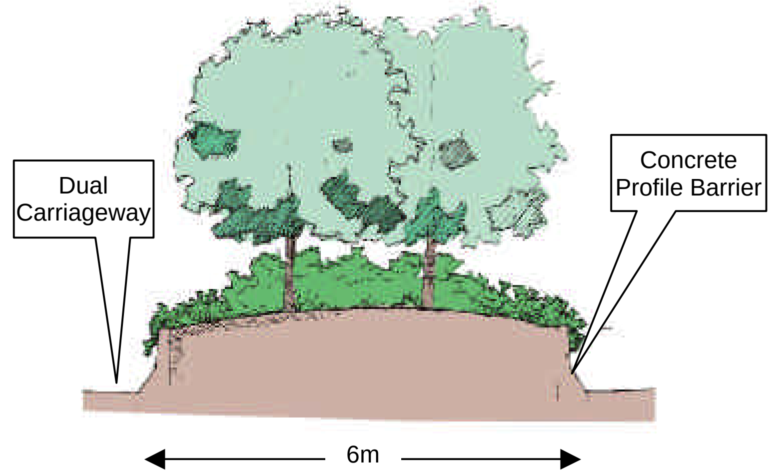


Figure 2.3d : Roadside Treatment

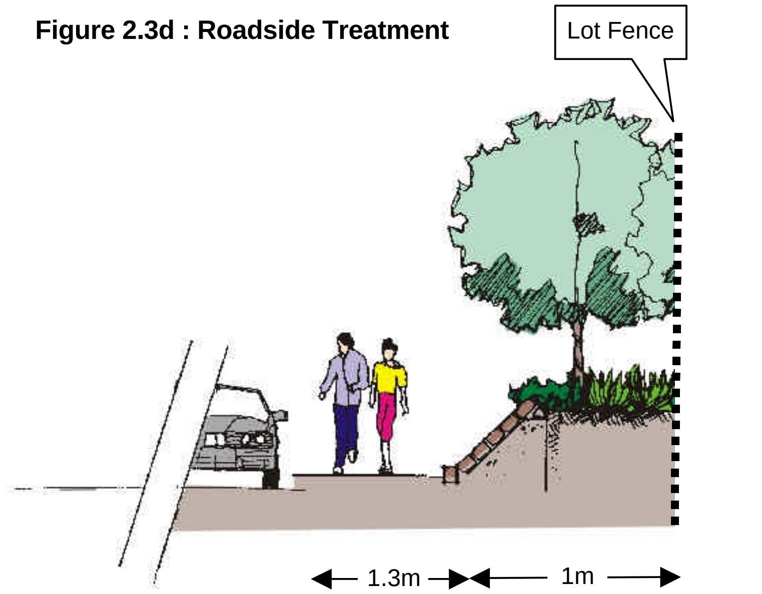


Figure 2.4a : Conceptual Internal Layout – Lot Distribution and Utility Connections

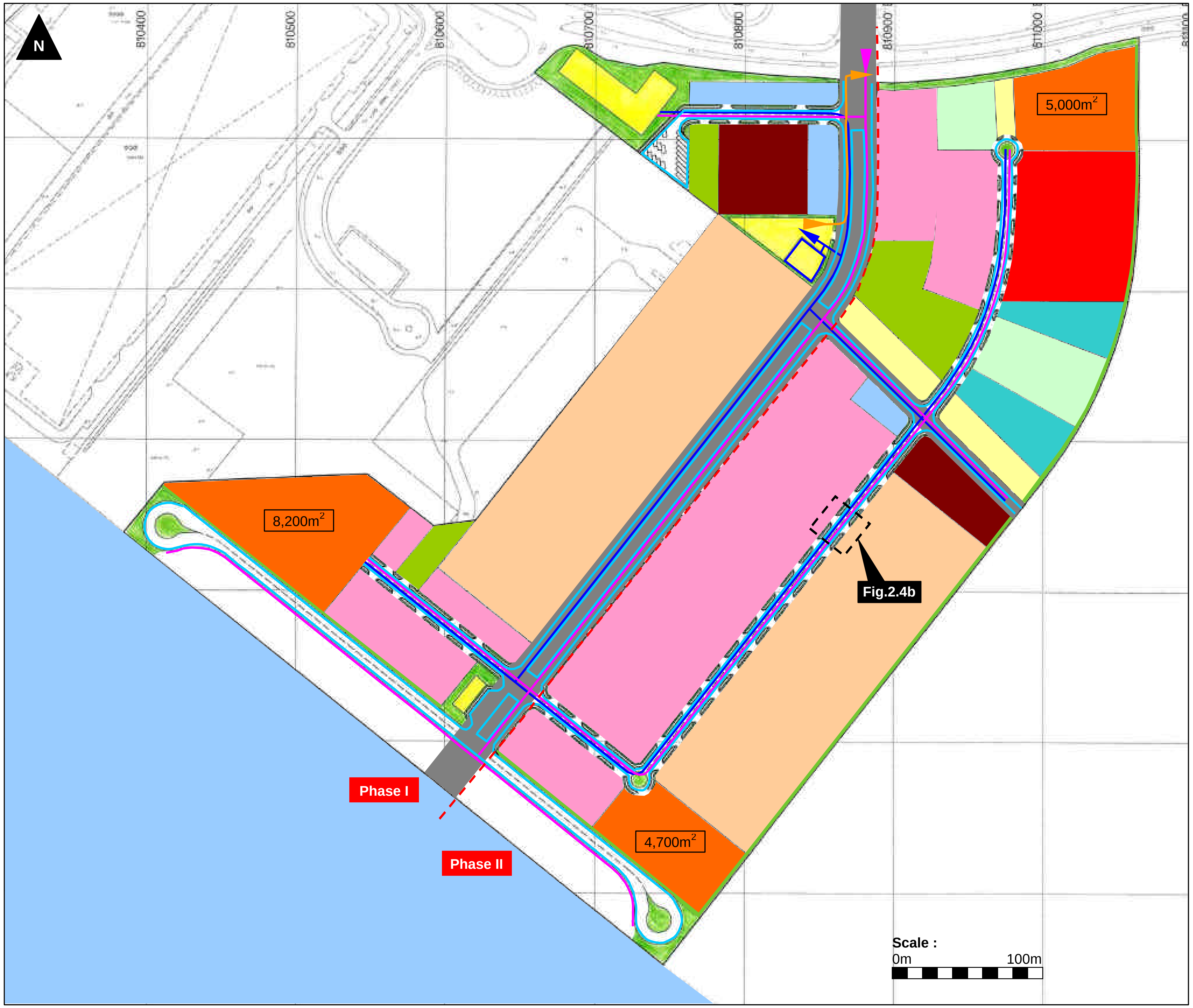
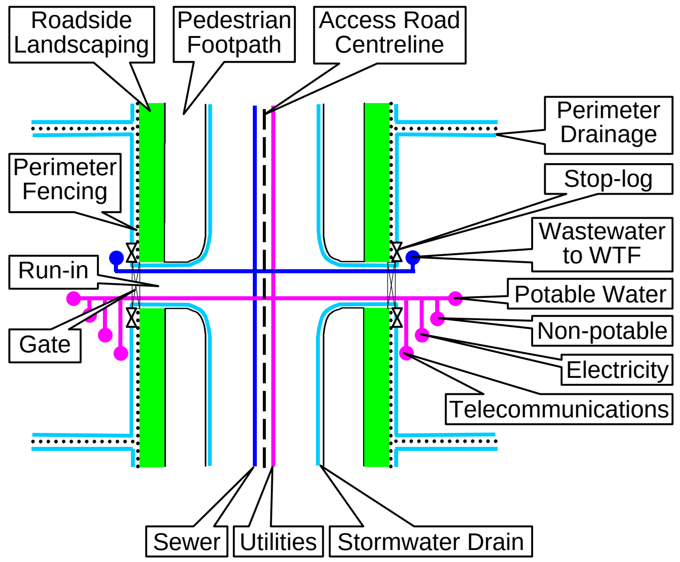


Figure 2.4b : Utility Connections – Detail Schematic



Key

DSD Drainage Reserves

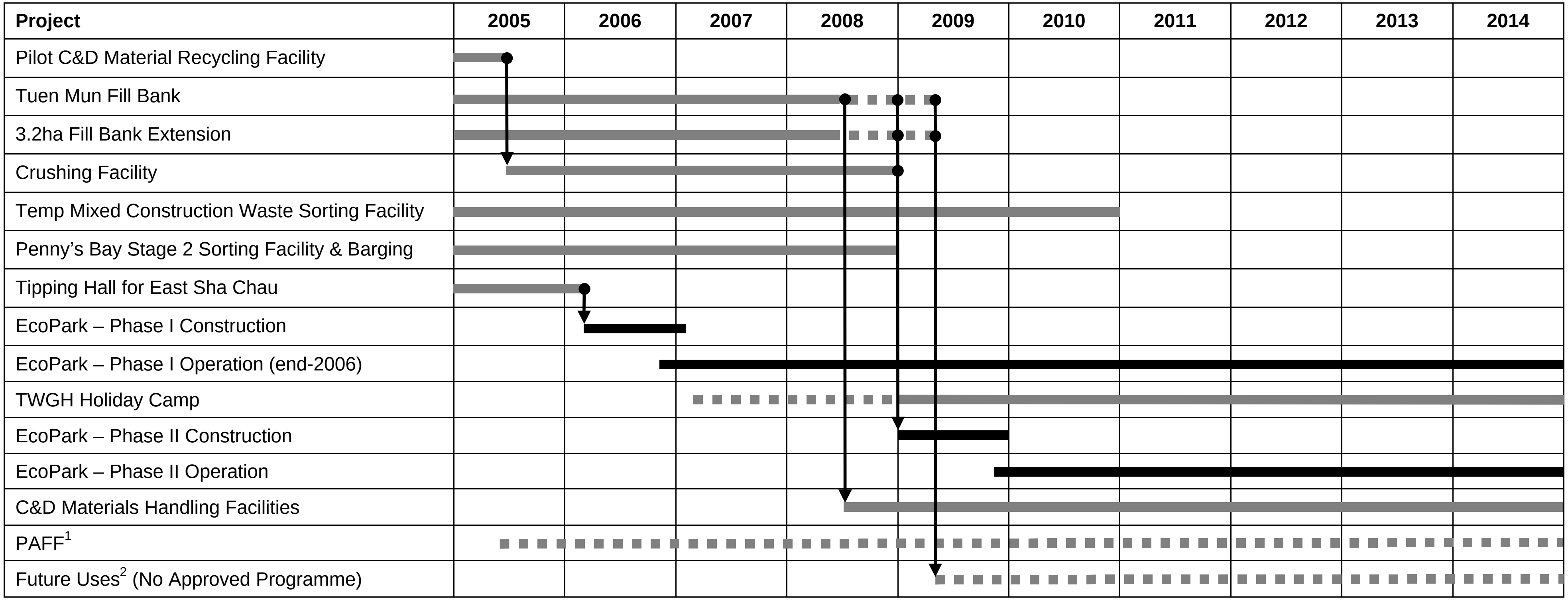
Approximate Lot Sizes

- $400m^2$
- $700m^2$
- $800m^2$
- $1,000m^2$
- $1,200m^2$
- $1,400m^2$
- $1,600m^2$
- $1,700m^2$
- $2,100m^2$
- As Indicated

Utilities

- Electricity/Telecommunications/Water (Potable/Non-potable)
- Recyclers' Effluent to WTF
- WTF Effluent to PPSTW
- Uncontaminated Stormwater Drainage

Figure 2.5 : Proposed Programme for EcoPark and Other Nearby Projects



Notes : 1. According to the tentative programme shown in the *PAFF EIA Report*,

2. Proposed future uses (post-2009) for Area 38 will likely include facilities related to waste management, but no approved projects, programmes or site particulars are available for these uses at this time.

3 AIR QUALITY IMPACT ASSESSMENT

3.1 Introduction

3.1.1 The Air Quality impact assessment has been conducted in accordance with the requirements of Annex 4 and Annex 12 of the EIAO-TM, and in accordance with the requirements as set out under Clause 3.4.1 of the EIA Study Brief. These require the following tasks :

(a) Background and Analysis of Activities;

(b) Identification of Air Sensitive Receivers (ASRs) and Examination of Emission/ Dispersion Characteristics;

(c) Construction Phase Air Quality Impact;

(d) Operational Phase Air Quality Impact;

(e) Quantitative Assessment Methodology; and

(f) Mitigation Measures for Non-compliance.

3.2 Relevant Guidelines, Standards & Legislation

Air Quality Objectives

3.2.1 The Air Pollution Control Ordinance (APCO) provides the statutory authority for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites. It encompasses Air Quality Objectives (AQOs) for seven air pollutants. The AQOs are given in Table 3.1 below :

Table 3.1 : Hong Kong Air Quality Objectives

Pollutant	Concentration[1] ($\mu g/m^3$) Averaging Time				
	1-hr[2]	8-hr[3]	24-hr[3]	3-Mth[4]	1-yr[4]
Sulphur Dioxide (SO_2)	800	–	350	–	80
Total Suspended Particulates (TSP)	–	–	260	–	80
Respirable Suspended Particulates (RSP)[5]	–	–	180	–	55
Nitrogen Dioxide (NO_2)	300	–	150	–	80
Carbon Monoxide (CO)	30,000	10,000	–	–	–
Photochemical Oxidants (as ozone[6])	240	–	–	–	–
Lead (Pb)	–	–	–	1.5	–

Notes :
1. Measured at 298K and 101.325kPa (one atmosphere).
2. Not to be exceeded more than three times per year.
3. Not to be exceeded more than once per year.
4. Arithmetic means.
5. Respirable Suspended Particulates (RSP) means suspended particles in air with a nominal aerodynamic diameter of 10 micrometers or less.
6. Photochemical oxidants are determined by measurement of ozone only.

Air Pollution Control (Construction Dust) Regulation

3.2.2 The APCO subsidiary regulation Air Pollution Control (Construction Dust) Regulation defines notifiable and regulatory works activities that are subject to construction dust control.

3.2.3 Notifiable Works :

(a) Site formation;
(b) Reclamation;
(c) Demolition of a building;
(d) Work carried out in any part of a tunnel that is within 100m of any exit to the open air;
(e) Construction of the foundation of a building;
(f) Construction of the superstructure of a building; or
(g) Road construction work,

3.2.4 Regulatory Works :

(a) Renovation of outer surface of external wall / upper surface of building roof;
(b) Road opening or resurfacing work;
(c) Slope stabilization work; or
(d) Any work involving any of the following activities:
  (i) Stockpiling of dusty materials;
  (ii) Loading, unloading or transfer of dusty materials;
  (iii) Transfer of dusty materials using a belt conveyor system;
  (iv) Use of vehicles;
  (v) Pneumatic or power-driven drilling, cutting and polishing;
  (vi) Debris handling;
  (vii) Excavation or earth moving;
  (viii) Concrete production;
  (ix) Site clearance; or
  (x) Blasting.

3.2.5 Notifiable works require that advance notice of construction activities be given to EPD. The Regulation also requires the Works Contractor to ensure that both notifiable works and regulatory works be conducted in accordance with the Schedule of the Regulation, which provides dust control and suppression measures.

Recovery Processes Controlled Under APCO for Initial Consideration

3.2.6 Part IV of the APCO provides regulatory control on "Specified Processes" (SPs) described in Schedule 1 of the Ordinance. A SP License is required to operate the specified process under the APCO.

3.2.7 Designs for the installation and alteration of furnaces, ovens and chimneys exceeding the fuel consumption limited under the Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations required approval under this regulation.

3.2.8 The initially considered processes within EcoPark that are controlled by the SP Licenses issued under APCO and Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations are provided in Table 3.2 (below).

Environmental Impact Assessment Ordinance

3.2.9 Annex 4 of Technical Memorandum on the Environmental Impact Assessment Process (EIAO-TM) for the Environmental Impact Assessment Ordinance (EIAO) stipulates the hourly average Total Suspended Particulate (TSP) concentration of 500$\mu g/m^3$ measured at 298K (25°C) and 101.325kPa (1 atmosphere) for construction dust impacts.

3.2.10 There are potential odour emissions from some of the recovery processes. Annex 4 of the EIAO-TM stipulates that the criterion for evaluating odour impacts must meet 5 Odour Units (OUs) based upon an averaging time of 5 seconds.

Table 3.2 : List of Recovery Processes Controlled under APC (Specified Processes) and (Furnaces, Ovens and Chimneys) Regulations for Initial Consideration

Material-type Input and Potential Processes	Possible Schedule 1 Specified Process & Reference Clause, or Relevant APC Regulations Involved
Glass – Re-manufacturing Melting cullet in furnace to form new glass products.	*30. Glass Works* Works in which the processing capacity exceeds 200 tonnes per annum (expressed as the glass products) and in which manufacturing process for making glass or glass products including mineral fibre and glass fibre is carried out.
Organic Food Waste Inedible Rendering	*28. Rendering Works* Works in which the processing capacity exceeds 250 kg per hour (expressed as the raw material) and in which rendering or reduction or drying through application of heat, or curing by smoking, of animal matter (including feathers, blood, bone, hoof, skin, offal, whole fish, and fish heads and guts and like parts, and organic manures but not including milk or milk products) is carried out.
Ferrous Metals Secondary metal melting to form ingots	*9. Iron and Steel Works* Works in which the installed furnace capacity exceeds 1 tonne, or, if the mode of operation is continuous, 1 tonne per hour, and in which a ferrous metal melting process for casting is carried out *10. Metal Recovery Works* Works in which scrap metals are treated in any type of furnace for recovery of metal with a processing capacity exceeding 50 kg per hour, where this is the primary object of the works.
Non-ferrous Metals Secondary metal melting to form ingots (for aluminium)	*2. Aluminium Works* Works of the following kinds in which the processing capacity exceeds 1 tonne (expressed as aluminium) or, if the mode of operation is continuous, 0.67 tonne (expressed as aluminium) per hour, and in which- (a) aluminium swarf is degreased by the application of heat; or (b) aluminium or aluminium alloys are recovered from aluminium or aluminium alloy scrap fabricated metal, swarf, skimmings, or other residues by melting under flux cover; or (c) molten aluminium or aluminium alloys are treated by chlorine or its compounds; or (d) aluminium is extracted from any compound containing aluminium by a process evolving any noxious or offensive gases; or (e) oxide of aluminium is extracted from any ore; or (f) aluminium is recovered from slag or drosses; or (g) materials used in the above processes or the products thereof are treated or handled by methods that cause noxious or offensive gases to be evolved. *10. Metal Recovery Works* Works in which scrap metals are treated in any type of furnace for recovery of metal with a processing capacity exceeding 50 kg per hour, where this is the primary object of the works.
Non-ferrous Metals Secondary metal melting to form ingots (for lead)	*17. Lead Works* Works of the following kinds in which- (a) by application of heat- (i) lead is extracted or recovered from any material containing lead or its compounds; or (ii) lead is refined; or (iii) lead is applied as a surface coating to other metals by spraying; or

Material-type Input and Potential Processes	Possible Schedule 1 Specified Process & Reference Clause, or Relevant APC Regulations Involved
Non-ferrous Metals Secondary metal melting to form ingots (for lead) (continued)	(b) compounds of lead are manufactured, extracted, recovered or used in processes which give rise to particulates emission, excluding the manufacture of electric accumulators and the application of glazes or vitreous enamels *10. Metal Recovery Works* Works in which scrap metals are treated in any type of furnace for recovery of metal with a processing capacity exceeding 50 kg per hour, where this is the primary object of the works.
Non-ferrous Metals Secondary metal melting to form ingots (for copper)	*6. Copper Works* Works in which the processing capacity exceeds 0.5 tonne (expressed as copper) or, if the mode of operation is continuous, 0.45 tonne (expressed as copper) per hour and in which- (a) by the application of heat- (i) copper is extracted from any ore or concentrate or from any material containing copper or its compounds; or (ii) molten copper is refined; or (iii) copper or copper alloy swarf is degreased; or (iv) copper alloys are recovered from scrap fabricated metal, swarf or residues; or (b) copper or copper alloy is melted and cast. *10. Metal Recovery Works* Works in which scrap metals are treated in any type of furnace for recovery of metal with a processing capacity exceeding 50 kg per hour, where this is the primary object of the works.
Non-ferrous Metals Secondary metal melting to form ingots (for zinc)	*29. Non-ferrous Metallurgical Works* Works in which the processing capacity exceeds 1 tonne per hour and in which melting of any non-ferrous metal, other than aluminium, copper, lead and zinc for galvanising is carried out. *10. Metal Recovery Works* Works in which scrap metals are treated in any type of furnace for recovery of metal with a processing capacity exceeding 50 kg per hour, where this is the primary object of the works
Paper Chlorine Bleaching and fuel consumption in pulping process	*5. Chlorine Works* Works in which chlorine is made or used in any manufacturing process *Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations* A furnace or oven, or a chimney or flue connected thereto, which exceed the fuel consumption limits specified in the regulation
Wood Chlorine Bleaching and fuel consumption in pulping process	*5. Chlorine Works* Works in which chlorine is made or used in any manufacturing process *Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations* A furnace or oven, or a chimney or flue connected thereto, which exceed the fuel consumption limits specified in the regulation

Source : APCO Schedule 1 and Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations

Non-statutory Guidelines

3.2.11 There are no statutory regulations for toxic air pollutants (TAPs), which are those pollutants known or suspected to cause cancer or other serious health effects, or to cause adverse environmental effects.

3.2.12 It is anticipated that there is potential for mercury emissions from the fluorescent lamp recovery process; and heavy metals, TAPs and other gaseous emissions from the metal recovery processes. However, no criteria have been established under the APCO.

3.2.13 In the absence of air quality guidelines in Hong Kong for certain pollutants, the assessment makes reference to international guidelines as per Annex 4 of EIAO-TM, such as the Air Quality Guidelines published by the World Health Organisation (WHO,) or those of the US Environmental Protection Agency (USEPA). The footnotes to Table 3.3 refer.

3.2.14 The air quality standards for the Toxic Air Pollutants (TAPs) are summarised in Table 3.3 :

Table 3.3 : Air Quality Standards for TAPs not Listed in AQOs and EIAO

Pollutant (and its compounds)	**Concentration (mg/m^3) Averaging Time**			
	1-hr	**4-hr**	**8-hr**	**1-yr**
Chlorine (Cl_2)	210(3)			0.2(3)
Hydrogen Chloride (HCl)	2,100(3)(5)			20(2)(5)
Fluorine / Fluoride (F)	240(3)			13(3)
White Phosphorus (P)				0.07(3)
Lead (Pb) (6)				0.5(1)
Beryllium (Be) (6)				0.02(2)
Cadmium (Cd) (6)				0.005(1)
Mercury (Hg)	1.8(3)(5)			1(1)(5)
Nickel (Ni) (6)	6(3)			0.05(3)
Arsenic (As) (6)		0.19(3)		0.03(3)
Tin (Sn)			40(4)	
Molybdenum (Mo)			100(4)	
Copper (Cu)	100(3)			2.4(3)
Antimony (Sb)				0.2(3)
Chromium VI (Cr^{6+}) (6)				0.2(3)
Platinum (Pt)			20(4)	
Selenium (Se)				20(3)
Rhodium (Rh)			2(4)	
Dioxins (TCDD) (6)				$1x10^{-6}$ I-TEQ(4)(5)

Notes :
1. World Health Organisation (WHO).
2. Integrated Risk Information System (IRIS), USEPA.
3. Office of Environmental Health Hazard Assessment of California Air Resources Board, Approved Chronic Reference Exposure Levels (RELs) and Target Organs, AB 2588 Air Toxic "Hot Spots" Program.
4. Connecticut Regulations for the Abatement of Air Pollution issued by the State of Connecticut Department of Environmental Protection.
5. Adopted in the approved EIA Report for Re-provisioning of Diamond Hill Crematorium (EIA-092/2003)
6. Included in the cancer risk assessment

3.2.15 Risk guidelines for the assessment of cancer risk from exposures to air toxics are given by California Air Resources Board (CARB), California Environmental Protection Agency. Guidelines value on acceptability of increased cancer risk from a lifetime exposure to air toxics have been provided and are summarised in Table 3.4 below :

Table 3.4 : Health Risk Guidelines for Exposure to Air Toxics

Acceptability of Cancer Risk	Estimated Individual Lifetime Cancer Risk Level*
Significant	> 10^{-4}
Risk should be reduced to As Low As Reasonably Practicable (ALARP)	> 10^{-6} – 10^{-4}
Insignificant	10^{-6}

Note : * Assumed as 70 years recommended by WHO.

3.2.16 The inhalation unit cancer risk factors are from WHO guidelines or, where unavailable, from those factors of OEHHA/ARB - approved inhalation unit cancer risk factors. The inhalation unit cancer risk factors of pollutants for the assessment of cancer risk level are summarised in Table 3.5 below :

Table 3.5 : Inhalation Unit Risk Factor for the Assessment of Cancer Risk

Pollutant	Inhalation Unit Risk (μg/m^3)$^{-1}$
Arsenic (As)	1.5×10^{-3}*
Chromium VI (Cr^{6+})	0.13
Nickel (Ni)	4×10^{-4}*
Lead (Pb)	1.2×10^{-5}**
Beryllium (Be)	2.4×10^{-3}**
Cadmium (Cd)	4.2×10^{-3}**
Dioxins (TCDD)	38**

Notes : * "*Air Quality Guidelines for Europe*", 2nd edition, WHO, 2000

****** Office of Environmental Health Hazard Assessment (OEHHA) and the California Air Resources Board (CARB) approved health values for use in facility health risk assessments conducted for the *AB 2588 Air Toxics Hot Spots Program*.

3.3 Baseline Conditions

Existing Environment

3.3.1 The proposed EcoPark is to be located on reclaimed land in Tuen Mun Area 38 in the western New Territories. To the south of the site are coastal waters, while Lung Mun Road – the main access to Tuen Mun Area 38 – adjoins the site to the north. Further north of the Road the land is zoned for container storage / repair (based on the current approved Outline Zoning Plan No. S/TM/20), beyond which is the restored Siu Lang Shui Landfill.

3.3.2 Immediately east of the Site are an Inert Construction & Demolition (C&D) Materials Recycling Facility (C&DMRF) (with a future crushing facility proposed), a public Fill Bank, a Public Fill Sorting Facility for Penny's Bay Reclamation Phase 2 (PBR2SF) and a Temporary Mixed Construction Waste Sorting Facility (TMCWSF). Further to the east is the River Trade Terminal (RTT). The Shiu Wing Steel Mill is located immediately west, and next to which there is a 6-ha area of land that has been allocated for the pending Permanent Aviation Fuel Facility (PAFF). Adjacent to the west there is also a Green Island Cement plant, beyond which the Castle Peak Power Station is located, at Tap Shek Kok. Figure 2.1 shows the location of EcoPark and the adjacent users in Area 38.

3.3.3 Many of these surrounding land uses strongly influence the background air quality, particularly industrial chimney emissions and road vehicle emissions in the long-term, and fugitive dust emissions from the Fill Bank, C&DMRF, PBR2SF and TMCWSF in the short term (i.e., to circa 2009).

3.3.4 As there are no EPD air quality monitoring stations located in the Tuen Mun area, reference has been made to representative data from other monitoring stations. According to EPD's Guidelines on *Assessing the 'Total' Air Quality Impacts,* Tuen Mun has an air quality category of "Rural / New Development", which is the same as Yuen Long area. Annual average ambient background concentrations of particulates, gaseous air pollutants and heavy metals were obtained from the Yuen Long air monitoring station, while dioxin concentrations were obtained from the Tsuen Wan monitoring station (being the closest of only two stations to collect this data; the other being Central).

3.3.5 The background air quality for the study area has thus been estimated with reference to the five years of monitoring data at EPD's Yuen Long and Tsuen Wan ambient air quality station as stated in *Air Quality in Hong Kong" (1999 – 2003)* as published by EPD. The background levels of the major air pollutants are summarised in Table 3.6 :

Table 3.6 : Indicative Background Air Quality at the Site

Pollutants	**Concentration (mg/m^3)**
Total Suspended Particulates (TSP)	94 (1)
Respirable Suspended Particulates (RSP)	58 (1)
Sulphur Dioxide (SO_2)	19 (1)
Nitrogen Dioxide (NO_2)	59 (1)
Carbon Monoxide (CO)	982 (2)
Lead (Pb)	86×10^{-3} (1)
Beryllium (Be)	0.076×10^{-3} (1)
Cadmium (Cd)	2.586×10^{-3} (1)
Mercury (Hg)	0.216×10^{-3} (1)
Nickel (Ni)	6.44×10^{-3} (1)
Arsenic (As)	5.48×10^{-3} (1)
Copper (Cu)	207×10^{-3} (1)
Chromium (Cr)	4.22×10^{-3} (1)
Selenium (Se)	1.78×10^{-3} (1)
Dioxins (TCDD)	0.079×10^{-6} I-TEQ (2) (3)

Notes : 1. 5-year average background level measured at Yuen Long Air Quality Monitoring Station
2. 5-year average background level measured at Tsuen Wan Air Quality Monitoring Station
3. I-TEQ = International Toxic Equivalent

Future Trends

3.3.6 The current statutory plan (i.e., Tuen Mun Outline Zoning Plan No. S/TM/20) indicates that the Site and its surroundings will generally remain industrial in nature. These include a public Fill Bank (operative), a C&DMRF (operative), PBR2SF (operative), TMCWSF (operative), PAFF (planned), and permanent C&D Material Handling Facility (C&DMHF) (planned), and other future uses within the Tuen Mun Area 38 (planned). Apart from the industrial uses in the Tuen Mun Area 38, a Holiday Camp Site is planned for the "G/IC" zone to the northeast.

3.3.7 Construction activities, including works for EcoPark and the other nearby planned facilities, will generate dust and vehicle emissions that will cumulatively affect background air quality conditions. However, these impacts will be of a short-term and temporary nature only, and are not expected to cause any significant change in the air quality in the surrounding areas.

3.4 Air Sensitive Receivers

3.4.1 Annex 12 of the EIAO-TM provides guidelines for the determination of Air Sensitive Receivers (ASRs). Accordingly, ASRs identified near the Site include the planned PAFF, RTT, Shiu Wing Steel Mill, Green Island Cement plant, TMCWSF, the future occupiers in the existing Fill Bank to the east of EcoPark on the rest of Tuen Mun Area 38, future users in the proposed holiday camp site and the future occupiers of EcoPark (internal ASRs).

3.4.2 The closest domestic premises to the Site are at San Shek Wan San Tsuen Phase 2 and Lung Kwu Tan (both village housing), and these are located over 4km and 3km away from the Site, respectively. As these distances are well beyond the 500m Study Area as defined in the ESB, there are no domestic ASRs for the assessment. There is, however, a planned holiday campsite in the vicinity that is considered as a future ASR and that has been considered in the assessment.

3.4.3 The identified ASRs and their description are summarised in Table 3.7, below, and their relative locations are shown in Figure 3.2.

Table 3.7 : Air Sensitive Receivers

ASR Ref. ID	Description	Type	Distance[(1)]* from EcoPark (m)	Assessment Elevation (mPD)
SW	Shiu Wing Steel Mill	Office & Factory	~ 80 - 230	8.5 – 29.5
GIC	Green Island Cement Plant	Office & Factory	~ 430 - 460	8.5
RTT	River Trade Terminal	Office & Factory	~ 340 - 370	8.5
PBR2	Public Fill Sorting Facility with Barging Facilities for Penny's Bay Reclamation Stage 2 (during construction and operation of Phase I EcoPark)	Office & Factory	~ 250 - 260	8.5
TMCDSF	Temporary Mixed Construction Waste Sorting Facility	Office & Factory	~ 400	8.5
FB	Fill Bank (during construction and operation of Phase I EcoPark)	Office & Factory	~ 80 - 110	8.5
PAFF	Permanent Aviation Fuel Facility (PAFF) (planned)	Office & Factory	~ 20 - 30	8.5
PLAN[(2)]	Future ASRs at the existing Fill Bank area (planned) (during construction and operation of Phase II EcoPark)	Not known at this time	~ 100	8.5 – 38.5
HCS	Planned Holiday Camp Sites (planned)	Temporary Housing	~ 200 - 280	41.5 – 61.5
EcoPark	Future occupiers in EcoPark (planned)	Office & Factory	NA	8.5 – 38.5

Note : 1. Distances are measured between ASRs and the nearest boundary of EcoPark.

2. ASRs referenced as "PLAN" are various planned or proposed uses in the future in the area currently occupied by the existing Fill Bank. It is not considered appropriate to speculate on what such uses might ultimately be, however, representative ASRs have been assigned to this location to ensure that the air quality assessment takes these future users into account.

3.5 Construction Phase Impact Assessment

Impacts Identification

3.5.1 The major construction works for EcoPark development that may generate dust include notifiable or regulatory works, which are described below :

- The construction will begin with site clearance, including removal of debris on the site. This will be regulatory works that require appropriate dust suppression measures under the Regulation and therefore dust will be adequately controlled within acceptable level.
- Erection of site hoarding and fencing may involve very minor excavation, and constitutes a regulatory work activity for which dust control measures will be implemented to control dust to within an acceptable level.
- There will be some excavation works for the installation of utilities (e.g., pipe works, sewer, drain), which are a regulatory works. Dust control measures are required and expected to control the dust within acceptable level.
- The construction of foundations (e.g., for the Administration Building, Wastewater Treatment Facility, etc.) is a notifiable work that requires proper dust suppression measures. Therefore dust impacts can be controlled.
- The construction of building superstructures is notifiable work that requires proper dust suppression measures. Therefore dust impacts will be adequately controlled.
- There will be use of trucks for material transport to the site. Use of vehicle is a regulatory work and dust control measures are required. Therefore dust level shall be controlled to acceptable level.
- There may be stockpiling of dusty materials on site. This will require proper dust suppression measures as it is regulatory work and therefore dust impact can be controlled.

Cumulative Impacts

3.5.2 The Phase I EcoPark construction is anticipated to commence in early-2006 for completion by late 2006. With reference to the PAFF EIA Study, assuming a ‘worst-case’ cumulative air quality impact scenario whereby the PAFF development proceeds, the earliest that construction could commence is mid-2005, with a construction period of 1.5 years. There will be a potential cumulative effect should the PAFF construction programme overlap with that of EcoPark Phase I. However, dust control measures will be implemented during the construction phase of EcoPark, while PAFF construction will also have to implement dust control measures in accordance with the Air Pollution Control (Construction Dust) Regulation. As a result, no significant cumulative dust impacts are anticipated from PAFF construction.

3.5.3 The adjacent Fill Bank, managed by CEDD, is a potential source of fugitive dust emissions, and CEDD have recently been granted an EP for the expansion of this facility towards the EcoPark site and extend the operation period until early-2009. Relevant information was obtained from CEDD’s consultants during the fugitive dust impact assessment for the *Project Profile for the Expansion and Extension of Fill Bank at Tuen Mun Area 38*. This information allowed consideration of cumulative dust impacts associated with Fill Bank operation, and other concurrent sources of dust (e.g., construction of Phase I EcoPark and PAFF and operation of Phase I EcoPark, Green Island Cement plant, C&DMRF, PBR2 Sorting Facility and TMCWSF).

3.5.4 The construction period for Phase II is expected to last up to 12 months. The construction work will be generally minor and most of the works will be notifiable/regulatory. The associated fugitive dust impact can be controlled through appropriate mitigation measures. The land for Phase II is currently occupied by the Fill Bank (and its planned extension) and by the Pilot C&D Material Recycling Facility (which will soon be replaced by a proposed Crushing Facility). Within the area to be occupied by Phase II, these facilities will operate until end-2008, after which Phase II of EcoPark can be developed, subject to user demand. As mentioned in the fugitive dust impact assessment, the potential dust emission before handing over the Fill Bank site for EcoPark Phase II construction represents the worst case scenario. As such, cumulative dust sources will be from the remaining Fill Bank operations, TMCWSF (until 2010), the Green Island Cement plant and Phase I EcoPark operations.

Evaluation of Potential Impacts

3.5.5 The *Project Profile for Expansion and Extension of Fill Bank at Tuen Mun Area 38* included an assessment of the cumulative dust impact for the construction of Phase I of EcoPark (since this is adjacent to the proposed Fill Bank expansion). Based on this assessment, the existing air quality will not worsen significantly as a result of the Phase I construction works. As such, construction air quality monitoring is not considered to be necessary.

3.5.6 The Administration Building, Marine Frontage Management Office, WTF and waste collection facilities will all be constructed in Phase I of EcoPark. During Phase II, there will be no major construction works. Moreover, based on the assessment results presented in Appendix D.6, the worst-case operational dust impacts from the Phase I EcoPark will contribute <19$\mu g/m^3$ to ambient dust levels. As such, and with the implementation of construction dust control measures in accordance with the Air Pollution Control (Construction Dust) Regulation, no adverse fugitive dust impacts are anticipated from the construction of Phase II EcoPark.

Mitigation Measures

3.5.7 All the dust control measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, where applicable, should be implemented. Typical dust control measures include :

- Restricting heights from which materials are dropped, as far as practicable to minimise the fugitive dust arising from unloading/loading;
- All stockpiles of excavated materials or spoil of more than 50m^3 should be enclosed, covered or dampened during dry or windy conditions;
- Effective water sprays should be used to control potential dust emission sources such as unpaved haul roads and active construction areas;
- Vehicles that have the potential to create dust while transporting materials should be covered, with the cover properly secured and extended over the edges of the side and tail boards;
- Materials should be dampened, if necessary, before transportation;
- Travelling speeds should be controlled to reduce traffic induced dust dispersion and re-suspension within the site from the operating haul trucks;
- Vehicle washing facilities will be provided to minimise the quantity of material deposited on public roads;
- Erection of hoarding of not less than 2.4m high from ground level along the perimeter of EcoPark site (tenants will also be responsible for implementing dust control measures within their allocated lots); and
- Dusty activities should be re-scheduled to avoid high-winds weather.

3.5.8 The EM&A requirements are discussed in Section 12.4.

3.6 Operational Phase Impact Assessment

Initial Screening

3.6.1 The purpose of this initial screening is to identify a subset of the processes initially proposed in Table B.1 (in Appendix B) that could realistically be carried out within EcoPark without requiring prohibitively costly Air Pollution Control (APC) equipment, without unduly reducing material throughputs and without adversely affecting the flexibility of the EcoPark Operator.

3.6.2 It can be seen from Table B.1 that a large number of processes and sub-processes have been initially proposed. The majority of these processes will result in some level of air quality impact. These impacts will arise either from the processing itself or from the on-site combustion of fossil fuels to power these processes.

3.6.3 To meet AQOs for EcoPark, mitigation may be required for some of the processes initially proposed. Mitigation can include the use of cleaner fuels, the installation of APC equipment, a reduction in material throughput, or a combination of these. At this early stage in the development of EcoPark, future tenants have not been identified and so cannot be consulted on the level and type of mitigation they would likely use. Therefore, this EIA has to make assumptions on the level of mitigation that will be implemented by future tenants.

3.6.4 While reductions in throughput or use of cleaner fuels can be managed by administrative means (e.g. through existing statutory requirements, guidelines, lease conditions, etc.) and will not have a significant financial impact on future tenants, the mandatory requirement for installation of APC equipment to meet AQOs has the potential to cause significant financial problems for would-be tenants. Furthermore, this limits the flexibility of the Operator in promoting EcoPark to various sectors within the recycling industry – in effect, by specifying too costly APC equipment, EcoPark could price itself out of the market.

3.6.5 While it is acknowledged that the mitigation of most air quality impacts likely to arise from the processes proposed for EcoPark is technically possible, for some processes the cost of meeting AQOs through APC equipment would be prohibitive. This means that recyclers could not afford to install the necessary APC equipment and so would not relocate to EcoPark. If the EIA were, nevertheless, to take into consideration impacts from these processes (that would not actually be carried out) this would further limit impacts from other processes in order to meet AQOs. As a result, the EIA would impose undue limits on future recycling activities based on unrealistic assumptions of a wider range of processes being carried out than would actually occur.

3.6.6 Key to resolving this issue is identifying the level of APC equipment that a typical recycler could be reasonably be expected to install in his premises if he were to relocate to EcoPark. Given that typical recyclers are Small-to-Medium size Enterprises (SMEs) it would be unreasonable to expect these businesses to install state-of-the-art APC equipment that would cost many millions of dollars in capital and operation costs to meet emissions requirements for some of the initially proposed processes. Therefore, the approach taken has been to assume that the best available APC equipment that does not entail excessive cost would be installed by future tenants.

3.6.7 Comprehensive research was conducted on the energy consumption and air pollutant emission inventory of processes initially proposed in Table A.1 to identify and highlight those that would result in significant air quality impacts, and to screen-out these processes prior to quantitative assessment. In this context, significant refers to air quality that impacts could not be mitigated by affordable, cost-effective APC equipment.

3.6.8 It should be noted, however, that because a process has been screened-out on the basis of significant air quality impacts, this does not imply that the process cannot be carried out within EcoPark. As APC technology develops throughout the operational life of EcoPark, equipment that is now prohibitively expensive will reduce in cost such that it may become affordable in the future. Alternatively, a particular tenant may wish to carry out a particular process within EcoPark and be willing to install the necessary APC equipment, despite the expense. In both of these situations, the Design Audit process (see Section 12.2) provides the mechanism by which the process could be introduced into EcoPark, on condition that there would be no unacceptable (individual or cumulative) environmental impacts.

3.6.9 For those processes known to generate significant environmental impacts, the following paragraphs (and Table 3.8, below) summarise the pre-emptive mitigation measures assumed for the air quality impact assessment in terms of cleaner fuel requirements, the screening-out of specific processes, and reductions in throughput of certain material types.

3.6.10 It should be noted that those processes initially screened-out shall also be considered screened-out for the purposes of other assessments to ensure that the EIA has been carried out in a consistent manner.

Fuel Consumption and Restriction

3.6.11 Many of the recovery processes identified in Table B.1 (in Appendix B) such as glass manufacturing, in-vessel composting of organic food waste, metal recovery, paper pulping, plastic-wood composite manufacturing, etc. will consume liquid fuel. According to the Air Pollution Control (Fuel Restriction) Regulations, liquid fuel with a sulphur content of more than 0.5% (by weight) is prohibited for use in the HKSAR. Given the high energy demand of many of the recovery processes, it is expected that large quantities of liquid fuel would be used, resulting in high levels of SO_2 being emitted from EcoPark.

- **Liquid Fuel.** To minimise the quantities of SO_2 from fuel, it is recommended and has been assumed that Ultra-Low Sulphur Diesel (ULSD) (diesel with 0.005% sulphur content by weight) will be mandated within EcoPark for all processes requiring liquid fuel.
- **Gaseous Fuel.** To further minimise the quantities of SO_2 from fuel, consideration has also been given to the use of gaseous fuels, however, it is noted that this would require a gas pipeline and associated facilities at EcoPark, all of which would involve significant capital and maintenance costs. Notwithstanding, gaseous fuels may also be considered provided that overall NO_x emissions do not exceed those of ULSD combustion.

Processes with Significant Air Quality Impacts

3.6.12 On the assumption that tenants could not afford to install state-of-the-art APC equipment but instead would use the best available APC equipment that does not entail excessive cost, the following processes are considered to result significant air quality impacts that could not be mitigated by the assumed APC equipment :

- **Inedible Rendering (Organic Food Waste).** An initial odour assessment based on the emission factor stated in the USEPA AP-40 concluded that significant odour would be generated by the inedible rendering process (i.e., lard boiling). It was identified that odour control equipment with >99.9% control efficiency would be required to mitigate the odour level to the 5 OU standard at off-site ASRs, while a higher control efficiency would be required to mitigate impacts on internal ASRs. Odour control equipment such as bio-filters can be adopted, although it is unlikely that this alone could achieve the necessary control efficiency. A condenser plus afterburner with higher removal efficiency may also be feasible to control odour, although such an arrangement would be unlikely to be cost-effective. Furthermore, there remains some doubt that even the adoption of such combined technology could achieve the required control efficiency in practice. Based on these conclusions, this process has been screened-out and will not be assessed further.

Reduction in Throughput

3.6.13 Certain processes are known to generate relatively greater emissions per unit throughput than others. Overall AQOs can be met only if the throughput of some of these processes are reduced :

- **Melting of Shredded Metal (Ferrous Metals).** The melting point of the non-ferrous metals included in Table A.1 range from 327^{O}C to 1,083^{O}C, averaging at 622^{O}C. In comparison, the melting point of iron (and various steels) is ~1,540^{O}C, which is almost x2.5 greater. For the same amount of fuel this means that x2.5 more non-ferrous metals can be processed within EcoPark than ferrous metals. Alternatively, there will be x2.5 more air emissions (from fuel burning) to process ferrous metal than non-ferrous metals. Therefore, to maximise the overall throughput of metal thermal processing and to minimise the fuel-related air emissions, it has been decided to reduce the melting of shredded ferrous metal to zero for all scenarios.

- **Melting/Sweating/Refining/Leaching of Lead, Aluminium, Copper and Zinc (Non-ferrous Metals).** Non-ferrous metal recovery will typically include high temperature processes using a furnace(s) that are expected to generate heavy metal particulate, TAPs (i.e., dioxins) and other gaseous emissions. Initial modelling results indicated that air quality impacts associated with the heavy metal and TAP emissions are significant. As such, the total throughput for high temperature non-ferrous metal recovery has been reduced to 10,000tpa (for Scenario 1) and to 2,500tpa (for Scenario 2).
- **Pulping/Cleaning/De-inking/Bleaching/Additives/Pressing of Secondary Fibres (Paper).** Given the high energy consumption from the recycled paper pulping process and the large throughput, it is expected that fuel combustion-related emissions (i.e., PM, SO_2 and NO_2) will significantly contribute to the overall air quality impact upon ASRs, despite the use of ULSD. Therefore, the throughput of paper for the pulping has been reduced from 507,590tpa to 200,000tpa in the assessments.

Table 3.8 : Summary of Initial Screening of Processes

Material Type/Process	Screening Implications/Rationale
Fuel Consumption and Restriction (All Processes)	
Liquid Fuel Diesel	To minimise the quantities of SO_2 from fuel, it is recommended and has been assumed that ULSD (diesel with 0.005% sulphur content) will be mandated within EcoPark for all processes requiring liquid fuel.
Gaseous Fuel Towngas, LPG, LFG, etc	To further minimise the quantities of SO_2 from fuel, consideration has also been given to the use of gaseous fuel (natural gas), however, it is noted that this would require a gas pipeline and associated facilities at EcoPark, all of which would involve significant capital and maintenance costs. Notwithstanding, gaseous fuels may also be considered provided that overall NO_x emissions do not exceed those of ULSD combustion.
Processes Screened-Out Because of Significant Air Quality Impacts	
Organic Food Waste Inedible Rendering	An initial odour assessment concluded that significant odour would be generated by the inedible rendering process (i.e., lard boiling). Research has indicated that the level of odour that cannot be mitigated by assumed APC equipment. This process has therefore been screened-out and will not be assessed further.
Reduction in Throughput	
Ferrous Metals Melting	The melting point of ferrous metals is x2.5 greater than the average melting point of non-ferrous metals. Thus, for the same amount of fuel this means that x2.5 more non-ferrous metals can be processed within EcoPark than ferrous metals. Alternatively, there will be x2.5 more air emissions (from fuel burning) to process ferrous metal than non-ferrous metals. Therefore, it has been decided to reduce the melting of shredded ferrous metal to zero for all scenarios.
Non-ferrous Metals Melting/Sweating/Refining /Leaching of Lead, Aluminium, Copper and Zinc	Non-ferrous metal recovery will typically include high temperature processes using a furnace(s) that will generate heavy metal particulate, TAPs (i.e., dioxins) and other gaseous emissions. To mitigate this, the total material throughput for high temperature non-ferrous metal recovery process has been reduced from 57,100tpa to 10,000tpa (for Scenario 1) and to 2,500tpa (for Scenario 2).
Paper Pulping/Cleaning/De-inking/Bleaching/Additives /Pressing of Secondary Fibres	Given the high energy consumption from the recycled paper pulping process due to the large throughput it is expected that fuel combustion-related emissions (i.e., PM, SO_2 and NO_2) will significantly contribute to the overall air quality impact upon ASRs, despite the use of ULSD. Therefore, the throughput of paper for the pulping has been reduced from 507,590tpa to 200,000tpa in the assessments.

Emission Identification

3.6.14 Having completed the initial screening and identified clean fuel requirements, the subset of processes and reductions in throughputs, Table 3.9, below, identifies potential air quality impacts for each of the remaining processes (full details of each process are provided in Table B.1 in Appendix B). From Table 3.9, it can be seen that emissions are either fugitive or from the stack and that the level of impact is either negligible or "to be determined" (TBD). Where indicated, impacts will be determined in the quantitative assessments carried out in the following Sections (and detailed in Appendix D.1). In addition to fugitive emissions and stack emissions, other potential emission sources are the WTF and from road vehicle/marine traffic exhaust. These are also described below :

Fugitive Emissions

3.6.15 Potential fugitive dust impacts may be generated from material separation processes for batteries and electronics, shredding/crushing of electronic goods and glass bottles, and chipping of wood. However, further to the implementation of dust control measures as stated in Appendix D.1, no significant fugitive dust impacts associated with these processes are anticipated.

Stack Emissions from the Processes

3.6.16 During EcoPark operation various air pollutants may be emitted from a range of waste recovery processes. These emissions include dust (Particulate Matter as TSP/RSP), sulphur dioxide from process and fuel combustion emissions, nitrogen dioxide and carbon monoxide from fuel combustion, Volatile Organic Compounds (VOC) from various processes; and heavy metals and TAPs from the non-ferrous metal recovery processes.

Odour Emission from the Wastewater Treatment Facility

3.6.17 Based on the anticipated process technology to be adopted in the WTF (see para.5.5.14), there are unlikely to be any odour impacts arising from the WTF. This conclusion is further justified in paras.3.6.47 to 3.6.49 and should be confirmed in the follow-on D&C consultancy when the actual design of the WTF has been developed.

Vehicle and Marine Vessel emissions from Transportation

3.6.18 Exhaust emissions from road vehicles and marine vessels will be generated during transportation of waste and recovered materials when accessing and leaving EcoPark.

Table 3.9 : Potential Air Quality Impacts from Processes to be Assessed

Material Type	Process	Air Pollutant Emissions	Level of Impact
Batteries	Mechanical / physical separation / shredding	PM (fugitive)	Negligible
Electronics	Electromagnetic and electrostatic separation / shredding / dismantling	PM (fugitive)	Negligible
	Crush-and-sieve of fluorescent lamp using an electric-powered machine	PM (fugitive) Hg (from stack)	Negligible TBD
Glass	Crushing	PM (fugitive)	Negligible
	Melting / moulding / forming / finishing	PM and VOC (fugitive)	TBD
	Fuel Combustion	PM, SO_2, NO_2, CO, VOC	TBD
Organic Food Waste	In-vessel composting	Odour (fugitive)	Negligible
	Fuel combustion	PM, SO_2, NO_2, CO, VOC	TBD
Ferrous Metals	Sorting and baling	Nil	Nil
	Mechanical shearing and shredding	Nil	Nil

Material Type	Process	Air Pollutant Emissions	Level of Impact
Non-ferrous Metals	Recovery (sweating, melting, refining)	PM, SO_2, heavy metals, halogens, TAP	TBD
	Fuel combustion	PM, SO_2, NO_2, CO, VOC	TBD
Paper	De-inking with non-chlorine bleaching operations	VOC	Negligible
	Fuel combustion	PM, SO_2, NO_2, CO, VOC	TBD
Plastics	Blending / extruding	PM and VOC (fugitive) Odour (fugitive)	TBD Negligible
	Moulding	PM and VOC (fugitive)	TBD
Textiles	Sorting and Baling	Nil	Nil
Rubber Tyres	Shredding / grinding	PM (fugitive)	TBD
	Re-treading	PM and VOC (fugitive)	Negligible
Wood	Chipping	PM (fugitive)	Negligible
	Non-chlorine bleaching	Nil	Nil
	Plastic-wood composite manufacturing	PM and VOC (fugitive) Odour (fugitive)	TBD Negligible
	Fuel Combustion	PM, SO_2, NO_2, CO, VOC	TBD
Spent Copper Etchant	Electrolytic and chemical treatment process	Nil	Nil

Note : "TBD" – level of air quality impact at ASRs 'To Be Determined' in the quantitative assessment

Cumulative Impacts

3.6.19 Cumulative fugitive dust emission sources (in short-term) include the C&DMRF, which are now currently occupied the land for the Phase II EcoPark. The existing TMCWSF and PBR2 Sorting Facility will also generate dust impacts. The construction of PAFF will also contribute to the cumulative impacts to the surroundings.

3.6.20 In assessing the cumulative impacts during EcoPark operation, the long-term aerial emissions from the Shiu Wing Steel Mill and Green Island Cement plant have been considered quantitatively, and the impacts from the permanent C&DMHF have been considered qualitatively. For other planned or committed projects in Tuen Mun Area 38, no details are available that would allow consideration in this cumulative assessment. However, EcoPark would be considered as an existing use during any cumulative assessments for those projects.

3.6.21 The aerial emissions from other sources are summarised in Table 3.10, below.

Table 3.10 : Sources of Cumulative Air Emissions

Source of Emission	List of Concerned Air Pollutant Emissions
Shiu Wing Steel Mill	PM, SO_2, NO_2, CO, VOC (from stack) (during operation of EcoPark Phases I + II)
Green Island Cement	PM, SO_2, NO_2 and Heavy Metals (from stack) (during operation of EcoPark Phases I + II)
C&D Material Handling Facility	PM (during operation of EcoPark Phase II)
Temporary Mixed Construction Waste Sorting Facility	PM (during operation of EcoPark Phases I +II until 2010)
Tuen Mun Fill Bank	PM (during operation of EcoPark Phase I only)
C&D Material Recycling / Crushing Facility	PM (during operation of EcoPark Phase I only)
Public Fill Sorting Facility with Barging Facilities for Penny's Bay Reclamation Stage 2	PM (during operation of EcoPark Phase I only)
Permanent Aviation Fuel Facility (Construction)	PM (during operation of EcoPark Phase I+II)

Assessment Criteria

3.6.22 The air quality criteria for this AQIA are summarised in Table 3.11, below.

Table 3.11 : Air Quality Criteria for the Assessment

Pollutant (and its compounds)	**Concentration (mg/m^3) Averaging Time**					
	1-hr	**4-hr**	**8-hr**	**24-hr**	**3-mth**	**Annual**
Total Suspended Particulates (TSP)	–	–	–	260	–	–
Total Respirable Particulates (RSP)	–	–	–	180	–	–
Sulphur Dioxide (SO_2)	800	–	–	350	–	–
Nitrogen Dioxide (NO_2)	300	–	–	150	–	–
Carbon Monoxide (CO)	30,000	–	10,000	–	–	–
Chlorine (Cl_2)	210	–	–	–	–	0.2
Hydrogen Chloride (HCl)	2100	–	–	–	–	20
Fluorine / Fluoride (F)	240	–	–	–	–	13
White Phosphorus (P)		–	–	–	–	0.07
Lead (Pb)	–	–	–	–	1.5	0.5
Beryllium (Be)		–	–	–	–	0.02
Cadmium (Cd)		–	–	–	–	0.005
Mercury (Hg)	1.8	–	–	–	–	1
Nickel (Ni)	6		–	–	–	0.05
Arsenic (As)		0.19	–	–	–	0.03
Tin (Sn)		–	40	–	–	–
Molybdenum (Mo)		–	100	–	–	–
Copper (Cu)	100	–	–	–	–	2.4
Antimony (Sb)	–	–	–	–	–	0.2
Chromium VI (Cr^{6+})	–	–	–	–	–	0.2
Platinum (Pt)	–	–	20	–	–	–
Selenium (Se)	–	–	–	–	–	20
Rhodium (Rh)	–	–	2	–	–	–
Dioxins (TCDD)	–	–	–	–	–	$1x10^{-6}$ I-TEQ

Assessment Methodology

3.6.23 The Industrial Source Complex Short-Term (ISCST3) Gaussian dispersion model developed by the USEPA was used to evaluate the industrial chimney emissions from EcoPark as well as other identified sources. The use of the ISCST3 model is accepted by EPD and has been commonly used in air quality impact assessments.

<u>Meteorological Data</u>

3.6.24 The latest (2002) meteorological data (including hourly wind speed, wind direction, stability class, ambient temperature) measured from the closest Tuen Mun weather station obtained from the Hong Kong Observatory was used in the assessment.

<u>Source of Emissions</u>

3.6.25 The emission inventory of concerned air pollutants from the operation of EcoPark was based on the assumed material throughputs and with reference to relevant emission factors

– particularly those presented in the USEPA document AP-42, "*Compilation of Air Pollution Emission Factors*".

3.6.26 Detailed calculations of emission rates for the recovery processes in EcoPark and the other cumulative sources (as listed in Table 3.10 above) are given in Appendices D.2 and D.3.

Modelling Assumptions and Parameters

3.6.27 All potential air pollutant emissions from individual processes will be collected, treated by APC equipment (as necessary) and discharged through a chimney/vent in the proper manner. Therefore, no uncontrolled fugitive emissions are anticipated and so all emissions from individual processes are assumed to be from a point source for the purposes of assessment.

3.6.28 The detailed assumptions are presented in Table 3.12 :

Table 3.12 : Chimney and Modelling Parameters

Parameter	**Assumption**
Stack height	15m above ground (Scenario 1) 30m above ground (Scenario 2) 15m above ground (Scenario 3) 6m (for Hg emission from fluorescent lamp recovery in ALL scenarios)
Exit temperature: • Combustion related emissions • Non-combustion related emissions	 80^{O}C (including metal recovery process emission) 23.5^{O}C (annual average ambient temperature)
Efflux velocity	9m/s (for PM, SO_2, NO_x, CO, TAPs and VOC) 16.4m/s (for Hg emission from fluorescent lamp recovery)
Stack diameter	1m (for PM, SO_2, NO_x, CO, TAPs and VOC) 0.25m (for Hg emission from fluorescent lamp recovery)
Operating Hours	07:00 – 19:00 hours (12 hours)
Dispersion Options	Rural, Gradual Plume Rise
Meteorology Options – Anemometer Height	69m
Emission Rates	Un-mitigated Scenarios 1 – 3 (Appendix D.2 refers) Mitigated Scenarios 2 – 3 (Appendix D.3 refers)

3.6.29 Until lots are assigned by the Operator and tenants construct their premises and install their plant and equipment, the actual locations of any chimneys within EcoPark cannot be known. Nor any can assumptions be made on the possible future locations of chimneys.

3.6.30 Therefore, the cumulative chimney emissions from all assessed processes have been grouped into a single location, which is a very conservative assumption and will not happen in practice. Nevertheless, this represents the absolute worst-case emission scenario from EcoPark on both offsite and on-site ASRs. Furthermore, the location of this single chimney has been has been assessed at 9 no. different positions within EcoPark (designated A1 to A9) to determine if there is will be constraint on chimney location in terms of air quality impacts. These 9 no. locations are shown in Figure 3.1.

3.6.31 For assessing the cumulative TSP impact of EcoPark Phase I together with Fill Bank Operation, the predicted TSP concentrations as stated in the *Dust Impact Assessment of the Project Profile for Expansion and Extension of Fill Bank at Tuen Mun Area 38* were adopted. The predicted TSP concentrations were calculated based on the following equations, where "all sources" refers to emissions from Green Island Cement, EcoPark and Shiu Wing, but excludes TMCSF :

- **TSP concentration at 1.5m above ground =** Net TSP concentration of EcoPark and Shiu Wing + Max. overall TSP concentration of Fill Bank at 1.5m above ground (i.e., 238µg/m^3).
- **TSP concentration at 4.5m above ground =** Net TSP concentration of EcoPark and Shiu Wing + Max. overall TSP concentration of Fill Bank at 4.5mabove ground (i.e., 221µg/m^3).
- **TSP concentration at 7.5m above ground =** Net TSP concentration of EcoPark and Shiu Wing + Max. overall TSP concentration of Fill Bank at 7.5mabove ground (i.e., 194µg/m^3).
- **TSP concentration at >7.5m above ground =** TSP concentration of all sources excluding TMCSF+ background concentration + max. Fugitive Dust Model (FDM) result of Fill Bank, including all operational dust sources, at 7.5m aboveground (i.e., 90µg/m^3).
- **TSP concentration at Holiday Camp Site =** TSP concentration of all sources excluding TMCSF+ background concentration + max. FDM result of Fill Bank, including all operational dust sources, at Holiday Camp Site (i.e., 13µg/m^3).

3.6.32 For TSP concentrations at 7.5m or below, the approach in assessing the cumulative TSP impact of Ecopark Phase I provides a conservative TSP estimation on ASRs within EcoPark Phase I and other off-site ASRs, except Green Island Cement (GIC) and Fill Bank. Cumulative TSP concentrations at GIC and Fill Bank during EcoPark Phase I operation would be underestimated by this approach and TSP concentrations at GIC and Fill Bank would exceed AQO. However, it should be noted that TSP exceedances at GIC and Fill Bank result from their respective operations and should be viewed as an occupational health issue, rather than an environmental issue in terms of AQOs.

3.6.33 For assessing the cumulative TSP and RSP impact of EcoPark Phase II, dust emissions from EcoPark, Shiu Wing Steel Mill, Green Island Cement and TMCSF were incorporated into the ISCST model.

Receptors

3.6.34 The identified ASRs in the vicinity of EcoPark were presented in Table 3.7. The assessment point of the receptor is assumed to be at an elevation of 1.5m above the local ground level for a single-storey building (to reflect the typical 'breathing zone'), and 1.5m above each subsequent floor level for multi-storey buildings (i.e. assumes an air intake at each floor).

3.6.35 The selected representative worst-case ASRs for the assessment are presented in Table 3.13, below, and shown in Figure 3.2. The acceptability of air quality impacts from the various waste recovery processes upon future occupiers of EcoPark has been evaluated based on the best available information of discrete receptor locations (RP1 to RP15 within EcoPark) as presented in Table 3.13 :

Table 3.13 : Representative ASRs for the Assessment

ASR Ref. ID	Location (Grid Ref.)		Ground Level (mPD)	Assessment Elevation (mPD)
	Northing	Easting		
Shiu Wing Steel Mill – Office Building (1/F-7/F)				
SW1	810481.1	825758.3	7	11.5 – 29.5 (from 1/F to 7/F, 3m/floor)
SW2	810458.4	825729.3	7	11.5 – 29.5 (from 1/F to 7/F, 3m/floor)
Shiu Wing Steel Mill				
SW3	810551.9	825674.9	7	8.5
SW4	810475.8	825577.4	7	8.5
SW5	810411.7	825497.4	7	8.5
SW6	810339.7	825407.3	7	8.5

ASR Ref. ID	Location (Grid Ref.)		Ground Level (mPD)	Assessment Elevation (mPD)
	Northing	Easting		
Green Island Cement				
GIC1	810366.9	825968.4	7	8.5
GIC2	810338.0	825950.7	7	8.5
GIC3	810308.2	825932.5	7	8.5
River Trade Terminal				
RTT1	811489.0	825503.8	7	8.5
RTT2	811468.9	825454.4	7	8.5
RTT3	811450.6	825413.4	7	8.5
RTT4	811429.9	825363.0	7	8.5
Permanent Aviation Fuel Facility (planned)				
PAFF1	810438.3	825428.0	7	8.5
PAFF2	810410.5	825394.6	7	8.5
PAFF3	810385.4	825363.4	7	8.5
Future ASRs at Existing PBR2 Sorting Facility (planned)				
PBR21	810967.5	824905.8	7	8.5
PBR22	811028.6	824999.9	7	8.5
PBR23	811091.6	825089.9	7	8.5
Future ASRs at Existing Fill Bank (planned)				
Plan1	811218.3	825528.4	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan2	811160.4	825451.4	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan3	811097.1	825371.6	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan4	811037.0	825291.4	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan5	810975.8	825212.0	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan6	810914.4	825132.1	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Plan7	810852.9	825050.8	7	8.5 – 38.5 (from 1/F to 10/F, 3m/floor)
Holiday Camp Site (planned)				
HCS1	811283.8	825908.6	60	61.5
HCS2	811333.6	825826.7	60	61.5
HCS3	811444.9	825758.1	40	41.5
HCS4	811482.9	825711.4	40	41.5
Future Tenants in EcoPark (planned)				
RP1	811082.5	825511.4	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP2	810960.7	825351.7	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP3	810838.4	825191.0	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP4	811058.1	825648.1	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP5	811001.0	825573.2	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP6	810938.6	825492.5	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP7	810877.3	825414.4	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP8	810815.3	825333.6	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP9	810755.4	825254.9	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP10	810692.3	825173.5	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP11	810921.3	825632.6	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP12	810799.3	825473.6	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP13	810678.7	825315.6	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP14	810778.7	825611.1	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)
RP15	810533.6	825295.3	7	8.5 – 38.5 (from G/F to 10/F, 3m/ floor)

Assessment Scenarios

3.6.36 The potential air pollutant emissions from the recovery processes to be assessed were summarised in Table 3.9. The potential air quality impacts from recovery process emissions to be determined in the quantitative assessment are summarised in Table 3.14 below, with details in Appendix D.2.

3.6.37 For the purposes of assessment, three scenarios (Scenarios 1, 2 and 3) have been developed to provide a range of possible situations. The rationale for developing these three scenarios is presented in the following paragraphs.

3.6.38 Table 3.14, below, summarises the major assumptions of different assessment scenarios. It should be noted that many of the materials have been assessed at their "buffered" throughputs (determined in Table 1.2). Although for some materials certain process have been removed, this does not affect the overall material throughput (except for Organic Food Waste following the removal of inedible rendering). This is indicated in the Table 3.15 for the avoidance of doubt.

Table 3.14 : Air Pollutant Emissions from the Processes for the Assessment

Material Type	Process	Air Pollutant Emissions
Electronics	Crush-and-sieve of fluorescent lamp	Hg
Glass	Melting / forming and finishing	PM and VOC
	Fuel Combustion	PM, SO_2, NO_2, CO, VOC
Organic Food Waste	Fuel Combustion	PM, SO_2, NO_2, CO, VOC
Non-ferrous Metals	Metal recovery (sweating, melting, refining)	PM, SO_2, heavy metals, halogens, TAP
	Fuel combustion	PM, SO_2, NO_2, CO, VOC
Paper	Fuel combustion	PM, SO_2, NO_2, CO, VOC
Plastics	Extruding	PM and VOC
	Moulding	PM and VOC
Rubber Tyres	Grinding	PM
Wood	Plastic-wood composite manufacturing	PM and VOC
	Fuel combustion	PM, SO_2, NO_2, CO, VOC

Scenario 1

3.6.39 Fuel combustion-related emissions have been assessed based on a fuel consumption rate of 15,781 /hr. This has been determined by using the fuel consumption for processing glass (42,680tpa), non-ferrous metals (10,000tpa) and paper (200,000tpa). Fuel consumption for organic food waste and wood recovery were estimated by adopting a conservative percentage of the combined consumption for glass, non-ferrous metals and paper. Detailed energy consumption calculations are presented in Annex 7 of Appendix D.2.

3.6.40 This scenario represents no control of fuel consumption for these processes and it is anticipated that NO_2 emission from fuel combustion and other parameters will significantly exceed the AQO.

Scenario 2

3.6.41 In Scenario 1, heavy metals and TAP emissions from non-ferrous metal recovery processes will likely exceed relevant criteria. Therefore, a more moderate Scenario 2 has also been considered that reduces the overall fuel consumption rate and total throughput for non-ferrous metal recovery and increases the stack height to allow for better dispersion.

3.6.42 Scenario 2 assumes a reduced fuel consumption of 7,500 /hr for the entire EcoPark and that the total throughput for non-ferrous metal recovery processes is reduced to 2,500tpa. The stack height has been increased from 15m to 30m above ground.

Scenario 3

3.6.43 In Scenario 2, TAPs (particularly dioxins) may be generated in measurable quantities from non-ferrous metal recovery processes. Therefore, a more conservative Scenario 3 has also been considered that further reduces fuel consumption and excludes non-ferrous metal recovery processes. Moreover, a 30m high chimney may be an issue in terms of the visual impact of EcoPark and so this has been reduced in height.

3.6.44 Scenario 3 assumes a reduced fuel consumption rate of 3,500 /hr for the entire EcoPark and that non-ferrous metal recovery process will not be carried out. The stack height has been reduced from 30m to 15m above ground, as in Scenario 1.

3.6.45 Table 3.15 summarises the major assumptions of different assessment scenarios :

Table 3.15 : Major Assumptions of Different Assessment Scenarios

Material Type	Using Buffered Throughputs from Table 2.2	Consuming Liquid Fuel (ULSD)	Using All Processes from Table B.1	Material Throughput (tpa)		
				Scenario 1	Scenario 2	Scenario 3
Batteries	✓			2,240	2,240	2,240
Electronics	✓		✓	25,100	25,100	25,100
Glass	✓	✓	✓	42,680	42,680	42,680
Organic Food Waste (1)		✓		19,750	19,750	19,750
Ferrous Metals (2)	✓			270,380	270,380	270,380
Non-ferrous Metals (3)		✓	✓	10,000	2,500	0
Paper (4)		✓	✓	200,000	200,000	200,000
Plastics	✓		✓	102,740	102,740	102,740
Textiles	✓		✓	8,010	8,010	8,010
Rubber Tyres	✓		✓	20,020	20,020	20,020
Wood	✓	✓	✓	41,260	41,260	41,260
Spent Copper Etchant	✓		✓	3,290	3,290	3,290
Fuel Consumption (/hr) (ULSD) (5)				15,781	7,500	3,500
Chimney Height (m)				15	30	15

Notes:
1. Inedible Rendering (Organic Food Waste) has been initially screened-out because of odour impacts. As a result, the throughput for Organic Food Waste has decreased overall, although In-vessel Composting remains and has been assumed at "buffered" throughput.
2. Melting of Ferrous Metals has been initially screened-out in order to maximise processing throughput of metals while minimising air quality impacts. However, the remaining processes (Sorting, Bailing, Shearing and Shredding) are assumed at "buffered" throughput, and do not consume liquid fuel.
3. To reduce fuel combustion-related air quality impacts, the throughput for Melting/Sweating/Refining/ Leaching (Non-ferrous Metals) has been reduced as shown, although all other processes are assumed at "buffered" throughput. The full range of processes has been assumed except for Scenario 3, where the throughput of Melting/Sweating/Refining/Leaching has been reduced to zero.
4. To reduce fuel combustion-related air quality impacts, the throughput for Pulping/Cleaning/De-inking/Bleaching/Additives/Pressing of Secondary Fibres (Paper) has been reduced as shown, although all other processes are assumed at "buffered" throughput.
5. Energy consumptions of glass, non-ferrous metals and paper were calculated based on the material throughput. Energy consumption of organic food waste and wood were calculated as 10% of the total fuel consumption of glass, non-ferrous metals and paper. Refer to Annex 7 of the Appendix D.2 for detailed calculations.

Evaluation of Potential Impacts

<u>Chimney Emissions from the Processes</u>

Scenario 1

3.6.46 According to the assessment results of Scenario 1, all criteria pollutants (except CO) will exceed the air quality standards at the ASRs. Tables 3.16 and 3.17 summarise the assessment results arising from the 9 no. different source locations, and shows the maximum predicted concentration (at the most affected ASR). Detailed results for all ASRs are presented in Appendix D.4.

Table 3.16 : Summary of Assessment Results at Existing/Planned Off-site ASRs – Scenario 1 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m³) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	1161	739	1463	2275	597	524	598	448	483
TSP (Ph II)	24-hour	260	3792	3448	3322	2185	886	446	474	321	427
RSP	24-hour	180	3755	3412	3286	2149	850	410	438	284	390
Sulphur Dioxide	1-hour	800	22207	21221	21081	23680	6524	5485	5393	4335	5683
	24-hour	350	5236	4752	4573	2969	1134	514	555	322	438
Nitrogen Dioxide	1-hour	300	1851	1772	1760	1970	582	500	493	408	516
	24-hour	150	480	441	427	297	149	99	102	83	93
Carbon Monoxide	1-hour	30000	2849	2766	2754	2972	1526	1441	1434	1345	1458
	8-hour	10000	1735	1687	1682	1726	1165	1106	1109	1051	1084
VOC	Annual	–	39	34	33	10	7	7	7	7	5
Chlorine	1-hour	210	8972	8573	8517	9561	2581	2210	2173	1746	2291
	Annual	0.2	113	110	109	38	30	29	37	23	13
Hydrogen Chloride	1-hour	2100	14953	14289	14195	15935	4302	3684	3622	2909	3818
	Annual	20	188	183	182	63	49	48	61	38	21
Fluorine/ Fluoride	1-hour	240	2991	2858	2839	3187	860	737	724	582	764
	Annual	13	38	37	36	13	10	10	12	8	4
White Phos.	Annual	0.07	38	37	36	13	10	10	12	8	4
Lead	3-month	1.5	560	527	515	85	126	39	49	34	32
	Annual	0.5	79	77	77	26	21	20	26	16	9
Beryllium	Annual	0.02	0.008	0.007	0.007	0.003	0.002	0.002	0.003	0.002	0.001
Cadmium	Annual	0.005	3.756	3.672	3.648	1.254	0.986	0.966	1.232	0.766	0.426
Mercury	1-hour	1.8	299.1	285.8	283.9	318.7	86.0	73.7	72.4	58.2	76.4
	Annual	1	3.8	3.7	3.6	1.3	1.0	1.0	1.2	0.8	0.4
Nickel	1-hour	6	2991	2858	2839	3187	860	737	724	582	764
	Annual	0.05	37.54	36.70	36.46	12.52	9.84	9.64	12.31	7.64	4.24
Arsenic	4-hour	0.19	371.4	357.3	354.8	394.9	90.2	62.1	63.7	44.4	65.4
	Annual	0.03	7.51	7.34	7.30	2.51	1.97	1.93	2.47	1.53	0.85
Tin	8-hour	40	1809	1695	1682	1785	441	298	302	167	245
Molybdenum	8-hour	100	1206	1130	1121	1190	294	199	201	111	163
Copper	1-hour	100	5982	5716	5678	6374	1721	1474	1449	1164	1527
	Annual	2.4	75.3	73.6	73.1	25.2	19.9	19.5	24.8	15.5	8.7
Antimony	Annual	0.2	18.8	18.3	18.2	6.3	4.9	4.8	6.1	3.8	2.1
Chromium VI	Annual	0.2	0.17	0.17	0.16	0.06	0.05	0.05	0.06	0.04	0.02
Platinum	8-hour	20	241	226	224	238	59	40	40	22	33
Selenium	Annual	20	8	7	7	3	2	2	2	2	1
Rhodium	8-hour	2	121	113	112	119	29	20	20	11	16
Dioxins	Annual	1×10^{-6} I-TEQ	0.8×10^{-6} I-TEQ	0.8×10^{-6} I-TEQ	0.7×10^{-6} I-TEQ	0.3×10^{-6} I-TEQ	0.3×10^{-6} I-TEQ	0.3×10^{-6} I-TEQ	0.3×10^{-6} I-TEQ	0.2×10^{-6} I-TEQ	0.2×10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	0.07	0.07	0.07	0.02	0.02	0.02	0.02	0.01	0.01

Note : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Table 3.17 : Summary of Assessment Results at Internal ASRs Within EcoPark – Scenario 1 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (μg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	4312	4200	4197	2474	3674	3981	2547	2213	1271
TSP (Ph II)	24-hour	260	4222	4110	4107	2384	3584	3891	2457	2123	1181
RSP	24-hour	180	4185	4073	4070	2348	3548	3855	2421	2087	1144
Sulphur Dioxide	1-hour	800	20845	23077	22870	22407	22340	22363	22909	22362	12385
	24-hour	350	5844	5685	5681	3250	4943	5377	3353	2872	1546
Nitrogen Dioxide	1-hour	300	1741	1921	1905	1867	1862	1864	1908	1864	1058
	24-hour	150	529	517	516	320	457	492	328	289	182
Carbon Monoxide	1-hour	30000	2734	2922	2904	2865	2860	2862	2908	2862	2022
	8-hour	10000	1979	1949	1942	1569	1790	1910	1694	1702	1261
VOC	Annual	–	40	40	42	43	35	38	28	10	10
Chlorine	1-hour	210	8422	9324	9240	9053	9026	9035	9256	9035	5001
	Annual	0.2	195	189	187	182	160	182	127	37	38
Hydrogen Chloride	1-hour	2100	14036	15540	15400	15088	15043	15059	15427	15058	8334
	Annual	20	324	315	312	304	267	303	211	61	63
Fluorine/ Fluoride	1-hour	240	2807	3108	3080	3018	3009	3012	3085	3012	1667
	Annual	13	65	63	62	61	53	61	42	12	13
White Phos.	Annual	0.07	65	63	62	61	53	61	42	12	13
Lead	3-month	1.5	345	335	333	208	543	539	200	84	160
	Annual	0.5	136	132	131	128	112	127	89	26	26
Beryllium	Annual	0.02	0.013	0.013	0.013	0.012	0.011	0.012	0.009	0.003	0.003
Cadmium	Annual	0.005	6.488	6.299	6.250	6.085	5.339	6.068	4.226	1.225	1.257
Mercury	1-hour	1.8	280.7	310.8	308.0	301.8	300.9	301.2	308.5	301.2	166.7
	Annual	1	6.5	6.3	6.2	6.1	5.3	6.1	4.2	1.2	1.3
Nickel	1-hour	6	2807	3108	3080	3018	3009	3012	3085	3012	1667
	Annual	0.05	64.86	62.97	62.48	60.83	53.37	60.66	42.24	12.23	12.55
Arsenic	4-hour	0.19	398.0	386.9	382.6	287.6	338.6	376.7	367.6	374.5	143.9
	Annual	0.03	12.98	12.60	12.50	12.17	10.68	12.14	8.45	2.45	2.51
Tin	8-hour	40	2396	2324	2307	1411	1944	2230	1710	1730	672
Molybdenum	8-hour	100	1598	1549	1538	941	1296	1487	1140	1153	448
Copper	1-hour	100	5615	6216	6160	6036	6018	6024	6171	6023	3334
	Annual	2.4	129.9	126.1	125.2	121.9	106.9	121.5	84.7	24.7	25.3
Antimony	Annual	0.2	32.4	31.5	31.2	30.4	26.7	30.3	21.1	6.1	6.3
Chromium VI	Annual	0.2	0.29	0.28	0.28	0.27	0.24	0.27	0.19	0.06	0.06
Platinum	8-hour	20	320	310	308	188	259	297	228	231	90
Selenium	Annual	20	13	13	12	12	11	12	8	2	3
Rhodium	8-hour	2	160	155	154	94	130	149	114	115	45
Dioxins*	Annual	1 x 10^{-6} I-TEQ	1.3 x 10^{-6} I-TEQ	1.2 x 10^{-6} I-TEQ	1.2 x 10^{-6} I-TEQ	1.2 x 10^{-6} I-TEQ	1.1 x 10^{-6} I-TEQ	1.2 x 10^{-6} I-TEQ	0.9 x 10^{-6} I-TEQ	0.3 x 10^{-6} I-TEQ	0.3 x 10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	0.10	0.10	0.10	0.09	0.08	0.09	0.06	0.02	0.02

Notes : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

3.6.47 The result findings of Scenario 1 are summarised in Table 3.18, below.

Table 3.18 : Summary Assessment of Findings – Scenario 1 (Unmitigated)

Pollutants	Existing/ Planned Off-site ASRs	Internal ASRs Within EcoPark
PM	Both Phases I and II TSP and RSP concentrations highly exceed AQOs, mainly due to fuel combustion and demagging of the secondary aluminium	Both Phases I and II TSP and RSP concentrations highly exceed AQOs, mainly due to fuel combustion and demagging of the secondary aluminium
SO_2	Highly exceed AQOs mainly due to secondary lead recovery process	Highly exceed AQOs mainly due to secondary lead recovery process
NO_2	Highly exceed AQOs mainly due to fuel combustion	Highly exceed AQOs mainly due to fuel combustion
CO	Existing air quality condition will not be worsened significantly	Existing air quality condition will not be worsened significantly
Dioxin	Existing air quality condition will not be worsened significantly	Exceed the ambient limit level
Heavy metals & TAPs	Highly exceed the criteria mainly due to non-ferrous metal process	Highly exceed the criteria mainly due to non-ferrous metal process
Cancer Risk	Highly exceed the criterion	Highly exceed the criterion

3.6.48 Exceedance of the air quality standards has been identified to be mainly associated with fuel combustion and process emissions from non-ferrous metal recovery. As unmitigatable impacts were predicted, this scenario has been abandoned. Furthermore, from this scenario it has been proved that a reduction in total fuel consumption and the material throughput for the non-ferrous metal recovery process will be necessary.

Scenario 2

3.6.49 After reducing the total fuel consumption (i.e., 7,500 /hr) for EcoPark and the material throughput for non-ferrous metal recovery (i.e. 2,500tpa), Tables 3.19 and 3.20 present the maximum concentration (at the most affected ASR), with detailed results presented in Appendix D.4.

Table 3.19 : Summary of Assessment Results at Existing/Planned Off-site ASRs – Scenario 2 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	315	282	283	271	281	267	274	264	265
TSP (Ph II)	24-hour	260	501	467	454	272	271	271	273	275	271
RSP	24-hour	180	464	431	417	235	235	234	237	239	235
Sulphur Dioxide	1-hour	800	2375	1757	1745	2041	1408	944	744	791	1154
	24-hour	350	571	525	507	206	173	112	113	79	107
Nitrogen Dioxide	1-hour	300	416	323	321	362	257	199	169	166	220
	24-hour	150	143	136	133	86	82	73	72	68	72
Carbon Monoxide	1-hour	30000	1354	1256	1254	1298	1188	1128	1096	1093	1149
	8-hour	10000	1163	1148	1143	1064	1037	1022	1024	1009	1008
VOC	Annual	–	12	12	11	3	4	3	4	2	1
Chlorine	1-hour	210	941	694	689	794	515	370	290	264	424
	Annual	0.2	8.5	8.4	8.3	3.7	4.1	4.1	5.6	3.5	1.6
Hydrogen Chloride	1-hour	2100	1568	1157	1149	1323	858	616	483	439	707
	Annual	20	14	14	14	6	7	7	9	6	3
Fluorine/ Fluoride	1-hour	240	314	231	230	265	172	123	97	88	141
	Annual	13	3	3	3	1	1	1	2	1	1
White Phos.	Annual	0.07	2.85	2.80	2.78	1.23	1.36	1.36	1.86	1.17	0.53
Lead	3-month	1.5	49.0	46.7	45.8	5.9	17.7	6.5	7.5	4.3	5.9
	Annual	0.5	6.1	6.0	5.9	2.7	2.9	2.9	4.0	2.5	1.2
Beryllium	Annual	0.02	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Cadmium	Annual	0.005	0.287	0.283	0.280	0.126	0.126	0.138	0.189	0.120	0.056
Mercury	1-hour	1.8	31.4	23.1	23.0	26.5	17.1	12.3	9.7	8.8	14.1
	Annual	1	0.3	0.3	0.3	0.1	0.1	0.1	0.2	0.1	0.1
Nickel	1-hour	6	314	231	230	265	172	123	97	88	141
	Annual	0.05	2.85	2.81	2.78	1.24	1.36	1.36	1.87	1.18	0.54
Arsenic	4-hour	0.19	32.24	29.44	28.28	20.68	16.60	12.24	10.61	8.79	8.93
	Annual	0.03	0.58	0.57	0.56	0.25	0.28	0.28	0.38	0.24	0.11
Tin	8-hour	40	229	211	204	102	70	51	51	34	33
Molybdenum	8-hour	100	153	141	136	68	46	34	34	22	22
Copper	1-hour	100	627	463	460	529	343	247	193	176	283
	Annual	2.4	5.9	5.8	5.8	2.7	2.9	2.9	3.9	2.6	1.3
Antimony	Annual	0.2	1.4	1.4	1.4	0.6	0.7	0.7	0.9	0.6	0.3
Chromium VI	Annual	0.2	0.017	0.017	0.016	0.010	0.010	0.010	0.012	0.009	0.007
Platinum	8-hour	20	31	28	27	14	9	7	7	4	4
Selenium	Annual	20	0.557	0.248	0.273	0.273	0.374	0.236	0.108	0.002	0.002
Rhodium	8-hour	2	15	14	14	7	5	3	3	2	2
Dioxins	Annual	1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	4.9 x 10^{-3}	4.8 x 10^{-3}	4.8 x 10^{-3}	2.1 x 10^{-3}	1.9 x 10^{-3}	2.3 x 10^{-3}	3.2 x 10^{-3}	2.0 x 10^{-3}	9.1 x 10^{-4}

Notes : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Table 3.20 : Summary of Assessment Results at Internal ASRs Within EcoPark – Scenario 2 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	392	449	469	476	566	567	395	321	327
TSP (Ph II)	24-hour	260	302	359	379	386	476	477	305	231	237
RSP	24-hour	180	266	323	343	350	440	440	268	194	201
Sulphur Dioxide	1-hour	800	1673	2073	1946	1790	1899	1774	2057	1877	1220
	24-hour	350	301	379	406	416	538	538	304	201	213
Nitrogen Dioxide	1-hour	300	310	370	351	327	344	325	368	340	241
	24-hour	150	102	113	118	119	138	138	102	86	88
Carbon Monoxide	1-hour	30000	1243	1306	1286	1261	1279	1259	1304	1275	1171
	8-hour	10000	1079	1105	1112	1115	1153	1153	1076	1064	1041
VOC	Annual	–	13	18	19	19	12	12	10	3	5
Chlorine	1-hour	210	661	820	770	707	751	701	814	741	480
	Annual	0.2	8.4	17.3	18.1	18.5	8.5	8.5	7.3	2.0	5.1
Hydrogen Chloride	1-hour	2100	1101	1367	1283	1179	1252	1168	1357	1235	799
	Annual	20	14	29	30	31	14	14	12	3	8
Fluorine/ Fluoride	1-hour	240	220	273	257	236	250	234	271	247	160
	Annual	13	3	6	6	6	3	3	2	1	2
White Phos.	Annual	0.07	2.79	5.76	6.04	6.15	2.82	2.82	2.44	0.66	1.69
Lead	3-month	1.5	15.0	23.3	23.4	23.9	47.4	47.4	12.7	5.9	20.9
	Annual	0.5	5.9	12.2	12.8	13.0	6.0	6.0	5.2	1.5	3.6
Beryllium	Annual	0.02	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000
Cadmium	Annual	0.005	0.282	0.578	0.607	0.618	0.618	0.284	0.246	0.068	0.172
Mercury	1-hour	1.8	22.0	27.3	25.7	23.6	25.0	23.4	27.1	24.7	16.0
	Annual	1	0.3	0.6	0.6	0.6	0.3	0.3	0.2	0.1	0.2
Nickel	1-hour	6	220	273	257	236	250	234	271	247	160
	Annual	0.05	2.80	5.77	6.05	6.16	2.83	2.82	2.44	0.67	1.70
Arsenic	4-hour	0.19	21.30	27.67	30.15	31.00	30.17	30.22	19.31	19.66	15.40
	Annual	0.03	0.56	1.16	1.21	1.24	0.57	0.57	0.49	0.14	0.34
Tin	8-hour	40	123	156	165	168	217	216	119	103	75
Molybdenum	8-hour	100	82	104	110	112	144	144	80	68	50
Copper	1-hour	100	441	547	513	472	501	468	543	494	320
	Annual	2.4	5.8	11.7	12.3	12.5	5.8	5.8	5.1	1.5	3.6
Antimony	Annual	0.2	1.4	2.9	3.0	3.1	1.4	1.4	1.2	0.3	0.8
Chromium VI	Annual	0.2	0.017	0.030	0.031	0.031	0.017	0.017	0.015	0.007	0.012
Platinum	8-hour	20	16	21	22	22	29	29	16	14	10
Selenium	Annual	20	1.210	1.232	0.566	0.565	0.489	0.134	0.340	0.002	0.002
Rhodium	8-hour	2	8	10	11	11	14	14	8	7	5
Dioxins	Annual	1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.2 x 10^{-6} I-TEQ	0.2 x 10^{-6} I-TEQ	0.2 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ	0.1 x 10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	4.8 x 10^{-3}	9.9 x 10^{-3}	1.0 x 10^{-2}	1.1 x 10^{-2}	4.8 x 10^{-3}	4.8 x 10^{-3}	4.2 x 10^{-3}	1.1 x 10^{-3}	2.9 x 10^{-3}

Notes : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

3.6.50 The result findings of Scenario 2 are summarised in Table 3.21 :

Table 3.21 : Summary of Assessment Findings – Scenario 2 (Unmitigated)

Pollutants	Existing/Planned Off-site ASRs	Internal ASRs Within EcoPark
PM	Both Phases I and II TSP and RSP concentrations are significant, mainly due to high PM emission from demagging of the secondary aluminium.	Both Phases I and II TSP and RSP concentrations are significant, mainly due to high PM emission from demagging of the secondary aluminium.
SO_2	Significant impacts, mainly from secondary lead process	Significant impacts, mainly from secondary lead process
NO_2	Except emissions at source location A1 and 10/F of the future planned use of Fill Bank, existing air quality condition will not be worsened significantly	Selected ASRs up to 9/F will not experience adverse air quality impacts
Dioxin	Existing air quality condition will not be worsened significantly	Existing air quality condition will not be worsened significantly
Heavy Metals & TAPs	Most of the predicted concentrations are significant, mainly due to non-ferrous metal process	Most of the predicted concentrations are significant mainly due to non-ferrous metal process
Cancer Risk	Significant adverse impact	Significant adverse impact

3.6.51 According to the assessment results, limiting the throughput of non-ferrous metals to 2,500tpa and restricting fuel consumption to 7,500 /hr would significantly reduce the air quality impacts. However, the predicted NO_2 concentration from source location A1 upon the planned campsite, high elevation internal ASRs and future ASRs in the existing Fill Bank area will still exceed the AQO. Therefore, the chimney location (in relation to the source of fuel combustion emissions) and the fresh-air intake location of ASRs in EcoPark and future ASRs in the existing Fill Bank area must be restricted.

3.6.52 It has been identified in the calculated emission rates (summarised in Appendix D.2) that 'demagging', which is associated with the secondary aluminium process, is the dominant source of dust impacts. It is not considered feasible to mitigate this level of dust with the assumed APC equipment and therefore it is proposed that the 'demagging' process is removed at this time.

3.6.53 Based on calculated emission rates presented in Appendix D.2, significant SO_2 emissions will be generated from the secondary lead process. Therefore, suitable control devices (such as a wet scrubber) shall be required to further mitigate residual impacts.

Scenario 3

3.6.54 In Scenario 3 the total fuel consumption rate has been further reduced to 3,500 /hr, and non-ferrous metal recovery has been removed. As such, no heavy metals (except Hg from fluorescent lamp recovery) and TAP emissions will be generated. Tables 3.22 and 3.23, below, present the maximum concentrations (at the most affected ASRs) and detailed results are presented in Appendix D.4.

3.6.55 The result findings of Scenario 3 are summarised in Table 3.24, below. According to the assessment results, the NO_2 concentrations predicted in between the 6/F and 10/F of internal ASRs would exceed the AQO. Therefore, it will be necessary to place a restriction on the elevation of the fresh in-take in accordance with EPD guidelines.

Table 3.22 : Summary of Assessment Results at Existing/Planned Off-site ASRs – Scenario 3 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	242	243	243	242	242	241	243	241	240
TSP (Ph II)	24-hour	260	270	270	270	270	270	270	270	270	270
RSP	24-hour	180	234	234	234	234	234	234	234	234	234
Sulphur Dioxide	1-hour	800	227	227	227	227	232	227	227	229	231
	24-hour	350	40	40	39	40	40	39	39	39	40
Nitrogen Dioxide	1-hour	300	456	439	436	483	181	157	155	136	160
	24-hour	150	152	144	140	112	79	68	68	65	67
Carbon Monoxide	1-hour	30000	1396	1377	1375	1424	1109	1084	1082	1062	1087
	8-hour	10000	1149	1138	1137	1148	1022	1010	1011	997	1004
VOC	Annual	–	38	33	32	9	7	6	7	7	5
Mercury	1-hour	1.8	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Annual	1	4 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}

Notes : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Table 3.23 : Summary of Assessment Results at Internal ASRs Within EcoPark – Scenario 3 (Unmitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	241	241	243	241	242	242	241	241	243
TSP (Ph II)	24-hour	260	151	151	153	152	151	151	151	151	152
RSP	24-hour	180	115	115	116	115	115	115	115	115	115
Sulphur Dioxide	1-hour	800	125	125	125	125	125	126	139	128	125
	24-hour	350	36	35	35	34	34	34	39	34	34
Nitrogen Dioxide	1-hour	300	432	472	468	460	459	459	469	459	280
	24-hour	150	163	160	160	117	147	155	119	110	86
Carbon Monoxide	1-hour	30000	1370	1412	1408	1399	1398	1398	1409	1398	1212
	8-hour	10000	1203	1196	1194	1112	1161	1187	1140	1141	1044
VOC	Annual	–	39	38	40	42	35	37	27	9	10
Mercury	1-hour	1.8	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Annual	1	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}	3 x 10^{-4}

Notes : Predicted concentrations highlighted exceed the relevant standard.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Table 3.24 : Summary of Assessment Findings – Scenario 3 (Unmitigated)

Pollutants	Existing/Planned Off-site ASRs	Internal ASRs Within EcoPark
PM	Contribution to the existing baseline air quality is insignificant for both Phases I and II TSP/RSP*	Contribution to the existing baseline air quality is insignificant for both Phases I and II TSP/RSP.
NO_2	Existing air quality condition will not be worsened significantly except the ASRs of the future planned uses in Fill Bank up to 6/F	Existing air quality condition will not be worsened significantly at the ASRs up to 6/F
SO_2	Existing air quality condition will not be worsened significantly.	Existing air quality condition will not be worsened significantly
CO	Existing air quality condition will not be worsened significantly	Existing air quality condition will not be worsened significantly
Hg	Existing air quality condition will not be worsened significantly	Existing air quality condition will not be worsened significantly

Notes : * The predicted dust concentration at Green Island Cement (GIC) will exceed the AQOs. However, the dust impact is mainly contributed by GIC (>99%) only which is considered an occupational health issue.
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Odour Emission from the Wastewater Treatment Facility

3.6.56 The technology assumed for the EcoPark WTF is sulphide precipitation, which is an established means for treating wastewater containing Pb, Cu, Ag, Cd, Zn, Hg, Ni, Ti, As, Sb and V. It is not appropriate to specify a bespoke system at this stage, since that choice will be made during the follow-on D&C consultancy. Notwithstanding, undetectable odour emissions from the WTP are easily achievable with existing abatement technologies and so the assumption of negligible odour from the WTP is certainly realistic and it is recommended that this be made a requirement for the design of the WTF.

3.6.57 The chosen insoluble sulphide process operates on the principle that FeS will dissociate into ferrous ions and sulphide ions to the degree predicted by its solubility product. As sulphide ions are consumed, additional FeS will dissociate to maintain the equilibrium concentration of sulphide ions. Therefore, only a low concentration of dissociated sulphide ions (~0.02ppb) will remain in the wastewater, which prevents formation of H_2S at detectable levels, and thus odour.

3.6.58 High concentrations of VOCs in wastewater arising from the recovery processes are not expected. However, insignificant quantities of VOCs could be present in the wastewater from accidental spillages, e.g., of organic solvents used in metal degreasing. The use of a compact activated carbon adsorption unit for such situations is recommended to prevent detectable VOC emission from the WTP.

Vehicle and Marine Vessel Emissions from Transportation

3.6.59 According to Tables 11.1 of the Road Traffic Impact Assessment (RTIA) for this Study, the predicted year 2009 (i.e. Phase I + II) total AM peak hour traffic volume along Lung Mun Road will be approximately 4,900pcu/hr (all local traffic). Of this total, according to Table 12.1 of the RTIA, only 344pcu/hr (~7%) will be associated with EcoPark. As such, no adverse air quality impacts associated with EcoPark road vehicle emissions are anticipated.

3.6.60 According to Table 2.3 of the Marine Traffic Impact Assessment (MTIA) Report for this Study, only 48 vessel movements / day will be associated with EcoPark. Moreover, according to the length of marine frontage of EcoPark, fewer than 6 marine vessels will be stationary for material loading / unloading at any one time. As the horizontal distance separation between these stationary vessels and the internal ASRs is >50m, it is anticipated that the impacts from marine vessel exhaust emissions on the on-site (and off-site) ASRs will be negligible. In addition, the 48 vessel movement/ day generated from EcoPark contributes to the total marine traffic of the HKSAR are considered negligible.

Therefore, no adverse marine vessel emissions from EcoPark upon the ASRs along the navigation route(s) are anticipated.

Mitigation Measures

Scenario 1

3.6.61 This scenario will not be adopted in EcoPark due to the unacceptable air quality impacts, no mitigation measures are proposed. It is further recognized that this scenario would essentially be unmitigatable due to the wide range and high concentrations of air pollutants.

Scenario 2

Removing Demagging from Secondary Aluminium Process

3.6.62 As stated in Section 3.6.52, the TSP/ RSP concentration will slightly exceed the AQO, with the major dust contribution being the demagging process from the secondary aluminium recovery. As such, demagging from the secondary aluminium process has been removed in order to reduce the overall dust impacts.

Control of Heavy Metals and TAPs Emissions from the Non-ferrous Metal Recovery

3.6.63 Although the demagging process of secondary aluminium has been removed, the predicted heavy metal and TAP concentrations from the non-ferrous metal recovery process still exceed the impact evaluation criteria. Therefore, the heavy metal and TAPs emissions should be further mitigated by reducing the heavy metal and TAP emission rates.

3.6.64 For dust and heavy metals except mercury, fabric filters are proposed as the abatement technique. For the other gaseous pollutants including chlorine, hydrogen chloride, fluorine/fluoride and mercury, abatement techniques as recommended in the 1996 EU Directive on *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Non Ferrous Metals Industries* are proposed.

3.6.65 The controlled emission rates for heavy metals and TAPs are specified in Appendix D.3.

Wet-Scrubber

3.6.66 As stated in Section 3.6.52, SO_2 control equipment should be installed to further reduce the SO_2 emission from the secondary lead process to an acceptable level. Adoption of a wet-scrubber is proposed.

Chimney Location Restrictions

3.6.67 For NO_2 emissions from fuel combustion, the chimney location will be restricted. Figure 3.3 shows the restricted area within which no chimney may be installed.

Fresh Air Intake Restrictions

3.6.68 According to the Section 2.4(ii) of the EPD's *Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models*, the restricted height range will be the region of unacceptable air quality plus a 10m safety margin added to both lower and upper ends. Based on the assessment results of Scenario 2, the unacceptable air quality was predicted at 32.5mPD. Therefore, the fresh air intake locations of the internal ASRs in EcoPark should be restricted to 22.5mPD in order to comply with the EPD's guidelines as well as the air quality criteria. These fresh air intake restrictions will also be imposed to the future uses in the existing Fill Bank area.

3.6.69 Assessment results of Scenario 2 after adopting the above mitigation measures are summarised in Tables 3.25 and 3.26, and detailed calculations are presented in Appendix D.5.

Table 3.25 : Summary of Assessment Results at Existing/Planned Off-site ASRs – Scenario 2 (Mitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	N/A	242	243	241	242	241	242	241	241
TSP (Ph II) *	24-hour	260	N/A	177	177	177	177	177	177	177	177
RSP	24-hour	180	N/A	141	141	141	141	141	141	141	141
Sulphur Dioxide	1-hour	800	N/A	337	243	227	429	227	227	293	373
	24-hour	350	N/A	62	50	41	56	45	44	43	47
Nitrogen Dioxide	1-hour	300	N/A	278	213	176	257	199	169	166	220
	24-hour	150	N/A	86	78	67	80	73	71	68	72
Carbon Monoxide	1-hour	30000	N/A	1210	1143	1103	1188	1128	1096	1093	1149
	8-hour	10000	N/A	1040	1022	1004	1037	1019	1011	1009	1008
VOC	Annual	–	N/A	2	2	2	2	3	4	2	1
Chlorine	1-hour	210	N/A	3	2	2	3	2	2	1	2
	Annual	0.2	N/A	0.020	0.014	0.021	0.014	0.023	0.031	0.020	0.009
Hydrogen Chloride	1-hour	2100	N/A	65	46	35	58	42	33	30	48
	Annual	20	N/A	0.40	0.27	0.41	0.28	0.46	0.63	0.39	0.18
Fluorine/ Fluoride	1-hour	240	N/A	8	6	4	7	5	4	4	6
	Annual	13	N/A	0.050	0.034	0.052	0.035	0.057	0.078	0.049	0.022
White Phos.	Annual	0.07	N/A	0.009	0.006	0.010	0.006	0.010	0.014	0.009	0.004
Lead	3-month	1.5	N/A	0.187	0.195	0.173	0.254	0.180	0.216	0.160	0.167
	Annual	0.5	N/A	0.130	0.116	0.131	0.117	0.136	0.154	0.129	0.105
Beryllium	Annual	0.02	N/A	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Cadmium	Annual	0.005	N/A	0.0036	0.0033	0.0035	0.0033	0.0036	0.0040	0.0035	0.0030
Mercury	1-hour	1.8	N/A	0.163	0.115	0.091	0.146	0.105	0.088	0.084	0.120
	Annual	1	N/A	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
Nickel	1-hour	6	N/A	1.49	1.05	0.80	1.33	0.95	0.75	0.68	1.09
	Annual	0.05	N/A	0.016	0.013	0.016	0.013	0.017	0.021	0.015	0.011
Arsenic	4-hour	0.19	N/A	0.132	0.097	0.063	0.134	0.100	0.079	0.073	0.074
	Annual	0.03	N/A	0.007	0.007	0.007	0.007	0.008	0.008	0.007	0.006
Tin	8-hour	40	N/A	0.57	0.40	0.22	0.54	0.36	0.28	0.26	0.26
Molybdenum	8-hour	100	N/A	0.38	0.26	0.14	0.36	0.24	0.18	0.17	0.17
Copper	1-hour	100	N/A	3.19	2.31	1.80	2.86	2.11	1.70	1.57	2.40
	Annual	2.4	N/A	0.225	0.220	0.226	0.220	0.228	0.236	0.225	0.215
Antimony	Annual	0.2	N/A	0.005	0.003	0.005	0.003	0.005	0.007	0.005	0.002
Chromium VI	Annual	0.2	N/A	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Platinum	8-hour	20	N/A	0.076	0.053	0.029	0.072	0.048	0.037	0.035	0.034
Selenium	Annual	20	N/A	0.004	0.003	0.004	0.003	0.004	0.005	0.004	0.003
Rhodium	8-hour	2	N/A	0.038	0.026	0.014	0.036	0.024	0.018	0.017	0.017
Dioxins	Annual	1×10^{-6} I-TEQ	N/A	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	N/A	2×10^{-5}	1×10^{-5}	2×10^{-5}	1×10^{-5}	2×10^{-5}	3×10^{-5}	2×10^{-5}	7×10^{-6}

Notes : Predicted concentrations highlighted exceed the relevant standard (no exceedances predicted).

Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

* The predicted dust concentration at Green Island Cement (GIC) will exceed the AQOs. However, the dust impact is mainly contributed by GIC only (>99%) which is considered as an occupational health issue. The predicted concentrations at GIC were excluded in the determination of the maximum predicted TSP and RSP concentrations at the ASRs.

Table 3.26 : Summary of Assessment Results at Internal ASRs Within EcoPark – Scenario 2 (Mitigated)

Pollutant	Time Average	Predicted Maximum Concentration (mg/m^3) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	N/A	240	242	241	242	241	241	241	243
TSP (Ph II)	24-hour	260	N/A	149	150	150	149	149	149	149	149
RSP	24-hour	180	N/A	113	114	113	113	113	113	113	113
Sulphur Dioxide	1-hour	800	N/A	125	125	125	125	139	143	167	125
	24-hour	350	N/A	33	36	34	37	35	35	39	37
Nitrogen Dioxide	1-hour	300	N/A	100	100	100	123	113	100	109	124
	24-hour	150	N/A	67	71	67	70	68	65	66	72
Carbon Monoxide	1-hour	30000	N/A	1015	1015	1015	1016	1019	1016	1021	1017
	8-hour	10000	N/A	1005	1007	1005	1012	1007	1001	1001	1010
VOC	Annual	–	N/A	4	4	4	2	2	1	1	2
Chlorine	1-hour	210	N/A	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.50
	Annual	0.2	N/A	0.026	0.033	0.026	0.016	0.011	0.006	0.004	0.016
Hydrogen Chloride	1-hour	2100	N/A	9	10	10	10	10	10	10	10
	Annual	20	N/A	0.52	0.65	0.53	0.32	0.22	0.12	0.09	0.31
Fluorine/ Fluoride	1-hour	240	N/A	1	1	1	1	1	1	1	1
	Annual	13	N/A	0.065	0.082	0.066	0.040	0.028	0.015	0.011	0.039
White Phos.	Annual	0.07	N/A	0.012	0.015	0.012	0.007	0.005	0.003	0.002	0.007
Lead	3-month	1.5	N/A	0.202	0.229	0.203	0.168	0.164	0.117	0.115	0.264
	Annual	0.5	N/A	0.143	0.157	0.144	0.121	0.110	0.099	0.095	0.120
Beryllium	Annual	0.02	N/A	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Cadmium	Annual	0.005	N/A	0.0038	0.0041	0.0038	0.0033	0.0031	0.0029	0.0028	0.0033
Mercury	1-hour	1.8	N/A	0.077	0.077	0.077	0.094	0.080	0.077	0.077	0.094
	Annual	1	N/A	0.002	0.002	0.002	0.001	0.001	0.001	0.000	0.001
Nickel	1-hour	6	N/A	0.22	0.23	0.23	0.32	0.27	0.23	0.27	0.32
	Annual	0.05	N/A	0.018	0.021	0.019	0.014	0.012	0.009	0.008	0.014
Arsenic	4-hour	0.19	N/A	0.039	0.040	0.041	0.047	0.047	0.036	0.039	0.045
	Annual	0.03	N/A	0.008	0.008	0.008	0.007	0.006	0.006	0.006	0.007
Tin	8-hour	40	N/A	0.23	0.25	0.23	0.30	0.25	0.19	0.18	0.28
Molybdenum	8-hour	100	N/A	0.15	0.17	0.16	0.20	0.17	0.13	0.12	0.19
Copper	1-hour	100	N/A	0.64	0.65	0.65	0.76	0.70	0.65	0.70	0.80
	Annual	2.4	N/A	0.231	0.237	0.231	0.222	0.217	0.213	0.211	0.221
Antimony	Annual	0.2	N/A	0.006	0.007	0.006	0.004	0.003	0.001	0.001	0.004
Chromium VI	Annual	0.2	N/A	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Platinum	8-hour	20	N/A	0.031	0.033	0.031	0.040	0.033	0.026	0.023	0.037
Selenium	Annual	20	N/A	0.004	0.005	0.004	0.003	0.003	0.002	0.002	0.003
Rhodium	8-hour	2	N/A	0.015	0.017	0.016	0.020	0.017	0.013	0.012	0.019
Dioxins	Annual	1×10^{-6} I-TEQ	N/A	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ	0.1×10^{-6} I-TEQ
		Individual Lifetime Cancer Risk Level									
Cumulative Cancer Risk	Lifetime	10^{-4}	N/A	2×10^{-5}	3×10^{-5}	2×10^{-5}	1×10^{-5}	1×10^{-5}	5×10^{-6}	4×10^{-6}	1×10^{-5}

Notes : Predicted concentrations highlighted exceed the relevant standard (no exceedances predicted).
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

3.6.70 Detailed modelling results and air pollution contours are provided in Appendices D.5 and D.7. Contours entitled "Cumulative 1-hour TAPs Concentration", "Cumulative 4-hour TAPs Concentration", "Cumulative 8-hour TAPs Concentration" and "Cumulative annual TAPs Concentration" represent concentrations of Cl_2, HCl, Fluorine/Fluoride, P, Be, As, Mo, Sb, Pt, Se and Rh. Because these contours were generated based on an emission rate of 1g/s, the actual TAP concentration can be multiplied by the emission rate of that TAP :

TAPs concentration on the contour = the contour values x TAP's emission rate + relevant background concentration

3.6.71 For CO, SO_2, Cu, annual Hg and Sn, as the maximum concentrations are far below the criteria, contours for these pollutants are considered unnecessary.

3.6.72 According to the concentrations presented in Appendix D.5, source locations A4, A6 and A8 would be the worst source locations. For the upper limit of fresh air intake region, the source location that would pose the maximum air quality impact was selected to represent the air pollution distribution at 22.5mPD. For the planned "holiday camp", however, source locations A2 and A5 were the worst source locations and the air pollution contours were shown at 61.5mPD.

3.6.73 Thus, to provide modelling that reflects the location of ASRs within 500m of EcoPark, three different elevations have been chosen. The 8.5mPD elevation represents low-level ("ground level") ASRs, 22.5mPD represents the fresh air restriction zone for EcoPark and future ASRs in the existing Fill Bank area, and 61.5mPD represents the elevation of the proposed "Holiday Camp" ASR. As such, the pollution contours in Appendix D.7 have adequate coverage for the pollutants, emission sources and locations and heights of ASRs.

3.6.74 As shown by the assessment results in Appendix D.5 and air pollution contours presented in Appendix D.7, the existing air quality will not be worsened significantly provided that the above mitigation measures are adopted.

3.6.75 It should be noted that the RSP exceedance shown on the contour plots is, in part, a result of the conservative approach of assuming all dust from all cumulative sources is RSP, such as Green Island Cement and Shiu Wing. In reality, RSP exceedances are unlikely to occur as a result of the operation of EcoPark.

Scenario 3

Fresh Air Intake Restrictions

3.6.76 According to the Section 2.4(ii) of the EPD's *Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models*, the restricted height range will be the region of unacceptable air quality plus a 10m safety margin added to both lower and upper ends. Based on the assessment results of Scenario 3, the unacceptable air quality was predicted at 27.3mPD. Therefore, the fresh air intake locations of the internal ASRs in EcoPark should be restricted to 17.3mPD in order to comply with the EPD's guidelines as well as the air quality criteria. These fresh air intake restrictions will also be imposed to the future uses in the existing Fill Bank area.

3.6.77 For CO and SO_2, as the maximum concentrations are far below the criteria, contours for these pollutants are considered unnecessary.

3.6.78 Elevations of 8.5mPD, 22.5mPD and 61.5mPD are representative of ASR at lower levels, the fresh air restriction zone for EcoPark and future planned users of Fill Bank, and the future Holiday Camp Site, respectively. Accordingly, pollution contours have been prepared for each of these elevations.

3.6.79 According to the concentrations presented in Appendix D.4, source locations A4, A6 and A8 would be the worst source locations. For the upper limit of fresh air intake region, the source location that would pose the maximum air quality impact was selected to represent the air pollution distribution at 17.3mPD. For the planned Holiday Camp Site, however, source locations A1, A2 and A5 were the worst source locations and the air pollution contours were shown at 61.5mPD.

3.6.80 Accordingly, the pollution contours in Appendix D.8 have adequate coverage for the pollutants, emission sources and locations and heights of ASRs.

3.6.81 As shown by the assessment results in Appendix D.4 and air pollution contours presented in Appendix D.8, the contribution to the existing baseline air quality is insignificant and will not result in adverse air quality impacts after adopting the above mitigation measures.

3.6.82 Assessment results of Scenario 3 after adopting the above mitigation measures are summarised in Tables 3.27 and 3.28, below :

Table 3.27 : Summary of Assessment Results at Existing/Planned Off-site ASRs – Scenario 3 (Mitigated)

Pollutant	Time Average	Predicted Maximum Concentration ($\mu g/m^3$) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	242	243	243	242	242	241	243	241	240
TSP (Ph II)*	24-hour	260	177	177	177	177	177	177	177	177	177
RSP	24-hour	180	141	141	141	141	141	141	141	141	141
Sulphur Dioxide	1-hour	800	227	227	227	227	232	227	227	229	231
	24-hour	350	40	40	39	39	40	39	39	39	40
Nitrogen Dioxide	1-hour	300	276	184	143	121	181	139	119	122	160
	24-hour	150	85	75	70	67	71	67	68	64	67
Carbon Monoxide	1-hour	30000	1207	1112	1070	1046	1109	1065	1044	1047	1087
	8-hour	10000	1041	1016	1012	999	1015	1005	1002	997	1004
VOC	Annual	–	5	5	5	4	3	6	7	7	5
Mercury	1-hour	1.8	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
	Annual	1	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}

Notes : Predicted concentrations highlighted exceed the relevant standard (no exceedances predicted).
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.
* The predicted dust concentration at Green Island Cement (GIC) will exceed the AQOs. However, the dust impact is mainly contributed by GIC only (>99%) which is considered as an occupational health issue. The predicted concentrations at GIC were excluded in the determination of the maximum predicted TSP and RSP concentrations at the ASRs.

Table 3.28 : Summary of Assessment Results at Internal ASRs Within EcoPark – Scenario 3 (Mitigated)

Pollutant	Time Average	Predicted Maximum Concentration ($\mu g/m^3$) from Different Source Locations									
		Criteria	A1	A2	A3	A4	A5	A6	A7	A8	A9
TSP (Ph I)	24-hour	260	240	241	243	241	242	242	240	241	243
TSP (Ph II)	24-hour	260	139	139	140	139	139	139	139	139	139
RSP	24-hour	180	102	102	103	103	102	102	102	102	102
Sulphur Dioxide	1-hour	800	125	125	125	125	125	126	127	127	125
	24-hour	350	31	31	31	31	32	31	31	31	31
Nitrogen Dioxide	1-hour	300	100	100	100	100	118	107	100	100	113
	24-hour	150	64	68	72	69	70	71	66	65	71
Carbon Monoxide	1-hour	30000	1015	1018	1020	1020	1021	1021	1016	1013	1014
	8-hour	10000	996	1011	1012	1012	1012	1012	1002	997	1006
VOC	Annual	–	4	10	10	10	5	5	3	1	4
Mercury	1-hour	1.8	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
	Annual	1	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}	3×10^{-4}

Notes : Predicted concentrations highlighted exceed the relevant standard (no exceedances predicted).
Predicted RSP concentrations at ASRs were assumed to be equal to the predicted TSP concentrations.

Cumulative Impacts

Phase I Operation

3.6.83 The cumulative air quality assessment presented in the *Project Profile for the Expansion and Extension of Fill Bank at Tuen Mun Area 38* included EcoPark Phase I operation as a dust source. It concluded that EcoPark Phase I operation would comply with the AQO daily average of 260µg/m^3. Based on the air pollution contours presented in that assessment, the maximum TSP concentration at 1.5m above ground was 238µg/m^3 at the drainage reserve, which forms the boundary between EcoPark Phase I and Phase II.

3.6.84 The assumptions in the *Fill Bank Project Profile*, however, only included dust emissions from the rubber grinding process. It is now anticipated that in addition to rubber grinding, Phase I operations may also include emissions from glass remanufacturing, non-ferrous metal recovery, plastic and fuel combustion, as summarised in Table 3.14. Thus, the conclusion in the *Fill Bank Project Profile* that EcoPark Phase I operation would comply with the AQO must be re-examined in light of the additional processes that are now anticipated.

3.6.85 The major dust sources during Phase I EcoPark will be from the Fill Bank, C&DMRF, PBR2SF, TMCWSF, Shiu Wing and the Green Island Cement plant. Based on the assessment results of both the mitigated Scenarios 2 and 3, the maximum net contribution of TSP from EcoPark are predicted to be less than 13µg/m^3 at the Holiday Camp Site (refer to Appendix D.6 for detailed results). It is concluded that no adverse cumulative dust impacts are anticipated.

Phase II Operation

3.6.86 The permanent C&DMHF to the immediate east of EcoPark is planned to commence operation after decommissioning of the Fill Bank and CEDD have provided information relating to the conceptual layout, facility operation and the internal access road. In terms of air quality emissions, the permanent C&DMHF should not generate insurmountable air quality at the EcoPark by proper design and implementation of appropriate dust control measures, such as directing all vehicle traffic inside C&DMHF away from the boundary of the EcoPark and water spraying.

3.6.87 As the cumulative dust impact from EcoPark, Shiu Wing Steel Mill, Green Island Cement and the TMCWSF will not change during Phases I and II of EcoPark, and so no adverse cumulative air quality impacts are anticipated, considering that appropriate dust control measures have been implemented by the permanent C&DMHF. Also, there would be adverse air quality impact at the Drainage reserve area in accordance with the project profile for the *Expansion and Extension of Fill Bank at Tuen Mun Area 38*. The C&DMHF may require a buffer to prevent causing adverse air impact at EcoPark Phase II.

3.6.88 After decommissioning of the Fill Bank and other temporary CEDD facilities in Tuen Mun Area 38, dust levels will likely be reduced. The presence of EcoPark will therefore not pre-empt other users of Area 38, such as the C&DMHF. However, during the detailed design stage of the C&DMHF it is recommended that an air quality assessment should be carried out to confirm that cumulative impacts from existing uses (which will by that time include EcoPark), the C&DMHF itself and other future committed or planned developments in Tuen Mun Area 38 will not significantly worsen the existing air quality.

3.7 Conclusions and Recommendations

Construction Phase

3.7.1 Through proper implementation of dust control measures as required under the Air Pollution Control (Construction Dust) Regulation, construction dust can be controlled to within acceptable limits, and no significant impacts are anticipated.

Operational Phase

3.7.2 An initial screening exercise was carried out to identify a subset of the processes initially proposed in Table B.1 (in Appendix B) that could realistically be carried out within EcoPark without requiring prohibitively costly Air Pollution Control (APC) equipment, without unduly reducing material throughputs and without adversely affecting the flexibility of the EcoPark Operator. The majority of the initially proposed processes would result in some level of air quality impact and these impacts would arise either from the processing itself or from the on-site combustion of fossil fuels to power these processes.

3.7.3 To ensure that existing air quality is not adversely affected by EcoPark, mitigation may be required for some of the processes initially proposed. Mitigation can include the use of cleaner fuels, the installation of APC equipment, a reduction in material throughput, or a combination of these.

3.7.4 On the assumption that the best available APC equipment that does not entail excessive cost would be installed by future tenants, the following initial screening decisions were made :

- Only Ultra-Low Sulphur Diesel (ULSD) would be permitted within EcoPark.
- Inedible Rendering (Organic Food Waste) would be screened-out and not assessed further because air quality impacts could not be controlled to within AQO limits using cost-effective APC equipment.
- To maximise processing throughput of metals overall and to minimise air emissions, the Melting of Shredded Metal (Ferrous Metal) would be reduced to zero (although the non-thermal ferrous metal processes would be carried out).
- To reduce heavy metal particulate, TAPs (i.e., dioxins) and other gaseous emissions, the total throughput for Melting/Sweating/Refining/Leaching of Lead, Aluminium, Copper and Zinc (Non-ferrous Metals) would be reduced.
- To reduce fuel combustion-related emissions (i.e., PM, SO_2 and NO_2), the throughput for Pulping/Cleaning/De-inking/Bleaching/Additives/Pressing of Secondary Fibres (Paper) would be reduced.

3.7.5 Based on the above, three scenarios (Scenarios 1, 2 and 3) were then developed to provide a range of possible situations for quantitative assessment.

<u>Scenario 1</u>

3.7.6 Scenario 1 was initially considered, and it was identified that the predicted pollutant concentrations would significantly exceed the majority of air quality criteria, in particular heavy metals and TAP emissions from the non-ferrous metal recovery processes and NO_2 emission from fuel combustion. To mitigate these impacts without reducing throughput would require extensive use of costly APC equipment by a large number of tenants. As such, this scenario was not considered further.

3.7.7 Scenario 1 provides the greatest flexibility for the future operation of EcoPark in that very few restrictions are placed on material types or throughputs. As a result, however, almost none of the AQOs can be met and cost-effective APC equipment would be unlikely to achieve a sufficient reduction in emissions. While more expensive state-of-the-art APC equipment would likely achieve AQOs, this would be prohibitively costly for most tenants and if made a mandatory requirement, EcoPark could price itself out of the market.

3.7.8 Based on the above conclusions, Scenario 1 is not recommended as the "base case" for EcoPark development.

Scenario 2

3.7.9 A more moderate Scenario 2 was then considered in which the overall fuel consumption rate and total throughput for the non-ferrous metal recovery was reduced and in which the stack height was increased from 15m to 30m above ground to allow for better dispersion. No adverse cumulative air quality impacts were anticipated with the adoption of various cost-effective mitigation measures that include :

- Use of a high efficiency dust control device (such as a baghouse) to meet emission limits.
- Use of wet or semi-dry alkaline scrubber for chlorine, hydrogen chloride and fluorine/fluoride emitted from non-ferrous metal recovery.
- Use of Boliden/Norzink process, Bolchem process, Outokumpu process, Sodium thiocyanate process, activated carbon filter, Superlig Ion Exchange Process, Added with potassium iodide, selenium scrubber, Selenium Filter or Lead Sulphide Process for mercury emitted from non-ferrous metal recovery.
- Use of SO_2 control device (such as a wet-scrubber) to meet emission limits for secondary lead recovery.
- Restricted chimney location.
- Removal of 'demagging' from the secondary aluminium process.
- Restricting the fresh-air intake elevation of the internal ASRs and future ASRs in the existing Fill Bank area.

3.7.10 Scenario 2 maximises the throughput of materials with EcoPark to provide for the greatest possible number of processes to be included within the umbrella assessment, yet requires only that tenants use, where necessary, the best available APC equipment that does not entail excessive costs. Furthermore, the 30m chimney height provides for air intake elevations up to 22.5mPD.

3.7.11 Based on the above conclusions, the optimum scenario for EcoPark is represented by Scenario 2 (Mitigated). This scenario will also form the "base case" for the following assessments of water quality, waste management implications and prevention of contaminated land (see Section 13 for a summary of "base case" assumptions).

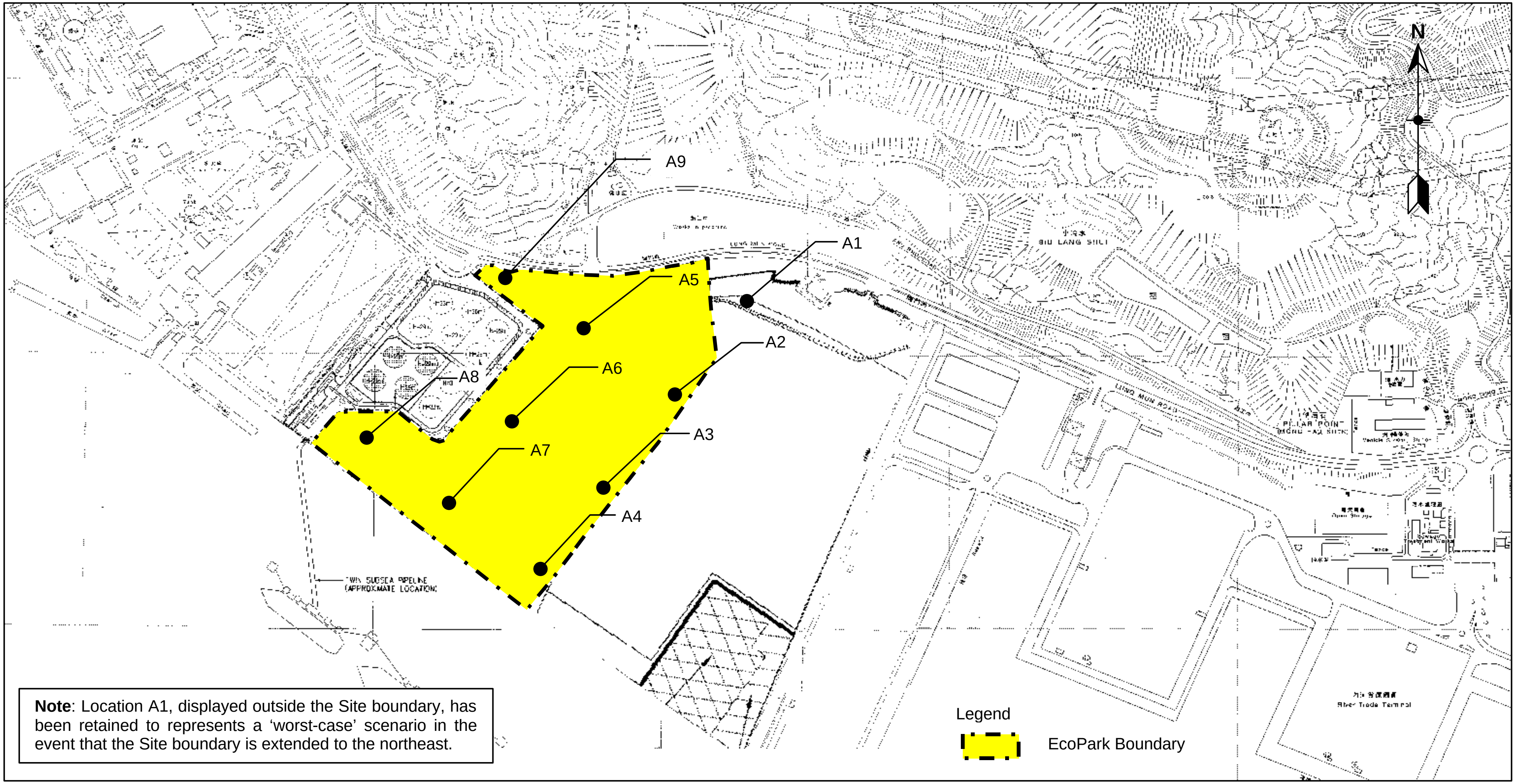
Scenario 3

3.7.12 A more conservative Scenario 3 was also considered in which total fuel consumption was further reduced and non-ferrous metal recovery was reduced to zero. Based on these assessment results, the only mitigation required to avoid all adverse cumulative air quality impacts was restricting the fresh-air intake location of the internal ASRs – the use of cost-effective APC equipment was not necessary.

3.7.13 Scenario 3 does not require any APC equipment except control devices for fugitive dust and VOC emission, however, this is achieved only by significantly limiting the throughput of materials and also the number of processes. As such, there is limited flexibility for the future operation of EcoPark. Furthermore, the 15m chimney height limits air intake elevations to 17.3mPD.

3.7.14 Based on the above conclusions, Scenario 3 is not recommended as the "base case" for EcoPark development.

Figure 3.1 : Locations of Emission Sources Within EcoPark



Note: Location A1, displayed outside the Site boundary, has been retained to represents a 'worst-case' scenario in the event that the Site boundary is extended to the northeast.

Figure 3.2 : Locations of Air Sensitive Receivers

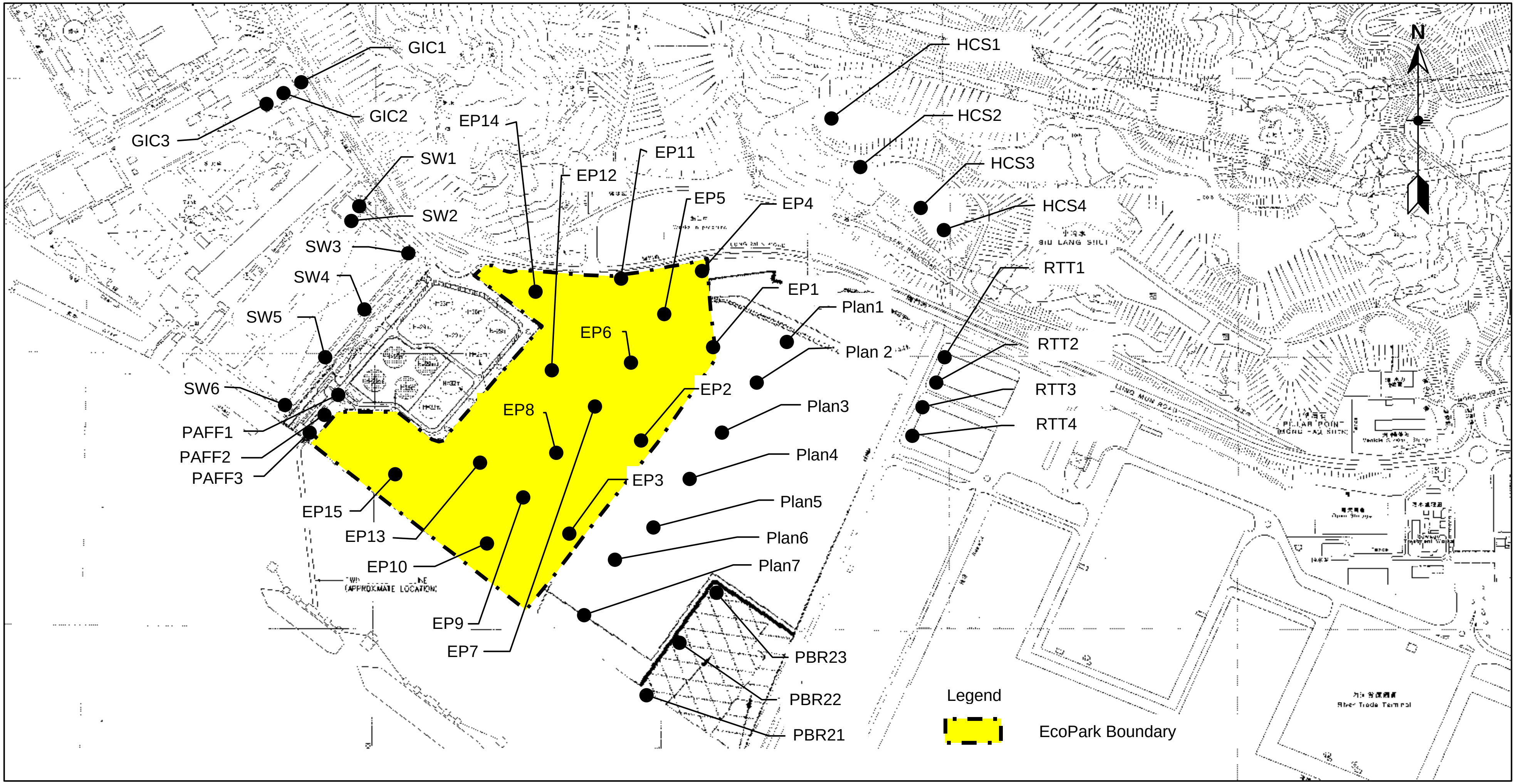
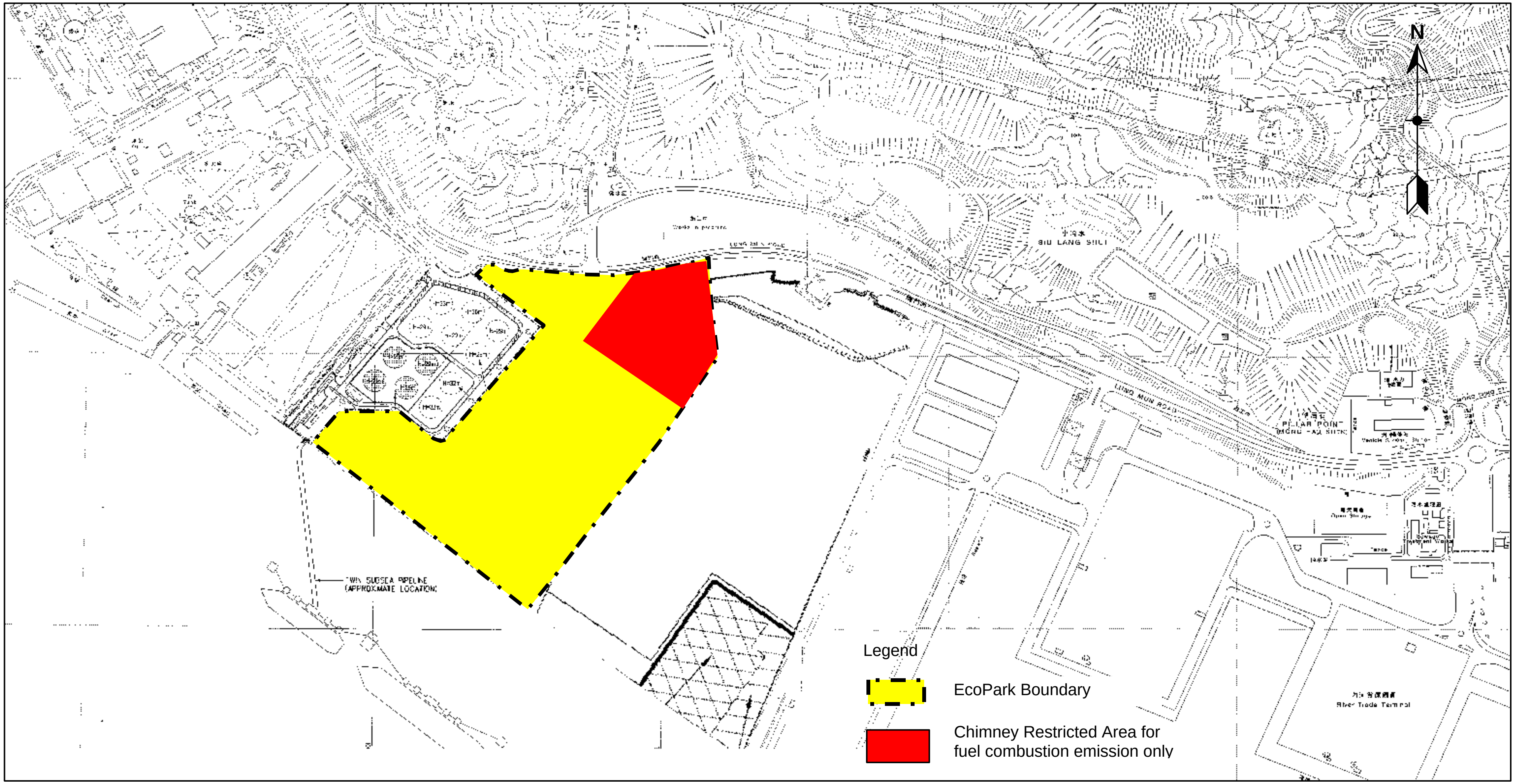


Figure 3.3 : Proposed Chimney Restricted Area (for Fuel Combustion Emissions Under Scenario 2)



4 NOISE ISSUES

4.1 General

4.1.1 The *Preliminary Study* indicated that there were no Noise Sensitive Receivers (NSRs) in the vicinity of EcoPark – the nearest existing NSRs are village houses in Lung Kwu Tan and Melody Garden and Butterfly Estate, all located more than 2km away. As such, it was not anticipated that there would be any noise impact on these existing NSRs from EcoPark and noise impact assessment is not required under the ESB.

4.1.2 However, since commencement of this Study, a "holiday camp" development has been proposed close to EcoPark, on the hillside to the northeast of EcoPark on the opposite side of Lung Mun Road, as shown in Figure 4.1. Concerns have been raised regarding possible noise impacts to the proposed "holiday camp" from EcoPark.

4.1.3 Based on the latest information provided by the project proponent, the "holiday camp" will commence operation after development of Phase I of EcoPark, but before development of Phase II. Therefore, the "holiday camp" could be affected by construction and operation noise from Phase II, and road traffic noise from trucks using Phase I + II of EcoPark.

4.2 Construction and Operation Noise

4.2.1 In terms of noise generation within EcoPark, the closest point at which noise will be generated would be the roadworks at the Phase II northern roundabout, which are 100m within EcoPark boundary, as shown on Figure 4.1. There will be no works requiring Powered Mechanical Equipment closer than this, since the lots within EcoPark will simply be hydroseeded and enclosed by chain-link fences.

4.2.2 From Figure 4.1, it can be seen that the distances between the closest part of EcoPark and NSR1 and NSR2 are 330m and 393m, respectively. The closest distances between noise-generating works within EcoPark and NSR1 and NSR2 are therefore 430m and 493m, respectively, and the closest distance between noise-generating works within EcoPark and closest boundary of the "holiday camp" is 373m.

4.2.3 Given these distances, it is concluded that there are unlikely to be any adverse noise impact on the "holiday camp" during construction and operation of EcoPark. As such, it is considered that a full quantitative noise assessment for EcoPark is not required.

4.3 Road Traffic Noise

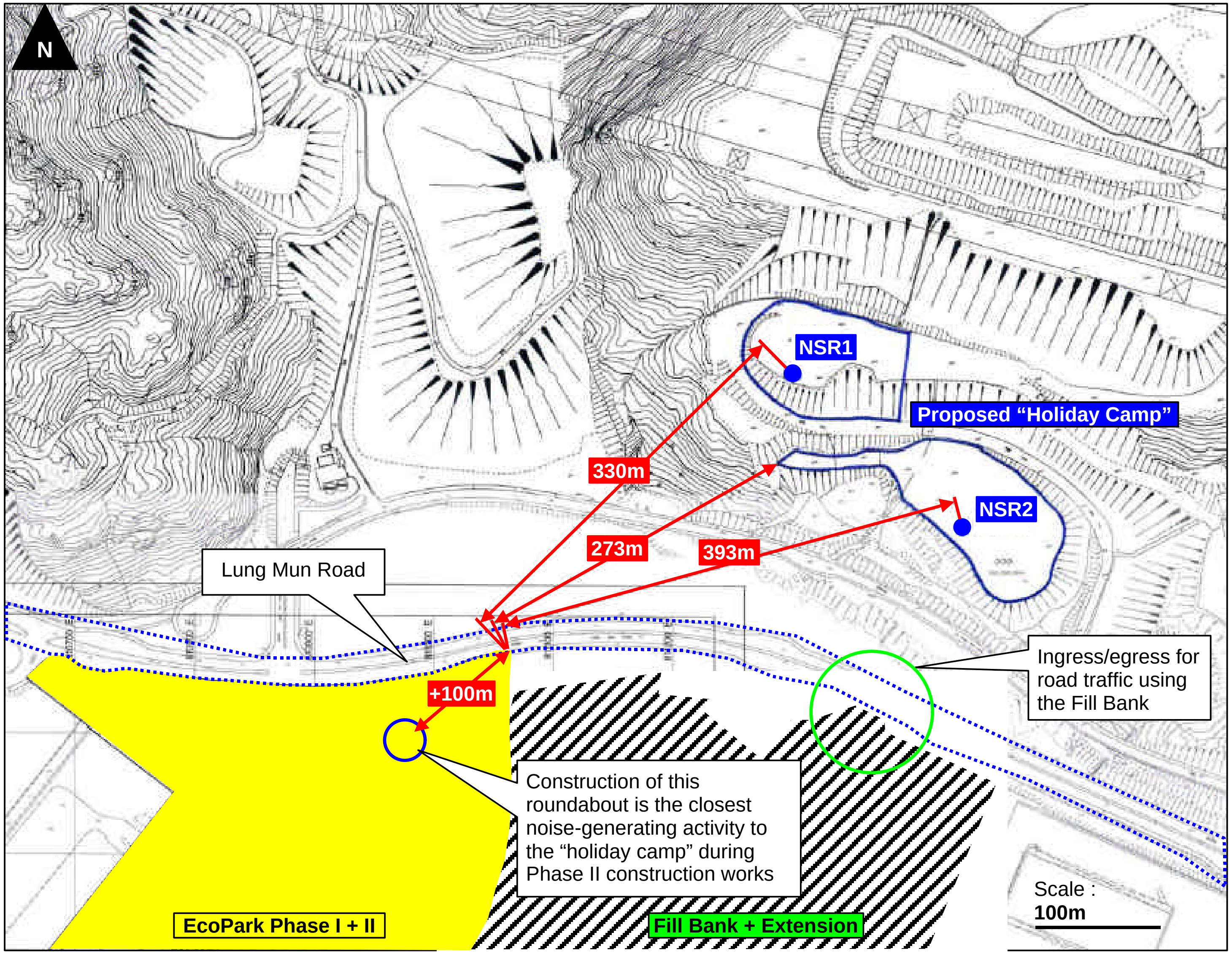
4.3.1 The operation of EcoPark will generate traffic on nearby roads, in particular Lung Mun Road, which passes below the proposed "holiday camp", as shown on Figure 4.1.

4.3.2 The Road Traffic Impact Assessment conducted for EcoPark has estimated the total number of inbound and outbound truck trips associated with the operation of Phase I + II of EcoPark in 2009 at 86 vehicles/hour during the peak hour. Although some of these trucks will turn west along Lung Mun Road, away from the "holiday camp", for worst case scenario it can be assumed that all of these vehicles will turn east along Lung Mun Road, passing below the "holiday camp".

4.3.3 The recently issued (March 2005) Project Profile for the *Expansion and Extension of the Fill Bank at Tuen Mun Area 38*, which is adjacent to EcoPark, assessed noise based on 416 inbound and outbound vehicles/hour during the peak hour, and also included a fixed noise assessment from Fill Bank operations. The noise assessment concluded that "*the residual environmental impacts at the proposed holiday camp would be insignificant".*

4.3.4 Given that there are "insignificant" noise impacts from the Fill Bank, it follows that the impacts from EcoPark will be less, as the peak vehicles/hour are less. As such, it is considered that a full quantitative noise assessment for EcoPark is not required.

Figure 4.1 : Distances Between EcoPark, NSRs in the "Holiday Camp" and Lung Mun Road



5 WATER QUALITY IMPACT ASSESSMENT

5.1 Introduction

5.1.1 The assessment follows the requirements of Annexes 6 and 14 of the EIA-TM, and the objectives as set out under Clause 3.4.2.5 of the EIA Study Brief, as follows:

(i) Collection and review of background information on the existing and planned water system(s) and their respective catchments and sensitive receivers which might be affected by the Project during operation;

(ii) Characterization of water and sediment quality of the water system(s) and respective catchments and sensitive receivers which might be affected by the Project during operation based on existing information or appropriate site survey and tests;

(iii) Identification and analysis of all existing and planned future activities and beneficial uses related to the water system(s) and identification of all water sensitive receivers. The Applicant shall refer to, *inter alia*, those developments and uses earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans and Layout Plans;

(iv) Identification of pertinent water and sediment quality objectives and establishment of other appropriate water and sediment quality criteria or standards for the water system(s) and all the sensitive receivers;

(v) Identification and quantification of all likely water and sediment pollution sources and loading, including point and non-point discharges generated during the construction and operation stages of the Project and discharged to the marine waters and existing and planned drainage systems and water courses within the study area;

(vi) Identification and analysis of the adequacy of capacity of sewerage system serving Tuen Mun Area 38 and the requirements for upgrading the system to accommodate the wastewater generated from the Project;

(vii) Establishment and provision of a pollution load inventory on the quantities and characteristics of all existing and likely future water pollution sources identified above. Field investigation and laboratory tests shall be conducted as appropriate to fill in any major information gaps;

(viii) Recommendation on provision of mitigation measures to reduce pollution arising from both point and non-point discharges identified in (v) above, to within acceptable limits;

(ix) Assessment of the cumulative impacts due to other related concurrent and planned projects, activities or pollution sources along the identified water system(s) and sensitive receivers that may have a bearing on the environmental acceptability of the Project. This shall include the potential cumulative operational water quality impact arising from, *inter alia*, other pollution sources within the study area;

(x) Recommendation of appropriate mitigation measures, including a contingency plan, to minimise the duration and impact of any emergency overflow discharges and malfunction of the on-site wastewater treatment plant.

5.2 Environmental Legislation

Water Pollution Control Ordinance

5.2.1 The 1980 Water Pollution Control Ordinance (WPCO) (Cap. 358) is the principal legislation governing marine water quality in Hong Kong. Under the provisions of this Ordinance Hong Kong's waters have been divided into a series of Water Control Zones (WCZs). Water Quality Objectives (WQOs) have been declared to protect the specific beneficial uses and conservation goals of each of the zones.

5.2.2 The EcoPark lies within the North Western Water Control Zone (NWWCZ). Marine waters within the NWWCZ are identified as having the following beneficial uses :

- A source of food for human consumption.
- Commercial fisheries resource.
- Habitat for marine organisms generally.
- Recreational bathing.
- Secondary contact recreation, including diving, sailing and windsurfing.
- Domestic and industrial supply.
- Navigation and shipping.
- Aesthetic enjoyment.

5.2.3 Subsequent to the gazettal of the NWWCZ the waters around Lung Kwu Chau and Sha Chau have been declared a Marine Park to protect marine life. Relevant Marine WQOs applicable to the NWWCZ are summarised in Table 5.1 :

Table 5.1 : Water Quality Objectives for the NWWCZ

Parameter	**Objective**
Aesthetic Appearance	• There should be no objectionable odours or discolouration of the water. • Tarry residues, floating wood, articles made of glass, plastic, rubber or any other substances should be absent. • Mineral oil should not be visible on the surface. • There should be no recognisable sewage derived debris. • Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.
Bacteria	• The levels of *Escherichia coli* should not exceed 180 counts per 100 ml at bathing beaches, calculated as the geometric mean of the 5 most recent samples collected by EPD. • The levels of *Escherichia coli* should not exceed 610 counts per 100 ml at secondary contact recreation sub-zones, calculated as the geometric annual mean.
Dissolved Oxygen	• The depth averaged concentration of dissolved oxygen should not fall below 4 mg/ for 90% of the sampling occasions during the whole year • The concentration of dissolved oxygen should not be less than 2 mg/ within 2m of the seabed for 90% of the sampling occasions during the whole year
pH	• The pH of the water should be within the range 6.5 – 8.5 units. • Human activity should not cause the natural pH range to be extended by >0.2.
Temperature	• Waste discharges shall not cause the natural daily temperature range to change by more than 2^{o}C.
Salinity	• Waste Discharges shall not cause the natural ambient salinity to change by >10%.
Suspended Solids	• Human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.
Ammonia	• The un-ionised ammoniacal nitrogen level should not be >0.21mg/ calculated as the annual average (arithmetic mean).
Nutrients	• Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants • Without limiting the generality of the above point, the level of inorganic nitrogen should not exceed 0.5 mg/ , or 0.3 mg/ within Castle Peak sub-zone, expressed as the annual water column average.
Toxins	• Waste discharges shall not cause the toxins in water to attain such a level as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other. • Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.

WPCO Technical Memorandum on Effluent Discharges

5.2.4 Should any polluting effluents be discharged from EcoPark during either construction or operation, WPCO requires that the Works Contractor and/or Operator obtain a discharge permit. In setting conditions of required effluent quality the Authority would be guided by the Technical Memorandum (WPCO-TM) issued under Section 21 of the WPCO, which indicates maximum permissible concentrations for a comprehensive suite of pollutants (depending on the point of discharge).

5.2.5 The standards for effluent discharging into sewerage systems are summarised in Table 5.2 and for effluent discharging into coastal water are summarised in Table 5.3, below :

Table 5.2 : Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants

Flow Rate (m^3/day) / Determinant	£10	>10 & £100	>10 & £200	>200 & £400	>400 & £600	>600 & £800	>800 & £1000	>1000 & £1500	>1500 & £2000	>2000 & £3000	>3000 & £4000	>4000 & £5000	>5000 & £6000
pH	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temp (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
SS	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable Solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1	1	0.8	0.7	0.6	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other Toxic Metals	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Total Toxic Metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total N	200	200	200	200	200	200	200	100	100	100	100	100	100
Total P	50	50	50	50	50	50	50	25	25	25	25	25	25
Total Surfactants	200	150	50	40	30	25	25	25	25	25	25	25	25

Source : *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*, Environmental Protection Department, January 1991.

Note : All units in mg/ unless otherwise stated. All figures are upper limits unless otherwise stated.

Table 5.3 : Standards for Effluents Discharged into the Inshore Waters of NWWCZ

Flow Rate (m^3/day) / Determinant	£10	>10 & £100	>200 & £400	>400 & £600	>600 & £800	>800 & £1000	>1000 & £1500	>1500 & £2000	>2000 & £3000	>3000 & £4000	>4000 & £5000	>5000 & £6000
pH	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temp (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour*	1	1	1	1	1	1	1	1	1	1	1	1
SS	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other Toxic Metals	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total Toxic Metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Residual Cl	1	1	1	1	1	1	1	1	1	1	1	1
Total N	100	100	80	80	80	80	50	50	50	50	50	30
Total P	10	10	8	8	8	8	5	5	5	5	5	5
Total Surfactants	20	15	15	15	15	15	10	10	10	10	10	10
E.coli (per 100ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Note : All units in mg/ unless otherwise stated; all figures are upper limits unless otherwise stated.
* Colour in lovibond units (25mm cell length).

Source : *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*, Environmental Protection Department, January 1991.

EIAO Technical Memorandum on EIA Process

5.2.6 Annex 6 and Annex 14 of the EIAO-TM stipulate "Criteria for Evaluating Water Pollution" and "Guidelines for the Assessment of Water Pollution", respectively. These requirements will be addresses in the subsequent sub-sections.

5.3 Existing Conditions

Introduction

5.3.1 The North Western Waters are situated at the mouth of the Pearl River Estuary and as such are heavily influenced by the massive freshwater flows from the Pearl River, which is distinctly seasonal. The estuarine influence is the strongest in the wet summer months when the freshwater flows are greatest and a strong salinity and temperature stratification is evident. During winter months water conditions are more typically marine and salinity and other parameters vary less with depth. Water temperature ranges between about 15^{O}C and 30^{O}C over an annual cycle with a mean of about 22^{O}C to 24^{O}C. Salinity typically varies within the range 9 to 33ppt.

5.3.2 The Pearl River carries very heavy loadings of suspended solids (SS) and nutrients to this WCZ, resulting in much higher SS and nutrients in this zone than in zones to the south and east of Hong Kong, which are dominated by oceanic influences.

Existing Pollution Sources and Activities

5.3.3 The NWWCZ contains several major sewage outfalls (Pillar Point, Urmston Road, Siu Ho Wan) and cooling water discharges from a number of users including Castle Peak Power Station and Shiu Wing Steel Mill.

5.3.4 There is an existing culvert that runs below EcoPark and leads to an outfall at the edge of the site (see Figure 2.1). The upstream catchment is predominantly a natural area. The River Trade Terminal, Castle Peak Power Station and proposed PAFF are close by. There is a potential for the quality of stormwater in the culvert to be affected by any contaminants washed off from these sites, while on-going construction activities in the area may lead to sediment accumulation in the culvert and discharge to coastal waters.

5.3.5 Urmston Road is a very busy shipping channel for river trade vessels, high speed ferries, and large coal vessels servicing Castle Peak Power Station.

5.3.6 Within the site itself, the presence of nearby SLSL may have resulted in leachate contamination of groundwater beneath EcoPark site. The presence of leachate in groundwater can be identified by high Chemical Oxygen Demand (COD) and high total nitrogen concentrations. The implications to the construction phase are discussed in Section 5.4.

Sensitive Receivers

5.3.7 There are a number of potentially important sensitive receivers within the WQ study area, illustrated in Figure 5.1. They include areas of direct human contact, such as bathing beaches, and various seawater abstraction points for domestic, commercial or industrial use. The study area also contains two un-gazetted bathing beaches at Lung Kwu Tan.

5.3.8 There are a number of major seawater intakes in the study area serving North Lantau New Town and Hong Kong International Airport to the south, and industrial users (particularly Castle Peak Power Station and Shiu Wing Steel Mill) immediately to the west of Tuen Mun Area 38. For the Castle Peak Power Station intake there is a specific requirement that SS concentrations must be maintained below a level of 150mg/ within a 5km radius of the intake.

Baseline Water Quality Conditions

5.3.9 Existing water quality and sediment quality in the North Western Waters have been monitored for a number of years as part of the EPD Routine Monitoring Programme. Water quality is monitored bi-monthly at six stations within the NWWCZ, shown in Figure 5.1 (except Station NM8, which is distant from the study area).

5.3.10 Of these, stations NM3 and NM5 are closest to EcoPark and so could be affected by the Project. A summary of the data published by EPD for the NWWCZ for 2001 to 2002 is presented in Table 5.4, below.

5.3.11 Some temporal and spatial variability is evident in this dataset but compliance is usually observed with the key WQOs for dissolved oxygen (DO), total inorganic nitrogen (TIN) and unionised ammonia notwithstanding generally eutrophic conditions resulting from the heavy nutrient load carried by the Pearl River.

Table 5.4 : Water Quality at Selected EPD Monitoring Stations in NWWCZ

Parameter	NM3		NM5	
	2001[1]	**2002[2]**	**2001[1]**	**2002[2]**
Temperature (°C)	23.3 (16.8-28.2)	23.5 (18.0-27.8)	23.5 (16.8-28.1)	23.7 (18.3 - 27.9)
Salinity	28.1 (18.2-31.7)	29 (23.6-32.4)	26.8 (16.6-31.7)	28 (22.9 - 31.7)
Dissolved Oxygen (Top) (mg/)	5.7 (3.7-7.6)	6.2 (3.9-7.6)	5.7 (4.1-7.9)	5.9 (3.0 - 7.5)
Dissolved Oxygen (Bottom) (mg/)	5.5 (2.5-7.8)	5.8 (3.2-7.7)	5.3 (2.3-7.5)	5.4 (2.5 - 7.2)
Dissolved Oxygen (Top) (%age saturation)	78 (53-97)	85 (55-106)	77 (59-100)	81 (43 - 102)
Dissolved Oxygen (Bottom) (%age saturation)	75 (37-99)	80 (45-103)	73 (34-97)	74 (36 - 97)
pH	8.1 (7.8-8.4)	8 (7.4-8.2)	8.1 (7.8-8.3)	8 (7.4 - 8.2)
Secchi Disc Depth (m)	1.4 (1.0-2.1)	1.6 (1.0-2.5)	1.2 (0.5-2.0)	1.6 (1.0 - 2.0)
Turbidity (NTU)	17.8 (11.2-26.2)	15.5 (6.6-26.0)	20.2 (12.9-25.9)	19.4 (12.7 - 25.9)
Suspended Solids (mg/)	13.3 (5.1-28.0)	10.3 (2.5-23.8)	13.6 (3.3-29.3)	14.5 (6.4 - 28.1)
5-day Biochemical Oxygen Demand (mg/)	0.6 (0.1-0.9)	0.9 (0.6-1.4)	0.8 (0.2-2.0)	0.9 (0.3 - 1.8)
Ammonia Nitrogen (mg/)	0.12 (0.03-0.21)	0.11 (0.04-0.19)	0.15 (0.04-0.27)	0.16 (0.04 - 0.35)
Unionised Ammonia (mg/)	0.007 (<0.001 - 0.020)	0.004 (0.002-0.009)	0.008 (<0.001 -0.010)	0.006 (0.001 - 0.012)
Nitrite Nitrogen (mg/)	0.06 (0.02-0.11)	0.05 (0.01-0.12)	0.07 (0.02-.13)	0.07 (0.03 - 0.16)
Nitrate Nitrogen (mg/)	0.27 (0.10-0.68)	0.26 (0.09-0.49)	0.34 (0.11-0.68)	0.34 (0.13 - 0.57)
Total Inorganic Nitrogen (mg/)	0.45 (0.26-0.95)	0.41 (0.25-0.66)	0.56 (0.26-0.93)	0.56 (0.29 - 0.78)
Total Kjeldhal Nitrogen (mg/)	0.27 (0.13-0.40)	0.23 (0.17-0.36)	0.33 (0.17-0.48)	0.32 (0.20 - 0.49)
Total Nitrogen (mg/)	0.6 (0.38-1.12)	0.54 (0.36-0.78)	0.74 (0.48-1.13)	0.72 (0.40 - 0.98)
Orthophosphate Phosphorus (mg/)	0.03 (0.02-0.08)	0.017 (0.009-0.024)	0.03 (0.01-0.04)	0.025 (0.014 - 0.051)
Total Phosphorus (mg/)	0.06 (0.04-0.08)	0.04 (0.03-0.06)	0.06 (0.04-0.09)	0.05 (0.04 - 0.08)
Silica (as SiO_2) (mg/)	1.8 (0.8-4.2)	1.4 (0.3-3.1)	2.1 (1.0-5.8)	1.8 (0.4 - 3.7)
Chlorophyll-a (µg/)	1.6 (0.4 -3.7)	2.8 (0.6 -6.3)	1.9 (0.5-5.7)	2.8 (0.8 - 7.7)
E.coli (cfu/100mL)	450 (310-1,800)	560 (100-2,000)	700 (220-2,000)	770 (310 – 1,500)
Faecal Coliforms (cfu/100ml)	1,200 (590-4,600)	1,300 (290-4,500)	1,600 (520-3,900)	1,800 (570 – 3,800)

Source : 1. Table D10, *Marine Water Quality in Hong Kong in 2001*, EPD, November 2002
2. Table D10, *Marine Water Quality in Hong Kong in 2002*, EPD, November 2003

Note : Figures show annual mean (range)

5.4 Key Issues

Construction Phase

5.4.1 The actual construction works involved for EcoPark are relatively minor – laying of utilities and drains, the provision of an internal access road, the construction of the Administration Building, preparation of the marine frontage and general landscaping works. No site reclamation is involved and no substantial structures will be built. The seawall at the marine frontage has already been constructed and the works required to install mooring points, bollards, fenders, etc. are minor.

5.4.2 The principal water quality issues during the construction phase relate to material being washed off the site due to heavy rainfall, i.e., elevated suspended sediment levels in stormwater runoff (this also applies to cementitious materials from any concreting works) and the need for dewatering for any deep foundations.

5.4.3 As groundwater below the site may be contaminated with leachate from SLSL, prior to any dewatering, the Works Contractor should carry out water quality testing to confirm that any discharge to stormwater drains or direct to the sea will meet the WPCO-TM standard, as shown in Table 5.3. Should the standard (at the proposed discharge rate) be exceeded then discharge rates should be modified to ensure compliance. Alternatively, any extracted water that cannot comply with the WPCO-TM standard should be taken off site for treatment at an appropriate facility.

5.4.4 To avoid the need for temporary connections into existing foul sewers or installation of a temporary wastewater treatment plant, it is recommended that portable chemical toilets be used by construction workers on site. These facilities would be maintained by a specialist contractor so as not to cause any adverse water quality impacts.

Operation Phase

<u>Drainage Design</u>

5.4.5 To minimise land contamination impact (see Section 7), soakaways and other similar drainage systems will not be permitted in within EcoPark.

5.4.6 Although not yet operational, the Tuen Mun Sewage Pumping Station (TMSPS), adjacent to EcoPark site (see Figure 2.1), connects to the Pillar Point Sewerage Treatment Works (PPSTW), which discharges through the Pillar Point Outfall. It is proposed that EcoPark makes use of the TMSPS and PPSTW to minimise the need for duplicate infrastructure.

5.4.7 Of key concern, therefore, is the adequacy of the capacity of TMSPS (and PPSTW) to handle the volume of wastewater anticipated from EcoPark, and the treatment capacity of PPSTW to handle any additional "domestic sewage" loading from EcoPark.

5.4.8 The following drainage design is recommended :

- **Industrial Wastewater** (from recycling processes) that meets the influent standards of the WTF will be connected into a dedicated internal sewer leading to the on-site WTF. Industrial wastewater will be treated by the WTF to the WPCO-TM standard for *"effluents discharged into foul sewers leading into Government sewage treatment plants"* (see Table 5.2). Treated effluent from the WTF will flow to the TMSPS, then to PPSTW and will finally be discharged at Pillar Point Outfall.
- **Domestic Wastewater** (from toilets, washing facilities, kitchens, etc.) will be connected into a dedicated internal sewer leading to the TMSPS. From here, sewage will be pumped to PPSTW for treatment and subsequent discharge at Pillar Point Outfall.
- **Clean Stormwater** will be directed to the existing stormwater drainage culvert beneath the site, or other discharge point as appropriate.

Contaminated Surface Discharge

5.4.9 An existing culvert runs below EcoPark site, collecting stormwater via the local drainage system and discharging to the sea (Figure 2.1). A key source of stormwater contamination from EcoPark would be contaminated wash-off from open areas of EcoPark. This contamination could be the result of normal operations, which is unlikely because good operational and management practice will be implemented (and audited as part of the operation EM&A programme). Alternatively, contamination could be the result of accidental spillage, which would also be unlikely as an emergency plan would be implemented by EcoPark Operator.

5.4.10 Section 7.2 and Table 7.1 identify particular processes that have a higher risk of contamination (by virtue of the materials used in the process). The drainage system collecting stormwater from these areas will need to be intercepted by suitable device (such as a stop-log) to reduce the amount of contaminants to an acceptable level in case of accidental spillage. Furthermore, it is recommended that any such processes are carried out under cover to ensure that any spillage is not exacerbated by rainfall, thereby minimising the quantities of contaminated runoff requiring interception.

Loading and Unloading of Marine Cargo

5.4.11 A portion of the materials passing into or out of EcoPark will utilise marine transport, and will make use of the marine frontage within EcoPark. Depending on the loading methodology and the characteristics of the materials, accidental spillage of the materials will have the potential to contaminate the waterfront. There are, however, a number of procedures and guidelines such as the *International Maritime Organisation Code of Practice for the Safe Loading and Unloading of Bulk Carriers*. The likelihood of such accidental spillage is low and the effect on the surrounding environment is anticipated to be limited provided that a suitable emergency action plan for spillage is in place.

5.5 Water Quality Impact Assessment

Construction Phase

5.5.1 There is much local experience in controlling site runoff during the construction phase of projects. Accordingly, Section 5.6 identifies appropriate mitigation measures to minimise water quality impacts during the works, such as those highlighted in *ProPECC PN 1/94*. Portable chemical toilets shall be used by site workers to avoid sewage discharge from site.

5.5.2 Provided that these measures are implemented (which will be audited as part of the construction EM&A programme) and good site practice is adopted, no adverse water quality impacts are anticipated from the construction phase of EcoPark. Notwithstanding, the Works Contractor must comply with the WPCO and will be required to obtain a Discharge Licence for any effluents discharged from site.

Operation Phase

5.5.3 The principal water quality assessments for the operation phase will focus on the impact to the capacity of the local sewerage system from the loading imposed by EcoPark, and also the impact to surrounding marine waters from possible contaminated stormwater from open areas of EcoPark.

Impact on the Local Sewerage System Capacity

5.5.4 The TMSPS was constructed to meet future sewerage demand of Tuen Mun Area 38, which is some 56.5ha in size. The pumping station is ready for operation but is not yet in use. There are 2 no. duty and 1 no. standby pumps in the station, each with a throughput of $0.63m^3/s$, giving a daily operation capacity of $108,864m^3/day$ ($1.26m^3/s$). The principle area of service for TMSPS will be EcoPark, the PAFF and various C&D Material facilities.

5.5.5 Based on Table 2 of the *DSD Sewerage Manual*, the flow factor ceiling for industrial developments with a plot ratio <7 is 660m^3/ha. The total area within EcoPark that is available for recycling (industrial) activities has been estimated at 14.13ha. Although tenants are likely to use much of their lot for storage, it has been conservatively assumed that 50% of each lot would be enclosed by some form of building in which recycling activities would be carried out. Thus, of the 14.13ha it has been assumed that 7.07ha would be used for recycling. Therefore, the estimated industrial wastewater flow is 4,666m^3/day (0.054m^3/s). After treatment, this volume would flow to the TMSPS.

5.5.6 In terms of sizing the WTF, based on Table 3 of the DSD Sewerage Manual a peak factor of 3 should be adopted for a population within EcoPark of less than 10,000 and where the WTF will not be required to treat stormwater. Therefore, the design capacity of the WTF should be 3 x 4,666m3/day = 14,000m^3/day (0.162m^3/s) and it is recommended that this is confirmed during the detailed design of the WTF in the follow-on D&C consultancy. In terms of sewage infrastructure planning, however, a peak factor of 5 is adopted for the estimation of flows into the public sewerage system, based on the DSD Sewerage Manual. In this case, the estimated flow into the public sewerage system is estimated at 5 x 4,666m^3/day = 23,330m^3/day (0.270m^3/s).

5.5.7 In addition to industrial wastewater, sewage will also be generated by workers within EcoPark, and this will flow directly to PPSTW (via TMSPS) for treatment. The design capacity of PPSTW (and TMSPS) was based on it serving an area of 56.5ha, and in terms of a m^3/ha allowance, this equates to 1,927m^3/ha/day (0.022m^3/s). On this basis, the 19.52ha EcoPark should be allocated 37,615m^3/day (0.135m^3/s) of capacity. Table 2 of the DSD Sewerage Manual provides a flow factor ceiling of 0.35m^3/day/employee of sewage. On this basis, an EcoPark working population almost 15,000 could be accommodated within this capacity allowance. As mentioned above, since the EcoPark working population will be less than 10,000, no capacity problems are envisaged to the public sewerage system.

5.5.8 The flow from EcoPark WTF has been estimated at 4,666m^3/day (0.054m^3/s). Compared to the PPSTW (and TMSPS) design capacity of 108,864m^3/day (1.260m^3/s), this represents just 4.3%. Furthermore, 104,192m^3/day (1.206m^3/s) of design capacity remains available for other users, including the domestic sewage flow from EcoPark. In terms of a m^3/ha allowance, this equates to just 12.4% of the 37,615m^3/day (0.135m^3/s) capacity allowance for EcoPark at PPSTW (and TMSPS). Therefore, no capacity problems are envisaged in terms of flows of treated industrial effluent from the WTF. Notwithstanding, it is recommended that these issues are confirmed through a Drainage Impact Assessment (DIA) in the follow-on D&C consultancy.

5.5.9 In terms of others users of Tuen Mun Area 38, the *PAFF EIA* estimates that only 2.9m^3/day capacity will be required by the PAFF, which is easily accommodated within the 103,900m^3/day spare capacity. The capacity requirements for other users of Tuen Mun Area 38 are not known, however, provided that they remain within their allocated 1,927m^3/ha/day capacity, there will be no problems with the capacity of PPSTW or TMSPS.

<u>EcoPark WTF Design</u>

5.5.10 It has been established that the design capacity of the WTF should be 14,000m^3/day. The other issue with regard to design is the quality (composition) of the industrial wastewater that the WTF will need to treat such that the effluent from the WTF meets the WPCO-TM standard for *"effluents discharged into foul sewers leading into Government sewage treatment plants"* (see Table 5.2).

5.5.11 The quality of the industrial wastewater depends upon the characteristics of the recycling processes to be carried out within EcoPark, as indicated in Table 5.5, below. Please note that some processes have been excluded from assessment in this EIA because of environmental unacceptability or to address perceived concerns of the local community – this has been indicated where relevant in the table.

Table 5.5 : Recovery Process and Generation of Wastewater

Material Type	Process	Generation of Wastewater
***Batteries*[1]**		
Lead-acid	Mechanical / Physical Separation	Neutralised sulphuric acid
Zinc-carbon / Alkaline	Shredding & Neutralization	Acid-bath effluent
	Electromagnetic separation	
Lithium	Shredding and Electromagnetic/ Physical separation	Hydrosaline-bath to be disposed in hazardous waste disposal system
	Hydrosaline deactivation	
NiCd/NiMH/li ion	Shredding	None
Electronics		
CRT Recovery	Separation and Testing	None
	Shredding, electromagnetic and electrostatic sorting	
Computer/Electronics Recovery	Separation and Testing	None
	Shredding and Separation	
White Goods Dismantling	Separation and Testing	None
	Manual Dismantling and Separation	
Fluorescent Lamp Recovery	Crush-and-Sieve	None
	Volatization	
	Cyclone / magnetic separation	
Glass		
Sorting	Manual Sorting	None
	Automated Sorting	
Processing	Crusher	Effluent from cleaning baths
Re-manufacturing	Melting	Quench Water
	Moulding	
	Forming and Finishing	
Organic Food Waste		
In-vessel composting	Enclosed composting vessel	From cleaning vessel (high BOD and SS)
	Curing	
Inedible rendering	Crusher	*These processes were screened-prior to the Air Quality Impact Assessment (Section 3) due to concerns about significant odour generation*
	Cooker	
	Drainer	
	Screw Press and Filter	
Ferrous Metals		
Sorting	Sorting	None
Baling	Baling	None
Processing	Shearing and Shredding	None
	Electric Arc Furnace	*This process was screened-out prior to the Air Quality Impact Assessment (Section 3) to maximise the overall throughput of metal thermal processing and to minimise the fuel-related air emissions*

Material Type	Process	Generation of Wastewater
Non-ferrous Metals		
Sorting	Visual Sorting	None
Baling	Baling	None
Processing (Lead)	Shearing/cutting/chopping/ shredding	Process / Cooling Water
	Melting/Sweating	
	Melting (Blast-melting cupola)	
Processing (Aluminium)	Shearing/cutting/chopping/ shredding	Process / Cooling Water
	Sweating Furnace	
	Melting (Reverberatory Furnace)	
	Refining (demagging, alloying)	*This process was removed after the Air Quality Impact Assessment (Section 3) showed unacceptable air quality impacts*
Processing (Copper)	Shearing/cutting/chopping/ shredding	Process / Cooling Water
	Sweating (Cupola)	
	Melting/Alloying/Casting	
Processing (Zinc)	Shearing/cutting/chopping/ shredding	Process / Cooling Water
	Sweating (Reverberatory)	
	Leaching (Sodium carbonate)	
	Melting (Kettle Pot)	
	Refining/Alloying (Muffle Distillation)	
Paper		
Sorting	Automated	None
Baling	Baling	None
Processing (Secondary Fibre)	Pulping	Process Water from washing Effluent from process-specific wastewater pre-treatment plant
	Cleaning	
	De-inking (Washing / Flotation)	
	Non-chlorine Bleaching	
	Additives	
	Pressing/Drying	
Plastics		
Plastics Recovery Facility	Sorting	None
	Crushing and Baling	None
Flaking and Washing	Flaking/shredding/cutting	Residue (organic/inorganic) from washing processes
	Washing	
	Separation/Centrifugal Drying	
Blending	Batch / continuous blender	Wastewater from hydrolysis
Moulding/Extrusion	Melting (electrical powered furnace)	None
	Cooling and Cutting	Cooling Water
	Centrifugal drying	Extracted Water
PWC Manufacture	PWC manufacture	None
Textiles		
Sorting	Sorting	None
Baling	Baling	None

Material Type	Process	Generation of Wastewater
Rubber Tyres		
De-beading	Manual Stripping	None
Shredding	Mechanical shredding	None
Crumbing	Mechanical	None
	Cryogenic Processing	
Processing	Magnetic separation	None
	Air separator	
	Sieving	
Retreading	Sorting and Buffing	None
	Inspection and Curing	
	Vulcanisation / Autoclave	
Wood		
Dismantling / Sorting	Dismantling / Sorting	None
	Bulk reduction equipment	
Pallet refurbishment	Pallet refurbishment	None
Chipping / bleaching	Chipping / non-chlorine bleaching	Effluent from process-specific wastewater pre-treatment plant
	Magnetic separation	
Spent Copper Etchant		
Processing	Electrolytic Process	Effluent from process-specific wastewater pre-treatment plant
	Chemical Treatment Process	

5.5.12 It is not possible to estimate the quality of effluent from every type of processes that could possibly be carried out in EcoPark. However, based on the assumption that these processes will use the best practicable control technology currently available, the quality of the effluent will be equal to the standards published in *US Code of Federal Regulations, Title 40 : Protection of Environment 40-CFR-Chapter I – Part 42.*

5.5.13 Key contaminant concentrations entering the WTF are shown in Table 5.6, below.

5.5.14 There are a number of appropriate wastewater treatment technologies available to choose from in the detailed design, to be carried out under the follow-on D&C consultancy. Biological Aerated Filtration (BAF) and sulphide precipitation have been demonstrated to be effective methods for the removal of heavy metals from industrial wastewaters. The WTF will need to fit into an area of 1,200m^2, which has been allocated in the conceptual design. It would also be preferable for the WTF to be of modular design so as to avoid over-sizing during Phase I, when the flow will be less than 50% of the total Phase I + II flow.

5.5.15 The need to disinfect WTF effluent cannot be confirmed at this stage but is considered to be unlikely as the WTF will treat industrial wastewater only. For the purposes of this assessment, however, chlorine will not be used for any purpose in connection with the operation of the WTF. Should disinfection of WTF effluent be required, non-chlorine alternatives shall be considered.

5.5.16 It is important to note that during the design of the WTF, maximum influent criteria will be identified, based on the treatment technology chosen. Should tenants be unable to meet these criteria, they would be required to install an appropriate level of pre-treatment within their premises before discharge to the EcoPark foul sewerage system, such that the maximum influent criteria of the WTF are met.

5.5.17 To conclude, the sewage flow generated by the operation of EcoPark will be well within the design flow allowed for this area in the Tuen Mun Drainage Master Plan. No adverse effects are anticipated on the PPSTW and its outfall due to the quality of WTF effluent.

Table 5.6 : Contaminant Concentration of the Effluents Entering the WTF, Based on Best Practical Control Technology

Contaminants	WPCO Standard (mg/)	Max Concentration for any Single Day (mg/)*	Max Concentration for Monthly Average (mg/)*
Ammonia-N (Total N)	100	32	11
Antimony	0.15	0.0008	0.0004
Arsenic	0.15	0.0007	0.0007
BOD5	800	6,832	3,549
Cadmium	0.001	0.0016	0.0007
Copper	1	4.81	2.4
Cyanide	0.1	4.64	1.55
Lead	0.15	0	0
Nickel	0.6	0	0
Oil and grease	20	212	106
pH	6-10	Not Available	Not Available
Phenols (4AAP)	0.1	1.24	0.42
Selenium	0.15	0.05	0
Total suspended solids	800	9,610	6,828
Zinc	0.6	96.14	48.05

Note : * Based on Average Daily flow of 4,666m^3/day and in conformance with *US Code of Federal Regulations, Title 40 : Protection of Environment 40-CFR-Chapter I – Part 42*

Impact on Stormwater System and Open Sea

5.5.18 The key concern for the stormwater system is the washed-off contaminants left on open space either due to poor operational practice or accidents. The former can be avoided by adherence to suitable management practices, while the latter can be mitigated by implementation of an Emergency Response Plan (ERP).

5.5.19 Section 7 has identified a number of processes that could result in a high level of contamination if there was an accident within a lot. These processes are summarised in Table 5.7 below. A stop-log should be installed at a suitable location(s) in the perimeter drainage system so that contaminants can be contained in the event of a spill. In this case, contaminated water collected in the surface drainage systems around these process areas would be diverted to the WTF for treatment, or to another appropriate treatment facility.

Table 5.7 : Processes with a High Risk of Accidental Contamination

Material Type	Process	Likely Contaminants	Level of Contamination
Batteries			
Lead-acid	Mechanical / Physical Separation	Sulphate (from sulphuric acid)	High
Electronics			
Fluorescent Lamp Recovery	Volatization	Elemental Mercury	High
Organic Food Waste			
In-vessel composting	Enclosed composting vessel	Organic Liquids, Ammonia	High
	Curing		
Spent Copper Etchant			
Processing	Electrolytic Process	Copper (in solution)	High

Source : Extracted from Table 7.1.

Loading and Unloading of Cargo

5.5.20 Waters adjacent to the marine frontage could be contaminated by spillage of materials into the sea during loading and unloading. The type of contamination depends on the characteristic of the materials and those with high/medium risk were shown in Table 5.8.

5.5.21 There are a number of loading methods, including bulk cargo, packed in container or as loose materials in a barge. Amongst these three types, unloading and loading loose materials has the highest potential for spillage and contamination of the open sea. This method should therefore be discouraged.

5.5.22 Surface run off from the marine frontage area will include water from rainfall and from cleaning activities. As such, it is possible that this water may not be clean. To avoid it discharging directly to the sea, the marine frontage area will be constructed on a slight gradient, with the seaward side of the frontage higher than the back. This will ensure that water (whether from rain or cleaning activities) flows away from the sea and towards the surface drains at the edge of the access road. These surface water drains will be connected to petrol- and grease- interceptors prior to discharge into the sea. A series of stop-logs will also be installed to isolated sections of this drainage system in case of accidental spillage of contaminated material.

5.5.23 An ERP will be formulated by the Management Contractor to address various accident scenarios within EcoPark. The ERP will be certified by the Environmental Team (ET) and verified by the Independent Environmental Checker (IEC) under the operation EM&A programme. The ERP will include actions in the event of spillage to :

- Contain the contaminants and prevent their escape and/or dispersion.
- Retrieve and treat the contaminated materials as soon as possible.

5.5.24 In the event of an emergency caused by accidental spillage of contaminants within a tenant's lot or at the marine frontage, the ERP should cover :

- Contact personnel and the means to contact.
- Evacuation procedure in the case of risk to life.
- Procedures to contain contaminants and prevent their escape and/or dispersion, e.g., through closing the stop-logs to isolate in the lot's perimeter drainage system from EcoPark's stormwater drainage system.
- Procedures to divert/transport the contaminated materials to a designated temporary storage area or appropriate treatment facility.
- Procedures to clear up the lot and/or perimeter drainage system prior to opening the stop-logs.

5.5.25 In the event of an emergency caused by a malfunction of the WTF, the ERP should cover :

- Contact personnel and the means to contact.
- Procedures to initiate emergency repairs.
- Procedures to temporarily divert the incoming effluent to any designated temporary holding facility, or to engage a bypass to discharge untreated effluent to PPSTW via TMSPS (only to avoid loss of life).
- Procedures to partially/fully treat effluents at an alternative treatment facility.

5.5.26 These contingency requirements will be developed further in the follow-on D&C consultancy when the detailed design of the WTF and lot infrastructure has been developed. By following the ERP, the risk to the surrounding environment from any accidental spillage or malfunction of the WTF will be minimised.

5.6 Mitigation Measures

Construction Phase

5.6.1 General construction activities on land should also be governed by good working practice, such as that highlighted in *ProPECC PN 1/94*, and as described below, and should be written into the Works Contract :

- Wastewater from temporary site facilities should be controlled to prevent direct discharge to surface or marine waters.
- Portable chemical toilets should be provided. The use of soakaways shall be avoided.
- Storm drainage shall be directed to storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels, earth bunds or sand bag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks.
- Silt removal facilities, channels and manholes shall be maintained and any deposited silt and grit shall be removed regularly, including specifically at the onset of and after each rainstorm.
- Temporary access roads should be surfaced with crushed stone or gravel.
- Rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.
- Measures should be taken to prevent the washout of construction materials, soil, silt or debris into any drainage system.
- Open stockpiles of construction materials (e.g. aggregates and sand) on site should be covered with tarpaulin or similar fabric during rainstorms.
- Manholes (including any newly constructed ones) should be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers.
- Discharges of surface run-off into foul sewers must always be prevented.
- All vehicles and plant should be cleaned before they leave the construction site to ensure that no earth, mud or debris is deposited by them on roads. A wheel washing bay should be provided at every site exit.
- Wheel wash overflow shall be directed to silt removal facilities before being discharged to the storm drain.
- The section of construction road between the wheel washing bay and the public road should be surfaced with crushed stone or coarse gravel.
- Wastewater generated from concreting, plastering, internal decoration, cleaning work and other similar activities, shall be screened to remove large objects.
- Vehicle and plant servicing areas, vehicle wash bays and lubrication facilities shall be located under roofed areas. The drainage in these covered areas shall be connected to foul sewers via a petrol interceptor in accordance with the requirements of the WPCO or collected for off site disposal.
- Surface run-off from bunded areas should pass through oil/grease traps or pollutant trap prior to discharge to the stormwater system.

Operation Phase

5.6.2 The single most important mitigation measure in the operational phase is the construction of the WTF that will treat effluents from recycling processes. The Operator will be required to obtain a Discharge Licence for the effluent from the WTF and to carry our regular performance monitoring to ensure it complies with the requirements of the discharge licence under the WPCO. This will be audited as part of the operation EM&A programme.

5.6.3 Any covered areas within lots will be connected directly to the WTF through the foul sewers. Since these areas are covered, they should not collect rainwater and so will not overload the WTF during rainstorms. Lease conditions should state that any processes or activities identified as causing potentially high levels of contamination (in the opinion of the EcoPark Operator) will be required to be located under a covered area within the lot.

5.6.4 Stop-logs will be installed in the perimeter drainage system to isolate contamination and prevent it from entering the stormwater system. To ensure that there is no chance of contaminated runoff leaving the site untreated during high rainfall, the perimeter drainage system shall have sufficient capacity (whether within the channels or at a designated sump) to store any contaminated runoff (spillage plus collected rainwater) from the area isolated by the ERP and allow it to be treated at the WTF or other appropriate treatment facility.

5.6.5 Furthermore, provision may need to be made in the tenant's lease to give the Operator the right to inspect sewerage and drainage connections within a tenant's lot to ensure that there are no misconnections that might lead to water pollution incidents.

5.6.6 Other mitigation measures recommended for the operational phase are to be included in an ERP (to be prepared by the Operator) that provides contingency procedures to ensure containment and safe disposal of any contaminants leaking from the recycling processes, treatment plants or pipework. Suitable absorbent materials (e.g. sand or 'vermiculite') shall be kept on site to deal with chemical spillages.

5.6.7 To minimise the chance of accidental spillage during loading and unloading, and thereby reduce marine water quality impacts, there are well established guidelines, such as the *International Maritime Organisation Code of Practice for the Safe Loading and Unloading of Bulk Carriers*, of which Sections 5 (loading) and 6 (unloading) should be followed.

5.6.8 Materials with a higher risk of contamination should be packed in a container together with suitable package protection. If this is not possible, bulk cargo should be properly packed and protected with suitable materials. For wet materials, waterproofing protection should be added to the package. This will minimise the dispersion of contaminants in the event that the cargo fall into the sea.

5.7 Conclusions

Residual Impacts

5.7.1 With the implementation of the recommended mitigation measures, the water quality impact during normal operation will not be significant and, therefore, no adverse residual impacts are anticipated.

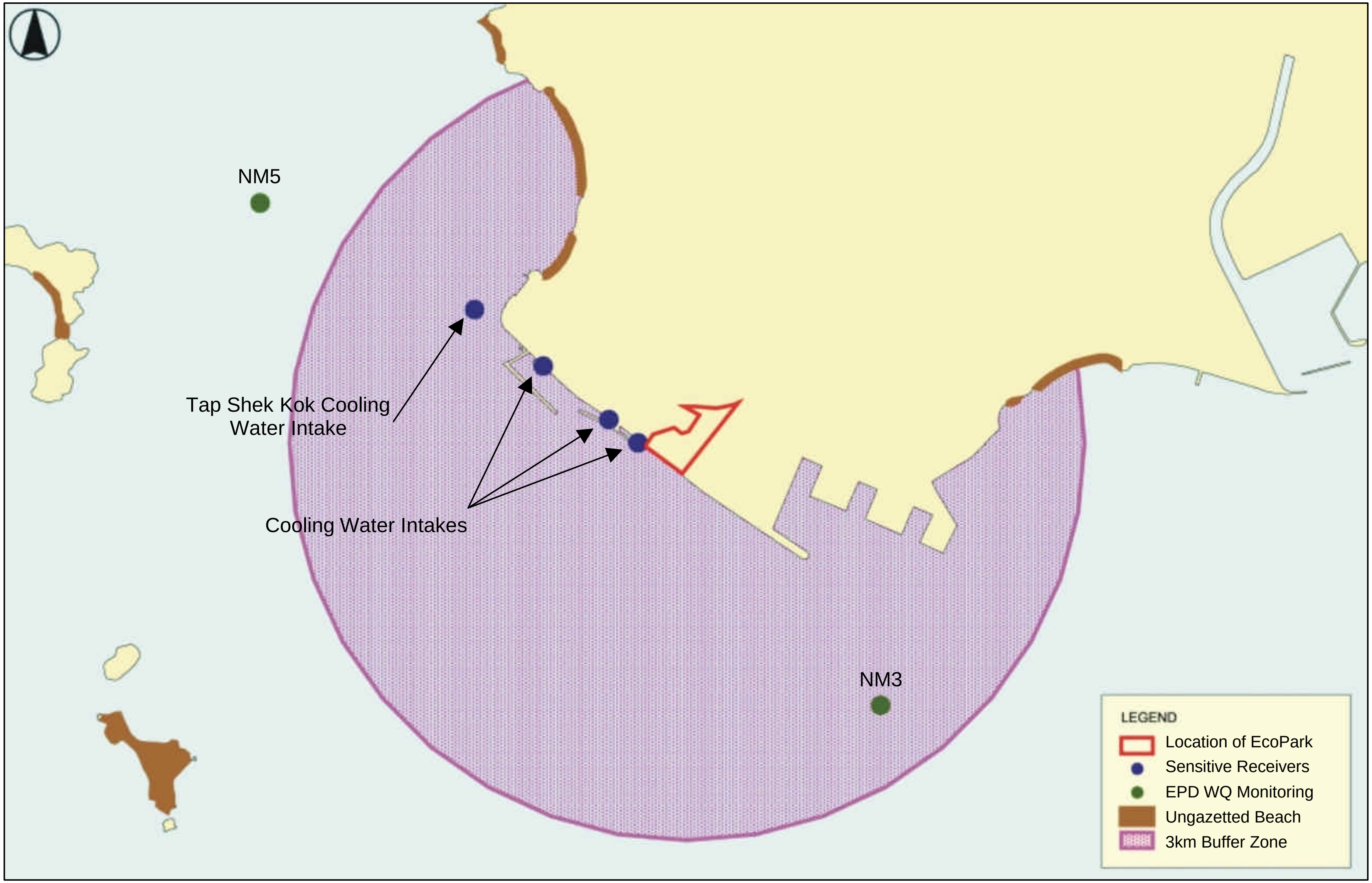
Cumulative Impacts

5.7.2 The construction of PAFF facilities is anticipated to start shortly but the schedule is still uncertain. It is possible that the construction works period could overlap with the construction of the park. Similarly, the programme for construction actives in other parts of Tuen Mun Area 38 is also not certain and related works could also be concurrent with the construction of EcoPark.

5.7.3 Notwithstanding, the cumulative effect of construction activities on coastal waters can be mitigated by good construction management, which can be assumed not only at the PAFF but at other proposed users, such as CEDD's C&D Materials facilities. As such, no cumulative construction impact is anticipated.

5.7.4 The estimated effluent flow rate from EcoPark WTF is 4,666m^3/day, which is just 12.4% of EcoPark's allocation (and 4.3% of the total capacity) of PPSTW and TMSPS. Hence, the TMSPS will be sufficient to handle the flow generated from EcoPark WTF without exceeding the design capacity of the downstream sewerage system and will also be able to handle the allocated flows from other parts of Area 38. In terms of domestic sewage, no capacity problems are envisaged in terms of treatment at PPSTW, however it is recommended that these issues are confirmed through a Drainage Impact Assessment (DIA) in the follow-on D&C consultancy.

Figure 5.1 : Water Quality Sensitive Receivers



6 WASTE MANAGEMENT IMPLICATIONS

6.1 Introduction

6.1.1 This section of the EIA report summarises the environmental implications arising from the construction and operation of EcoPark, including opportunities to avoid solid waste generation, minimise waste generation, re-use or recycle materials within EcoPark, and disposal. It is also essential to understand the nature and composition of the wastes, in particular whether the waste materials are inert or contaminated for allocating the appropriate disposal route. Mitigation measures will be suggested for handling, collection and transportation of residual wastes.

6.1.2 Wastes generated during the operational phase will include general MSW-type materials from daily operations, non-MSW wastes arising from recycling activities within EcoPark. Issues relating to domestic sewage from the toilets of the Administration Building and from toilet facilities on individual on lots, and wastewater/ effluents arising from recycling activities within EcoPark are discussed in Section 5.

6.2 Objectives

6.2.1 The waste management assessment has been conducted in accordance with the requirements of Annexes 7 and 15 of the EIA-TM, and the objectives as stated under Clause 3.4.3.2 of the EIA Study Brief. The objectives are as follows :

- Analysis of Activities and Waste Generation shall involve identifying the quantity, quality and timing of the waste and chemical waste arising from the construction and the operation of the Project, based on the sequence and duration of these activities.
- As regards proposals for waste management, the following shall be considered :
  - Opportunities for reducing waste generation, on-site or off-site reuse and recycling. Measures that can be taken in the planning and design stages shall be separately considered.
  - The types and quantities of residual waste that require disposal and the appropriate disposal options.
  - The impacts caused by handling (including stockpiling, labelling, packaging and storage), collection, transportation and disposal, together with appropriate mitigation.

6.3 Legislation, Standards, Guidelines and Criteria

6.3.1 Legislation, Standards, Guidelines and Criteria which are of relevance to this Project are :

- Waste Disposal Ordinance (Cap. 354) and relevant Regulations.
- The Land (Miscellaneous Provisions) Ordinance (Cap 28).
- Environmental Impact Assessment Ordinance (Cap. 499).
- Public Health and Municipal Services Ordinance (Cap. 132).
- Waste Reduction Framework Plan (WRFP).
- Various Works Bureau Technical Circulars.

Waste Disposal Ordinance (Cap. 354) and Relevant Regulations.

6.3.2 The Waste Disposal Ordinance (WDO) enacted in 1980 provides the statutory framework for the management of all wastes from where they arise to the point of final disposal i.e. control on the collection, treatment and disposal of waste. The WDO prohibits any person from using any land or premises for the disposal of wastes unless the person has been authorised by or has obtained a license from the waste disposal authority. The ordinance was amended in early 1995 to enable permit control on import and export of wastes in line with the requirements under the Basel Convention, and was in place in September 1996.

6.3.3 The Waste Disposal (Chemical Waste) (General) Regulation (CWR) provides for cradle-to-grave control of chemical wastes and was implemented in May 1993 to control all aspects of chemical waste disposal, including packaging, labelling, storage, collection, transport, treatment and final disposal. Under CWR, any person who produces or causes to produce chemical waste must register with the EPD. CWR requires waste producers to arrange for proper disposal of their wastes at licensed facilities and to engage a licensed collector to remove and transport the waste.

Land (Miscellaneous Provisions) Ordinance (Cap 28)

6.3.4 Requires that dumping licences are obtained by individuals or companies who deliver suitable construction wastes to public filling areas, public filling barging points or fill banks. Under the licence conditions public filling facilities will accept only inert building debris, soil, rock and broken concrete.

Environmental Impact Assessment Ordinance (Cap. 499)

6.3.5 Designated projects specified under Schedule 2 of the EIAO must follow the statutory EIA process and apply for environmental permits for their construction and operation. Annex 7 of the TM under the EIAO specifies the assessment criteria for evaluating waste management implications.

Public Health and Municipal Services Ordinance (Cap. 132)

6.3.6 The Public Health and Municipal Services Ordinance provides for the control of discharge of hazardous materials to sewers, and for the control of littering. It also places restrictions on the storage of wastes in buildings. This may be applicable to construction site offices.

Waste Reduction Framework Plan

6.3.7 The Waste Reduction Framework Plan (WRFP) sets out programme to avoid and minimise waste, promote recycling and reuse of materials, prolong the life of existing landfills and reduce the increasing costs of waste transportation, treatment and disposal.

Technical Circulars

6.3.8 The following Technical Circulars are applicable to this Project :

- **WBTC No. 2/93 and 2/93B.** These relate to Public Filling Facilities and outline policy relating to C&D materials. They state that C&D material suitable for use as fill material should not be disposed of to landfills, but should be reused in public filling area or reclamation and land formation projects. The Public Filling Sub-Committee together with Project Departments are responsible for considering the suitability of a site as a public filling area. In order to dispose of the inert portion of C&D material in a public filling area, a license issued by CEDD is required.
- **WBTC Nos. 25/99, 25/99A and 25/99C.** These relate to incorporation of information on C&D material management in Public Works Subcommittee Papers. They promulgate policy and guidelines for incorporating this information in those Papers recommending upgrading of projects to Cat. A.
- **ETWB TC(W) No.31/2004.** This relates to the Trip-ticket System for Disposal of C&D materials and supersedes WBTCs Nos. 5/99 and 5/99A and ETWB TC(W) No.21/2002. It promulgates the auditing requirements for the implementation of the trip-ticket system in PWP contracts for proper disposal of C&D materials at public filling facilities or landfills.
- **ETWB TC(W) No.15/2003.** This relates to Waste Management Plans (WMPs) and to on-site sorting and supersedes WBTC No. 29/2000. It requires contractors to prepare and implement an enhanced WMP to encourage on-site sorting of C&D materials and to minimise their generation.

6.4 Assessment Methodology

6.4.1 The assessment of environmental impacts from the handling, storage, collection, transportation and disposal of waste material (liquid and solids) generated by the Project has been undertaken in accordance with Annexes 7 and 15 of the EIAO-TM and the ESB.

6.4.2 The waste management hierarchy has been applied in the assessment and development of mitigation measures for waste. The waste management hierarchy is a concept which shows the desirability of various waste management methods and comprises the following in order of preference :

- Avoidance.
- Minimisation.
- Reuse.
- Recycling.
- Treatment.
- Disposal.

6.4.3 All opportunities for reducing waste generation have been assessed based upon the following factors :

- Avoiding or minimising waste generation through changes in the design.
- Adopting better management practices to promote segregation of waste materials.
- Reuse and recycling.
- Diverting waste to public filling areas or other construction sites.

6.4.4 The types and quantities of waste have been estimated and disposal options for each category of waste identified, taking into account the existing or future spare capacities of the waste disposal facilities and the environmental implications of the handling, collection and disposal of waste material.

6.4.5 The assessment comprises :

- Analysis of Activities and Waste Generation during the Construction Phase for :
  - Excavated C&D materials from site preparation
  - Chemical waste arising from maintenance of plant and equipment
  - General waste from daily activities
- Analysis of Activities and Waste Generation during the Operation Phase for :
  - Waste from Recycling Activities
  - Chemical waste arising from maintenance of plant and equipment.
  - Sewage sludge (from the WTF).
  - General waste from daily activities.
- Proposals for Waste Management during Construction Phase and Operation Phases for their respective sources of waste, in terms of :
  - Reduction, Reuse and Recycling.
  - Disposal Options.
  - Impacts and Mitigation.

6.5 Analysis of Activities and Waste Generation During the Construction Phase

6.5.1 There are three main sources of waste generation during the proposed 22-month construction phase, namely :

- Excavated C&D materials from site preparation.
- Chemical waste arising from maintenance of plant and equipment.
- General waste from daily activities.

Excavated C&D Materials

6.5.2 No major earthworks will be required as the site has already been formed and will be available for the development of EcoPark. Excavated materials generated from site preparation (e.g. utility trenches, foundation works, etc.) will be dependent on the detailed design of EcoPark, which will be prepared under the follow-on D&C consultancy. As such, it is not possible to estimate the likely quantities of excavated C&D materials at this time.

6.5.3 Notwithstanding, all such excavated materials should be stockpiled on site. Although landscaping of EcoPark is not anticipated to be significant, all stockpiled material will be fully used to ensure the site achieves a material balance, or else will be a net importer of material (preferably C&D material from Fill Banks).

6.5.4 The contract documents should specify that no excavated materials shall be removed from the site, but should instead be reused within the site as appropriate. Import of public fill into the site should also be encouraged. On this basis it has therefore been assumed that there will be no net excavated C&D materials arising.

Chemical Waste

6.5.5 Servicing of the Works Contractor's plant and equipment will likely be the primary source of chemical waste during the construction period. The majority of chemical waste produced is therefore expected to consist of solid wastes and liquid wastes.

6.5.6 The volume of chemical waste arising will depend upon the total number of plant/equipment and the level of on-site maintenance. Based on experience, this is expected to be <50 litres/month or, conservatively, 1.2 tonnes during the 22-month construction phase.

General Waste

6.5.7 To determine the quantities of general waste generated during the construction phase, reference has been made to *Monitoring of Solid Waste in Hong Kong – Statistics for 2003* (EPD, June 2004). Plate 2.7 of that report shows that between 1999 and 2003, the average per capita generation of MSW was 1.39kg/person/day. This MSW rate, rather than the domestic waste rate, has been applied to the construction phase since this will take into account the wider variety of wastes that will arise during construction, e.g., packaging of equipment and construction materials, maintenance of plant, etc.

6.5.8 The total volume of general waste generated depends on the number of workers to be employed on site. Based on the construction cost estimates and the 24-month construction programme (both Phase I and Phase II) provided in the *Preliminary Report* it has been assumed that an <u>average</u> of 50 no. workers would be present on site for 6 days per week during this period. The total general waste arising would therefore be :

Waste Arising = 22 months x 4.3 wks/month x 6 days/wk x 1.39 kg/worker/day x 50 workers
= 40 tonnes (approximately)

6.5.9 Thus 40 tonnes of general waste is expected, which is less than 2 tonnes/month (~420kg/week) on average throughout the 22-month construction phase. This figure does not take into consideration recyclable materials collected by the Works Contractor (see Section 6.7) and so represents a conservative estimation.

6.5.10 Toilet facilities will be provided by portable facilities that are maintained off-site by specialist contractor. There will be no impacts from toilet facilities during the construction phase.

6.6 Analysis of Activities and Waste Generation During the Operation Phase

6.6.1 There are four main sources of waste generation during the operation phase, namely :

- Waste from Recycling Activities, comprising :
  – Waste removed from incoming feedstock
  – Rejected recyclables
  – Spent process chemicals
- Chemical waste arising from maintenance of plant and equipment.
- Sewage sludge (from the WTF).
- General waste from daily activities.

6.6.2 It is intended that tenants operating within EcoPark should be encouraged to reuse and recycle wastes that are generated by their own recycling processes, such that the "waste" product from one process can be used as the feedstock of another process, thereby reducing the level of waste generated.

6.6.3 It is also intended that this concept should be further expanded so that businesses form symbiotic links with each other, such that the "waste" product from one business can be used as the feedstock of another business – this is termed "vertical integration". Figure 2.2 shows the potential vertical integration between material-types within EcoPark. It should be noted, however, that for the purposes of this waste assessment a more conservative approach has been adopted, i.e., one that does not assume that all potential vertical integration will occur and therefore one that will generate higher quantities of waste.

6.6.4 This vertical integration concept has been applied in the calculation of waste arisings in Table 6.1, although not all of the possible integrations have been included. For example, it has been assumed that plastic from the casings of lead-acid batteries would form part of the feedstock of the various plastics processes, but it has not assumed that textiles recovered from de-beading tyres would form part of the feedstock for textile processing (because the quality of the textiles recovered from tyres is unlikely to be suitable for the types of textile processing assumed in EcoPark at present).

Waste from Recycling Activities

6.6.5 The potential waste arising from the processes listed in Table B.1 (in Appendix B) include waste removed from incoming feedstock, rejected recyclables and spent process chemicals, and are estimated in Table 6.1, below. Please note that some processes have been excluded from assessment in this EIA because of environmental unacceptability or to address perceived concerns of the local community – this has been indicated where relevant in the table.

6.6.6 It should also be noted that Table 6.1 provides a worst-case assessment for the generation of waste. To this end, while processes that have been "excluded from assessment" are also excluded from Table 6.1, throughput reductions identified under Section 3 have not been considered, i.e., this table is based on the original "buffered" throughputs for the remaining processes. The reason for this approach is that the reductions in throughput considered in Section 3 were necessary to achieve reductions in air quality impacts. However, in the future improved and/or more cost-effective mitigation measures may be available to reduce air quality impacts, instead of imposing throughput reductions, and so throughput could return to the original "buffered" throughput levels.

6.6.7 Therefore, the worst-case assessment should consider the long-term "buffered" throughputs established in Table B.1 (in Appendix B) and not the reduced throughputs proposed in Section 3, which may not be long-term. Processes that have not been assessed may be re-introduced at a later date (via the Process Review mechanism), and their waste management implications would be fully considered at that time.

Table 6.1 : Estimate of Solid Waste Arisings from Recycling Activities

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Batteries	"Buffered" Throughput = 2,240tpa				***188tpa***
Lead-acid (est. throughput = 1,565.8tpa)	Metallic Lead (25%); Lead sulphate/oxide (50%); Acid (15%); Plastics (5%); Other materials and residuals (5%)	Acids (15%); plastics (5%) and other material (5%) (assume 100% recovery)	Plastics (to other EcoPark processes)	Assumed 5% other materials and residuals	5% x 1,565.8tpa = **78tpa**
Zinc-carbon / Alkaline (est. throughput = 157.9tpa)	Zinc (29%); Manganese (20%); Steel (15%), Carbon (10%); Other (35%)	Assume 35% loss due to removal of non-recyclable materials	None (feedstock for next stage processing)	Assumed 35% shredded batteries and non-recyclable materials	35% x 157.9tpa **=** **55tpa**
	Shredded batteries	Impurities (NDA)	Metal (feedstock for next stage processing) and non-metal components (for export or to other EcoPark processes)	None	**None**
	Separated metal components	NDA	Magnetic ferrous bricks (for export)	None	**None**
Lithium (est. throughput = 157.9tpa)	Lithium (3.5%); vanadium oxide (23.9%); recyclable hardware (44.9%); Others (polymers and others;27.7%)	Recyclable hardware (metals; 44.9%), polymers and other materials (assume 27.7%)	Metals (feedstock for next stage processing).	Assumed 27.7% Polymers and other materials are waste	27.7% x 157.9tpa = **44tpa**
	Lithium and vanadium oxides (as recovered in the separation process)	NDA	Lithium salt mixture (for export)	None	**None**
NiCd/NiMH (est. throughput =365.1tpa)	Cadmium (13-22%); Cobalt (0.5-2%); Lithium Hydroxide (0-4%); Nickel (20-32%); Potassium Hydroxide (0-4%) and Sodium Hydroxide (0-4%); Others (assume polymers, metals; 32%)	Other materials (assume 97% diversion)	Metals (feedstock for next stage processing) and non-metals (for export)	Assumed 3% Polymers and other materials are waste	3% x 365.1tpa = **11tpa**

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Electronics	"Buffered" Throughput = 25,100tpa				***3,645tpa***
CRT Recovery (est. throughput = 6,275tpa)	Portable and Table televisions, console televisions, monitors	Plastics, metals (NDA on quantities)	Reusable CRTs (for refurbishment) Recyclable materials (plastics, metals) (to other EcoPark processes) and separated CRTs (feedstock for next stage processing)	None	**None**
	Sorted CRTs	Separated glass and plastics	Glass (for export)	Assumed 10% unusable glass	10% x 6,275tpa = **627tpa**
Computer/ Electronics Recovery (est. throughput = 6,275tpa)	Varies depending on type and quantity of computer/electronics	NDA	Re-usable computer / electronics (can be repaired for reuse)	None	**None**
	Non-reusable computer / electronics	Steel breakage (25.7%) packaging (17.9%); CRT glass to lead (16.1%); Solid waste (13.1%); Printed circuit boards (5.9%); Export scrap (5.9%); Export reusable materials (4.5%); Plastics (4.4%); Copper-bearing materials (3.3%); CRT glass to glass (3.2%)	Metals (aluminium, steel, gold, silver, lead, etc.) (for export / to Ferrous and Non-Ferrous Metals processing facilities) Plastics (for export / to Plastics Recovery Facility)	Assumed 13.1% non-reusable computer / electronics	13.1% x 6,275tpa = **822tpa**
White Goods Dismantling (est. throughput = 6,275tpa)	Varies depending on type of white good	Varies depending on type of white good	Re-usable White Goods (can be repaired for reuse)	None	**None**
	Non-reusable white goods	Varies depending on type of white good	Metals (primarily steel) (to other EcoPark processes) Plastics (to Plastics Recovery Facility)	Assumed 20% non-metal non-plastic wastage	20% x 6,275tpa = **1,255pa**

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Fluorescent Lamp Recovery (est. throughput = 6,275tpa)	Glass (95.8%by wt), metals (2.5% by wt), others (phosphor powder, elemental mercury; 1.7% by wt)	NDA	Separated components (feedstock into next stage processing)	None	**None**
	Glass particles and mercury-containing phosphor powder	NDA	Elemental mercury (for export) Phosphorous (for export)	None	**None**
	Glass particles	NDA	Glass (for export / to Glass processing facilities) Aluminium (for export / to Non-Ferrous Metals processing facilities)	Assume 15% non-recoverable glass	15% x 6,275tpa = **941tpa**
Glass	"Buffered" Throughput = 42,680tpa				***9,229tpa***
Sorting	Glass, Others (dyes, paper, plastics)	40+% loss of glass as mixed colour residual (for colour glass sorting only);18-36% residual per tonne of raw feed for general glass material	Sorted glass (feedstock into Processing stage)	None	**None**
		5-15% residual waste	Sorted glass (feedstock into Processing stage)	Assumed 15% residual glass, unsuitable for further processing	15% x 42,680pa = **6,402tpa**
Processing	Sorted glass	Typical residual waste factor ~2% (paper, plastics from labels)	Cullet (for export / (feedstock for Re-manufacturing stage))	Assumed 2% waste (paper, plastics from labels) from sorted glass quantities	2% x 36,278tpa = **726tpa**
Re-manufacturing	Crushed glass (to 20mm)	Typical residual waste factor of 3% (paper, plastics from labels)	Molten glass (feedstock into next stage processing)	Assumed 3% waste (paper, plastics from labels) from crushed glass quantities	3% x 35,552tpa = **1,067tpa**
	Molten Glass	Typical residual waste factor of 3% (ceramics and other contaminants)	Pressed and blown glass for forming and finishing (feedstock into next stage processing)	Assumed 3% waste (ceramics and other contaminants) from molten glass quantities	3% x 34,485tpa = **1,034tpa**
	Pressed and blown glass	NDA	Glass products (for export)	None	**None**

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Organic Food Waste “Buffered” Throughput = 82,180tpa					***1,975tpa***
In-vessel Composting (est. throughput = 19,750tpa)	Organic material (from agriculture premises; markets)	Unacceptable materials (dependent on grade of feedstock)		Assumed 10% unusable materials	10% x 19,750tpa = **1,975tpa**
		Impurities	Packaged Compost (for local use)	None	**None**
Inedible Rendering (est. throughput = 62,430tpa)	*These processes were screened-prior to the Air Quality Impact Assessment (Section 3) due to concerns about significant odour generation*				
Ferrous Metals “Buffered” Throughput = 270,380tpa					***13,519tpa***
Sorting	Varies depending on quality of feedstock	NDA	Sorted ferrous metals (for Baling or Processing)	Assumed 5% unusable materials / general refuse	5% x 270,380tpa = **13,519tpa**
Baling	Sorted ferrous metals	NDA	Baled metals (for export / to other EcoPark processes)	None	**None**
Processing	Sorted ferrous metals	NDA	Shredded metal for furnace	None	**None**
	This process was screened-out prior to the Air Quality Impact Assessment (Section 3) to maximise the overall throughput of metal thermal processing and to minimise the fuel-related air emissions				
Non-ferrous Metals “Buffered” Throughput = 57,100tpa					***8,710tpd***
Sorting	Varies depending on quality of non-ferrous metals input	Varies depending on quality of non-ferrous metals input	Sorted non-ferrous metals (for Baling or Processing)	Assumed 15% unusable materials / general refuse	15% x 57,100tpa = **8,566tpa**
Baling	Sorted non-ferrous metals	NDA	Baled non-ferrous metals (for export)	None	**None**
Processing (Lead) (est. throughput = 12,135tpa)	Sorted lead pieces/material	NDA	Size reduction of material (feedstock into next stage)	None	**None**
	Lead pieces, size-reduced material and lead ingots (from lead acid battery processing)	NDA	Recovery of low grade molten lead ((feedstock into next stage processing))	Baghouse (for dust control) on furnace will typically give 3kg/dust per tonne melted	0.3% x 12,135tpa = **36tpa**
	Recovered low grade lead, addition of high quality feedstock if required	Impurities and removal of dross (which is returned for further processing)	Crude lead bullion (for export)		

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Processing (Aluminium) (est. throughput = 12,135tpa)	Sorted aluminium pieces/material	NDA	Size reduction of material (feedstock into next stage processing)	None	**None**
	Shredded non-ferrous metals; dross	Higher-melting materials (iron, brass, etc.) diverted for further processing	Recovery of aluminium (feedstock into next stage processing)	Baghouse (for dust control) on furnace will typically give 3kg/dust per tonne melted	0.3% x 12,135tpa = **36tpa**
	Recovered aluminium, addition of high quality feedstock if required	Impurities and removal of dross (which is returned for further processing)	Molten aluminium (feedstock into next stage processing)		
	Refining (demagging, alloying) processes were removed after the Air Quality Impact Assessment (Section 3) showed unacceptable air quality impacts				
Processing (Copper) (est. throughput = 12,135tpa)	Sorted copper and brass pieces/material	NDA	Size reduction of material (feedstock into next stage processing)	None	**None**
	Size reduced copper material	NDA	Molten copper (feedstock into next stage processing)	Baghouse (for dust control) on furnace will typically give 3kg/dust per tonne melted	0.3% x 12,135pa = **36tpa**
	Molten copper	Impurities and removal of dross (which is returned for further processing)	Ingots (for export)	None	**None**
Processing (Zinc) (est. throughput = 12,135tpa)	Sorted zinc pieces/material	NDA	Size reduction of material (feedstock into next stage processing)	None	**None**
	Size reduced zinc material	Dross and skimmings	Molten low grade zinc (feedstock into next stage processing)	Baghouse (for dust control) on furnace will typically give 3kg/dust per tonne melted	0.3% x 12,135tpa = **36tpa**
	Dross and skimmings	NDA	Zinc Oxide (for export)	None	**None**
	Molten low grade zinc	Impurities and removal of dross (which is returned for further processing)	Molten zinc (feedstock into next stage processing)	Baghouse (for dust control) on furnace will typically give 3kg/dust per tonne melted	**None** (use same Baghouse as above)
	Molten zinc	NDA	Ingots (for export)	None	**None**

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Paper	"Buffered" Throughput = 507,590tpa				***162,429pa***
Sorting	Mixed paper	Removal of contaminants (staples, string, plastics, etc.)	Sorted paper (by grade; for Baling or Processing)	Assumed 20% waste (staples, string, plastics, etc.	20% x 507,590tpa = **101,518tpa**
Baling	Mixed/separated paper	NDA	Baled paper (for export)	None	**None**
Processing (Secondary Fibre)	Sorted or mixed paper (depending on requirements of facility)	NDA	Slurry (feedstock into next stage processing)	Assumed 150kg/tonne of wastewater treatment sludges from process-specific wastewater treatment (not from EcoPark general wastewater treatment plant)	15% x 406,072tpa = **60,911tpa**
	Slurry	Large contaminants (i.e. paper clips, plastics, staples, etc.)	Screened slurry (feedstock into next stage processing)		
	Screened slurry	Ink, toner fluids, other contaminants (i.e. labels, adhesives, etc.)	De-inked slurry (feedstock into next stage processing)		
	De-inked slurry	NDA	Whitened pulp in slurry (feedstock into next stage processing)		
	De-inked or bleached slurry	NDA	Finished pulp (for export (dried) or paper manufacturing (feedstock into next stage processing)		
	Finished pulp	NDA	Paper and paper products		
Plastics	"Buffered" Throughput = 102,740tpa				***32,663tpa***
Plastics Recovery Facility	Mixed plastics	NDA	Sorted plastics (for Baling or for Processing)	Assumed 20% waste comprising non-plastic materials (e.g. paper, glass, etc.) unsuitable for recycling	20% x 102,740tpa = **20,548tpa**
	Sorted plastics	NDA	Baled plastics (for export)	None	**None**
Flaking and Washing	Sorted plastics	NDA	Shredded plastics (for export or feedstock into next stage processing)	Assumed 13% waste comprising non-plastic materials (e.g. labels, glues, adhesives, etc.) unsuitable for recycling	13% x 82,192tpa = **10,685tpa**
	Plastic flakes	NDA	Clean plastic flakes (feedstock into next stage)		
	Clean plastic flakes	NDA	Dried plastic flakes (feedstock into next stage)		

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Blending	Dried flakes and pellets (virgin material)	NDA	Uniform recycled/virgin materials of the same resin (for export or feedstock into next stage processing)	None	**None**
Moulding/ Extrusion	Uniform recycled/virgin materials of the same resin	NDA	Molten plastic extruded through tubes (feedstock into next stage processing)	Assumed 2% waste (e.g. cleaning filters, residue in cooling water system, etc.) unsuitable for recycling	2% x 71,507tpa = **1,430tpa**
	Strands of plastic from melting process (above)	NDA	Pellets (wet) (feedstock into next stage processing)		
	Wet pellets	NDA	Pellets (for export)		
Plastic Wood Composite (PWC) Manufacture	Wood chips (50%), plastic (virgin and/or recycled) (50%)	NDA	Plastic wood composite material (for export / local manufacturing)	None	**None**
Textiles	"Buffered" Throughput = 8,010tpa				***2,003tpa***
Sorting	Varies depending on feedstock received	2-10%	Sorted textiles (feedstock into next stage processing)	Assumed 25% waste (e.g. textiles, plastics, etc.) unsuitable for recycling	25% x 8,010tpa = **2,003pa**
Baling	Mixed / sorted textiles	NDA	Baled textiles (for export)	None	**None**
Rubber Tyres	"Buffered" Throughput = 20,020tpa				***1,970tpa***
De-beading (est. throughput = 16,557tpa)	Used Tyre Casings	Metal (16.5%), textiles (5.5%), rubber tyre (including polymers, carbon, etc.) (78%)	Steel (for export / feedstock into next stage processing);Textiles (if removed); Waste tyres (feedstock into Shredding)	Assumed that 5.5% "textiles" component removed from tyres will be unsuitable for further processing	5.5% x 16,557tpa = **911tpa**
Shredding	Debeaded Tyres; Unused Tyre Casings	Rubber fragments contaminated with other materials (5-30%; depending on whether metal & fibres have been removed)[12]	Large sized rubber fragments (feedstock into Crumbing)	Assumed 5% waste rubber unsuitable for recycling	5% x 15,646tpa = **782tpa**

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Crumbing	Shredded Tyre Casings; Unused Tyre Casings; production waste and stripped treads and/or inner tubes	Metals and textiles/fibres (40-50%; depending on whether metal & fibres have been debeaded prior to shredding)	Smaller sized rubber fragments (crumbs) (feedstock into Processing)	None	**None**
		NDA	Smaller sized rubber fragments (crumbs) (feedstock into Processing)		
Processing	Crumbed Rubber (from Crumbing Process)	Steel scrap	Rubber granulate and textiles (feedstock into next stage processing)	None	**None**
		Textile scrap	Rubber granulate (feedstock into next stage)		
		Rubber granulate	Rubber granulates (sorted into required size range) (for export)		
Retreading (est. throughput = 3,463tpa)	Used Tyre casings	buffed rubber tyre; 0.325kg per tyre (or 5% of total feedstock)	Tyres sorted for retreading or for crumbing (feedstock into next stage processing)	Assumed that 8% (~4.25kg/tyre) is waste unsuitable for further processing	8% x 3,463pa = **277tpa**
	Used Tyre casings selected for retreading	NDA	Pre-cured or mould-cured tyres (feedstock into next stage processing)		
	Pre-cured or mould-cured tyres	NDA	Re-treaded tyres (for local sale or export)		
Wood	"Buffered" Throughput = 41,260tpa				***0tpa***
Dismantling / Sorting	Wooden pallets, boxes	Varies depending on quality of the feedstock	Sorted wood for further processing within EcoPark (Pallet Refurbishment or for Chipping)	Scrap metal (nails, staples), paper, etc. processed elsewhere in EcoPark	**None**
	Large-sized wooden material	NDA	Size-reduced wooded material (feedstock for Chipping/Bleaching)		

Material Type & Estimated Throughput*	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	By-products for Use in Other (EcoPark / off-site) Recovery Processes	Details of Waste Arising	Estimated Quantity of Waste Arising (tpa)*
Pallet Refurbishment	Re-usable pallets	Varies depending on quality of the feedstock	Refurbished pallets (for local sale or export)	None	**None**
Chipping / Bleaching	Sorted and dismantled wood pieces	NDA	Cut wood chips (feedstock into next stage processing)	Scrap metal (nails, staples), paper, etc. processed elsewhere in EcoPark	**None**
	Wood chips	Metals (in the form of nails, staples), paper	Wood chips (bleached as needed) (for export or feedstock for PWC Manufacture)		
Spent Copper Etchant "Buffered" Throughput = 3,290tpa					***0tpa***
Processing	Collected spent copper etchant	NDA	Copper solution (for local sale or reuse)	Any unused chemical reagents	**Minimal**

Notes : Assumptions for waste arisings based on research on industry norms and also on professional judgement.

* To provide a worst-case assessment for the generation of waste, none of the throughput reductions identified under Scenarios 2 and 3 in Section 3 have been incorporated into this table, i.e., this table is based on the original "buffered" throughputs. Therefore, the estimated quantity of waste will be greater than that for the reduced throughput Scenarios. The reason for this approach is that the reductions in throughput considered in Section 3 were necessary to achieve reductions in air quality impacts. However, in the future improved and/or more cost-effective mitigation measures may be available to reduce air quality impacts, instead of imposing throughput reductions, and so throughput could return to the original "buffered" throughput levels. Therefore, the worst-case assessment should consider the long-term buffered throughputs and not the reduced throughputs, which may not be long-term.

6.6.8 Table 6.2, below, provides a breakdown of the total waste arisings estimated in Table 6.1. It should be noted that these estimates represent net waste arisings, after taking into consideration the recycling of materials within individual businesses, and also within EcoPark as a whole, i.e., as a result of the vertical integration of processes. Although Table 6.1 indicated a number of processes that result in zero waste, it is appreciated that in practice there will always be some waste arising from all processes. To provide a conservative estimate of this, the total waste arisings have been increased by 5%.

Table 6.2 : Summary of Solid Waste Arisings from Recycling Activities

Material Type	Anticipated Waste Types (cannot be reused / recycled)	Estimated Quantity (tpa)
Batteries	Shredded batteries, non-recyclables, waste polymers and metals	188
Electronics	CRT glass, computer components, white goods residuals, glass	3,645
Glass	Residual (mixed) glass, paper/plastic labels, ceramics	9,229
Organics	Putrescible waste that cannot be composed	1,975
Ferrous Metals	General refuse, baghouse dust (from APC equipment)	13,519
Non-ferrous	General refuse, baghouse dust (from APC equipment)	8,710
Paper	Staples, string, plastics, etc., wastewater treatment sludges	162,429
Plastics	Paper, glass, labels, glues, adhesives, filter cleaning residues, etc.	32,663
Textiles	Textiles, plastics, etc.	2,003
Rubber Tyres	Textiles and rubber	1,970
Wood	None	0
Spent Etchant	None	0
	Estimated Waste Arisings from EcoPark Processes (tpa)	**236,331**
	5% "Contingency" for Additional Waste Arisings (tpa)	**11,816**
	Total Estimated Waste Arisings (tpa)	**248,147**

Chemical Waste

6.6.9 The volume of chemical waste arising will depend upon the type and throughput of the various process to be used. It is likely, however, that chemical waste will be generated at a lower rate than during the construction phase, since no heavy plant will be used. Based on the likely processes identified in Table B.1 (in Appendix B), it is not anticipated that significant quantities of chemical waste will arise from recycling activities.

6.6.10 Therefore, the quantity of chemical waste will likely be <50 litres/month or, conservatively, 0.60tpa.

Sewage Sludge

6.6.11 There are many types of wastewater treatment technologies available to reduce the pollutant loading in the sewage effectively. As demonstrated in Section 5, sulphide precipitation is one of the technologies to reduce the pollutant loadings that is feasible for EcoPark. As sulphide precipitation is likely to yield greater quantities of sludge than other technologies (such as BAF) this can be considered as the worst case scenario for sludge arisings.

6.6.12 Based on reagent consumption rates, it the total mass of dry solids formed is estimated to be 1.15g/ of throughput. Although the design capacity of the WTF is 14,000m^3/day, the actual flows were estimated to be 4,666m^3/day (para.5.5.5) and this will yield 5,366kg/day dry weight of sludge. Assuming that density of dry sludge is typically 1.80tones/m^3, the volume of dry solids formed will be 2.98m^3/day. If the sludge cake contains 30% solids, which is typical, the volume of sludge cake arising will be some 10m^3/day, equivalent to 4,526tpa of sludge cake.

General Waste

6.6.13 To determine the quantities of general waste generated during the operation phase, reference has again been made to *Monitoring of Solid Waste in Hong Kong – Statistics for 2003* (EPD, June 2004). Plate 2.7 shows that between 1999 and 2003, the average per capita generation of domestic waste was 1.11kg/person/day. This domestic rate, rather than the MSW rate, has been applied to the operation phase since this is more representative of the wastes that will arise during operation, e.g., paper, food, etc.

6.6.14 The *Preliminary Report* estimated that 54 no. management/maintenance/security staff would be employed during Phase I+II operation. Based on the use of Area 38 as an industrial estate with 7,955 workers occupying an area of 37.85ha, the *Preliminary Report* also estimated 210 workers/ha, which equates to 2,967 workers within the 14.13ha of EcoPark allocated to tenants. Thus a total of 2,967 persons (management/maintenance/ security staff plus tenants) would be resident within EcoPark on a daily basis, with an assumed 6 days per working week. The total general waste arising would therefore be :

Waste Arising = 4.3 weeks/month x 6 days/week x 1.11 kg/person/day x 2,967 persons
= 85 tonnes/month (1,020tpa)

6.6.15 Thus 85 tonnes per month of general waste is expected, which is 1,020tpa during the operation of Phase I + II. This figure does not take into consideration recyclable materials collected by the Operator (see Section 6.8) and so represents a conservative estimation.

6.6.16 All toilet facilities (both in the Administration Building and on individual lots) would be connected to foul sewer and thereby to the on-site wastewater treatment plant (see "Sewage Sludge", above). Sewage arisings were discussed in Section 5.

6.7 Proposal for Waste Management During the Construction Phase

6.7.1 Proposals for waste management during the construction phase comprise :

- Reduction, Reuse and Recycling.
- Disposal Options.
- Impacts and Mitigation.

6.7.2 These three proposals will be examined in terms of the three major sources of waste generation during the construction phase, namely :

- Excavated C&D materials from site preparation.
- Chemical waste arising from maintenance of plant and equipment.
- General waste from daily activities.

6.7.3 To enhance waste management during construction, the Works Contractor shall prepare and implement a Waste Management Plan in accordance with the requirements of WBTC No.15/2003, to the satisfaction of the Engineer.

Reduction, Reuse and Recycling

<u>Excavated C&D Materials</u>

6.7.4 Small amounts of excavated C&D materials generated from the site preparation and trenches for infrastructure works will be stockpiled. Through careful landscape design, stockpiled material can be used to ensure the site achieves a material balance, or else will be a net importer of material (preferably C&D material from Hong Kong's fill banks). Relevant WBTCs, such as *WBTC No. 19/2001 – Metallic Site Hoardings and Signboards,* that relate to environmentally-responsible construction methods, waste reduction, reuse and recycling will be followed.

Chemical Waste

6.7.5 Plant/equipment maintenance schedules should be designed to optimise maintenance and thereby minimise the generation of chemical wastes – contractors will generally adopt this approach as a matter of course because of the corresponding cost savings.

6.7.6 Chemical waste that is collected will be transported off-site for treatment by a licensed collector. The Works Contractor will need to register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lubricants) should recycled at an appropriate facility, e.g. at an oil re-refinery.

General Waste

6.7.7 The Works Contractor should implement an education programme for workers relating to avoiding, reducing, reusing and recycling general waste. This should include provision of three-colour recycling bins throughout the site (to allow paper, plastic and aluminium to be collected separately) and posters and leaflets advising on the correct use of recycling bins.

Disposal Options

Excavated C&D Materials

6.7.8 It is not expected that any significant quantities of excavated C&D materials will require disposal, as most will be reused on-site. Notwithstanding, a the trip-ticket system should be put in place in accordance with ETWB TC(W) No.31/2004. Copies/counterfoils from trip-tickets (showing the quantities of C&D Materials taken off-site) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

Chemical Waste

6.7.9 Solid and liquid chemical wastes liquid that cannot be recycled (or re-refined in the case of waste lubricants) should be disposed at an appropriate facility, such as EPD's Chemical Waste Treatment Centre on Tsing Yi. Landfilling of chemical waste should be avoided. Copies/counterfoils from collection receipts issued by the licensed chemical waste collector (showing the quantities and types of chemical waste taken off-site, and details of the treatment facility) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

General Waste

6.7.10 Residual, non-recyclable, general waste should be stored in appropriate containers prior to collection and offsite disposal at WENT landfill, which is the nearest landfill to EcoPark. Copies/counterfoils from collection receipts issued by the nominated general waste collector (showing the quantities and types waste taken off-site, and details of the disposal facility) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

Impacts and Mitigation

Excavated C&D Materials

6.7.11 As it is unlikely that surplus excavated C&D materials will be generated by this Project, there will be no impacts caused by the handling, collection, transportation and disposal of these materials, other than during stockpiling. In this case, stockpiled material will be covered (e.g. by a tarpaulin) until used in order to prevent wind-blown dust during dry weather, and to reduce muddy runoff during wet weather. If any topsoil-like materials need to be stockpiled for any length of time, consideration should be given to hydroseeding the topsoil on the stockpile to improve its visual appearance.

Chemical Waste

6.7.12 Plant/equipment maintenance schedules should be designed to optimise maintenance and thereby minimise the generation of chemical wastes – contractors will generally adopt this approach as a matter of course because of the corresponding cost savings.

6.7.13 Chemical waste that is collected will be transported off-site for treatment by a licensed collector. The Works Contractor will need to register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lubricants) should recycled at an appropriate facility, e.g. at an oil re-refinery.

General Waste

6.7.14 All recyclable materials (separated from the general waste) should be stored on-site in appropriate containers (such as 2,400 litre covered bins) prior to collection by a local recycler for subsequent reuse and recycling. Residual, non-recyclable, general waste should be stored in appropriate containers (that contain odours, in the case of putrescible waste). Regular collection will be made by an approved waste collection contractor in purpose-built Refuse Collection Vehicles (RCVs) that minimise environmental impacts during transportation.

6.8 Proposal for Waste Management During the Operation Phase

6.8.1 Proposals for waste management during the operation phase comprise :

- Reduction, Reuse and Recycling.
- Disposal Options.
- Impacts and Mitigation.

6.8.2 These three proposals will be examined in terms of the four main sources of waste generation during the operation phase, namely :

- Residual recyclable materials, comprising :
  - Waste removed from incoming feedstock
  - Rejected recyclables
  - Spent process chemicals
- Chemical waste arising from maintenance of plant and equipment.
- Sewage sludge (from EcoPark wastewater treatment plant).
- General waste from daily activities.

Reduction, Reuse and Recycling

Residual Recyclable Materials

6.8.3 It is intended that tenants operating within EcoPark should be encouraged by the Operator to reduce, reuse and recycle wastes that are generated by their own recycling processes, such that within a business the "waste" product from one process can be used as the feedstock of another process.

6.8.4 It is also intended that this concept should be further expanded so that businesses form symbiotic links with each other, such that the "waste" product from one business can be used as the feedstock of another business – this is termed "vertical integration". This concept has been applied in the calculation of waste that cannot be recycled during the operation of EcoPark (Section 6.6 and Table 6.1). For example, it has been assumed that plastic from the casings of lead-acid batteries would form part of the feedstock of the various plastics processes. Similarly, the metal recovered from de-beading tyres would form part of the feedstock for the various ferrous metals processing.

6.8.5 To help achieve this second goal, the Operator may need to allocate certain areas of EcoPark for certain types of processing. This clustering of individual business will enable closer symbiosis and so increase the level of recycling within EcoPark itself.

6.8.6 If this is not possible, then individual tenants should be encouraged to send recyclable material off-site for processing elsewhere in Hong Kong. As a final option, where recyclable material can be legally exported for recycling, this should be pursued at the discretion of the individual tenant.

Chemical Waste

6.8.7 It is suggested that the Operator should register with EPD as a chemical waste producer and provide on-site collection and storage as part of the management services (as an additional charge to individual tenants who generate large/regular quantities of chemical waste).

6.8.8 Where possible, it is recommended that waste lubricants are recycled into new products at an appropriate facility, e.g. at an oil re-refinery. Solid chemical wastes that cannot be recycled should be disposed at an appropriate facility, such as EPD's Chemical Waste Treatment Centre on Tsing Yi (see below).

Sewage Sludge

6.8.9 There are no opportunities for the reuse or recycling of sludge, however, it is possible to reduce the quantity of sludge generated.

6.8.10 The quantity of sludge arising from the operation of the WTF will be a function of the technology used (e.g. sulphide precipitation, BAF, etc.) and the throughput. Since the throughput of the WTF will depend upon the quantities of materials being processed within EcoPark (and this will likely increase over time), the only means to reduce the quantities of sludge would be to use a technology that results in low sludge yield.

6.8.11 The choice of treatment technology will be made during the detailed design of EcoPark under the follow-on D&C consultancy, and this will need to take into consideration the capital and operating costs of the WTW, efficiency and ability to treat the expected quality and quantity of incoming wastewater and the future cost of disposing of the sludge.

General Waste

6.8.12 The Operator should implement an education programme for tenants relating to avoiding, reducing, reusing and recycling general waste. This should include provision of three-colour recycling bins throughout the site (to allow paper, plastic and aluminium to be collected separately) and posters and leaflets advising on the correct use of recycling bins.

6.8.13 Collected materials that are recyclable within EcoPark should be passed to the appropriate recycler for use as a feedstock (see "Waste from Recycling Activities", above). Recyclables that cannot be used by EcoPark tenants should be sold to off-site recyclers.

6.8.14 The Operator should also provide on-site collection and storage of residual, non-recyclable, waste as part of the management services (as an additional charge to individual tenants who generate large/regular quantities waste). Waste should be stored in appropriate containers prior to offsite disposal at WENT landfill.

Disposal Options

Residual Non-Recyclable Materials

6.8.15 Where it is not possible to further recycle residual material within EcoPark itself or elsewhere in Hong Kong, and where such materials cannot be exported for processing then this non-recyclable, non-chemical waste should be stored in appropriate containers prior to collection and off-site disposal at WENT landfill, which is the nearest landfill to EcoPark.

Chemical Waste

6.8.16 The dust collected by any air pollution control equipment installed by tenants must be tested to ensure compliance for landfill disposal. If compliant, then the Practice Note for disposal of dusty waste at landfill sites and the Admission Ticket System shall be followed. If not acceptable for direct landfill disposal, then the dust shall be considered as chemical waste and treated and disposed of accordingly.

6.8.17 Solid and liquid chemical wastes liquid that cannot be recycled (or re-refined in the case of waste lubricants) should be disposed at an appropriate facility, such as EPD's Chemical Waste Treatment Centre on Tsing Yi. Copies/counterfoils from collection receipts issued by the licensed chemical waste collector (showing the quantities and types of chemical waste taken off-site, and details of the treatment facility) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

Sewage Sludge

6.8.18 Sludge will be disposed of at WENT landfill, or at any future dedicated sludge treatment facility. Copies/counterfoils from collection receipts issued by the licensed sludge collector (showing the quantities of sludge waste taken off-site, and details of the treatment/disposal facility) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

General Waste

6.8.19 Residual, non-recyclable, general waste should be stored in appropriate containers prior to collection and offsite disposal at WENT landfill, which is the nearest landfill to EcoPark. Copies/counterfoils from collection receipts issued by the nominated general waste collector (showing the quantities and types waste taken off-site, and details of the disposal facility) shall be kept for record purposes, as required in para.8.3.4 of the EM&A Manual.

Impacts and Mitigation

Waste from Recycling Activities

6.8.20 Where it is not possible to recycle wastes within EcoPark itself or elsewhere in Hong Kong, and where materials cannot be exported for processing then residual non-chemical waste should be stored in appropriate containers (that contain odours, in the case of putrescible waste). Regular collection will be made by an approved waste collection contractor in purpose-built RCVs that minimise environmental impacts during transportation.

Chemical Waste

6.8.21 Chemical wastes will be stored in appropriate containers in a covered area. "No Smoking" signs will be clearly displayed to prevent accidental ignition of any flammable materials. Drip trays capable of storing 110% of the volume of the largest container will be used to mitigate possible leakage. Whenever the drip trays contain the maximum number of containers, a registered chemical waste collector will transport the containers to the appropriate treatment or disposal facility.

Sewage Sludge

6.8.22 Sludge will be collected by a licensed collector at regular intervals, as determined by the operation of the WTF. Purpose-built sludge tankers will minimise the potential for environmental impacts during transportation.

General Waste

6.8.23 All recyclable materials (separated from the general waste) that cannot be used by tenants within EcoPark should be stored on-site in appropriate containers prior to collection by an off-site recycler for subsequent reuse and recycling.

6.8.24 Residual, non-recyclable, general waste should be stored in appropriate containers (that contain odours, in the case of putrescible waste). Regular collection will be made by an approved waste collection contractor in purpose-built RCVs that will minimise the potential for environmental impacts during transportation.

6.9 Conclusions

6.9.1 This waste management assessment has looked at the construction phase of EcoPark and has estimated waste arisings in terms of C&D materials, chemical waste and general waste. It has also looked at the operation phase of EcoPark and has estimated waste arisings in terms of waste from recycling activities, chemical waste, sewage sludge (from the WTF) and general waste arisings.

6.9.2 Table 6.3, below, summarises the overall waste arisings from the construction and operation of EcoPark. It should be noted that these estimates represent net waste arisings, after taking into consideration recycling of materials within individual businesses, and also within the entire EcoPark, i.e., as a result of the vertical integration of processes.

Table 6.3 : Estimate of Overall Waste Arisings

Type of Waste Arising	Quantity of Waste Arising
Construction Phase	
C&D Materials*	0 tonnes
Chemical Waste	1.20 tonnes
General Waste	40.00 tonnes
Total	**41.20 tonnes (~1.9 tonnes/month)**
Operation Phase	
From Recycling Activities	248,147 tpa
Chemical Waste	0.60 tpa
Sewage Sludge	4,526 tpa
General Waste	1,020 tpa
Total	**253,694 tpa (~21,142 tonnes/month)**

Note : * Although excavated C&D Materials will arise during construction, all such material will be reused within the site, resulting in zero net C&D Materials overall.

Construction Phase

6.9.3 From Table 6.3, it can be seen that the construction phase will generate 41 tonnes of waste that will require treatment (chemical waste) or landfill disposal (general waste).

6.9.4 There is sufficient capacity within facilities in Hong Kong (e.g. Dunwell's oil re-refinery and EPD's CWTC) for the treatment of chemical wastes. The disposal of 41 tonnes of general waste over a 22-month period will not have a significant impact on the monthly waste disposal rate at WENT Landfill, which is presently some 182,624 tonnes per month, nor on its remaining disposal capacity, which is presently some 34.6M tonnes.

6.9.5 In conclusion, therefore, the waste management impacts resulting from the construction phase of EcoPark are not considered to be significant.

Operation Phase

6.9.6 On an annual basis, it has been estimated that EcoPark will generate 253,694tpa of waste that will require treatment (chemical waste, possibly sludge in the future), or landfill disposal (waste from recycling activities, sewage sludge and general waste).

6.9.7 There is sufficient capacity within facilities in Hong Kong (e.g. Dunwell's oil re-refinery and EPD's CWTC) for the treatment of 0.60tpa chemical wastes. For the landfill disposal of the remaining 253,693tpa of other wastes, EcoPark represents 11.5% of the annual waste disposal rate (2.2Mtpa) at WENT Landfill, which has a remaining disposal capacity of some 34.6M tonnes.

6.9.8 The impact of disposing of waste from EcoPark at landfill is not considered to be significant when waste diversion is taken into account – the generation of 253,693tpa of non-chemical waste by EcoPark arises from the diversion from landfill of up to 1,100,160tpa (excluding 62,430tpa inedible rendering) to EcoPark for processing (see Table 2.2). Thus, there will be an overall net reduction of waste requiring landfill disposal of some 846,654tpa, which is considered to be a significant benefit of operating EcoPark. It should be noted that this figure is based on assessment of the "buffered" throughputs. Should there be reductions in throughput (as proposed in Section 3) then the overall diversion rate will be lower and so the overall net reduction of waste requiring landfill disposal will also be lower.

7 LAND CONTAMINATION IMPACT ASSESSMENT

7.1 Introduction

7.1.1 The site on which EcoPark is to be constructed is recently reclaimed land, consisting of marine sands and C&D Material. There is no indication that the site is contaminated at present and so efforts should be made to ensure that the site does not become contaminated during the operation of EcoPark. The following assessment of contaminated land impact is in accordance with *ProPECC PN 3/94 on Contaminated Land Assessment and Remediation* issued by EPD.

7.2 Possible Sources of Contamination

7.2.1 Land will generally become contaminated due to accidental spillage or leakage of contaminating substances into the ground. *ProPECC PN 3/94* lists the following industries as examples of those having the potential for causing land contamination :

- Oil Installations (e.g. oil depots, oil filling stations).
- Gas Works.
- Power Plants.
- Shipyards / Boatyards.
- Chemical Manufacturing / Processing Plants.
- Steel Mills / Metal Workshops.
- Car Repairing / Dismantling Workshops.

7.2.2 Contaminated land is referred to in *ProPECC PN 3/94* as *"land which has been polluted by hazardous substances as a result of industrial operations carried out on a site over a number of years"* and goes on to explain that contaminants often pose hazardous risks or cause detrimental effects to land users, the nearby environment or even building materials, thus affecting building safety.

7.2.3 Land contamination in Hong Kong is often the result of leakage of hydrocarbons from underground (fuel) storage tanks. Given the range of processes anticipated in EcoPark, underground fuel storage may be considered and this source of contamination might be expected, and so care must be taken in the design and maintenance of such storage tanks. Alternatively, above-ground bunded storage tanks could be used in preference.

7.2.4 "Soakaway" surface drainage will not be permitted anywhere within EcoPark and so any substances that accidentally enter the surface water drainage system will not be a source of land contamination – see Section 5.4 for related water quality impacts.

7.2.5 Another source of contamination is leakage of hydrocarbons and other chemical wastes stored above ground, primarily through accidental spillage during transportation or storage, and this could occur at EcoPark. Furthermore, land can be contaminated by metal fines, resulting from improper collection of process wastes. Again, this could occur within EcoPark.

7.2.6 Based on the above considerations, the processes identified in Table B.1 (in Appendix B) have been assessed in terms of the level of contamination (and the nature of likely contaminants) that could arise should there be an accident on open ground within EcoPark. It should be noted that this is a qualitative assessment of possible sources of contamination, based on professional judgement, and not an assessment of the likelihood (or risk) of contamination.

7.2.7 Table 7.1, below, identifies possible sources of contamination, likely contaminants and the level of contamination that could arise should there be an accident on open ground within EcoPark. Please note that some processes have been excluded from assessment in this EIA because of environmental unacceptability or to address perceived concerns of the local community – this has been indicated where relevant in the table.

Table 7.1 : Possible Sources of Land Contamination

Material Type	Process	Likely Contaminants	Level of Contamination
Batteries			
Lead-acid	Mechanical / Physical Separation	Sulphate (from sulphuric acid)	High
Zinc-carbon / Alkaline	Shredding & Neutralization	Metal Fines	Low
	Electromagnetic separation	None	
Lithium	Shredding and Electromagnetic/ Physical separation	Metal Fines	Low
	Hydrosaline deactivation	None	
NiCd/NiMH/li ion	Shredding	Metal Fines	Low
Electronics			
CRT Recovery	Separation and Testing	None	Low
	Shredding, electromagnetic and electrostatic sorting	Metal Fines	
Computer/Electronics Recovery	Separation and Testing	None	Low
	Shredding and Separation	Metal Fines	
White Goods Dismantling	Separation and Testing	None	Low
	Manual Dismantling and Separation		
Fluorescent Lamp Recovery	Crush-and-Sieve	None	Low
	Volatization	Elemental Hg	High
	Cyclone / magnetic separation	None	Low
Glass			
Sorting	Manual Sorting	None	Low
	Automated Sorting		
Processing	Crusher	None	Low
Re-manufacturing	Melting	None	Low
	Moulding		
	Forming and Finishing		
Organic Food Waste			
In-vessel composting	Enclosed composting vessel	Organic Liquids, Ammonia	High
	Curing		
Inedible rendering	Crusher	*These processes were screened-prior to the Air Quality Impact Assessment (Section 3) due to concerns about significant odour generation*	
	Cooker		
	Drainer		
	Screw Press and Filter		
Ferrous Metals			
Sorting	Sorting	None	Low
Baling	Baling	None	Low
Processing	Shearing and Shredding	Metal Fines	Low
	Electric Arc Furnace	*This process was screened-out prior to the Air Quality Impact Assessment (Section 3) to maximise the overall throughput of metal thermal processing and to minimise the fuel-related air emissions*	

Material Type	Process	Likely Contaminants	Level of Contamination
Non-ferrous Metals			
Sorting	Visual Sorting	None	Low
Baling	Baling	None	Low
Processing (Lead)	Shearing/cutting/chopping/ shredding	Metal Fines	Low
	Melting/Sweating	None	
	Melting (Blast-melting cupola)		
Processing (Aluminium)	Shearing/cutting/chopping/ shredding	Metal Fines	Low
	Sweating Furnace	None	
	Melting (Reverberatory Furnace)		
	Refining (demagging, alloying)	*This process was removed after the Air Quality Impact Assessment (Section 3) showed unacceptable air quality impacts*	
Processing (Copper)	Shearing/cutting/chopping/ shredding	Metal Fines	Low
	Sweating (Cupola)	None	
	Melting/Alloying/Casting		
Processing (Zinc)	Shearing/cutting/chopping/ shredding	Metal Fines	Low
	Sweating (Reverberatory)	None	
	Leaching (Sodium carbonate)	Sodium	Medium
	Melting (Kettle Pot)	None	Low
	Refining/Alloying (Muffle Distillation)		
Paper			
Sorting	Automated	None	Low
Baling	Baling	None	Low
Processing (Secondary Fibre)	Pulping	None	Low
	Cleaning		
	De-inking (Washing / Flotation)		
	Bleaching		
	Additives		
	Pressing/Drying		
Plastics			
Plastics Recovery Facility	Sorting	None	Low
	Crushing and Baling		
Flaking and Washing	Flaking/shredding/cutting	None	Low
	Washing		
	Separation/Centrifugal Drying		
Blending	Batch / continuous blender	None	Low
Moulding/Extrusion	Melting (fuel powered furnace)	None	Low
	Cooling and Cutting		
	Centrifugal drying		
Plastic Wood composite manufacture	Plastic wood composite manufacture	None	Low
Textiles			
Sorting	Sorting	None	Low
Baling	Baling	None	Low

Material Type	Process	Likely Contaminants	Level of Contamination
Rubber Tyres			
De-beading	Manual Stripping	None	Low
Shredding	Mechanical shredding	Metal Fines	Low
Crumbing	Mechanical Cryogenic Processing	None	Low
Processing	Magnetic separation Air separator Sieving	None	Low
Retreading	Sorting and Buffing Inspection and Curing Vulcanisation / Autoclave	None	Low
Wood			
Dismantling / Sorting	Dismantling / Sorting Bulk reduction equipment	None	Low
Pallet refurbishment	Pallet refurbishment	None	Low
Chipping / bleaching	Chipping / bleaching Magnetic separation	None	Low
Spent Copper Etchant			
Processing	Electrolytic Process Chemical Treatment Process	Copper (in solution)	High

Notes : Refer to Table B.1 in Appendix B for full details of each process.
This assessment is based on professional judgement and identifies the level of contamination (and the nature of likely contaminants) that could arise should there be an accident on open ground within EcoPark. It is not an assessment of the likelihood (or risk) of contamination.

7.3 Operational Practices to Prevent Contamination

7.3.1 Prevention of land contamination problems is relatively simple, relying mainly on good engineering practice, well developed waste management strategies and established industrial guidelines, such as those that will likely be imposed by the Operator on its tenants (described in the following sub-sections). Any spillages of contaminating material shall be cleaned up immediately through the use of an absorbent material. Any such used material should then be considered chemical waste and disposed of accordingly.

7.3.2 When previously unoccupied lots within EcoPark are leased to tenants for the first time, the lot area will comprise open ground with a hydroseed grass cover. This ground is highly permeable and will not provide a stable surface on which to construct a building. Therefore, tenants will likely lay down hardstanding (i.e. concrete) before building their premises. The hardstanding will be relatively impermeable and so will prevent the ground beneath it from becoming contaminated by any materials that are spilled.

7.3.3 It is only areas within lots that are not covered by hardstanding that could allow any spilled substances to contaminate the ground. Such areas could be used for open storage or vehicle parking, although usually such uses would be provided with hardstanding, as it provides a more stable surface. Any areas within the lot to be used for recycling processes shall be concrete paved before recycling activities commence and connected to the perimeter drainage system as appropriate..

7.3.4 It should be noted that individual lots will be connected to the surface water drainage system provided as EcoPark infrastructure. Any spillages that fall on hardstanding and are not cleaned up by an absorbent could find their way into the surface water drainage system. To this end, "petrol interceptors" and "grease traps" will be used prior to discharge of surface water off-site, thereby preventing water pollution – see Section 5.

Chemical Wastes

7.3.5 The following practices are recommended to prevent land contamination during the operational phase of EcoPark :

- All chemical storage areas shall be provided with locks and be sited on sealed areas. The storage areas shall be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled oil and chemicals from contaminating the ground.
- Management of chemical waste is implemented through the control of waste storage, labelling of waste, transportation and treatment of waste at an appropriate facility.
- Chemical wastes will be collected, stored and disposed of in accordance with the Regulation. Disposal of other construction waste will be undertaken by licensed contractors in accordance with applicable statutory requirements in the WDO.
- Chemical wastes shall be handled according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Spent chemicals shall be stored and collected by an approved operator for disposal at a licensed facility in accordance with the Chemical Waste (General) Regulation.
- Containers used for storage of chemical waste shall :
  - Be suitable for the substance they are holding, resistant to corrosion, maintained in good condition, and securely closed
  - Have a capacity < 450 litres unless specifications have been approved by the EPD.
  - Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations
- The storage area for chemical waste shall:
  - Be clearly labelled and used solely for the storage of chemical waste
  - Be enclosed on at least 3 sides
  - Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest
  - Be covered to prevent rainfall entering (water collected within the bund must be tested and disposal as chemical waste if necessary)
  - Be arranged so that incompatible materials are adequately separated

Metallic Fines

7.3.6 Metallic fines may be generated by processes that involve crushing, cutting or melting metals. It is therefore important for tenants who carry out such processes to ensure that such materials are collected and disposed of in an appropriate manner. Since these materials will likely have an economic value, this provides further incentive for their collection and reclamation.

7.3.7 Appropriate practices include the provision of a collection device attached to the plant/ equipment that generates the metal fines. This can be as simple as a container to catch fines as they are emitted from a process, or could include a suction and filter bag combination – the specifics will depend on the process and plant/equipment in use.

7.4 Conclusions

7.4.1 Based on the types of contaminants likely to be generated within EcoPark and the risk of these substances reaching open ground, the likelihood of land contamination as a result of EcoPark operation is minimal. Adoption of good operational practice, to be encouraged by the Operator, will further reduce the likelihood of land contamination.

8 LANDFILL GAS HAZARD ASSESSMENT

8.1 Introduction

8.1.1 Under Section 6.5, Chapter 9 of the *Hong Kong Planning Standards and Guidelines*, an evaluation of the risk posed by landfill gas (LFG) is required for any development proposed within a 250m 'Landfill Consultation Zone'. The EcoPark falls within this category as it is approximately 150m from Siu Lang Shui Landfill (SLSL) at its closest point (see Figure 8.1).

8.1.2 In June 1997 EPD issued the *Landfill Gas Hazard Assessment Guidance Note* providing a risk assessment framework for developments close to landfill sites. Generally, a qualitative landfill risk assessment is required to ensure that appropriate levels of safety design features are incorporated within the development.

8.2 Objectives

8.2.1 This assessment has been undertaken with close reference to the *Guidance Note* and in line with Annexes 7 and 19 of the EIAO-TM. The objectives of this assessment, as set out under Clause 3.4.5.2 of the EIA Study Brief, are as follows:

- Review of background information relating to SLSL.
- Identification of the sources, nature and likely quantities/concentrations of LFG with the potential to affect EcoPark.
- Identification of likely viable pathways through the ground, underground cavities, utilities or groundwater via which LFG may reach EcoPark.
- Identification of EcoPark works that would be sensitive to the effects of the LFG emissions.
- Qualitative assessment of the degree of risk that the LFG emissions may pose to the EcoPark for the identified source-pathway-target combination
- Proposal of appropriate measures to minimise LFG hazard during construction and operation of EcoPark.

8.2.2 Figure 8.1 shows the location of EcoPark, SLSL, the 250m consultation zone around SLSL and the location for LFG monitoring under the ongoing SLSL restoration contract.

8.3 Potential Hazards Associated with LFG

8.3.1 LFG is a flammable, toxic and asphyxiating mixture of methane (CH_4) and carbon dioxide (CO_2), often with a trace of volatile organic compounds (VOCs). It is a product of the anaerobic decomposition of organic wastes. When CH_4 is mixed with air within the lower and upper explosive limits (LEL and UEL, 5-15% by volume) in confined spaces and given a source of ignition such as an electrical spark, an explosion can result.

8.3.2 The LFG mixture has a density similar to air, although this varies according to its exact composition. Upward movement of LFG is usually a result of excess pressure over the ambient rather than buoyancy. Also, bulk gas movements may be caused by the displacement by a rise in the water table, whereas subsurface lateral diffusion through semi-porous strata and cracks may occur due to a concentration gradient.

8.3.3 LFG is capable of migrating away from its source along permeable pathways such as cracks and fissures in the surrounding rock and other preferential pathways such as utility routes. It has been known to travel along these pathways more than 300m away from the source.

8.4 Landfill Gas Risk Assessment Methodology

8.4.1 The methodology set out in the *Landfill Gas Hazard Assessment Guidance Note* issued by EPD was adopted in this assessment. For ease of reference, the key points of the *Guidance Note* are reproduced in the following sub-sections.

Landfill Gas Assessment Criteria

8.4.2 The risk due to LFG may be evaluated based upon the following three components :

Source

8.4.3 This is the source (i.e. the landfill) and is classified as follows :

- **Minor.** Landfill sites at which gas controls have been installed and proven to be effective by comprehensive monitoring that has demonstrated that no migration of gas beyond the landfill boundary (or any specific control measures). The landfill must have measures to control gas that do not rely solely on an active gas extraction system or any other single control measure which is vulnerable to failure. Or, old landfill sites where the maximum concentration of CH_4 within the waste, as measured at several location across the landfill and on at least four occasions over a period of at least six months, is less than 5% v/v.
- **Medium.** Landfill sites at which some form of gas control has been installed (e.g. a lined site or one where vents or barriers have been retrospectively installed), but where there are only limited monitoring data to demonstrate prevention of off-site gas. Or, landfill sites where comprehensive monitoring has demonstrated that there is no migration of gas beyond the landfill boundary but where the control of gas relies solely on an active gas extraction system or any other single control system that is vulnerable to failure.
- **Major.** Recently filled landfill sites at which there is little or no control to prevent migration of gas or at which the efficacy of the gas control measures has not been assessed. Or, any landfill site at which monitoring has demonstrated that there is significant migration of gas beyond the site boundary.

Pathway

8.4.4 This is the nature and length of potential pathways through which LFG could migrate (such as geological features, utility services and leachate flow), and is classified as follows :

- **Very Short/Direct.** Path length of less than 50m for unsaturated permeable strata and fissured rock or less than 100m for anthropogenic conduits.
- **Moderately Short/Direct.** Path length of 50 to 100m for unsaturated permeable soil or fissured rock, or 100 to 250m for anthropogenic conduits.
- **Long/Indirect.** Path length of 100 to 250m for unsaturated permeable soils and fissured rock.

Target

8.4.5 This is the level of vulnerability of the development (both during construction and operation) and is classified according to the following evaluation criteria :

- **High Sensitivity.** Buildings and structures with ground level or below ground rooms/voids or into which services enter directly from the ground and to which members of the general public have unrestricted access or that contain sources of ignition. This would include developments where there is a possibility of additional structures being erected directly on the ground on an ad hoc basis and without regard to the potential risks.

- **Medium Sensitivity.** Other buildings, structures or service voids where there is access only by authorised, well trained personnel, such as the staff of utility companies, who have been briefed on the potential hazards relating to LFG and the specific safety procedures to be followed; and deep excavations.
- **Low Sensitivity.** Buildings/structures that are less prone to gas ingress by virtue of their design (such as those with a raised floor slab), shallow excavations or developments that involve essentially outdoor activities but where evolution of gas could pose potential problems.

Qualitative Assessment of Risk

8.4.6 Once the status of each of the source, pathway and target have been evaluated against the above criteria, a qualitative assessment of the overall risk may be made with reference to the classification of risk category set out in Table 8.1, below :

Table 8.1 : Classification of Risk Category

Source	Pathway	Target Sensitivity	Risk Category
Major	Very Short/Direct	High	Very High
		Medium	High
		Low	Medium
	Moderately Short/Direct	High	High
		Medium	Medium
		Low	Low
	Long/Indirect	High	High
		Medium	Medium
		Low	Low
Moderate	Very Short/Direct	High	High
		Medium	Medium
		Low	Low
	Moderately Short/Direct	High	High
		Medium	Medium
		Low	Low
	Long/Indirect	High	Medium
		Medium	Low
		Low	Very Low
Minor	Very Short/Direct	High	High
		Medium	Medium
		Low	Low
	Moderately Short/Direct	High	Medium
		Medium	Low
		Low	Very Low
	Long/Indirect	High	Medium
		Medium	Low
		Low	Very Low

Source : *Landfill Gas Hazard Assessment Guidance Note*, EPD

8.5 Description and History of Siu Lang Shui Landfill

Landfill History

8.5.1 SLSL occupies an area of 12ha and is located south of the Castle Peak Firing Range, adjacent to the old Lung Mun Road, and is approximately 150m north of the closest EcoPark boundary, as shown on Figure 8.1.

8.5.2 The landfill was formed in a valley and infilling abutted the steep valley sides. The landfill was initially infilled as two separate areas – firstly to the east and subsequently to the west. Two streams that drained the hill slopes were diverted in stages via a box culvert beginning at the north edge of the site, and infilling then continues over the box culvert. The average depth of the landfill is 10m, although it reaches a maximum of 40m in some places.

8.5.3 The site was operational from November 1978 to December 1983 and approximately 1.2M tonnes of mostly domestic and industrial wastes, as well as incinerator ash and green wastes, were deposited during this period. It is estimated that <50% of these wastes are biodegradable. After closure of SLSL, a soil covering layer of compacted gravely silty sand varying between 2m and 6m in thickness was placed directly onto the deposited wastes, and trees were planted.

Original Landfill Design / Engineering

8.5.4 The site was designed as a PVC-lined, containment landfill. Two separate leachate areas were constructed, one to the east and one to the west of the valley stream. The eastern area was developed first in 1978 and the western area some 2 to 3 years later. Collected groundwater from the eastern area was routed under the old Lung Mun Road to discharge at the beach, but with the reclamation of Tuen Mun Area 38, it now discharges via a stormwater culvert beneath EcoPark site.

8.5.5 The original LFG management system comprised vertical passive gas vents, which were installed at regular intervals in the refuse and extended as tipping progressed. A gravel layer was placed at the top of each refuse platform with interconnecting gas vent pipes prior to placement of the cover soils. In certain areas of the site, where the existing PVC liner was not damaged, gas movement into the surrounding ground was hindered. No other measures were implemented to prevent LFG migration until the restoration works in 2000.

Landfill Restoration

8.5.6 In common with the other closed landfill sites in Hong Kong, restoration works were deemed necessary to reduce the potential health and environmental risks associated with LFG and landfill leachate, and to allow beneficial afteruse of the site. The restoration works for SLSL commenced in February 1999 under a Design-Build-Operate (DBO) contract managed by EPD. These works were completed in September 2000, and SLS landfill relies solely on a passive LFG system.

Geology and Hydrogeology

8.5.7 SLSL was formed in the coastal flood plain of a small valley, and infilling directly abutted the steep valley sides. The underlying material in the valley base is alluvium, with clay, silt, sand and gravel over the upper portion, and marine sand covering the lower portion. The alluvium is replaced by sedimentary and volcanic rocks as the valley narrows.

8.5.8 The bedrock of the hill slopes comprises fine to medium grained granite on the east, and medium grained granite on the west. A north-south trending fault associated with the Yuen Tau Shan Fault has been identified through the valley axis.

8.5.9 Groundwater flow in the vicinity is southwards, down the valley, towards the former coastline and is within 1m to 2m below the surface of the reclaimed ground to the south of the landfill (i.e. the Area 38 reclamation).

8.6 Description of EcoPark Works Within the Landfill Consultation Zone

8.6.1 The works to be carried out as part of EcoPark are as follows :

- Construction of perimeter fencing and lot fencing.
- Construction of the Administration Building.
- Construction of main road and access roads.
- Installation of sub-surface drainage (wastewater and stormwater)
- Installation of sub-surface utilities.
- Grassing of individual lots prior to lease.
- Construction of buildings and/or hardstanding by individual tenants.
- Landscaping of site perimeter and individual lots.

8.7 Landfill Gas Risk Assessment

Source

8.7.1 SLSL is an old and moderately sized landfill that was restored in 2000. Restoration works were carried out with the aim of minimising the risks associated with off-site migration of LFG through a passive LFG management system. As part of the restoration contract, LFG monitoring has been carried out since completion of the restoration works.

8.7.2 Results of the LFG monitoring carried out under the restoration contract since October 2001 are shown in Table 8.2 (for CH_4) and Table 8.3 (for CO_2), below. From these tables, it can be seen that there is virtually no off-site migration of CH_4, although relatively high levels of CO_2 have been detected off-site. The "background" CO_2 levels shown in Table 8.3 are from the restoration contract but cannot be said to represent natural ambient CO_2 levels prior to landfill construction (i.e. before 1978), which would typically be expected in the range 5% to 10%. These background data actually represent the CO_2 levels in the ground surrounding the un-restored landfill and would therefore be expected to be relatively high.

8.7.3 Due to the age and history of the landfill there are no records of natural ambient CO_2 levels, however, monitoring point DP220 is located outside the landfill boundary. Not only does DP220 have a background CO_2 level of 5%, monitoring has also shown CH_4 and CO_2 levels consistently <0.1% (i.e. below detection limits). Thus, DP220 would appear to be a reliable indicator of natural ambient CO_2 levels. It is therefore considered appropriate to assume the 5% background CO_2 level at DP220 as representative of natural ambient CO_2 levels, i.e., the true "background". Under this assumption, and in accordance with EPD's *Guidance Note*, levels of CO_2 that exceed 10%v/v (i.e. 5% above "background") would be considered "significant" and levels that exceed 6.5%v/v (i.e. 1.5% above "background") would indicate "less than adequate control of the gas at source". Since a number of CO_2 readings exceed both of these criteria, the Source term is classified as <u>MEDIUM</u>.

Pathway

8.7.4 The geology surrounding SLSL provides a potential pathway for migration of LFG to EcoPark site, primarily from the existence of the north-south trending fault associated with the Yuen Tau Shan Fault through the valley axis, and inter-granular movement through the reclamation fill that underlies EcoPark site. Once leaving SLSL, there is approximately 150m of made ground where groundwater levels are within 1m to 2m below the surface. This will act to cut off any potential LFG migration pathways at deeper levels within the fill, and it would be unusual for any LFG at such a shallow depth to migrate over this distance without being oxidised or dissipating through the reclamation fill to the surface where it would naturally vent to the atmosphere.

Table 8.2 : Methane Concentrations at SLSL Monitoring Locations (% v/v)

Date	%age Methane (v/v) at Designated Monitoring Locations						
	DH201	DH203A	DH204	DP220	DP221	DP223	DP224
Compliance[†]	**1**	**1**	**1**	**1**	**1**	**1**	**1**
10/10/2001*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
06/11/2001*	<0.1	1.0	<0.1	<0.1	<0.1	<0.1	<0.1
05/12/2001*	<0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1
08/01/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
01/02/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
01/03/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
03/04/2002*	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1
02/05/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
01/06/2002*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
02/07/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
03/08/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
05/09/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
02/10/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
07/11/2002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
02/12/2002*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
02/01/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
04/02/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15/03/2003*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
01/04/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
17/05/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
10/06/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
09/07/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
04/08/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16/09/2003*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
17/09/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16/10/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21/11/2003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
10/12/1003	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
06/01/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
20/02/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
09/03/2004*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
08/04/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
17/05/2004	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
01/06/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15/07/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
10/08/2004	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Source : EPD/FDG

Notes : [†] The "Compliance" row indicates the acceptable level as stated in the landfill restoration contract

* 10/10/2001 : DH203A actually sampled on 31/10/2001
06/11/2001 : DH203A actually sampled on 05/12/2001
05/12/2001 : DH203A actually sampled on 19/12/2001
03/04/2002 : DH204 actually sampled on 19/04/2002
01/06/2002 : DH203A andDP221 actually sampled on 14/06/2002
02/12/2002 : DH203A actually sampled on 07/12/2002
15/03/2003 : DP223 actually sampled on 31/03/2003
16/09/2003 : DH203A, DH204, DP220 and DP224 actually sampled on 17/09/2003
09/03/2004 : DP223 actually sampled on 16/03/2004

Table 8.3 : Carbon Dioxide Concentrations at SLSL Monitoring Locations (% v/v)

Date	%age Carbon Dioxide(v/v) at Designated Monitoring Locations						
	DH201	DH203A	DH204	DP220	DP221	DP223	DP224
Background†	**29.5**	**30.6**	**12.6**	**5.0**	**17.1**	**31.7**	**16.8**
Compliance†	**31**	**32.1**	**14.1**	**6.5**	**18.6**	**33.2**	**18.3**
10/10/2001*	**9.2**	<0.1	1.3	<0.1	6.0	**19.8**	<0.1
06/11/2001*	**10.5**	**23.4**	0.8	<0.1	5.0	**12.5**	**15.0**
05/12/2001*	**7.6**	**23.5**	1.0	<0.1	6.2	**12.1**	**12.1**
08/01/2002	**8.2**	**21.7**	2.9	<0.1	5.6	**9.7**	**11.2**
01/02/2002	**6.9**	**22.4**	1.8	<0.1	**6.6**	**10.4**	**11.4**
01/03/2002	4.9	**13.3**	0.7	<0.1	5.3	**7.1**	**12.0**
03/04/2002*	4.7	**12.7**	<0.1	<0.1	6.3	**10.6**	**11.0**
02/05/2002	4.1	1.3	1.7	<0.1	3.3	**9.2**	**9.5**
01/06/2002*	**7.9**	4.2	<0.1	<0.1	**8.9**	**9.5**	**7.6**
02/07/2002	6.2	**14.9**	5.4	<0.1	**6.6**	**12.6**	4.2
03/08/2002	**11.2**	**8.7**	0.5	<0.1	**11.3**	1.0	**12.3**
05/09/2002	**7.5**	1.3	1.0	<0.1	**7.8**	**10.8**	**7.8**
02/10/2002	**7.2**	2.6	1.2	<0.1	5.9	**8.6**	**10.0**
07/11/2002	**8.9**	1.7	1.0	<0.1	**8.8**	**10.8**	**9.4**
02/12/2002*	**7.7**	1.5	<0.1	<0.1	**7.4**	**9.2**	**8.8**
02/01/2003	**7.4**	**17.1**	<0.1	<0.1	**7.9**	**7.8**	**9.1**
04/02/2003	**8.4**	**13.3**	2.4	<0.1	5.9	4.0	**10.3**
15/03/2003*	6.0	**11.1**	0.8	<0.1	**9.0**	4.1	**10.8**
01/04/2003	5.4	3.2	1.0	<0.1	6.5	4.1	**9.4**
17/05/2003	4.9	0.4	<0.1	<0.1	2.0	4.0	2.1
10/06/2003	5.7	**8.3**	<0.1	<0.1	**7.6**	1.7	**10.0**
09/07/2003	5.7	0.3	<0.1	<0.1	3.0	**8.0**	6.2
04/08/2003	5.2	**11.8**	<0.1	<0.1	3.6	**11.6**	4.9
16/09/2003*	**11.6**	3.7	<0.1	<0.1	**13.6**	<0.1	**9.8**
16/10/2003	**6.9**	1.3	1.9	<0.1	**12.4**	5.1	**10.2**
21/11/2003	**6.8**	0.9	2.9	<0.1	**7.4**	4.8	4.5
10/12/1003	**8.9**	2.3	2.3	<0.1	**10.1**	6.2	6.1
06/01/2004	**7.6**	8.2	<0.1	<0.1	**10.6**	2.5	**9.5**
20/02/2004	**7.2**	0.3	0.2	<0.1	**8.9**	**7.5**	**7.5**
09/03/2004*	**7.0**	4.9	<0.1	<0.1	**10.4**	**9.8**	3.5
08/04/2004	**8.7**	6.3	0.1	<0.1	**8.1**	2.8	2.7
17/05/2004	4.9	2.9	0.4	<0.1	2.2	**14.9**	**7.5**
01/06/2004	4.9	**9.0**	0.3	<0.1	1.8	**7.3**	6.4
15/07/2004	3.8	**14.4**	<0.1	<0.1	5.4	**16.3**	6.2
10/08/2004	4.9	**6.9**	0.7	<0.1	6.1	**10.5**	2.8

Source : EPD/FDG

Notes : † The "Compliance" row indicates the acceptable level as stated in the landfill restoration contract and has been based on the "background" levels also set under that contract. However, for the purposes of this assessment the true background level has been assumed as 5%v/v (see para.8.7.3).

Bold shows exceedance of 6.5%v/v level, and **Bold** shows exceedance of 10%v/v level (see para.8.7.3).

* 10/10/2001 : DH203A actually sampled on 31/10/2001
06/11/2001 : DH203A actually sampled on 05/12/2001
05/12/2001 : DH203A actually sampled on 19/12/2001
03/04/2002 : DH204 actually sampled on 19/04/2002
01/06/2002 : DH203A andDP221 actually sampled on 14/06/2002
02/12/2002 : DH203A actually sampled on 07/12/2002
15/03/2003 : DP223 actually sampled on 31/03/2003
16/09/2003 : DH203A, DH204, DP220 and DP224 actually sampled on 17/09/2003
09/03/2004 : DP223 actually sampled on 16/03/2004

8.7.5 A drainage culvert runs below the site, however, this is a contiguous, water-tight concrete structure, and should any LFG be present in the culvert it would be unable to migrate into the site. Instead it would vent to the atmosphere at the outfall of the culvert. The risk of the culvert acting as a potential pathway is therefore low.

8.7.6 Therefore, potential pathways for migration of LFG from SLSL to EcoPark can be classified as MODERATELY SHORT/DIRECT.

Target

8.7.7 The EcoPark development will include an Administration Building (likely two-storey) and a number of individually demarcated lots that will initially be grassed. The tenants will construct whatever facilities they require within their lot, and this is expected to be one or more single storey buildings on top of hardstanding. All buildings within the LFG Consultation Zone (including the Administration Building) will be designed with a raised floor slab (approx.500mm) to prevent ingress of any LFG and should therefore be considered as having a low vulnerability to LFG.

8.7.8 Although below ground works will be required for the installation of drainage and other utilities, this will be carried out by appropriately trained staff. Therefore, the Target term is classified as LOW for both construction and operation phases.

Assessment of Risk

8.7.9 A qualitative assessment of LFG risk posed by SLSL to EcoPark is set out in Table 8.4 :

Table 8.4 : Qualitative LFG Risk Assessment

Source	Pathway	Target	Qualitative Risk
SLSL (MEDIUM)	150m from SLSL through reclamation fill (MODERATELY SHORT / DIRECT)	Construction Phase (LOW)	LOW
		Operational Phase (LOW)	LOW

8.7.10 The qualitative LFG risk assessment has indicated the risks associated with LFG at EcoPark during both construction and operation are LOW. As such, some precautionary measures ("passive control") will be required to ensure EcoPark is safe. Definitions of "passive control" are annotated in Chapter 4 of the *Guidance Note*. The following precautionary and protection measures are considered appropriate :

- Design Stage :
  - Cut-off barrier to seal any service trench entering the site. Figure B.6 in the *Guidance Note* provides details of a suitable design
  - Service entries into buildings should be made above ground level
  - Prefabricated offices should be elevated from the ground (raised floor of 500mm)
- Construction Phase
  - All workers should be aware of potential presence of LFG
  - Safety precautions should be made available during trenching and excavation
  - Train and provide breathing apparatus and gas detection equipment for confined spaces or deep trenching
- Operational Phase
  - Alert workers and visitors of possible LFG hazards
  - Prohibit smoking and open fires on site
  - Conduct regular LFG monitoring at mobile offices, equipment stores, etc.

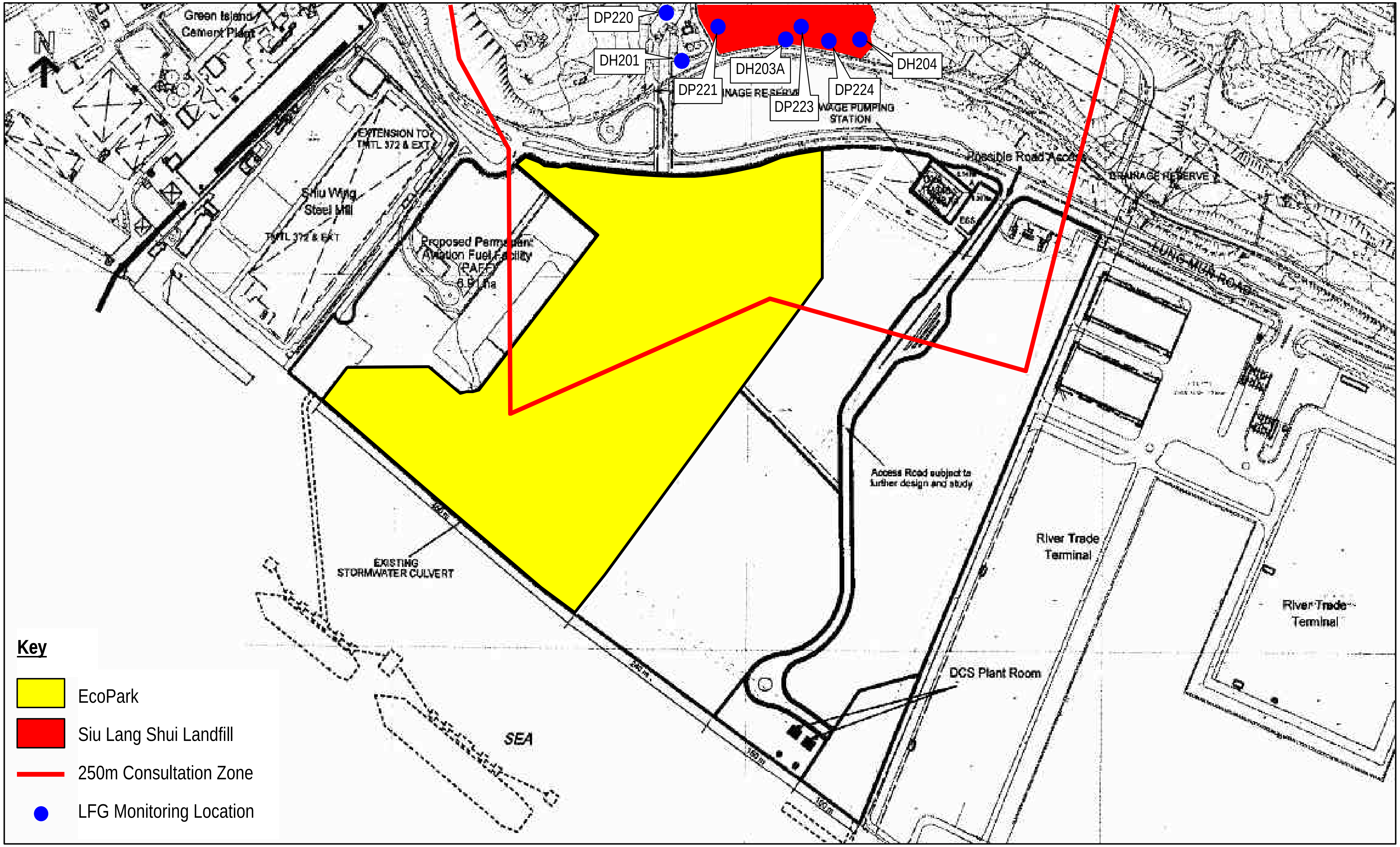
8.7.11 With regard to the "regular LFG monitoring" during the operational phase, as stated above, it is considered that quarterly monitoring would be sufficient. However, should EPD alert the Operator that high LFG levels had been detected during monthly monitoring under the SLSL restoration contract, then the Operator may be required to increase LFG monitoring to monthly until such time as EPD inform the Operator that quarterly monitoring can be resumed.

8.8 Conclusions

8.8.1 The LFG hazard assessment has been undertaken in accordance with the *Landfill Gas Hazard Assessment Guidance Note* issued by EPD.

8.8.2 The risks associated with LFG during the construction phase and operational phase of the project have been classified as LOW and appropriate precautionary and protection measures have been recommended for the design stage, construction phase and operation phase.

Figure 8.1 : EcoPark and Siu Lang Shui Landfill



9 LANDSCAPE AND VISUAL ISSUES

9.1 General

9.1.1 Since commencement of this Study, it has been suggested that landscape and visual issues should be addressed, although this was not a requirement specified in the ESB. Notwithstanding, the following sub-sections provide a brief examination of the issues.

9.1.2 For reference only, Figures 9.1 and 9.2 provide a photomontage and a computer-generated 3D rendering, respectively, based on the conceptual design. It should be noted, however, that the conceptual design will not constrain the actual design to be carried out under the follow-on D&C consultancy, although may be used for guidance.

9.2 Sensitive Receivers

9.2.1 For landscape and visual impacts consideration is given to the potential to impact upon individual landscape features and the aggregate impact upon the landscape character of the area. Visual impacts are considered in relation to identified receptor groups within the "Zone of Visual Influence" (ZVI). Within the ZVI, receptors can be classified as being of a high, medium or low sensitivity, depending upon their nature, (permanent residents tending to be high) and their proximity to the site.

9.2.2 The land on which EcoPark is to be located is newly reclaimed and as such does not possess any unique landscape characteristics that could be compromised as a result of EcoPark. In fact, the "green" landscaped design of EcoPark (see Figure 2.3) provides an improvement to the area, in terms of landscape and visual amenity.

9.2.3 The existing and planned landuses surrounding EcoPark are industrial and therefore considered low sensitivity. The site is not visible from any permanent residential areas, other than Tung Chung, which is some 10km distant and also shielded somewhat by the airport island. Notwithstanding, users of the proposed "holiday camp" in the hills behind Lung Mun Road, which runs to the north of EcoPark, would be able to see EcoPark in its entirety as a result of their elevated vantage point. The main visual impact, therefore, is likely to be on users of the proposed "holiday camp", visitors to EcoPark, users of Lung Mun road and to marine users passing close by.

9.3 Potential Impacts

Construction

9.3.1 The visual impact during the construction of EcoPark will primarily be dependent upon the length of time required for the construction works. Based on the programme shown in Figure 2.5, the Phase I construction is expected to be substantially completed in 10 months, with Phase II completed in around 12 months.

9.3.2 As discussed in Section 2.5, the infrastructure to be constructed under the Works Contract includes the two- or three-storey Administration Building and the single-storey Marine Frontage Management Office and Solid Waste Collection Point. The WTF will also likely be single-storey. Each of these structures will be surrounded by landscape screening and planting, which in the case of the Administration Building will occupy a relatively large area, as shown on Figure 2.3 – the design of the Administration Building and the landscaping surrounding it will be a welcome feature in an otherwise industrial area.

9.3.3 The 2 to 5m deep landscaping works proposed along the northern and eastern boundary of the site and along the marine frontage access road will provide sufficient area for dense vegetation to grow, including tree species that will also serve as a visual barrier. Thus, visual impact will be minimised for passers-by on Lung Mun Road (northern boundary planting), for future users of the Fill Bank site (eastern boundary planting) and for marine users (marine frontage access road planting, rather than seafront planting, since the entire marine frontage will be in use during the operation of EcoPark). Perimeter planting is not considered necessary along the western boundary with the PAFF as planting (on the PAFF side) is already provided under the PAFF project.

9.3.4 The landscaping works within EcoPark, in particular along the primary access road, together with that along the perimeter of the site, will give EcoPark a green look, compared to the surrounding landuses that include a Fill Bank, steel mill, cement plant and power station, and will soon include an aviation fuel facility. Visual receivers at elevated levels looking towards EcoPark, such as users of the proposed "holiday camp", will see an oasis of green in an otherwise industrial setting and, as such, the impact will be positive rather than negative.

Operation

9.3.5 The types and nature of structures (e.g. buildings, chimneys, etc.) likely to be erected within lots (by tenants of EcoPark) during the operation phase cannot be anticipated at present. When the facility has been commissioned, lots will be allocated to Tenants by the Operator and only at this time will the layout of tenants' lots (including buildings and any chimneys) be known.

9.3.6 For the purposes of visual assessment, a typical building height guideline (excluding chimneys) of 30 to 35m has been assumed for the operational phase. This guideline is based, in part, on the air quality impact assessment (in Section 3) which has limited air-intakes for buildings within EcoPark to 22.5mPD. This guideline is also based, in part, on the elevation of the adjacent Fill Bank, which although a temporary structure, will be present until the completion of Phase II construction works in 2009. It is also noted that the heights of structures within the existing steel mill, cement plant and power station sites all significantly exceed the assumed building height guideline.

9.3.7 Based on the current operations of the recycling industries elsewhere in Hong Kong, it is not anticipated that EcoPark tenants will want to, or need to, construct high-rise buildings within their lots – the majority of buildings are likely to be single storey, with only a few requiring additional floors. Of all the processes to be carried out in EcoPark, only a few will require the installation of a chimney, The height of any chimneys has been limited to 30m above ground in the air quality assessment (in Section 3), with chimney diameters ranging from 0.25m to 1m. Thus, chimneys will not be substantial structures from a visual perspective.

9.3.8 Overall, therefore, the buildings and structures within EcoPark will be generally low-rise and compatible with the existing character of nearby industrial uses, with no super-high structures.

9.4 Mitigation Measures

Construction

9.4.1 The visual impact due the construction work for EcoPark will be minimal, however, the following mitigation measure should be incorporated during the works :

- Ensuring all site compounds and works areas are shielded from view during construction, e.g. by use of standard site hoardings as typically used in Hong Kong.

9.4.2 It is recommended that the design intention of EcoPark, during the follow-on D&C consultancy, should promote harmony between the low-rise buildings to be constructed under the Works Contract and the landscaped areas in order to improve the overall visual appearance of the area. Special attention will be paid to the views from Lung Mun Road and from the sea when undertaking the landscape design.

9.4.3 Other measures to be considered in the design should include :

- Designing the landscape hard works to blend in with the existing environment (this will include the natural landscape of the area north of Lung Mun Road).
- Proposed landscape slope/strip should be at an appropriate angle suitable for landscape planting.
- Allow a landscaped buffer in front of each lot that will provide screening from the internal roads and median strip planting within the main access road, if appropriate.
- Provide landscaped grounds around the Administration Building and perimeter planting along the northern boundary, eastern boundary (after decommissioning of the Fill Bank) and north of the marine frontage access road to provide screening of EcoPark from all directions.
- Incorporate effective landscape design and treatments to ensure that the landscaped environment can be easily maintained during the operation phase by the Operator.

Operation

9.4.4 The environment surrounding EcoPark will be taken into account in the architectural design of the buildings and structures. It is recommended that consideration be given to developing a commonality in the architectural design and a harmonised colour theme under the follow-on D&C consultancy, and it is further recommended that this commonality be promoted throughout EcoPark by the Operator and adopted by tenants, if practicable. The Management Contract, to be developed under the follow-on D&C consultancy, would need to determine how best to address this.

9.4.5 There will be landscaping in common and rest areas inside and around EcoPark. Together with the landscaping around individual facilities and buildings, the overall "green" setting of EcoPark will blend into the natural environment of the hinterland (i.e., the natural landscape of the area north on Lung Mun Road) and so visual impact, if any, will be mitigated.

9.4.6 Figure 9.1 provides a photomontage from an elevated vantage point overlooking Area 38 at a point in time when both Phase I and Phase II of EcoPark are operational. EcoPark can be seen at the centre of the photomontage, located between the PAFF and the C&DMHF. Landscape and visual mitigation shown as planting can also be seen. EcoPark comprises predominantly low-rise buildings and some chimneys and, compared to the adjacent landuses, is considered to generate less visual impact.

9.4.7 Figure 9.2 shows a computer-generated 3D rendering within EcoPark. Landscape and visual mitigation shown as planting can be seen. This image is taken from the Phase II side of the main access road, looking to the southwest across the access road – the tall vegetation anticipated in the median planting strip has not been included in this image to allow the other side of the primary access road to be shown. Again, it can be seen that EcoPark comprises both single-storey and multi-storey buildings (some with taller chimneys) but all considered to be "low-rise". There will be no "super high rise" structures within EcoPark. Compared to the adjacent landuses, EcoPark is considered to generate less visual impact.

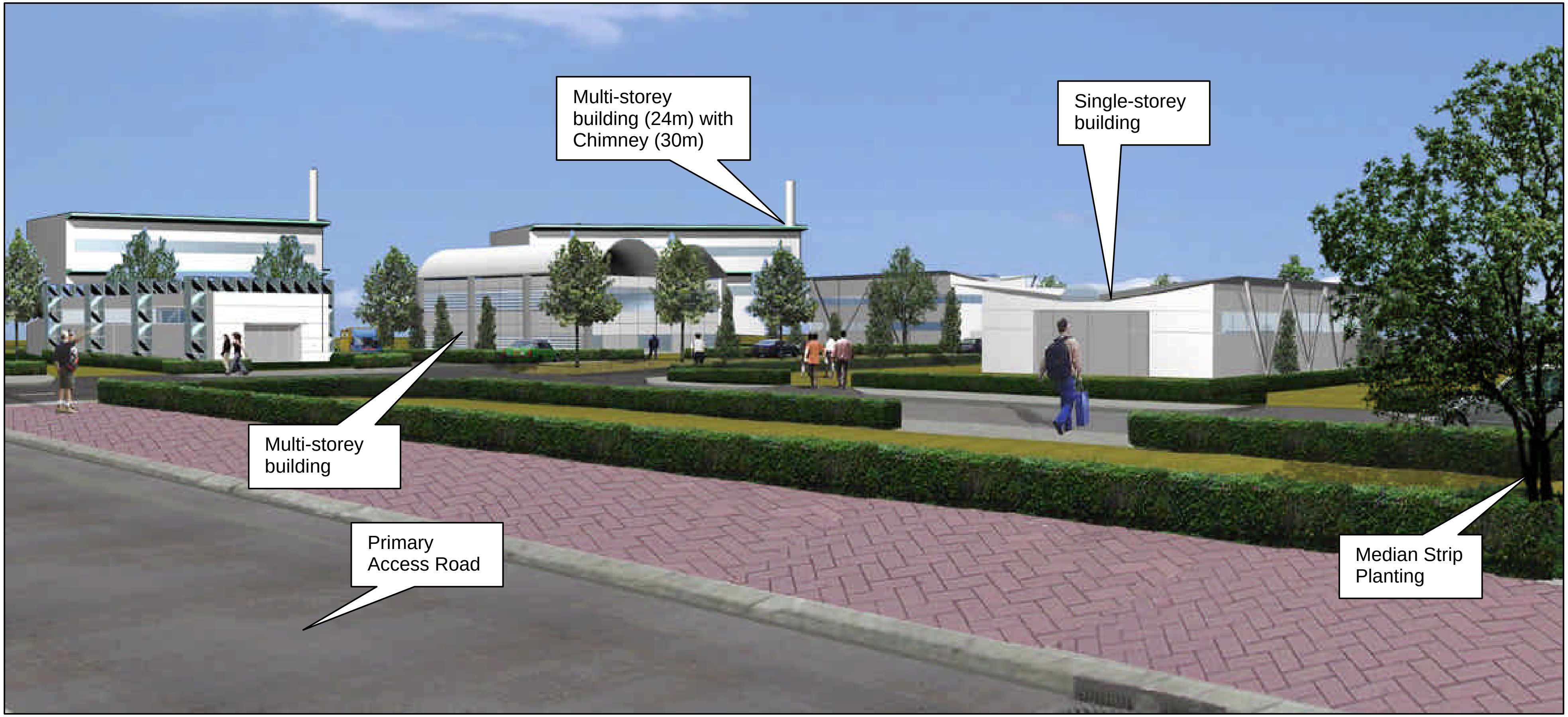
9.5 Conclusions

9.5.1 Rather than detract from the surrounding natural landscape, the intention in designing EcoPark will be to provide an "oasis" of green in an otherwise industrial setting and thereby provide an improved and more aesthetically pleasing environment, in particular for those VSRs at elevated locations that overlook EcoPark. This can be seen in Figure 9.1.

9.5.2 It is intended that EcoPark should be a "showcase" for recycling and environmental industries within Hong Kong, demonstrating that the industry can be "clean and green". This can be seen in Figure 9.2. Thoughtful architectural design and attractive landscaping will go a long way in this regard, and will demonstrate that environmental industries can add aesthetic value to the surrounding area.

Figure 9.1 : Photomontage – Elevated Vantage Point

Figure 9.2 : Computer-generated 3D Rendering – Typical Internal View



10 HAZARD TO LIFE ASSESSMENT

10.1 Substances Posing A Potential Risk

10.1.1 Under the EIAO, "Hazard to Life" refers only to the risk of fatalities to off-site populations that would result from the operation of a project. These risks are compared to the *Hong Kong Risk Guidelines* stipulated in the EIAO-TM. This "Hazard to Life" assessment for EcoPark does not purport to assess non-fatal off-site risks, nor to assess any health or safety implications to the on-site working population, as this is covered by other legislation. It should also be noted that any recommendations in this assessment do not pre-empt nor influence the application of any other relevant legislation by the appropriate authority.

10.1.2 Based on the throughputs and processes assumed under the "Base Case" (see "Scenario 2" in Table 3.15 and Table 13.1) and the anticipated substances involved in each process (see Figures A.1 to A.18 in Appendix A) it can be seen that there is the potential for Dangerous Goods (DGs) as defined under the Dangerous Goods Ordinance (DGO) (Cap.295) to be stored or transported by tenants within EcoPark.

10.1.3 Material types, substances posing potential risk, the DGO category and exempted quantities for a licence are summarised in Table 10.1, below. As noted in Section 5, this EIA has assumed that chlorine would not be used for any purpose in connection with the operation of the WTF, and so for the purposes of this assessment, chlorine will not be stored or transported within EcoPark.

Table 10.1 : Substances Posing a Potential Risk ("Base Case")

Material Type	Substance Posing A Potential Risk	DGO Category / Class	DGO Exempted Quantity (1)
Batteries	Battery Fluid (as sulphuric acid of strength not exceeding 50% by weight)	Cat. 3	25
Electronics	Nil	Nil	
Glass	Nil	Nil	
Organic Food Waste	Nil	Nil	
Ferrous Metals	Oxygen & Acetylene	Cat.2/Class 1&3	2 cylinders
Non-ferrous Metals (2)	Oxygen & Acetylene	Cat.2/Class 1&3	2 cylinders
	Zinc Dust	Cat. 6	10kg
Paper	Hydrogen Peroxide (of strength greater than 6% but not exceeding 35% by weight)	Cat.7	25
Plastics	Nil	Nil	
Textiles	Nil	Nil	
Rubber Tyres	Rubber Tyres	Cat.9A	500
Wood	Hydrogen Peroxide (of strength greater than 6% but not exceeding 35% by weight)	Cat.7	25
Spent Copper Etchant	Sludge or Spent Acid	Cat.3	50
ULSD Diesel	Diesel	Cat.5 / Class 3	2,500

Note : 1. The extent of DGs to be instantaneously stored or transported within EcoPark cannot be quantified at this stage.

2. The secondary processing of aluminium includes the use of chlorine and fluorine during demagging. However, since demagging has been removed in the Air Quality Impact Assessment (Section 3) because of dust impacts, DGs used in demagging have not been considered here.

10.1.4 Under the DGO, licences granted by Fire Services Department (FSD) would be required by individual tenants should their storage or transportation of DGs exceed the exempted quantities indicated in Table 10.1. Similarly, if any timber or wood stored by tenants falls within the definition of "timber" under the Timber Stores Ordinance (Cap.464), a licence granted by FSD would be required. It is not considered necessary to stipulate in this EIA or in any future tenancy agreement that these licences should be obtained, since these are statutory requirements.

10.2 Hazard to Life Assessment

10.2.1 Table 10.1 has identified a number of substances that pose a potential risk and that may be stored or transported within EcoPark during processing of materials to be carried out. The actual quantities of such substances, however, cannot be estimated at this time, since this will depend upon the actual throughput of materials that involve the transportation of storage of DGs, the proportion of that throughput that would be classified as DGs during processing, the rate at which materials are processed by the tenant and the storage capacity at any one time provided within a lot for incoming or outgoing materials or fuel.

10.2.2 Notwithstanding, the following paragraphs examine each of the DGs identified, provide a commentary as to the likely hazards posed, risks to off-site populations, and forms the basis of the hazard to life assessment. From Table 10.1, the following DGs are examined :

- Battery Fluid.
- Oxygen & Acetylene.
- Zinc Dust.
- Hydrogen Peroxide.
- Rubber Tyres.
- Sludge or Spent Acid.
- Ultra Low Sulphur Diesel.

Battery Fluid

10.2.3 Battery fluid (electrolyte) is a Category 3 DG, meaning that it is a corrosive substance due to its acidic properties. It may arise from the processing of lead-acid batteries.

10.2.4 Battery fluid is flammable and should be kept away from solvents, oxidisers, combustible materials, organic materials, alkalis, powdered metals and amines, and should not be stored in areas exposed to heat or water. Concentrated acid can ignite combustible metals. Hazardous decomposition products include SO_2, SO_3 and H_2S.

10.2.5 Any spill should be neutralised with soda ash or lime and adequate ventilation should be provided due to subsequent release of CO_2. The resulting salts should be collected into an appropriate container, considered as chemical waste and disposed off-site at an appropriate facility.

10.2.6 It is anticipated that the processing of lead-acid batteries would be carried out in a purpose-designed and fully enclosed plant where battery fluid is extracted and neutralised within the plant – such plant are commercially available as package units. As such, containers of battery acid would not be produced, stored or transported within a lot.

10.2.7 The consequences of battery fluid being present within EcoPark are therefore not life threatening, and it is inconceivable that any off-site fatality would occur as a result, i.e., quantified as zero off-site risk of fatality.

Oxygen & Acetylene

10.2.8 Oxygen is a Category 2, Class 1 DG, meaning that it is a compressed, permanent gas. Acetylene is a Category 2, Class 3 DG, meaning that it is a compressed, dissolved gas. Oxygen and acetylene flame-cutting lances may be used during the initial cutting up of waste metals and so cylinders of these gases would likely be stored within a tenant's lot.

10.2.9 Both oxygen and acetylene are flammable gases and cylinders may explode in the heat of a fire. Oxygen and acetylene cylinders should not be stored together and should be kept away from ignition sources. Oxygen vigorously accelerates combustion and so contact with all flammable materials should be avoided. Some materials which are not flammable in air will burn in pure oxygen or an oxygen-enriched atmosphere.

10.2.10 In case of gas leakage, there should be adequate ventilation to atmosphere (by forced ventilation if necessary) to maintain the concentration of gas below the flammable range. If not already outdoors, cylinders should be removed to an open area. In case of fire, cylinders should be moved away from the fire area, if this is possible without risk, and flames should be extinguished by a dry chemical, CO_2, water spray, fog or foam extinguishers.

10.2.11 Oxygen and acetylene cylinders shall be stored (separately) in licensed DG stores that comply with relevant fire services requirements – Regulation 74 of the DGO regarding the general storage requirements of Category 2 DGs should be observed.

10.2.12 DG stores shall be constructed of materials with not less than 2-hour Fire Resistance Period (FRP) or of mild steel of at least 6mm thick, with doors made of material with at least 1-hour FRP or mild steel with not less than 3mm thickness. In terms of explosion risk, there will be no flying shrapnel (from exploded cylinders) as these will be contained within the structure of the DG store.

10.2.13 The DG store shall also be located at a distance of at least 10m from the perimeter of EcoPark. The combustion of different materials results in fires with different radiant heat characteristics. It is considered that a minimum separation of 10m can provide sufficient distance from off-site populations such that the radiant heat from any fire would not be life threatening.

10.2.14 With the proper handling, storage and locating oxygen and acetylene DG stores away from the EcoPark perimeter it is inconceivable that any off-site fatality would occur as a result of fire or explosion, i.e., quantified as zero off-site risk of fatality.

Zinc Dust

10.2.15 Zinc dust is a Category 6 DG, meaning that it is can become dangerous by interaction with water. It will likely arise during the refining and alloying of zinc where it will be collected in baghouse dust and will be recycled by retort reduction.

10.2.16 Zinc dust should be kept away from moist conditions, water, mineral acids, sulphur and chlorinated hydrocarbons. In the event of spillage, the dust should be swept up immediately and stored in a dry, water-tight container prior to being recycled in the retort reduction process. In case of fire, foam or other smothering agents should be used to extinguish the flames.

10.2.17 It is anticipated that the refining and alloying of zinc would be carried out in a purpose-designed plant where baghouse dust would feed directly into the retort reduction process without the need for manual intervention. Thus, there is no chance for zinc dust to be exposed to humid atmospheric conditions or to become wet. Therefore, the chance of explosion/fire or spillage would be eliminated.

10.2.18 The consequences of zinc dust being present within EcoPark are therefore not life threatening, and it is inconceivable that any off-site fatality would occur as a result, i.e., quantified as zero off-site risk of fatality.

Hydrogen Peroxide

10.2.19 Hydrogen peroxide is a Category 7 DG, meaning that it is a strong supporter of combustion. It may be used during the bleaching of paper and wood.

10.2.20 Spontaneous combustion of hydrogen peroxide can occur if allowed to remain in contact with oxidisable materials. Mixtures of hydrogen peroxide with combustible material may be explosive. Hydrogen peroxide is stable only when cool and pure and so heat and impurities should be avoided – it should also be stored in a cool location, out of direct sunlight and be kept away from heavy metals, heavy metal ions/salts, rust, alkalis, organic material, reducing agents, dust and dirt. Hazardous decomposition products include can include oxygen, which will promote the combustion of flammable material.

10.2.21 In case of spillage, the source should be eliminated and the spill washed away with large amounts of water. In case of fire, any enclosed and surrounding areas should be evacuated. Hydrogen peroxide containers should be cooled with plenty of water and only water should be used to fight fires – large amounts of water should be applied for cooling and dilution. All liquids would be contained within the perimeter drainage system in each lot and transferred to the WTF for treatment.

10.2.22 Given the ferocity of fires that are supported by hydrogen peroxide, it is recommended that those processes that make use of this substance (i.e. bleaching processes) are located away from the perimeter of EcoPark.

10.2.23 With the proper handling, storage and locating hydrogen peroxide storage away from the EcoPark perimeter (10m minimum), any fire supported by hydrogen peroxide would be of sufficient distance from off-site populations such that the radiant heat would not be life threatening, and as such, it is inconceivable that any off-site fatality would occur as a result, i.e., quantified as zero off-site risk of fatality.

Rubber Tyres

10.2.24 Rubber tyres are a Category 9A DG, meaning they are combustible goods exempted from Sections 6 to 11 of the DGO. They may be stored within individual lots by rubber tyre recyclers prior to processing.

10.2.25 The particular risk posed by rubber tyres is fire and the associated noxious smoke. Standard fire extinguishers should be used including water, CO_2, foam and water-fog and fire should be treated as a hydrocarbon fire. For large fires, the Operator's ERP should be followed. Tenants processing rubber tyres should be encouraged to maintain their on-site stockpiles to 500 tyres or less (the DGO exempted quantity for storage within premises used exclusively for industrial undertakings, as opposed to residential premises). It is also recommended that tyre storage should be located away from the perimeter of EcoPark to eliminate the risk to off-site populations.

10.2.26 With the proper handling, storage and locating tyre stockpiles away from the EcoPark perimeter (10m minimum), any fire would be of sufficient distance from off-site populations such that the radiant heat would not be life threatening, and as such, it is inconceivable that any off-site fatality would occur as a result i.e., quantified as zero off-site risk of fatality. Furthermore, given the distance separation from the any tyre stockpile and the EcoPark boundary, any smoke plume from a tyre fire would not impact off-site populations.

Sludge or Spent Acid

10.2.27 Sludge or spent acid is a Category 3 DG, meaning that it is a corrosive substance due to its acidic properties. It will likely arise as a result of processing of spent copper etchant.

10.2.28 Spent copper etchant is corrosive, may ignite wood/organics and can generate poisonous vapours. Spent copper etchant should be kept away from most metals and easily oxidisible materials. Hazardous decomposition products include SO_2, SO_3 and H_2S, with the possibility of copper compounds.

10.2.29 In case of spill, the perimeter drainage around each lot would contain the sludge or spent acid. Lime or sodium carbonate should be carefully added to neutralise the sludge or spent acid. The residual salts should be containerised and treated as chemical waste for off-site disposal. The perimeter drainage should then be flushed with water and the rinsate diverted to the WTF for treatment. In case of fire, exposed containers should be cooled with water spray. Foam, CO_2 or dry chemical extinguishers should be used.

10.2.30 It is anticipated that the processing of sludge or spent acid would be carried out in a purpose-designed and fully enclosed plant, as it is currently at the Chemical Waste Treatment Centre. As such, containers of sludge spent acid would only be stored or transported within lots prior to processing. It is therefore recommended that any such containers are stored in a well ventilated area that is not exposed to heat or direct sunlight. Furthermore, containers should be stored in a bunded area with a capacity of 110% of the largest container to ensure that any leaks can be contained

10.2.31 Furthermore, and in addition to the bunded storage area within lots, each lot is also surrounded by a perimeter drainage system (with stop-logs) that would intercept any spilled liquids and prevent them from draining off-site.

10.2.32 The consequences of sludge or spent acid being present within EcoPark are therefore not life threatening, and it is inconceivable that any off-site fatality would occur as a result i.e., quantified as zero off-site risk of fatality.

Ultra Low Sulphur Diesel

10.2.33 Diesel is a Category 5, Class 3 DG, meaning it gives off inflammable vapour and has a flashpoint of $66^{O}C$ or higher. ULSD has been assumed as the predominant source of non-electrical energy consumed by users of EcoPark and would be used in the processing of glass, organic food waste, non-ferrous metals, paper and wood.

10.2.34 The uncontrolled combustion or heat of a diesel fire may produce hazardous decomposition products and vapours. Liquid evaporates and forms vapours which can catch fire with violent burning. High heat, open flames and other sources of ignition materials should be avoided, as should contact with strong oxidizing agents. Hazardous decomposition products include CO, CO_2 and SO_2 (even with ULSD).

10.2.35 Diesel is considered to be a water pollutant and spillages should be prevented. Any spilled diesel would be contained within the perimeter drainage system in each lot and cleaned up using appropriate techniques, such as absorbents. Underground leaks, which could cause land contamination, can be avoided by good design of fuel tanks and pipework.

10.2.36 Diesel shall be stored in licensed DG stores that comply with relevant fire services requirements.

10.2.37 Tanks for the storage of diesel in shall be tested by a competent person authorised by the Director of Fire Services. Pursuant to Regulation 125 of the DG (General) Regulations the tankage, ancillary container, fuel pipeline, filling and dispensing facility or pumping equipment shall be installed according to the designs and specifications and referred to the Authority for the satisfaction and installation by the Director of Fire Services.

10.2.38 In case of fire, the area should be evacuated and any above-ground tanks cooled with water spray. Standard fire extinguishers should be used including water, CO_2, foam and water-fog and fire should be treated as a hydrocarbon fire. For large fires, the Operator's ERP should be followed.

10.2.39 With the proper handling and storage and locating diesel storage away from the EcoPark perimeter (10m minimum), any fire would be of sufficient distance from off-site populations such that the radiant heat would not be life threatening, and as such, it is inconceivable that any off-site fatality would occur as a result, i.e., quantified as zero off-site risk of fatality. Furthermore, given the distance separation from the DG store and the EcoPark boundary, any smoke plume from a diesel fire would not impact off-site populations.

10.3 Process Review

10.3.1 Based on the currently proposed scheme for DG storage and transport and the above assessments, it can be concluded that there is no risk of fatality outside EcoPark, i.e., quantified as zero off-site risk of fatality.

10.3.2 The Process Review for each process to be carried out in EcoPark is described in Section 12.2. It is considered that this mechanism provides the most appropriate basis by which to further assess the risk posed by the storage and transport of DGs. For the purposes of the Process Review, the level of risk of off-site fatality assessed in this Hazard to Life assessment is quantified as zero.

10.3.3 The Process Review will determine the need for a hazard to life assessment and will confirm that any risk is acceptable in terms of the *Hong Kong Risk Guidelines* (Annex 4 of the EIAO-TM). If the tenant intends to store or transport DGs or timber above exempted quantities, he will also be reminded of licensing requirements under the DGO and TSO, which may require implementation of measures deemed necessary by FSD,

10.3.4 The Operator shall also physically locate tenants within EcoPark such that risks to and from both on-site and off-site populations are minimised, e.g. by taking into consideration the locations of other tenants who store or transport DGs within their lots, by locating certain tenants at a distance from the boundary with PAFF, etc., as recommended above.

10.4 Building Height Restriction

10.4.1 The planned PAFF adjacent to EcoPark site is not a PHI and the Quantitative Risk Assessment undertaken as part of the EIA for that project (Ref. EIA-081/2002) concluded *"the maximum risk on land … is zero offsite"*, i.e., that there is zero risk to EcoPark from the PAFF and paragraph 10.6.2.30 of the *PAFF EIA* report *"assumed that any future buildings immediately opposite the site boundary will not be high rise to avoid the impact of any smoke ingress into buildings"*. To address this issue, it is proposed to limit building heights (and thereby risks to workers) at EcoPark along the boundary with the PAFF.

10.4.2 The EIA Report for the *Tung Chung Cable Car Project* (Ref. EIA-090/2003) identified that the maximum recorded tilt angle for flames and smoke from aviation fuel was 60^{O}, i.e. any building below a tangent of 30^{O} from the base of the fire would not be affected by the smoke. Adopting this approach for EcoPark, the maximum building height (H) below any plume of smoke from the PAFF at a distance of D is calculated as $H = D \times \tan(30^{O})$.

10.4.3 Based on this approach, the proposed building height limit is shown in Table 10.2, below, and will only be applied to structures within which people will work at elevated levels, such as the Administration Building.

Table 10.2 : Building Height Restrictions Within EcoPark

Distance (D) of EcoPark Building from closest PAFF Boundary (m)	Maximum Height (H) of EcoPark Building (where workers may be at elevated levels) (m)
0	0.0
10	5.8
20	11.5
30	17.3
40	23.1
50	28.9

Note : $H = D \times \tan(30^{O})$, based on a 60^{O} tilt angle for aviation fuel flames and smoke, *Tung Chung Cable Car EIA*.

10.5 Conclusions

10.5.1 A number of substances posing a potential risk were identified from reviewing the process flow diagrams provided in Appendix A. The actual quantities of such substances cannot be estimated at this time, since this will depend upon the actual throughput of materials that involve the transportation or storage of DGs or timber, the proportion of the throughput that would be classified at DGs or timber during processing, the rate at which materials are processed by the tenant and the storage capacity at any one time provided within the lot for incoming or outgoing materials or fuel.

10.5.2 Notwithstanding, a Hazard to Life assessment was carried out for those DGs that were identified as possibly being stored and transported within EcoPark. The assessment identified the hazards posed by each DG and the type and applicability of mitigation measures to reduce the risk, such as EcoPark height restrictions (in case of a fire at the adjacent PAFF).

10.5.3 These mitigation measures should be considered by the Operator when allocating lots to tenants and in the general management of EcoPark. The Operator's Emergency Response Plan would also address on-site risk concerns through providing step-by-step procedures in case of fire or spillage.

10.5.4 Built-in safety measures within each lot include the perimeter drainage channel that can intercept and contain any spilled liquids and prevent them from escaping from the lot or the EcoPark itself. Where the storage of drums of chemicals is likely, it has been recommended that additional bunded areas be provided, and where gas cylinders are to be used, the appropriate storage facilities are to be provided. Thus, leakage of any spilled materials off-site is eliminated.

10.5.5 In case of fire, it has been recommended that those substances (including tyres and diesel) that would support combustion are located at a sufficient distance from the perimeter of EcoPark (minimum 10m) such that the radiant heat would not in itself be life threatening. Furthermore, given the distance separation from the DG store and the EcoPark boundary, any smoke plume from a tyre or diesel fire would not impact off-site populations. As such, it is inconceivable that any off-site fatality would occur as a result of a fire , i.e., quantified as zero off-site risk of fatality.

10.5.6 Based on the currently proposed scheme for DG storage and transport and the above assessments, it can be concluded that there is no risk of fatality outside EcoPark, i.e., quantified as zero off-site risk of fatality. The Process Review mechanism is considered to provide the most appropriate basis by which to further assess, if necessary, the risk posed by the storage and transport of DGs.

11 SUMMARY OF ENVIRONMENTAL OUTCOMES

11.1 Population and Environmentally Sensitive Areas Protected

11.1.1 Existing sites used informally for waste recycling activities throughout the New Territories have caused localised pollution because of the uncontrolled nature of the activities. These can cause direct impacts to local populations and to the immediate environment.

11.1.2 By relocating these activities to the controlled environment of EcoPark, the local populations and to the immediate environment at the former sites of informal waste recycling will benefit from immediate environmental improvement. Furthermore, the development of EcoPark in Tuen Mun Area 38 will not affect public health, as it is remote from residential areas, nor will it affect any environmentally sensitive areas, since the land is man-made, has been recently reclaimed and does not support any established ecosystems of ecological importance.

11.2 Environmentally Friendly Designs Recommended

Review of Proposed Processes

11.2.1 In seeking to develop environmentally friendly designs for EcoPark, and thereby minimising the environmental impacts of EcoPark itself, this EIA has demonstrated the benefits of applying the EIA process under the EIAO. From those processes initially proposed for inclusion in EcoPark (listed in Table B.1, in Appendix B), the environmental assessments, in particular the air quality assessment (Section 3), have identified a number of these processes that would result in undesirable environmental impacts, or would give rise to public health concerns.

11.2.2 Through ongoing public consultation with key stakeholders, such as the Tuen Mun District Council, the benefits of developing EcoPark, including job creation, have been acknowledged by the local community. As the EIA has progressed, Tuen Mun District Council has again been formally consulted on other issues, and this continuous public involvement has helped to define some of the operating parameters of EcoPark in terms of the types of processes to be included.

11.2.3 As the project proponent, EPD are sensitive to the perceptions of the local community to environmental issues associated with EcoPark. To this end, and through the application of EIA process demonstrated in this report, a number of processes have been excluded from assessment or throughputs reduced in the EIA to address real and perceived concerns.

11.2.4 Table 11.1, below, summarises those processes or throughputs that have been modified from those originally proposed in order to meet the environmental objectives of EcoPark, thereby ensuring that EcoPark achieves the support of the local community through an environmentally friendly design and operation :

Table 11.1 : Material Types / Processes and Throughputs Modified Through Application of the EIAO Process

Material Type / Process	Modification	Environmental Benefit
Fuel Consumption and Restriction (All Processes)		
Liquid Fuel Diesel	To minimise the quantities of SO_2 from fuel, it is recommended and has been assumed that Ultra Low Sulphur Diesel (with 0.005% sulphur content) will be mandated for all processes requiring liquid fuel.	SO_2 emissions from liquid fuel will be reduced.
Gaseous Fuel Towngas, LPG, LFG	To further minimise the quantities of SO_2 from fuel, consideration has also been given to the use of gaseous fuel (natural gas), however, it is noted that this would require a gas pipeline and associated facilities, all of which would involve significant capital and maintenance costs. Notwithstanding, gaseous fuels may also be considered provided that overall NO_x emissions do not exceed those of Ultra Low Sulphur Diesel combustion.	Further reduction in SO_2 emissions from using gaseous fuel instead of liquid fuel.
Processes Screened-Out Because of Significant Air Quality Impacts		
Organic Food Waste Inedible Rendering	An initial odour assessment concluded that significant odour would be generated by the inedible rendering process (i.e., lard boiling). Research has indicated that the level of odour that cannot be mitigated by assumed APC equipment. This process has therefore been screened-out and will not be assessed further.	Reduction in offensive odour.
Reduction in Throughput		
Ferrous Metals Melting	The melting point of ferrous metals is x2.5 greater than the average melting point of non-ferrous metals. Thus, for the same amount of fuel this means that x2.5 more non-ferrous metals can be processed within EcoPark than ferrous metals. Alternatively, there will be x2.5 more air emissions (from fuel burning) to process ferrous metal than non-ferrous metals. Therefore, it has been decided to reduce the melting of shredded ferrous metal to zero for all scenarios.	Reduction in fuel usage (SO_2, NO_2 and CO), VOC, heavy metals, halogen compounds, dioxin and furans.
Non-ferrous Metals Melting / Sweating / Refining / Leaching of Lead, Aluminium, Copper and Zinc	Non-ferrous metal recovery will typically include high temperature processes using a furnace(s) that will generate heavy metal particulate, TAPs (i.e., dioxins) and other gaseous emissions. To mitigate this, the total material throughput for high temperature non-ferrous metal recovery process has been reduced from 57,100tpa to 10,000tpa (for Scenario 1) and to 2,500tpa (for Scenario 2).	Reduction in fuel usage (SO_2, NO_2 and CO), VOC, heavy metals, halogen compounds, dioxin and furans.
Paper Pulping / Cleaning / De-inking / Bleaching / Additives / Pressing of Secondary Fibres	Given the high energy consumption from the recycled paper pulping process due to the large throughput it is expected that fuel combustion-related emissions (i.e., PM, SO_2 and NO_2) will significantly contribute to the overall air quality impact upon ASRs, despite the use of Ultra Low Sulphur Diesel. Therefore, the throughput of paper for the pulping has been reduced from 507,590tpa to 200,000tpa in the assessments.	Reduction in fuel usage (SO_2, NO_2 and CO) and also fresh water consumption.
Processes Removed After Assessment Because of Significant Air Quality Impacts		
Non-ferrous Metals Demagging of Aluminium	Based on the Air Quality Impact Assessment (Section 3) the demagging process for aluminium was identified to generate very high levels of dust that could not be mitigated using the best available APC equipment that does not entail excessive cost.	Reduction in TSP.

Note : Although specific processes have been screened-out, had throughputs reduced or have been removed from EcoPark, the full range of material types initially proposed will still be recycled in EcoPark, albeit at below the "buffered" throughput where indicated above.

Perimeter Drainage of Lots

11.2.5 The infrastructure to be constructed in EcoPark through the Public Works contract includes provision of empty lots, to be developed by individual tenants. Each lot will be provided with perimeter drainage for stormwater, leading to EcoPark stormwater drainage system. Covered areas where recycling activities are undertaken will be connected to the WTF through the sewer connection provided in each lot.

11.2.6 To avoid water pollution from accidental spillages within lots, however, each lot will also be provided with stop-logs that will be closed should the perimeter drainage system become contaminated and thereby prevent contamination of the stormwater drainage system, which drains into the adjacent marine waters. Contaminated liquids isolated and contained within the perimeter drainage system will be transported to the WTF for treatment in accordance with the ERP to be developed by the EcoPark Operator.

Wastewater Treatment Plant

11.2.7 Another environmentally friendly design recommended for the development of EcoPark is the provision of the WTF to treat to an acceptable level industrial wastewater discharges from EcoPark. The WTF is to be connected to existing sewerage infrastructure in Tuen Mun Area 38, i.e., TMSPS and from there to PPSTW for prior to discharge.

11.2.8 Although it is beyond the scope of this EIA to develop the detailed design of the WTF, the EIA has suggested appropriate technologies and has determined the performance requirements for the WTF in terms of treatment capacity, footprint and effluent quality. BAF and sulphide precipitation have been demonstrated to be effective methods for the removal of heavy metals from industrial wastewaters. In the follow-on D&C consultancy, the detailed design of the WTF will be carried out to meet all of these requirements using the most appropriate technology. Where tenants cannot meet the influent standards for the WTF, they will be required to install their own pre-treatment facilities within their premises.

11.2.9 It is further anticipated that as a modern, enclosed facility, there will be no odour or flare emissions with potential AQ impacts anticipated. However, this shall be subject to further study and assessment, as may be appropriate, at the detailed design of the WTF.

11.2.10 It can therefore be stated that the effluent from EcoPark will not cause any unacceptable environmental impacts, even though the actual design of the WTF that will achieve this has not been developed under this EIA.

11.3 Key Environmental Problems Avoided

11.3.1 The key environmental problems avoided relate to the uncontrolled emissions to air and water, noise, land contamination and waste generation that are caused, to varying degrees, at existing sites used informally for waste recycling activities throughout the New Territories.

11.3.2 These problems have been avoided through the environmentally friendly design of EcoPark, described above in Section 11.2.

11.4 Compensation Areas Included

11.4.1 The site of EcoPark in Tuen Mun Area 38 is recently reclaimed land and therefore does not support any established ecosystems of ecological importance. As such, it is not necessary to provide compensation areas.

11.5 Environmental Benefits of Environmental Protection Measures Recommended

11.5.1 The environmental benefits of EcoPark are fourfold. Firstly, where operators have relocated to EcoPark there will be an immediate benefit experienced by the local population and the immediate environment at former sites of informal waste recycling. Furthermore, the development of EcoPark in Tuen Mun Area 38 will not affect public health, as it is remote from residential areas, nor will it affect any environmentally sensitive areas, since the land is man-made, has been recently reclaimed and does not support any established ecosystems of ecological importance.

11.5.2 Secondly, the environmentally friendly design of EcoPark has resulted in ULSD being mandated, processes being screened-out because of excessive odour generation, throughputs of other processes being limited to reduce air pollution and even some processes being removed because of significant air quality impacts predicted in the modelling. The provision of key infrastructure, such as the stop-logs within perimeter lot drainage and the WTF will also eliminate unacceptable levels of water pollution from industrial wastewater generated within EcoPark.

11.5.3 Thirdly, because of the environmental controls provided within EcoPark, there will be an overall net reduction in environmental pollution, compared to that generated by the existing uncontrolled recycling activities carried out elsewhere within Hong Kong. This will be further demonstrated and confirmed in the Process Review to be carried out under the EM&A programme.

11.5.4 Finally, the synergy between the operations of the various tenants will result in waste reduction and the enhanced recovery of materials for on-site/off-site re-manufacture. It has been estimated (in Section 6) that the operation of EcoPark will result in an overall net reduction of waste requiring landfill disposal.

12 ENVIRONMENTAL MONITORING AND AUDIT

12.1 Introduction

12.1.1 This EIA Study has focused on the prediction and mitigation of potential impacts associated with the construction and operation of the Project. One of the key outputs has been recommendations on mitigation measures to be undertaken in order to ensure that residual impacts comply with regulatory requirements plus the requirements of the EIAO-TM.

12.1.2 No unacceptable environmental impacts have been identified as occurring during the construction or operation phases, nevertheless, the Environmental Monitoring and Audit (EM&A) covers both phases. To ensure effective and timely implementation of the mitigation measures, it is considered necessary to develop EM&A procedures and mechanisms by which the Implementation Schedule (Appendix C) may be tracked and its effectiveness assessed.

12.1.3 Furthermore, the EM&A programme will include a Process Review of all activities to be carried out in EcoPark. The purpose of this is to ensure that the EP conditions and EIA recommendations are applied to all processes, even if they have not been considered under the "umbrella" approach to this EIA. Not only does this apply to new processes coming into EcoPark (whether from new or existing tenants), but also to any changes to existing processes. Full details of the scope and requirements of the Process Review are provided in Section 12.2.

Implementation of EIA Findings and Recommendations

12.1.4 Sections 3 to 10 of this report have, where appropriate, identified and recommended the implementation of mitigation measures in order to minimise the potential construction and operational impacts of the Project. These findings and recommendations form the primary deliverable from the whole EIA process. Once endorsed by the EPD, they will form the basis of the measures and standards that are to be achieved. It is therefore essential that mechanisms are put in place to ensure that the mitigation measures prescribed in the Implementation Schedule are fully and effectively implemented during construction.

12.1.5 The required format for the Implementation Schedule was specified in Appendix C of the ESB. The format requires the specification of implementation agent(s), timing, duration and location for each of the recommended mitigation measures.

12.1.6 Apart from the mitigation measures defined in the EIA, there is also scope for other requirements to be included within the finalised Implementation Schedule. Prior to the issue of an Environmental Permit, there is an EIA Determination Period. During this period the EIA Report is reviewed and commented upon by both the public and professional bodies. Where recommendations are made and accepted by either the Advisory Council on the Environment (ACE) or its EIA subcommittee, these measures will be included within the Implementation Schedule, where appropriate.

Statutory Requirements

12.1.7 As the Project constitutes a Designated Project under the EIAO by virtue of Item G.4(b) of Part I of Schedule 2, an EP must be obtained before construction or operation of the Project.

12.1.8 Upon approval of the EIA Report an EP will be issued to WFBU and will likely have conditions attached to it, which must be complied with under the EIAO. Furthermore, WFBU, the Works Contractor and the Management Contractor must also comply with all other controlling environmental legislation and guidelines, which are discussed elsewhere in this report.

12.2 Process Review

12.2.1 The purpose of the process review is to confirm that all processes to be carried out within EcoPark comply with the conditions of the EP, to ensure that the findings of the EIA are met and to confirm that the risk posed by any storage or transportation of DGs is acceptable. The process review is carried out predominantly by the Operator's ET, on behalf of the tenant, although the IEC and WFBU can be consulted during the process as appropriate.

12.2.2 All processes will require WFBU approval to operate within EcoPark. When a tenant applies to lease space in EcoPark, he will be requested by the Operator to submit details of the materials he intends to process, the recycling processes(s) he intends to carry out, the throughput of materials he anticipates he will process and any need for transportation or storage of DGs. For each proposed process submitted, a ten-step process review is carried out. Figure 12.1 summarises the process review in the form of a flowchart.

Process Review Checklist

12.2.3 In the process review, reference is made to a Process Review Checklist (PRC). The PRC will be proposed by the Operator in his tender for the Management Contract, however, it is envisaged that the PRC will comprise a single sheet of paper (with attachments if necessary) and will include at least the following details :

- A Reference No. and references to other related processes (if any).
- Name of the tenant.
- Name and description of the process.
- Throughputs of materials associated with the process (including DGs if any).
- A tick box to indicate that the process has already been assessed in the EIA.
- A tick box to indicate that the process is unlikely to warrant a full design audit.
- A tick box to indicate that there are no unacceptable environmental impacts.
- A tick box to indicate that there are unacceptable environmental impacts.
- Signature/chop of the Operator's ET with date and recommendation.
- Signature/chop of EPD's IEC with date indicating verification.
- Signature/chop of WFBU with date indicating approval.
- Signature/chop of the Operator with date indicating tenant has been informed of result.

Ten-step Process Review

12.2.4 The process review comprises ten steps, as follows (see Figure 12.1) :

- **Step 1 – Has the Process Already Been Assessed in the EIA ?** The ET will initially determine whether the proposed process has already been assessed in the EIA – reference may be made to Table 14.1 and D.1 (in Appendix D) of the EIA Report. The ET shall also confirm that proposed throughputs are no greater than those assessed in the EIA. If the process has already been assessed in the EIA, then the PRC will be completed to indicate that environmental impacts are no greater than those already assessed and to recommend that the process should be approved for operation in EcoPark. It should also be determined whether the storage or transportation of DGs poses a risk, and if so a hazard to life assessment should be carried out confirm that any risk is acceptable in terms of the *Hong Kong Risk Guidelines* (Annex 4 of the EIAO-TM).
- **Step 2 – Is the Process Likely to Warrant a Design Audit ?** If the proposed process is minor in nature and, in the professional judgement of the ET, will not cause adverse environmental impact (including cumulative impacts with existing processes) or unacceptable risk (in terms of the *Hong Kong Risk Guidelines*) then the PRC will be completed to indicate that a Design Audit is not warranted and to recommend that the process should be approved for operation in EcoPark. Additional information shall be appended to the PRC providing full justification of this conclusion. It is suggested that the ET should obtain the IEC's informal agreement to this conclusion before officially requesting verification (Step 8). If in the opinion of the IEC a Design Audit should be carried out, then the ET should consider proceeding to Step 3.

- **Step 3 – Assessment.** The actual methodology shall be proposed by the Operator in his tender for the Management Contract but shall incorporate the following (additional assessments may be specified by the IEC or WFBU as appropriate) :
  - assessment of likely impacts to air quality in terms of TSP, RSP, SO_2, NO_2, CO, VOC, TAP (including but not limited to heavy metals, halogen compounds, dioxin and furans) and odour. Any other existing and planned/committed air pollution sources within 500m from the boundary of EcoPark should be included in determining the cumulative air quality impact at ASRs.
  - waste management implications in terms of quantities and composition of recyclable by-products, potential for vertical integration within processes already operating within EcoPark, quantity and composition of any non-recyclable materials that require off-site disposal / treatment.
  - potential for process to cause land contamination in terms of normal operations or accident.
  - determine the need for a hazard to life assessment and confirm that risk posed by the transportation or storage of any DGs is acceptable in terms of *Hong Kong Risk Guidelines*.

  Each assessment shall not be carried out in isolation but shall take into consideration an overview of all other processes currently operating within EcoPark and those that are anticipated, based on the feedback from the Operator's promotional efforts. By considering the environmental impacts and/or risks of each process in this holistic manner, the Operator shall develop EcoPark as a single, integrated facility, rather than simply as a collection of disparate recycling operations. In this way, the flexibility inherent in the Umbrella Approach and Design Audit Approach can be fully utilised, while demonstrating and ensuring environmental protection and compliance with the findings of the EIA Report and the conditions of the EP.

- **Step 4 – Does the Assessment Indicate that Impacts or Risks are Acceptable ?** If the assessment indicates that environmental impacts are acceptable (using the same criteria that were used in the EIA) or that risks are acceptable in terms of the *Hong Kong Risk Guidelines,* then the PRC will be completed to indicate that there are no unacceptable environmental impacts and/or risks and to recommend that the process should be approved for operation in EcoPark. Additional information (such as the assessment itself) shall be appended to the PRC providing full justification of this conclusion. It is suggested that the ET should obtain the IEC's informal agreement to this conclusion before officially requesting verification (Step 8). If in the opinion of the IEC impacts are not acceptable, then the ET should consider proceeding to Steps 5 and/or 6. Note that Step 6 can be carried out before Step 5, or in parallel, if required.
- **Step 5 – Can Processes be Modified to Reduce Impacts and/or Risks ?** Working with the tenant, the ET shall propose modifications to the tenant's intended process such that environmental impacts and/or risks are avoided or reduced to an acceptable level. Modification could be through adoption of cleaner technology, reduction of throughputs, elimination of DGs, etc. The tenant's agreement to modification of the process should be obtained (in writing) together with an agreed timetable, if appropriate. The modified process shall then be re-assessed (Step 3).
- **Step 6 – Can Mitigation Measures Reduce Impacts and/or Risks ?** Working with the tenant, the ET shall propose additional mitigation measures such that the environmental impacts and/or risks are reduced to an acceptable level. Mitigation could include air pollution control equipment (such as bag filters, electrostatic precipitators, etc.), agreement to develop the tenant's lot in such a way as to avoid potential for land contamination (such as provision of hardstanding and/or shelters), provision of improved storage facilities for DGs, etc. The tenant's agreement to install proposed mitigation should be obtained (in writing) together with an agreed timetable, if appropriate. The mitigated process shall then be re-assessed (Step 3).
- **Step 7 – Unacceptable Environmental Impacts and/or Risks Identified.** Steps 3 to 6 can be repeated as many times as necessary, in an iterative manner. However, should the ET and/or tenant conclude that the process cannot be further modified or mitigated such that there are no unacceptable environmental impacts and/or risks, then the PRC

will be completed to indicate that environmental impacts (individual and/or cumulative) and/or risks are unacceptable and to recommend that the process should not be approved for operation in EcoPark.

- **Step 8 – IEC Verification.** The ET shall pass the completed PRC to the IEC for verification. The IEC shall verify that the conclusions reach by the ET are sound and that any justifications are sufficient to support the conclusions. Should the IEC disagree with the ET's conclusions or recommendations, then this shall be resolved between the IEC and ET.
- **Step 9 – WFBU Approval.** The IEC shall pass the completed and verified PRC to WFBU for approval. WFBU shall approve the conclusions and recommendations of the ET based on the verification of the IEC. Should WFBU disagree with the ET's conclusions or recommendations, or with the IEC's verification, then this shall be resolved between the three parties.
- **Step 10 – Inform Tenant Whether Process is Approved.** WFBU shall pass the completed, verified and approved PRC to the Operator and the Operator shall inform the tenant whether the proposed process is approved for operation in EcoPark or if approval has not been given. If the latter, the Operator shall give an explanation to the tenant as to why. Should the tenant make improvements to one or more parts of the process at a later date, then the process can be resubmitted for process review.

12.2.5 For cases where processes have already been assessed (Step 1) or are unlikely to warrant a Design Audit (Step 2) and unacceptable risks are not anticipated, the process review provides a streamlined mechanism for approval to be given quickly without the need for a Design Audit, and for the tenant informed within a matter of days. Given the broad scope of the Umbrella Approach, it is anticipated that the majority of tenants initially relocating to EcoPark will fall into one of these two categories and, as such, the Process Review will not cause undue delays.

12.2.6 Where a process is not covered by the umbrella EIA and a Design Audit is required, the time taken to carry this out should be minimised as far as possible to reduce delays to the tenant requesting approval.

12.2.7 Copies of PRCs shall also be included in the Quarterly EM&A Operation Reports, as described in Section 8.3 of the EM&A Manual. The Operator, ET, IEC and WFBU may also keep copies of PRCs for their records.

Wastewater Generation and Treatment

12.2.8 The generation and treatment of wastewater has not been included in the Process Review described above because the WTF will treat EcoPark industrial wastewater to meet the conditions of the Discharge Licence under the WPCO, not the EIAO, and this is the responsibility of the Operator, not the tenants.

12.2.9 However, as an administrative/management procedure, the Operator will need to ensure that the maximum influent criteria for the WTF (to be determined during the follow-on D&C consultancy) is not exceeded by effluents discharged by tenants. It is therefore recommended that lease conditions should specify that the tenant is required to install an appropriate level of wastewater pre-treatment within their premises prior to discharge to the EcoPark foul sewerage system if their untreated wastewater would exceed the maximum influent criteria of the WTF.

12.3 Environmental Management Plan

12.3.1 For the construction and operation of EcoPark, it is envisaged that the Works Contract and the Management Contract to be prepared under the follow-on D&C consultancy will require the Works Contractor and the EcoPark Operator (i.e. WFBU's Management Contractor) to define mechanisms for achieving environmental targets. This will most likely be achieved by requiring preparation and implementation of an Environmental Management Plan (EMP).

A primary reason for adopting the EMP approach is to make sure that the Works Contractor and Operator are fully aware of their environmental responsibilities and to ensure commitment to achieving specified standards.

12.3.2 The EMP approach is grounded on the principle that the Works Contractor and Operator shall define the means by which the environmental requirements of the EIA process, and the contractual documentation shall be met. The Operator's EMP shall include reference to the Design Audit and to the Emergency Response Plan (ERP) for fire, spills and other accidents, although the EM does not strictly form part of the EMP or EM&A programme.

12.3.3 Each tender for the Works Contract and Management Contract shall include an outline EMP for submission as part of the tendering process, which will demonstrate the determination and commitment of the tenderer and indicate how the environmental performance requirements laid out in the EIA Report, EM&A Manual and EP will be met. It is recommended that this aspect be included as a specific criterion in the assessment of tender documents, since this will act as a clear indication of WFBU's commitment to the pro-active management and minimisation of environmental impacts throughout the construction and operating life of EcoPark.

12.3.4 Subsequent to award of the Works Contract and Management Contract, the Works Contractor and Operator shall be required to submit a draft and final version of the EMP for the approval of WFBU. During operation of EcoPark, the Operator's EMP will be subject to continuous review to ensure that it contains sufficient provision to provide environmental protection and Process Review for the wide range of processes to be carried out within EcoPark, particularly for future processes using technologies not commercially available and, hence, not examined in this EIA.

12.4 EM&A Manual

12.4.1 EPD requires the submittal for approval of an EM&A Manual prior to the commencement of construction. The EM&A Manual has the same purpose of defining the mechanisms for implementing the EM&A requirements specific to each phase of the work.

12.4.2 The EM&A Manual provides a description of the organisational arrangements and resources required for the EM&A programme, based on the conclusions and recommendations of this EIA. The EM&A Manual stipulates details of the construction monitoring required, and actions that shall be taken in the event of exceedances of the environmental criteria.

12.4.3 The EM&A Manual comprises descriptions of the key elements of the EM&A programme and these are generally considered to include :

- Organisational arrangements, hierarchy and responsibilities with regard to the management of environmental performance functions to include the EM&A team.
- A broad construction programme indicating those activities for which specific mitigation is required, as recommended in the EIA, and providing a schedule for implementation.
- Descriptions of the parameters to be monitored and criteria through which performance will be assessed including :
  - monitoring frequency and methodology
  - monitoring locations (in the first instance, those listed in the EIA)
  - monitoring equipment lists
  - event/action plans for exceedances of established criteria and schedule of mitigation
  - best practice methods for minimising adverse environmental impacts
- Procedures for undertaking on-site environmental performance audits (in particular Process Reviews as a means of ensuring compliance with environmental criteria.
- Reporting procedures.

12.4.4 The EM&A Manual will be a dynamic document that may undergo a series of revisions to accommodate the progression of the construction and operation programme.

Objectives of EM&A

12.4.5 In general, the objectives of carrying out EM&A for the Project include :

- To provide baseline information against which any short or long term environmental impacts of the projects can be determined.
- To provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards.
- To monitor the performance of the Project and the effectiveness of mitigation measures.
- To verify the environmental impacts predicted in the EIA Study.
- To determine Project compliance with regulatory requirements, standards and government policies.
- To take remedial action if unexpected problems or unacceptable impacts arise.
- To provide data to enable an environmental audit to be undertaken at regular intervals.

12.4.6 The following sections summarise the recommended EM&A requirements, further details are provided in the EM&A Manual, which has been issued as a separate document.

12.5 Air Quality

Construction Phase

12.5.1 It is necessary to ensure proper implementation of the dust control measures as required under the Air Pollution Control (Construction Dust) Regulation and therefore regular site audit of the construction activities is recommended. However, no specific construction dust monitoring is necessary as it was concluded that all dust AQOs will likely be met.

Operational Phase

12.5.2 Part IV of the APCO provides regulatory control on "Specified Processes" (SPs) described in Schedule 1 of the Ordinance. A SP license is required to operate the specified process under the APCO. The initially considered processes within EcoPark are controlled by SP licenses issued under *APCO and Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations*

12.5.3 When applying for approval to carry out a process in EcoPark (under the Process Review) an individual tenant will need to apply for a SP Licence under the APCO where appropriate, e.g. for or the installation of chimney. In this case, the tenant should carry out a separate air quality impact assessment to demonstrate the compliance of relevant statutory requirements and guidelines (i.e. *Guidance Note on the Best Practicable Means*). Upon issue of the SP License, regular monitoring of chimney emission may be required in accordance with the SP licence conditions.

12.5.4 As SP monitoring is provided for under the APCO, it does not form part of this EM&A programme, however, the results of any SP Licence monitoring should be made available in the EM&A reporting if appropriate.

12.6 Water Quality

Construction Phase

12.6.1 The implementation of good construction works practice as well as the mitigation measures identified in Appendix C are important to prevent pollution of marine water in the construction phase and therefore regular site audit of the construction activities is recommended. However, no specific construction water quality monitoring is necessary.

12.6.2 Should the Works Contractor need a Discharge License under the WPCO, then regular monitoring at the discharge point will be required under the WPCO to demonstrate compliance with the License requirements. As monitoring is provided for under the WPCO, it does not form part of this EM&A programme, however, the results of monitoring should be made available in the EM&A reporting if appropriate.

Operation Phase

12.6.3 During the operation phase the WTF will treat industrial effluents arising from various activities within EcoPark. The Operator will need to obtain a Discharge License under the WPCO for the WTF and so regular monitoring at the discharge point will be required under the WPCO to demonstrate compliance with the License requirements.

12.6.4 As monitoring is provided for under the WPCO, it does not form part of this EM&A programme, however, the results of monitoring should be made available in the EM&A reporting if appropriate.

12.7 Waste Management

Construction Phase

12.7.1 During the construction phase, no significant waste management impacts have been predicted, providing that good site practice is maintained. However, regular auditing of the implementation of good site practice will be carried out as part of the construction EM&A programme.

Operation Phase

12.7.2 It is recommended that compliance auditing should be carried out to determine whether wastes are being managed in accordance with the Operator's EMP. This audit, together with the adherence to good operational practice, will also minimise the chance of land contamination. These audits should address all aspects of waste management, including waste generation, storage, recycling, transportation and disposal.

12.8 Landfill Gas

Construction Phase

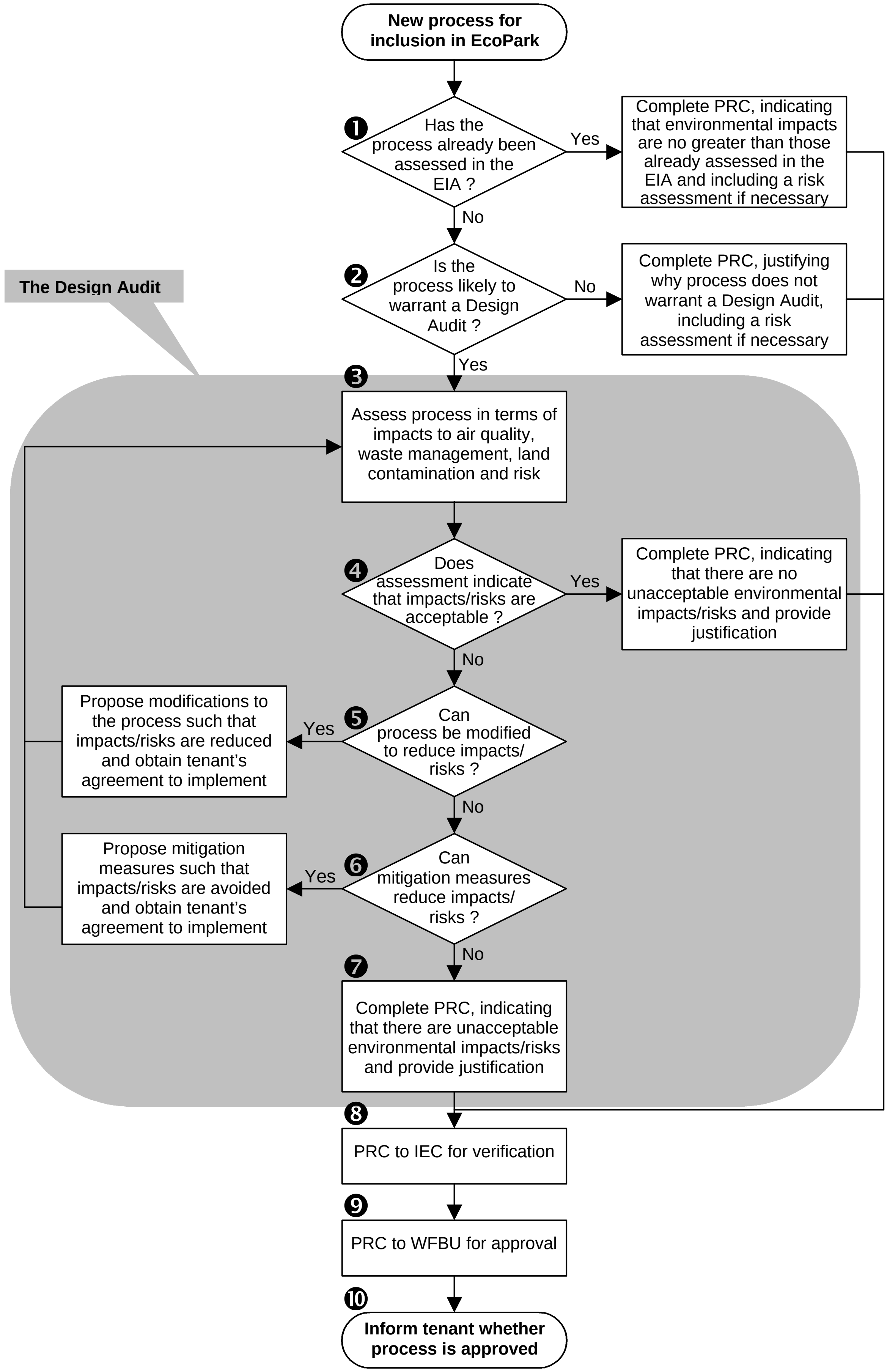
12.8.1 During the detailed design of EcoPark, in the follow-on D&C consultancy, cut-off barriers shall be used to seal any service trench entering the site, service entries into buildings shall be made above ground level and prefabricated offices shall be elevated from the ground (raised floor of 500mm).

12.8.2 LFG monitoring shall only be carried out when excavations of 1m depth or more are carried out. Monitoring shall be conducted through the use of an intrinsically safe and portable instrument, appropriately calibrated and capable of measuring methane, carbon dioxide and oxygen. Safety precautions should be made available during trenching and excavation, and training and breathing apparatus / gas detection equipment shall be provided for confined spaces or deep trenching.

Operation Phase

12.8.3 Workers and visitors shall be alerted to possible LFG hazards within EcoPark, and outdoor smoking and open fires will be prohibited. Regular LFG monitoring at mobile offices, equipment stores, etc. shall be carried out quarterly.

Figure 12.1 : Flowchart for Process Review



13 OPERATIONAL DESIGN ASSUMPTIONS FOR "BASE CASE" ASSESSMENT

13.1 General

13.1.1 In order to provide a basis for comparison during the Design Audit of new processes, this section contains the design assumptions for the "base case" assessment carried out in this EIA, i.e., the design envelope within which all processes must be carried out in order to meet the findings of the EIA Report and EIAO-TM requirements.

13.1.2 It should be noted that these design assumptions relate only to development within EcoPark that is not controlled by existing legislation – the Operator and tenants are also required to comply with other statutory requirements, such as the Air Pollution Control Ordinance, the Water Pollution Control Ordinance, the Waste Disposal Ordinance, etc.

13.2 Air Quality

13.2.1 The required chimney parameters, maximum permissible pollutant emission rates and the fresh air intake restriction for the "base case" are summarised below in Table 13.1. This table provides the basis for future comparison in terms of air quality assumptions.

13.2.2 The footnote to Table 13.1 should also be noted, as this will have a significant effect on the requirements for future tenants in terms of chimney parameters, maximum permissible pollutant emission rates and fresh air intake restrictions. The reason for this caveat is that if the "holiday camp" does not go ahead, then there will be no ASRs at this elevated location and so there is no need to limit the stack height, diameter, efflux velocity of exit temperature. As such, this allows greater flexibility to tenants in the design of their premises, although the maximum permissible emission rates must still be met to ensure that existing air quality will not be worsened significantly.

Table 13.1 : Air Quality "Base Case" Assumptions

Chimney Location	
Any locations other than the Chimney Restricted Area (as shown in Figure 3.3) within EcoPark	
Operating Hours	
07:00 to 19:00 Daily	
Recovery Process	
Electronics Crush-and-sieve of fluorescent lamp	Stack height* : 6m above ground Stack diameter* : 0.25m Efflux velocity* : 16.4m/s Exit temperature* : 23.5°C **<u>Max. Permissible Emission Rate (g/s)</u>** Hg : 2.4167×10^{-6}
Glass Melting / forming and finishing of glass	Stack height* : 30m above ground Stack diameter * : 1m Efflux velocity* : 9m/s Exit temperature* : $80^{O}C$ **<u>Max. Permissible Emission Rate (g/s)</u>** PM : 0.0202
Non-ferrous Metals – metal recovery (sweating, melting, refining)	Stack height* : 30m above ground Stack diameter * : 1m Efflux velocity* : 9m/s Exit temperature* : $80^{O}C$ **<u>Max. Permissible Emission Rate (g/s)</u>** PM : 0.0407 SO_2 : 1.5432

Recovery Process (continued)	
Non-ferrous Metals – metal recovery (sweating, melting, refining) (continued)	**Max. Permissible Emission Rate (g/s)** (continued) Cl_2 : 0.0177 HCl : 0.3550 F : 0.0444 White P : 0.0081 Pb : 0.0389 Be : 1.63×10^{-6} Cd : 0.0008 Hg : 0.0008 Ni : 0.0081 As : 0.0016 Sn : 0.0122 Mo : 0.0081 Cu : 0.0163 Sb : 0.0041 Cr^{6+} : 3.58×10^{-5} Pt : 0.0016 Se : 0.0016 Rh : 0.0008
Plastic Moulding and Extrusion	Stack height* : 30m above ground Stack diameter* : 1m Efflux velocity* : 9m/s Exit temperature* : 23.5^{O}C **Max. Permissible Emission Rate (g/s)** PM : 8.9580×10^{-3}
Rubber Tyres Grinding	Stack height* : 30m above ground Stack diameter * : 1m Efflux velocity* : 9m/s Exit temperature* : 23.5^{O}C **Max. Permissible Emission Rate (g/s)** PM : 9.1986×10^{-3}
Wood Plastic-wood composite manufacturing (extruding)	Stack height* : 30m above ground Stack diameter * : 1m Efflux velocity* : 9m/s Exit temperature* : 23.5^{O}C **Max. Permissible Emission Rate (g/s)** PM : 8.9580×10^{-3}
Fuel Combustion Emissions	
	Stack height* : 30m above ground Stack diameter * : 1m Efflux velocity* : 9m/s Exit temperature* : 80^{O}C Sulphur Content : $\leq$ 0.005% sulphur by weight
	Max. Permissible Emission Rate (g/s) PM : 0.5000 SO_2 : 0.1963 NO_x : 6.0000 CO : 1.2500
	Max. Permissible Emission Rate (g/s) PM : 0.5000 SO_2 : 0.1963 NO_x : 6.0000 CO : 1.2500
Fresh Air Intake Restriction in EcoPark and Future Uses in the Existing Fill Bank Area	
Maximum allowable elevation of fresh-air intake location is 22.5mPD	

Note : * These values are to be considered minimum values to be achieved if the proposed "holiday camp" on the hillside adjacent to EcoPark is not developed. However, if the "holiday camp" is developed then these values are to be considered exact values to be achieved.

13.3 Water Quality

13.3.1 The key assumption for water quality is that the WTF will be designed and operated such that it is capable of meeting the requirements of the Discharge Licence issued under the WPCO. As the WTF will be connected to a foul sewer running below Lung Mun Road that leads to the Pillar Point Sewage Treatment Works, the Discharge Licence will likely stipulate that effluent from the WTF must meet *Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants*. Thus, there is no need to carry out a Design Audit for the WTF under the context of the EIAO.

13.4 Waste Management

13.4.1 There are no quantitative assumptions for waste management, but each tenant is assumed to adopt the waste management hierarchy (i.e., avoid, reduce, reuse, recycle, treat and dispose, in order of preference). It is also assumed that the Operator and tenants should endeavour to promote and implement, respectively, the vertical integration of businesses within EcoPark.

13.5 Prevention of Land Contamination

13.5.1 Again, there are no quantitative assumptions, but it has been assumed that land contamination will be prevented by adopting suitable designs within lots. These include the placement of impermeable hardstanding in any areas within the lot to be used for recycling processes before recycling activities commence.

13.5.2 Any spillages of contaminating material shall be cleaned up immediately through the use of an absorbent material. Any such used material should then be considered as chemical waste and disposed of accordingly.

13.6 Landfill Gas

13.6.1 The risks associated with LFG have been classified as <u>LOW</u> and appropriate precautionary and protection measures have been assumed.

13.6.2 Within the LFG Consultation Zone, it has been assumed that tenants will elevate from the ground any prefabricated offices (raised floor of 500mm) and that service entries into buildings should be made above ground level. The tenant is also assumed to be familiar with possible LFG Hazards.

13.7 Hazard to Life

13.7.1 Based on the Hazard to Life assessment it has been assumed that the following DGs will not result in risk to off-site populations :

- Battery Fluid.
- Oxygen & Acetylene.
- Zinc Dust.
- Hydrogen Peroxide.
- Rubber Tyres.
- Sludge or Spent Acid.
- Ultra Low Sulphur Diesel.

13.7.2 For other substances that may be hazardous in nature, an assessment of risk in accordance with the *Hong Kong Risk Guidelines* may be deemed necessary during the Design Audit.

13.7.3 It has also been assumed that buildings constructed within EcoPark adjacent to the boundary with the PAFF will be set back as indicated in Table 13.2, below, in order to avoid any possible smoke impacts from a fire at the PAFF. Based on this approach, the proposed building height limit is shown in Table 13.2 will only be applied to structures within which people will work at elevated levels, such as the Administration Building.

Table 13.2 : Building Height Restrictions Within EcoPark

Distance (D) of EcoPark Building from closest PAFF Boundary (m)	Maximum Height (H) of EcoPark Building (where workers may be at elevated levels) (m)
0	0.0
10	5.8
20	11.5
30	17.3
40	23.1
50	28.9

Note : H = D x tan(30^{O}), based on a 60^{O} tilt angle for aviation fuel flames and smoke, *Tung Chung Cable Car EIA*.

14 CONCLUSIONS

14.1 The Project

14.1.1 The Government has previously set aside short-term land (“Short-term Tenancies”) for use by recyclers, and businesses have been encouraged to initiate waste reduction activities. However, municipal waste continues to increase and although by the end of 2003 Hong Kong was recycling 41% of its municipal waste, less than 4% was being recycled locally. Therefore, further measures need to be taken to improve the level of recycling.

14.1.2 After a site search, Government identified the most appropriate location for EcoPark as a 21ha site in Area 38, on the outskirts of Tuen Mun. This site is presently undeveloped reclaimed land between Shiu Wing Steel Mill and the River Trade Terminal and includes approximately 460m of marine frontage. The site is remote from existing residential developments, with the nearest being village houses at Lung Kwu Tan (>2km to the west of the site) and Melody Gardens (>2km to the east).

14.1.3 Existing uses of Area 38 include a C&D Material Fill Bank (including tipping halls for East Sha Chau and Penny’s Bay Stage 2) and a Pilot C&D Material Recycling Facility, all of which are managed by the Civil Engineering and Development Department (CEDD). The Tuen Mun Sewage Pumping Station (TMSPS) is located to the north of the Fill Bank.

14.1.4 Planned uses of Area 38 include the Permanent Aviation Fuel Facility (PAFF) to be constructed adjacent to the northwest boundary of EcoPark, the Fill Bank Expansion, a Crushing Facility, a Temporary Mixed Construction Waste Sorting Facility and a C&D Materials Handling Facility. A “holiday camp” to the north of the site, on the other side of Lung Mun Rd. is also planned. Proposed future uses (post-2009) for Tuen Mun Area 38 will likely include additional facilities related to waste management, but no approved projects, programmes or site particulars are available for these uses at this time.

14.1.5 It is intended to develop EcoPark in two phases (Phase I and Phase II) and it has been decided that EcoPark is to be constructed as a Public Works project. The completed infrastructure would then be awarded through open tender to a Management Contractor who would be responsible for the daily operation and marketing activities. The Design and Construction (D&C) consultancy to develop the detailed design, implement the Works Contract and develop the Management Contract is due to be awarded in early-2005.

14.1.6 Construction of EcoPark will involve provision of infrastructure (roads, drains, sewers and utilities), paving and grading machinery for surfacing works, empty (serviced) lots that will initially be grassed open ground, an Administration Building and facilities for the management/ operation of the marine frontage (including berthing facilities). A Wastewater Treatment Facility (WTF) and waste collection/storage facilities will also be provided.

14.1.7 Management (operation) of EcoPark will comprise allocation of lots to tenants (for construction of their facilities, delivery (by road and sea) and loading/unloading of recyclable materials and re-manufactured products, maintenance of common infrastructure, and Environmental Monitoring and Audit (EM&A) of operations.

14.1.8 The construction period for Phase I is expected to last 10 months, with EcoPark opening for business in late-2006, towards the end of the construction period. The construction period for Phase II is expected to last up to 12 months and will be initiated by user demand for EcoPark and availability of the Phase II site area through vacation by existing users.

14.1.9 The impacts arising at EcoPark from the operation of the various recycling businesses will be directly related to the type of materials processed, the recycling processes used, the throughput of each process and the transportation of materials into and out of EcoPark. All of these parameters have been defined within this EIA and the assessment of impacts has been carried out in accordance with the requirements of the EIA Study Brief (ESB).

14.2 Air Quality Impact

Construction

14.2.1 Quantitative air quality assessments were carried out for the construction phase, and cumulative dust impacts were identified as a key issue. Through mandatory implementation of dust control measures as required under the Air Pollution Control (Construction Dust) Regulation, it was concluded that construction dust can be controlled to within acceptable limits, and no significant impacts were anticipated.

Operation

14.2.2 An initial screening exercise identified that the use of Ultra-low Sulphur Diesel would significantly reduce sulphur dioxide emissions from fuel usage. It was also identified that inedible rendering of organic food waste would generate high levels of odour that could not be mitigated using the best available APC equipment that does not entail excessive cost.

14.2.3 It was further identified that to process ferrous metals would require more fuel than an equivalent quantity of non-ferrous metals, or that for the same quantity of metal processing, ferrous metals would generate more pollutants from fuel burning. High fuel usage requirements for non-ferrous metal processing and paper pulping were also noted.

14.2.4 As a result of the initial screening, it was decided to mandate that Ultra-low Sulphur Diesel should be used in EcoPark and that inedible rendering of organic food waste should be excluded from assessment. It was further decided that to maximise metal thermal processing and minimise air pollution from fuel usage, ferrous metal processing should be excluded from assessment. To further reduce emissions from fuel burning, overall throughputs for non-ferrous metals processing and paper pulping were also reduced by varying amounts.

14.2.5 Quantitative air quality assessments were then carried out for the operation phase, based on three scenarios, which provided for a range of material throughputs to be examined :

- **Scenario 1.** Provides the greatest flexibility for the future operation of EcoPark in that very few restrictions are placed on material types or throughputs.
- **Scenario 2.** Maximises the throughput of materials to provide allow the greatest possible number of processes to be included within the umbrella assessment, yet requires only that tenants use, where necessary, the best available APC equipment that does not entail excessive cost.
- **Scenario 3.** Less APC equipment is required compared with Scenario 2, however, this is achieved only by significantly limiting the throughput of materials and also the number of processes. As such, this limits flexibility for future operation of EcoPark.

14.2.6 Unmitigated modelling results for Scenario 1 showed that predicted pollutant concentrations would significantly exceed the majority of air quality criteria, in particular heavy metals and TAP emissions from the non-ferrous metal recovery processes and NO_2 emission from fuel combustion. To mitigate these impacts without using cleaner fuel or reducing throughput would require extensive use of costly APC equipment by a large number of tenants. As such, this scenario was not considered further.

14.2.7 Unmitigated modelling results for Scenario 2 showed significant exceedances, both within EcoPark and off-site, albeit for a smaller number of pollutants. However, with practicable mitigation (such a baghouse, wet or semi-dry alkaline scrubber, activated carbon filter, a wet-scrubber, etc.) for various parameters, the removal of aluminium “demagging” and restrictions on air-intake elevations, modelling showed that existing air quality would not be worsened significantly, either on-site or off-site.

14.2.8 Modelling results for Scenario 3 showed no adverse impacts when mitigated but required much greater restrictions than Scenario 2 in terms of throughput, fuel usage, fresh air intake levels and chimney height.

14.2.9 Based on the above it was concluded that the optimum scenario for EcoPark is represented by Scenario 2 (Mitigated) and this scenario formed the "base case" for the remaining assessments.

14.3 Noise Issues

14.3.1 The *Preliminary Study* indicated that there were no sensitive receivers in the vicinity – the nearest being more than 2km from EcoPark – and so it was not anticipated that there would be any noise impact on these existing NSRs. However, since commencement of this Study, a "holiday camp" development has been proposed close to EcoPark, comprising two sites on the hillside to the northeast of EcoPark on the opposite side of Lung Mun Road.

14.3.2 In terms of construction and operation noise impacts, the closest distances between noise-generating works within EcoPark and the two Noise Sensitive Receivers (NSRs) identified within the "holiday camp" are 430m and 493m, and the closest distance between noise-generating works within EcoPark and closest boundary of the Holiday Camp is 373m. Given these distances, it is concluded that there are unlikely to be any adverse noise impact on the "holiday camp" during construction and operation of EcoPark.

14.3.3 In terms of road traffic noise, the Road Traffic Impact Assessment for this Project has shown that peak hour traffic associated with EcoPark is considerably less than that generated by the adjacent Fill Bank. In the recently issued Project Profile for the *Expansion and Extension of the Fill Bank at Tuen Mun Area 38*, it was concluded that there would be insignificant noise impacts at the "holiday camp". It follows, therefore, that there will be no adverse noise impact on the "holiday camp" from road traffic associated with EcoPark.

14.4 Water Quality Impact

14.4.1 The EcoPark lies within the North Western Water Control Zone (NWWCZ). There are a number of potentially important sensitive receivers within the study area, including areas of direct human contact, such as bathing beaches, and various seawater abstraction points for domestic, commercial or industrial use. The NWWCZ contains several major sewage outfalls (Pillar Point, Urmston Road, Siu Ho Wan) and cooling water discharges from a number of users including Castle Peak Power Station and Shiu Wing Steel Mill, and there is an existing culvert that runs below EcoPark, draining predominantly natural areas to the north and leading to an outfall at the edge of the site.

Construction

14.4.2 The actual construction works involved for EcoPark are relatively minor – laying of utilities and drains, the provision of an internal access road, the construction of the Administration Building, preparation of the marine frontage and general landscaping works. No site reclamation is involved and no substantial structures will be built. The seawall at the marine frontage has already been constructed and the works required to install mooring points, bollards, fenders, etc. are minor.

14.4.3 The principal water quality issues during the construction phase relate to material being washed off the site due to heavy rainfall, i.e., elevated suspended sediment levels in stormwater runoff (this also applies to cementitious materials from any concreting works) and the need for dewatering for any deep foundations.

14.4.4 As groundwater below the site may be contaminated with leachate from SLSL, prior to any dewatering, the Works Contractor should carry out water quality testing to confirm that any discharge to stormwater drains or direct to the sea will meet the WPCO-TM standard for COD and total nitrogen. Should the standard (at the proposed discharge rate) be exceeded then discharge rates should be modified to ensure compliance. Alternatively, any extracted water that cannot comply with the WPCO-TM standard should be taken off site for treatment at an appropriate facility.

14.4.5 To avoid the need for temporary connections into existing foul sewers or installation of a temporary wastewater treatment plant, it is recommended that portable chemical toilets be used by construction workers on site. These facilities would be maintained by a specialist contractor so as not to cause any adverse water quality impacts.

14.4.6 The cumulative effect of construction activities on coastal waters can be mitigated by good construction management, which can be assumed not only at the PAFF but at other proposed users, such as CEDD's C&D Materials facilities. As such, no cumulative construction impact is anticipated.

Operation

14.4.7 During the operational phase the major water quality impacts will be the increase in sewage loading at Tuen Mun Sewage Pumping Station (TMSPS) that will be transferred to the Pillar Point Sewerage Treatment Works (PPSTW) and finally to the Pillar Point outfall. It is proposed that the WTF will be constructed and operated to provide a level of treatment such that the effluent will meet the *Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants* (i.e. to PPSTW via TMSPS).

14.4.8 The estimated effluent flow rate from the WTF is 4,666m^3/day, which is just 12.4% of EcoPark's allocation (and 4.3% of the total capacity) of PPSTW and TMSPS. Hence, the TMSPS will be sufficient to handle the flow generated from the WTF without exceeding the design capacity of the downstream sewerage system, and will also be able to handle the allocated flows from other parts of Area 38. In terms of domestic sewage, no capacity problems are envisaged in terms of treatment at PPSTW, and these issues will be confirmed through a Drainage Impact Assessment (DIA) in the follow-on D&C consultancy.

14.4.9 For the WTF, there are a number of wastewater treatment technologies available, such as Biological Aerated Filtration (BAF) and sulphide precipitation, both of which have been demonstrated to be effective methods for the removal of heavy metals from industrial wastewaters. Suitable plant can be incorporated into EcoPark. The design capacity of TMSPS will not be exceeded by the addition of flow from EcoPark and so the design capacity of PPSTW and its outfall will also not be exceeded. .

14.4.10 A key source of stormwater contamination from EcoPark would be contaminated wash-off from open areas of EcoPark, resulting from normal operations (unlikely because of good operational practice) or from accidental spillage, in which case the Emergency Response Plan (ERP) would be activated. Processes that have a higher risk of contamination were identified and it is recommended that interceptors be installed in the drainage system collecting stormwater from these areas to collect any contaminated water, thereby mitigating any impacts.

14.4.11 A portion of the materials passing through EcoPark will utilise the marine frontage and accidental spillage could potentially contaminate the waterfront. However, the likelihood of such accidental spillage is low and the effect on the surrounding environment is anticipated to be limited, provided that a suitable ERP for spillage is in place.

14.5 Waste Management Implications

14.5.1 The waste management hierarchy has been applied in the assessment and development of mitigation measures for waste. This comprises avoidance, minimisation, reuse, recycling, treatment and disposal, in order of preference. All opportunities for meeting the hierarchy have been assessed, including avoiding or minimising waste generation through changes in the design and adopting better management practices to promote segregation of waste.

Construction

14.5.2 There are three main sources of waste generation during construction phase, namely excavated C&D materials from site preparation, chemical waste arising from maintenance of plant and equipment and general waste from daily activities.

14.5.3 No major earthworks will be required and any excavated materials from site preparation will be stockpiled on site and fully used in landscaping works to ensure the site achieves a material balance. Servicing of the Works Contractor's plant and equipment will likely be the primary source of chemical waste and the quantity arising has been estimated at 1.21tonnes. Chemical wastes will be collected by a licensed collector and disposed of at appropriate facilities, which have sufficient capacity. Approximately 1.8 tonnes/month of general waste will arise on average throughout the construction phase, which will be disposed of at WENT Landfill and will not significantly affect the remaining capacity of that facility. Overall, the waste management impacts from construction are not considered to be significant.

Operation

14.5.4 There are four main sources of waste generation during the operation phase, namely waste from recycling activities (waste removed from incoming feedstock, rejected recyclables and spent process chemicals), chemical waste from maintenance of plant and equipment, sewage sludge (from the WTF) and general waste from daily activities.

14.5.5 It is intended that tenants operating within EcoPark should be encouraged to reuse and recycle wastes that are generated by their own recycling processes, such that within a business the "waste" product from one process can be used as the feedstock of another process, thereby reducing the level of waste generated. It is also intended that this concept should be further expanded so that businesses form symbiotic links with each other, such that the "waste" product from one business can be used as the feedstock of another business – this is termed "vertical integration" and has been applied in the calculation of waste arisings.

14.5.6 Taking into account vertical integration, the net operation waste arisings requiring treatment (chemical waste, possibly sludge in the future), or landfill disposal (waste from recycling activities, sewage sludge and general waste) have been estimated. There is sufficient existing treatment and disposal capacity and the impact of disposing of operational waste from EcoPark is not significant when waste diversion is taken into account – there will be an overall net reduction of waste requiring landfill disposal due to the operation of EcoPark.

14.5.7 As such, the operation of EcoPark can help to extend the operational life of the existing landfills. Furthermore, this net reduction in waste disposal translates into a significant cost saving to Government of through reduced disposal costs. Overall, therefore, EcoPark provides a very positive environmental benefit in waste management terms and is also a more sustainable approach.

14.6 Land Contamination Impact

14.6.1 The site on which EcoPark is to be built is recently reclaimed land, consisting of marine sands and C&D Material. There is no indication that the site is contaminated and so efforts should be made to ensure that the site does not become contaminated during the operation of EcoPark, from accidental spillage or leakage of toxic substances into the ground.

14.6.2 Measures for the prevention of land contamination problems are relatively simple, relying mainly on good engineering practice, well developed waste management strategies and established industrial guidelines. Hardstanding, constructed by tenants, will be relatively impermeable and so will prevent the ground beneath it from becoming contaminated by any materials that are spilled – these will be collected in the stormwater drainage system and intercepted by “petrol interceptors” and “grease traps” before discharge.

14.6.3 Based on the types of contaminants likely to be generated within EcoPark and the risk of these substances reaching open ground, the likelihood of land contamination as a result of EcoPark operation is minimal.

14.7 Landfill Gas Hazard Assessment

14.7.1 The EcoPark falls within the 250m 'Landfill Consultation Zone' for Siu Lang Shui Landfill (SLSL) and so an evaluation of the risk posed by landfill gas (LFG) is required. The methodology set out in the *Landfill Gas Hazard Assessment Guidance Note* issued by EPD was adopted in this assessment, i.e., source, pathway and target.

14.7.2 Although LFG control at SLSL does not rely on an active gas extraction system, there is an indication (in terms of elevated CO_2 levels) that off-site gas migration may be occurring, and so the source was classified as MEDIUM. Potential pathways for migration of LFG from SLSL to EcoPark were classified as MODERATELY SHORT/DIRECT. Although below ground works will be required for the installation of drainage and other utilities, this will be carried out by appropriately trained staff. Therefore, the target was classified as LOW for both construction and operation phases.

14.7.3 Overall, therefore, the qualitative LFG risk assessment has indicated the risks associated with LFG at EcoPark during both construction and operation is LOW and as such, some precautionary measures ("passive control") will be required to ensure EcoPark is safe – these have been specified and include measures for the design stage, construction phase and operation phase.

14.8 Landscape and Visual Issues

14.8.1 The land on which EcoPark is to be located is newly reclaimed and as such does not possess any unique landscape characteristics that could be compromised as a result of EcoPark. Indeed, the surrounding area is industrial in nature and includes a Fill Bank, steel mill and power station, and will soon include an aviation fuel facility.

14.8.2 it was recommended that the design intention of EcoPark, during the follow-on D&C consultancy, should promote harmony between the low-rise buildings and the landscaped areas in order to improve the overall visual appearance of the area. Given that air-intake elevation restrictions imposed by the Air Quality Impact Assessment, it is anticipated that buildings within EcoPark will be low-rise, with occasional chimneys. Compared to the adjacent landuses, EcoPark was considered to generate less visual impact.

14.8.3 Nevertheless, it was recommended that a commonality in the architectural design and harmonised colour theme should be developed by the architect under the follow-on D&C consultancy and it was further recommended that this commonality is promoted throughout EcoPark by the Operator and adopted by tenants.

14.8.4 Rather than detract from the surrounding natural landscape, the intention in designing EcoPark will be to provide an "oasis" of green in an otherwise industrial setting and thereby provide an improved and more aesthetically pleasing environment. It is intended that EcoPark should be a "showcase" for recycling and environmental industries within Hong Kong, demonstrating that the industry can be "clean and green". Thoughtful and attractive landscaping will go a long way in this regard and will prove that such industries can improve the local environment.

14.9 Hazard to Life

14.9.1 A number of substances posing a potential risk were identified from reviewing the proposed processes to be carried out in EcoPark. The actual quantities of such substances cannot be estimated at this time, since this will depend upon the actual throughput of materials that involve the transportation or storage of Dangerous Goods (DGs) or timber, the proportion of the throughput that would be classified at DGs or timber during processing, the rate at which materials are processed by the tenant and the storage capacity provided within the lot for incoming or outgoing materials or fuel.

14.9.2 Notwithstanding, a Hazard to Life assessment was carried out for those DGs that were identified as possibly being stored and transported within EcoPark. The assessment identified the hazards posed by each DG and the type and applicability of mitigation measures to reduce the risk. It was recommended that these mitigation measures should be considered by the Operator when allocating lots to tenants and in the general management of EcoPark. Such measures covered building height restrictions (in case of a fire at the adjacent PAFF) and DG storage and transportation.

14.9.3 Based on current knowledge of EcoPark DG storage and transport and the incorporation of recommended mitigation measures to reduce risk, the Hazard to Life assessment concluded that there is no risk of fatality outside EcoPark from the storage within lots and transportation of DGs within EcoPark.

14.10 Environmental Outcomes

14.10.1 By relocating existing sites used informally for waste recycling activities to the controlled environment of EcoPark, the local populations and to the immediate environment at the former sites of informal waste recycling will benefit from immediate environmental improvement. Furthermore, the development of EcoPark in Tuen Mun Area 38 will not affect the human health of local populations, as it is remote from residential areas, nor will it affect any environmentally sensitive areas, since the land is man-made, has been recently reclaimed and does not support any established ecosystems of ecological importance.

14.10.2 The environmentally friendly design of EcoPark has resulted in ULSD being mandated, processes being screened-out because of excessive odour generation, throughputs of other processes being limited to reduce air pollution and even some processes being removed because of significant air quality impacts predicted in the modelling. The provision of key infrastructure, such as stop-logs within perimeter lot drainage and the WTF will eliminate unacceptable levels of water pollution from industrial wastewater generated within EcoPark.

14.10.3 The key environmental problems avoided relate to the uncontrolled emissions to air and water, noise, land contamination and waste generation that are caused, to varying degrees, at existing sites used informally for waste recycling activities elsewhere. The site of EcoPark in Tuen Mun Area 38 is recently reclaimed land and therefore does not support any established ecosystems of ecological importance. As such, it is not necessary to provide compensation areas.

14.10.4 The environmental benefits of EcoPark are fourfold. Firstly, where operators have relocated to EcoPark there will be an immediate benefit experienced by the local population and the immediate environment at former sites of informal waste recycling. Secondly, the environmentally friendly design of EcoPark has been achieved through limiting and excluding initially considered processes and the provision of environmental protection facilities as basic infrastructure. Thirdly, because of the environmental controls provided within EcoPark, there will be an overall net reduction in environmental pollution, compared to that generated by the existing uncontrolled recycling activities carried out elsewhere within Hong Kong. Finally, the synergy between the operations of the various tenants will result in waste reduction and the enhanced recovery of materials for on-site/off-site re-manufacture and an overall net reduction of waste requiring landfill disposal.

14.11 Summary of Environmental Impacts

14.11.1 Table 14.1, below, provides a summary of the operational environmental impacts, in terms of Air Quality (AQ), Water Quality (WQ), Waste Management (WM) or Contaminated Land (CL) as per the ESB, associated with those materials and processes identified in Table B.1 (in Appendix B). Construction activities with appropriate mitigation are not considered to cause unacceptable environmental impacts (either individual or cumulative) and so have not been summarised in Table 14.1.

14.11.2 In Table 14.1, "✓" indicates that the environmental impact (both individual and cumulative) of the specific process is acceptable after appropriate mitigation as per the "base case". A "×" indicates that the environmental impact (either individual or cumulative) of the specific process (shown in **bold** in Table 14.1) is unacceptable, even after mitigation.

14.11.3 Any process (shown in **bold** in Table 14.1) with one or more "×" has not been approved under this EIA.

Table 14.1 : Summary of Operational Environmental Impacts / Mitigation

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Batteries			
Lead-acid	Mechanical/ physical separation of battery into separate components	• **AQ** Fugitive dust control required	✓
		• **WQ** Neutralised acid treated at WTF	✓
		• **WM** None – plastics to other recyclers	✓
		• **CL** Accidental acid spillage mitigated by ERP	✓
Zinc-carbon / Alkaline	Shredding & neutralization (of electrolyte)	• **AQ** Fugitive dust control required	✓
		• **WQ** Acid Bath Effluent treated at WTF	✓
		• **WM** Minimal waste from shredding	✓
		• **CL** Metal fines controlled by APC equipment	✓
	Electromagnetic separation	• **AQ** Fugitive dust control required	✓
		• **WQ** None	✓
		• **WM** None – unused metals to other recyclers	✓
		• **CL** None	✓
Lithium	Shredding and Electromagnetic/ Physical separation	• **AQ** Fugitive dust control required	✓
		• **WQ** None	✓
		• **WM** None – unused metals to other recyclers	✓
		• **CL** Metal fines controlled by APC equipment	✓
	Hydrosaline deactivation	• **AQ** None	✓
		• **WQ** Hydrosaline Bath Effluent treated at WTF	✓
		• **WM** None –lithium salt mix for export	✓
		• **CL** None	✓
NiCd / NiMH / Li ion	Shredding	• **AQ** Fugitive dust control required	✓
		• **WQ** None	✓
		• **WM** None – unused metals to other recyclers	✓
		• **CL** Metal fines controlled by APC equipment	✓
Electronics			
CRT Recovery	Separation and Testing	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None – either refurbished or to next stage	✓
		• **CL** None	✓
	Shredding, electromagnetic and electrostatic sorting	• **AQ** Fugitive dust control required	✓
		• **WQ** None	✓
		• **WM** Minimal waste from shredding	✓
		• **CL** Metal fines controlled by APC equipment	✓
Computer/ Electronics Recovery	Separation and Testing	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None – either refurbished or to next stage	✓
		• **CL** None	✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Computer/ Electronics Recovery (continued)	Shredding and Separation (Electromagnetic and electrostatic)	• **AQ** Fugitive dust control required • **WQ** None • **WM** Minimal wastage of unusable components • **CL** Metal fines controlled by APC equipment	✓ ✓ ✓ ✓
White Goods Dismantling	Separation and Testing	• **AQ** None • **WQ** None • **WM** None – either refurbished or to next stage • **CL** None	✓ ✓ ✓ ✓
	Manual Dismantling and Separation	• **AQ** Remove refrigerants prior to dismantling • **WQ** None • **WM** None – most plastic/metal to other recyclers • **CL** None	✓ ✓ ✓ ✓
Fluorescent Lamp Recovery	Crush-and-Sieve	• **AQ** Fugitive dust and Hg emission control required • **WQ** None • **WM** None – process enclosed • **CL** None	✓ ✓ ✓ ✓
	Volatization	• **AQ** Fugitive dust and Hg emission control required • **WQ** None • **WM** None • **CL** Accidental mercury spillage mitigated by ERP	✓ ✓ ✓ ✓
	Cyclone / magnetic separation	• **AQ** Fugitive dust and Hg emission control required • **WQ** None • **WM** Minimal wastage of unusable glass • **CL** None	✓ ✓ ✓ ✓
Glass			
Sorting	Manual Sorting	• **AQ** None • **WQ** None • **WM** Minimal waste of unusable glass, rubbish, etc. • **CL** None	✓ ✓ ✓ ✓
	Automated Sorting	• **AQ** None • **WQ** None • **WM** Minimal waste of unusable glass • **CL** None	✓ ✓ ✓ ✓
Processing	Crusher	• **AQ** Fugitive dust control required • **WQ** Effluent from cleaning baths treated at WTF • **WM** Minimal waste of unusable glass • **CL** None	✓ ✓ ✓ ✓
Re-manufacturing	Melting - Continuous regenerative furnace	• **AQ** Dust/VOC control plus restricted fuel usage • **WQ** None • **WM** Minimal waste of unusable glass • **CL** None	✓ ✓ ✓ ✓
	Moulding	• **AQ** Dust/VOC control plus restricted fuel usage • **WQ** Quench water treated at WTF • **WM** Minimal waste of unusable glass • **CL** None	✓ ✓ ✓ ✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Re-manufacturing (continued)	Forming and Finishing	• **AQ** Dust/VOC control plus restricted fuel usage	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Organic Food Waste			
In-vessel Composting	Enclosed composting vessel	• **AQ** Odour control	✓
		• **WQ** High BOD/COD from vessel cleaning to WTF	✓
		• **WM** Minimal levels of waste organic matter	✓
		• **CL** Accidental organics spillage mitigated by ERP	✓
	Curing	• **AQ** Odour control	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Inedible Rendering	**Crusher**	• **AQ** **Screened-out because of Unacceptable odour**	×
		• **WQ** *Not assessed due to being screened-out*	
		• **WM** *Not assessed due to being screened-out*	
		• **CL** *Not assessed due to being screened-out*	
	Cooker	• **AQ** **Screened-out because of Unacceptable odour**	×
		• **WQ** *Not assessed due to being screened-out*	
		• **WM** *Not assessed due to being screened-out*	
		• **CL** *Not assessed due to being screened-out*	
	Drainer	• **AQ** **Screened-out because of Unacceptable odour**	×
		• **WQ** *Not assessed due to being screened-out*	
		• **WM** *Not assessed due to being screened-out*	
		• **CL** *Not assessed due to being screened-out*	
	Screw Press and Filter	• **AQ** **Screened-out because of Unacceptable odour**	×
		• **WQ** *Not assessed due to being screened-out*	
		• **WM** *Not assessed due to being screened-out*	
		• **CL** *Not assessed due to being screened-out*	
Ferrous Metals			
Sorting	Sorting	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Minimal (non-metal) waste generation	✓
		• **CL** None	✓
Baling	Baling	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Processing	Shearing and Shredding	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
	Melting	Ferrous metals require x2.5 more energy than non-ferrous metals to process the same throughput, or generate x2.5 more air emissions than non-ferrous metals for the same throughput. Therefore, to maximise overall throughput of metals and to minimise air emissions, it has been decided to reduce the melting of shredded ferrous metal to zero.	

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Non-ferrous Metals			
Sorting	Materials sorted by visual inspection into various grades as per industry specifications	• **AQ** None • **WQ** None • **WM** Minimal (non-metal) waste generation • **CL** None	✓ ✓ ✓ ✓
Baling	Baling	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
Processing (Lead)	Shearing / cutting / chopping / shredding (depend on market / feed requirements)	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Melting/Sweating	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Melting (Blast-melting cupola)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
Processing (Aluminium)	Shearing / cutting / chopping / shredding (depend on market / feed requirements)	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Sweating Furnace	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Melting (Reverberatory Furnace)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Refining (demagging, alloying)	• **AQ** **Unacceptable dust impacts** • **WQ** *Not assessed due to AQ unacceptability* • **WM** *Not assessed due to AQ unacceptability* • **CL** *Not assessed due to AQ unacceptability*	✗
Processing (Copper)	Shearing / cutting / chopping / shredding (depend on market / feed requirements)	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Sweating (Cupola)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Processing (Copper) (continued)	Melting / Alloying / Casting (Rotary Furnace)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
Processing (Zinc)	Shearing / cutting / chopping / shredding (depend on market / feed requirements)	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Sweating (Reverberatory)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Leaching (Sodium carbonate)	• **AQ** Restricted fuel and material inputs • **WQ** Pre-treatment within recycler's premises then WTF • **WM** None • **CL** Accidental spillage mitigated by ERP	✓ ✓ ✓ ✓
	Melting (Kettle Pot)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Refining / Alloying (Muffle Distillation)	• **AQ** Dust/VOC control, restricted fuel & material usage • **WQ** Process/cooling water treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
Paper			
Sorting	Automated sorting via conveyors, optical sensors and chutes	• **AQ** None • **WQ** None • **WM** Low/Medium levels of unusable (non-paper) waste • **CL** None	✓ ✓ ✓ ✓
Baling	Baling	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
Processing (Secondary Fibre)	Pulping	• **AQ** Controls on fuel consumption • **WQ** Pre-treatment within recycler's premises then WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Cleaning	• **AQ** None • **WQ** Pre-treatment within recycler's premises then WTF • **WM** Minimal (non-paper) waste • **CL** None	✓ ✓ ✓ ✓
	De-inking (Washing / Flotation)	• **AQ** None • **WQ** Pre-treatment within recycler's premises then WTF • **WM** Minimal (non-paper) waste • **CL** None	✓ ✓ ✓ ✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Processing (Secondary Fibre) (continued)	Non-chlorine Bleaching	• **AQ** None	✓
		• **WQ** Pre-treatment within recycler's premises then WTF	✓
		• **WM** None	✓
		• **CL** None	✓
	Additives	• **AQ** None	✓
		• **WQ** Pre-treatment within recycler's premises then WTF	✓
		• **WM** None	✓
		• **CL** None	✓
	Pressing / Drying	• **AQ** None	✓
		• **WQ** Pre-treatment within recycler's premises then WTF	✓
		• **WM** Sludge from recycler's pre-treatment plant	✓
		• **CL** None	✓
Plastics			
Plastics Recovery Facility	Sorting	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Low/Medium levels of (non-plastic) waste	✓
		• **CL** None	✓
	Crushing and Baling	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Flaking and Washing	Flaking / shredding / cutting	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Low levels of (non-plastic) waste	✓
		• **CL** None	✓
	Washing	• **AQ** None	✓
		• **WQ** Organic/inorganic wash water treated at WTF	✓
		• **WM** None	✓
		• **CL** None	✓
	Separation / Centrifugal Drying	• **AQ** None	✓
		• **WQ** Extracted water from centrifuge treated at WTF	✓
		• **WM** None	✓
		• **CL** None	✓
Blending	Batch / continuous blender	• **AQ** None	✓
		• **WQ** Wastewater from hydrolysis treated at WTF	✓
		• **WM** None	✓
		• **CL** None	✓
Moulding/ Extrusion	Melting (fuel powered furnace)	• **AQ** Fugitive dust and VOC controls	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
	Cooling and Cutting	• **AQ** Fugitive dust and VOC controls	✓
		• **WQ** Cooling water treated at WTF	✓
		• **WM** Minimal unusable plastic off-cut waste	✓
		• **CL** None	✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Moulding/ Extrusion (continued)	Centrifugal drying	• **AQ** Fugitive dust and VOC controls • **WQ** Extracted water from centrifuge treated at WTF • **WM** None • **CL** None	✓ ✓ ✓ ✓
Plastic Wood Composite (PWC) Manufacture	PWC manufacturing	• **AQ** Fugitive dust, VOC and fuel usage controls • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
Textiles			
Sorting	Sorting	• **AQ** None • **WQ** None • **WM** Medium levels of (non-textile) waste • **CL** None	✓ ✓ ✓ ✓
Baling	Baling	• **AQ** None • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
Rubber Tyres			
De-beading	Used tyre casings are manually stripped of the steel and textiles	• **AQ** Fugitive dust control • **WQ** None • **WM** Minimal unusable textile waste • **CL** None	✓ ✓ ✓ ✓
Shredding	Mechanical shredding	• **AQ** Fugitive dust control • **WQ** None • **WM** Minimal unusable rubber waste • **CL** Metal fines controlled by APC equipment	✓ ✓ ✓ ✓
Crumbing	Mechanical	• **AQ** Fugitive dust control • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Cryogenic Processing	• **AQ** Fugitive dust control • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
Processing	Magnetic separation	• **AQ** Fugitive dust control • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Air separator	• **AQ** Fugitive dust control • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓
	Sieving	• **AQ** Fugitive dust control • **WQ** None • **WM** None • **CL** None	✓ ✓ ✓ ✓

Process	Specifics	Environmental Impacts / Mitigation	Acceptable ?
Retreading	Sorting and Buffing	• **AQ** Fugitive dust and VOC controls	✓
		• **WQ** None	✓
		• **WM** Low levels of unusable rubber waste	✓
		• **CL** None	✓
	Inspection and Curing	• **AQ** Fugitive dust and VOC controls	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
	Vulcanisation / Autoclave	• **AQ** Fugitive dust and VOC controls	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Wood			
Dismantling / Sorting	Dismantling / Sorting	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Metals/plastics to other recyclers	✓
		• **CL** None	✓
	Bulk reduction (hydraulic compaction / mechanical shearing)	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Metals/plastics to other recyclers	✓
		• **CL** None	✓
Pallet Refurbishment	Pallet refurbishment	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Chipping / Non-chlorine Bleaching	Chipping / Non-chlorine bleaching	• **AQ** Fugitive dust control	✓
		• **WQ** Effluent from recycler's pre-treatment plant	✓
		• **WM** None	✓
		• **CL** None	✓
	Magnetic separation	• **AQ** None	✓
		• **WQ** None	✓
		• **WM** Ferrous metals to other recyclers	✓
		• **CL** None	✓
Plastic Wood Composite (PWC) Manufacture	PWC manufacturing	• **AQ** Fugitive dust, VOC and fuel usage control	✓
		• **WQ** None	✓
		• **WM** None	✓
		• **CL** None	✓
Spent Copper Etchant			
Processing	Electrolytic Process	• **AQ** None	✓
		• **WQ** Pre-treatment within recycler's premises then WTF	✓
		• **WM** None – any unusable reagent to CWTF	✓
		• **CL** Accidental copper spillage mitigated by ERP	✓
	Chemical Treatment Process	• **AQ** None	✓
		• **WQ** Pre-treatment within recycler's premises then WTF	✓
		• **WM** None – any unusable reagent to CWTF	✓
		• **CL** Accidental copper spillage mitigated by ERP	✓

14.11.4 Based on Table 14.1, it can be seen that the following processes, or sub-processes, have been excluded from assessment in this EIA :

- **Organic Food Waste | Inedible Rendering Process.** Due to unacceptable levels of odour generation, even with mitigation applied. Applies to all sub-processes under Inedible Rendering, i.e., crusher, cooker, drainer and screw press/filter.
- **Ferrous Metals | Processing | Electric Arc Sub-process.** Ferrous metals require more energy than non-ferrous metals to process the same throughput, or generate more air emissions than non-ferrous metals for the same throughput. Therefore, to maximise overall throughput of metals processing and to minimise air emissions, it has been decided to reduce the melting of shredded ferrous metal to zero.
- **Non-ferrous Metals | Processing (Aluminium) | Melting Sub-process.** Due to significant dust emissions from the demagging sub-process.

14.11.5 It should be noted that the processes that have been "excluded from assessment" may be re-introduced to EcoPark at a later date, and their environmental impacts would be fully considered in the mandatory Process Review.

14.12 Environmental Monitoring and Audit

14.12.1 With recommended mitigation in place, no unacceptable environmental impacts have been identified during the construction or operation phases. Nevertheless the Environmental EM&A programme covers both phases.

14.12.2 Furthermore, the EM&A programme will include a Process Review of all activities to be carried out in EcoPark. The purpose of this is to ensure that the EP conditions and EIA recommendations are applied to all processes, even if they have not been considered under the "umbrella" approach to this EIA.

Construction

14.12.3 Construction phase EM&A comprising auditing only was recommended for air quality, water quality and waste management. LFG monitoring shall only be carried out when excavations of 1m depth or more are carried out.

14.12.4 The Works Contractor will be required to define mechanisms for achieving environmental targets through preparation and implementation of an Environmental Management Plan (EMP), which will ensure that he is fully aware of his environmental responsibilities. An outline EMP shall be included for submission as part of the tendering process and subsequent to the award of the Works Contract shall be approved by WFBU.

Operation

14.12.5 Operation phase EM&A comprising auditing only was recommended for air quality, water quality and waste management. No monitoring was recommended under the EM&A programme, however, specific monitoring required by a SP Licence under the APCO, or by a Discharge Licence under the WPCO should be made available in EM&A reporting.

14.12.6 The Operator will be required to define mechanisms for achieving environmental targets through preparation and implementation of an EMP, which will ensure that he is fully aware of his environmental responsibilities. An outline EMP shall be included for submission as part of the tendering process and subsequent to the award of the Management Contract shall be approved by WFBU. The EMP shall include reference to the Design Audit and to the Emergency Response Plan (ERP) for fire, spills and other accidents, although the ERP does not strictly form part of the EMP or EM&A programme.

Appendix A

Process Flow Diagrams

Appendix B

Initially Proposed Processes, Throughputs and Material Flows Within EcoPark

Table B.1 : Initially Proposed Processes and Throughputs

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Batteries	Estimated total material throughput = 900tpa (14.4% of overall estimated arisings in 2006[4]); assume 69.9% lead acid batteries; 16.3% NiCd/NiMH and 14.1% consumer batteries (zinc-carbon/alkaline and lithium)[2]				
Lead-acid (est. throughput = 629.1tpa)	Metallic Lead (25%); Lead sulphate/oxide (50%); Acid (15%); Plastics (5%); Other materials and residuals (5%)[3]	Acids (15%); plastics (5%) and other material (5%) (assume 100% recovery)	Mechanical / Physical separation of battery into separate components	Pre-treated scrap (separated into various components: metallic lead, lead sulphate/oxide; acid; plastics and waste (other materials and residue))	65%[1] (overall recycling rate^); Pre-treated scrap lead diverted for further processing at Non-ferrous Metals processing facility at EcoPark
Zinc-carbon / Alkaline (est. throughput = 63.45tpa)	Zinc (29%); Manganese (20%); Steel (15%), Carbon (10%); Other (35%)[4]	Assume 35% loss due to removal of non-recyclable materials	Shredding & neutralization (of electrolyte)	Shredded batteries	60%[1] (overall recycling rate^); Pre-treated scrap diverted for further processing at Non-ferrous Metals processing facility at EcoPark
	Shredded batteries	Impurities (NDA)	Electromagnetic separation	Metal and non-metal components	
Lithium (est. throughput = 63.45tpa)	Lithium (3.5%); vanadium oxide (23.9%); recyclable hardware (44.9%); Others (polymers and others;27.7%)[5]	Recyclable hardware (metals; 44.9%), polymers and other materials (assume 27.7%)	Shredding and Electromagnetic/ Physical separation	Metals (for further processing); polymers (for further recycling) or disposal to landfill with other waste materials	70%[1] (overall recycling rate^)
	Lithium and vanadium oxides (as recovered in the separation process)	NDA	Hydrosaline deactivation	Lithium salt mixture (for export)	
NiCd/NiMH/li ion (est. throughput =146.7tpa)	Cadmium (13-22%); Cobalt (0.5-2%); Lithium Hydroxide (0-4%); Nickel (20-32%); Potassium Hydroxide (0-4%) and Sodium Hydroxide (0-4%)[6]; Others (assume polymers, metals; 32%)	Other materials (assume 100% diversion)	Shredding	Metals and non-metals (for export / local processing)	55-60%[1] (overall recycling rate^)

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Electronics	Estimated total throughput = 10,000tpa (15% of overall estimated arisings in 2006[14])				
CRT Recovery (est. throughput = 2,500tpa)	Portable and Table televisions, console televisions, monitors	Plastics, metals (NDA on quantities)	Separation and Testing	Reusable CRTs (refurbishment), recyclable materials (plastics, metals) and separated CRTs for further processing	
	Sorted CRTs	Separated glass and plastics	Shredding, electromagnetic and electrostatic sorting	Glass (for export)	90% (overall recycling rate^)
Computer/ Electronics Recovery (est. throughput = 2,500tpa)	Varies depending on type and quantity of computer/electronics	NDA	Separation and Testing	Re-usable computer / electronics (can be repaired for reuse); Non-reusable computer / electronics	100% of the electronic goods are reusable in some shape or form; Depending on quality of feedstock quantity of goods diverted for repair can range anywhere between 60-90%
	Non-reusable computer / electronics	Steel breakage (25.7%) packaging (17.9%); CRT glass to lead (16.1%); Solid waste (13.1%); Printed circuit boards (5.9%); Export scrap (5.9%); Export reusable materials (4.5%); Plastics (4.4%); Copper-bearing materials (3.3%); CRT glass to glass (3.2%)[7]	Shredding and Separation (Electromagnetic and electrostatic)	Metals (aluminium, steel, gold, silver, lead, etc.) (for export/ feedstock into Ferrous and Non-Ferrous Metals processing facilities), Plastics (for export)	Type and quantity of material diverted includes televisions, packaging, communication electronics, household electronics, monitor and personal computers; If the capability exists, 90%+ of the materials in the computer can be recycled and used into new products.
White Goods Dismantling (est. throughput = 2,500tpa)	Varies depending on type of white good	Varies depending on type of white good	Separation and Testing	Re-usable White Goods (can be repaired for reuse); Non-reusable white goods (feedstock for next stage processing)	Depending on the machine, but typically over 80% of the machine consists of metals and plastics
	Non-reusable white goods	Varies depending on type of white good	Manual Dismantling and Separation	Metals (primarily steel), Plastics (for export/further processing at Plastics Recovery Facility at EcoPark)	

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Fluorescent Lamp Recovery (est. throughput = 2,500tpa)	Glass (95.8%by wt), metals (2.5% by wt), others (phosphor powder, elemental mercury; 1.7% by wt)[8]	NDA	Crush-and-Sieve	Separated components (feedstock for next stage processing)	
	Glass particles and mercury-containing phosphor powder	NDA	Volatization	Elemental mercury (for export), phosphorous (for export)	
	Glass particles	NDA	Cyclone / magnetic separation	Glass (for export/local remanufacturing), aluminium (for export/ to Non-ferrous Metals Processing Facility at EcoPark)	85% for glass (overall recycling rate^)
Glass	Estimated total throughput in vertically integrated system = 21,200tpa (15.1% of overall estimated arisings in 2006[14]				
Sorting	Glass, Others (dyes, paper, plastics)	40%+ loss of glass as mixed colour residual (for colour glass sorting only)[9] ;18-36% residual per tonne of raw feed for general glass material	Manual Sorting	Sorted glass (feedstock into Processing stage)	
		5-15% residual waste	Automated Sorting	Sorted glass (feedstock into Processing stage)	Process rate: 10tph for coloured glass through automated sorting technology
Processing	Sorted glass	Typical residual waste ~2% (paper, plastics from labels)	Crusher (Rotating drum, Hammermills, vertical & horizontal shaft impactors and rotating disc and break bars)	Cullet (for export / feedstock into Remanufacturing stage)	Selection of process will be dependent on output required; Low grade applications 100% - high grade applications 75% (overall recycling rate^)
Re-manufacturing	Crushed glass (to 20mm)	Typical residual waste ~ 3% (paper, plastics from labels)	Melting - Continuous regenerative furnace	Molten glass (feedstock for next stage processing)	Production capabilities - 50 to 300tpd glass
	Molten Glass	Typical residual waste ~ 3% (ceramics, etc.)	Moulding	Pressed and blown glass for forming and finishing (feedstock into next stage)	
	Pressed and blown glass	NDA	Forming and Finishing	Glass products (for export)	Any misshapen glass products recycled as cullet

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Organic Food Waste Estimated total throughput = 52,850tpa (4.2% of overall estimated arisings in 2006[14])					
In-vessel Composting (est. throughput = 12,700tpa)	Organic material (from agriculture premises; markets)	Unacceptable materials (dependent on grade of feedstock)	Enclosed composting vessel		There is a reduction factor of 40% for green waste
		Impurities	Curing	Packaged Compost (for local use)	A reduction factor of 40%can be expected.
Inedible Rendering (est. throughput = 40,150tpa)	Animal by-products (water - 59.1%; solids - 1.8%; fat - 39.1%)[10]	NDA	Crusher	Size-reduced feedstock material (feedstock for next stage processing)	
	Size-reduced feedstock material	NDA	Cooker	Cooked material (feedstock for next stage processing)	
	Cooked material	NDA	Drainer	Separated liquid fat and protein solids (feedstock for next stage processing)	
	Protein solids	Solids (cracklings) (for further processing as protein meal)	Screw Press and Filter	Fat (for local use/export)	
Ferrous Metals Estimated Total Throughput in vertically integrated system = 155,300tpa (18.9% of overall estimated arisings in 2006[14])					
Sorting	Varies depending on quality of feedstock	NDA	Sorting	Sorted ferrous metals (for Baling or Processing)	85% (overall recycling rate^)
Baling	Sorted ferrous metals	NDA	Baling	Baled metals (for export)	100% (overall recycling rate^)
Processing	Sorted ferrous metals	NDA	Shearing and Shredding	Shredded metals (feedstock for next stage processing)	98% (overall recycling rate^)
	Shredded metals (further processing)	NDA	Melting	Metal ingots (for export)	
Non-ferrous Metals Estimated Total Throughput in vertically integrated system = 32,800tpa (25% of overall estimated arisings in 2006[14]); assume primary non-ferrous metals are aluminium, copper, lead and zinc and total throughput is equally distributed among them)					
Sorting	Varies depending on quality of non-ferrous metals input	Varies depending on quality of non-ferrous metals input	Materials are sorted by visual inspection into various grades according to industry specifications	Sorted non-ferrous metals (for Baling or Processing)	85% (overall recycling rate^)
Baling	Sorted non-ferrous metals	NDA	Baling	Baled metals (for export)	90% (overall recycling rate^)

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Processing (Lead) (est. throughput = 8,200tpa)	Sorted lead pieces/material	NDA	Shearing/cutting/chopping/ shredding (dependent on market requirements)	Size reduction of material (feedstock for next stage processing)	
	Lead pieces, size-reduced material and lead ingots (from lead acid battery processing)	NDA	Melting/Sweating	Recovery of low grade lead (for export or feedstock for next stage processing)	
	Recovered low grade lead, addition of high quality feedstock if required	Impurities and removal of dross	Melting (Blast-melting cupola)	Crude lead bullion (for export)	Dross returned for further processing
Processing (Aluminium) (est. throughput = 8,200tpa)	Sorted aluminium pieces/material	NDA	Shearing/cutting/chopping/ shredding (dependent on market requirements and feedstock materials)	Size reduction of material (feedstock for next stage processing)	
	Shredded non-ferrous metals; dross	Higher-melting materials (iron, brass and any oxidation products; diverted for further processing at other process lines)	Sweating Furnace	Recovery of aluminium (feedstock for next stage processing)	
	Recovered aluminium, addition of high quality feedstock if required	Loss in drosses (Reverberatory (2-3%)[11])	Melting (Reverberatory Furnace)	Molten aluminium (for export or feedstock for next stage processing)	
	Molten aluminium	NDA	Refining (demagging, alloying)	Removal of magnesium content in molten aluminium prior to alloying/pouring to form ingots (for export)	
Processing (Copper) (est. throughput = 8,200tpa)	Sorted copper and brass pieces/material	NDA	Shearing/cutting/chopping/ shredding (dependent on market requirements)	Size reduction of material (feedstock for next stage processing)	
	Size reduced copper material	NDA	Sweating (Cupola)	Molten copper (feedstock for next stage processing)	
	Molten copper	Dross (for reprocessing through sweating process)	Melting / Alloying / Casting (Rotary Furnace)	Ingots (for export)	

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Processing (Zinc) (est. throughput = 8,200tpa)	Sorted zinc pieces/material	NDA	Shearing/cutting/chopping/ shredding (dependent on market requirements)	Size reduction of material (feedstock for next stage processing)	
	Size reduced zinc material	Dross and skimmings	Sweating (Reverberatory)	Molten low grade zinc (feedstock for next stage)	
	Dross and skimmings	NDA	Leaching (Sodium carbonate)	Zinc Oxide (for export to primary zinc smelter)	
	Molten low grade zinc	Dross and skimmings	Melting (Kettle Pot)	Molten zinc (feedstock for next stage processing)	
	Molten zinc	NDA	Refining / Alloying (Muffle Distillation)	Ingots (for export)	
Paper	Estimated Total Throughput in vertically integrated system = 306,700tpa (15.8% of overall estimated arisings in 2006[14])				
Sorting	Mixed paper	Removal of contaminants (staples, string, plastics, etc. Removal efficiency 20%)	Automated sorting via conveyors, optical sensors and chutes	Sorted paper (by grade; for baling or for Processing)	80% separation efficiency
Baling	Mixed/separated paper	NDA	Baling	Baled paper (for export)	100% efficiency may be achieved if no sorting into various grades is required
Processing (Secondary Fibre)	Sorted or mixed paper (depending on requirements of facility)	NDA	Pulping	Slurry (feedstock for next stage processing)	
	Slurry	Large contaminants (paper clips, plastics, staples, etc.)	Cleaning	Screened slurry (feedstock for next stage processing)	
	Screened slurry	Ink, toner fluids and other contaminants (labels, adhesives, etc.)	De-inking (Washing / Flotation)	De-inked slurry (feedstock for next stage processing)	Washing recovers 80% fibre; Flotation yields up to 90-95% of feedstock; this step required for only high quality products
	De-inked slurry	NDA	Bleaching	Whitened pulp in slurry (feedstock for next stage)	
	De-inked or bleached slurry	NDA	Additives	Finished pulp (for export (dried) or paper manufacturing (feedstock for next stage processing)	
	Finished pulp	NDA	Pressing/Drying	Paper and paper products	

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Plastics	Estimated Total Throughput in vertically integrated system = 66,800tpa (7.1% of overall estimated arisings in 2006[14])				
Plastics Recovery Facility	Mixed plastics	NDA	Sorting	Sorted plastics (baling for export or Processing)	90% (overall recycling rate^)
	Sorted plastics	NDA	Crushing and Baling	Baled plastics (for export)	100% (overall recycling rate^)
Flaking and Washing	Sorted plastics	NDA	Flaking/shredding/cutting	Shredded plastics (for export or feedstock for next stage processing)	87% (overall recycling rate^)
	Plastic flakes	NDA	Washing	Clean plastic flakes (feedstock for next stage)	
	Clean plastic flakes	NDA	Separation/Centrifugal Drying	Dried plastic flakes (for export or feedstock into Blending)	
Blending	Dried flakes and pellets (virgin material)	NDA	Batch / continuous blender	Uniform recycled/virgin materials of the same resin (for export or feedstock for next stage processing)	
Moulding/ Extrusion	Uniform recycled/virgin materials of the same resin	NDA	Melting (fuel powered furnace)	Molten plastic extruded through tubes (feedstock for next stage processing)	39% of the emissions related to plastic wood composite manufacturing; remaining emissions due to pellet production
	Strands of plastic from melting process (above)	NDA	Cooling and Cutting	Pellets (wet) (feedstock for next stage processing)	98% (overall recycling rate^)
	Wet pellets	NDA	Centrifugal drying	Pellets (for export or for feedstock into PWC Manufacture)	
Plastic Wood Composite (PWC) Manufacture (see also PWC under "Wood")	Wood chips (50%), plastic (virgin and/or recycled; 50%))[15]	NDA	PWC manufacturing	PWC material (for export / local manufacturing)	Under worst case scenario, assume all wood chips (26,300tpa) from wood processing will be used in PWC manufacture. The same quantity of plastics also required (26,300tpa).

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Textiles	Estimated Total Throughput in vertically integrated system = 4,600tpa (2.8% of overall estimated arisings in 2006[14])				
Sorting	Varies depending on feedstock received	2-10%	Sorting	Sorted textiles (feedstock for next stage processing)	75-85% (overall recycling rate^)
Baling	Mixed / sorted textiles	NDA	Baling	Baled textiles (for export)	Assume 100% efficiency for both sorted and mixed textiles
Rubber Tyres	Estimated Total Throughput = 11,500tpa (52.3% of overall estimated arisings in 2006[14]); assumes 1,989tpa (17.3%) diverted for re-treading and remaining quantities passed through remaining processes[13]				
De-beading	Used Tyre Casings	Metal (16.5%), textiles (5.5%), rubber tyre (including polymers, carbon, etc.) (78%)[12,13]	Used tyre casings are manually stripped of the steel and textiles; rubber tyre diverted for further processing	Steel (for export / (feedstock for other EcoPark processes));Textiles (if removed); Waste tyres (feedstock into Shredding)	Assume 100% efficiency as rubber tyres will be further processed to separate out any foreign material still remaining (i.e. metals and fibres)
Shredding	Debeaded Tyres; Unused Tyre Casings	Rubber fragments contaminated with other materials (5-30%; depending on whether metal & fibres have been removed)[12]	Mechanical shredding	Large sized rubber fragments (feedstock into Crumbing)	95%
Crumbing	Shredded Tyre Casings; Unused Tyre Casings; production waste and stripped treads and/or inner tubes	Metals and textiles/fibres (40-50%; depending on whether metal & fibres have been debeaded prior to shredding)[12]	Mechanical (Incoming materials are ground in a grinding mill; Granulated material manually / mechanically separated into rubber granulate, steel and textile; Rubber granulate sieved into different particle sizes)	Smaller sized rubber fragments (crumbs) (feedstock into Processing)	100% separation efficiency (for rubber, metals and textiles) during first pass through Grinding Mill); Purity of rubber granulate is <0.05% of residual materials (assume closed loop)
		NDA	Cryogenic Processing (Incoming material cooled to <0^{O}C; Frozen material ground in hammer mill and separated into rubber granulate, steel and textile; a grinding mill provides further size reduction)	Smaller sized rubber fragments (crumbs) (feedstock into Processing)	100% separation efficiency (for rubber, metals and textiles); Purity of rubber granulate is <0.05% of residual materials (assumed close loop)

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Processing	Crumbed Rubber (from Crumbing Process)	Steel scrap	Magnetic separation	Rubber granulate and textiles (feedstock for next stage processing)	
		Textile scrap	Air separator	Rubber granulate (feedstock for next stage processing)	
		Rubber granulate	Sieving	Rubber granulates (sorted into required size range) (for export)	
Retreading (est. throughput = 1,989tpa)	Used Tyre casings	buffed rubber tyre; 0.325kg per tyre (or 5% of total feedstock)[13]	Sorting and Buffing	Tyres sorted for retreading or for crumbing (feedstock for next stage processing)	
	Used Tyre casings selected for retreading	NDA	Inspection and Curing	Pre-cured or mould-cured tyres (feedstock for next stage processing)	
	Pre-cured or mould-cured tyres	NDA	Vulcanisation / Autoclave	Re-treaded tyres (for local sale or export)	
Wood	Estimated Total Throughput in vertically integrated system = 26,300tpa (12.6% of overall estimated arisings in 2006[4])				
Dismantling / Sorting	Wooden pallets, boxes	Varies depending on quality of the feedstock	Dismantling / Sorting	Sorted wood for further processing (pallet refurbishment or for chipping)	Under worst case scenario, assume no material diversion (i.e. maximum volume)
	Large-sized wooden material	NDA	Bulk reduction equipment (hydraulic compaction/mechanical shearing)	Size-reduced wooded material ((feedstock for Chipping/Bleaching))	
Pallet Refurbishment	Re-usable pallets	Varies depending on quality of the feedstock	Pallet refurbishment	Refurbished pallets (for local sale or export)	Under worst case scenario, assume no pallets diverted for refurbishment; all used to make wood chips for PWC manufacturing

Process & Estimated Throughput	(Typical) Composition of Process Feedstock	Type and Quantity of Material Diverted	Process Specifics	Outputs	Remarks
Chipping / Bleaching	Sorted and dismantled wood pieces	NDA	Chipping / bleaching	Cut wood chips (feedstock for next stage processing)	
	Wood chips	Metals (in the form of nails, staples), paper	Magnetic separation	Wood chips (bleached as needed) (for export or feedstock for PWC Manufacture))	Assume all wood chips diverted/sold to plastic wood composite manufacturing process
Plastic Wood Composite (PWC) Manufacture (see also PWC under "Plastics")	Wood chips (50%), plastic (virgin and/or recycled; 50%))[15]	NDA	PWC manufacturing	PWC material (for export / local manufacturing)	Under worst case scenario, assume all wood chips (26,300tpa) from wood processing will be used in PWC manufacture. The same quantity of plastics also required (26,300tpa).
Spent Copper Etchant Estimated Total Throughput = 2,400tpa[10]					
Processing	Collected spent copper etchant	NDA	Electrolytic Process	Copper solution (for local sale or reuse)	
			Chemical Treatment Process		

Notes : NDA No Data Available
^ Overall Recycling Rates (quantity of the initial weight of the recovered material that has been recycled)

Sources :

1. Vassart, Alan. "Putting the batteries back - Reasons for variations in portable battery collection and recycling". Waste Management World. November - December 2003, pp39-48
2. "Batteries Digest - Batteries/Recycling 031031". http://www.batteriesdigest.com/recycling_m.htm
3. Wilson, Brian. "Battery Design for Cleaner Production" http://www.aprcp.org/articles/papers/wilson.htm
4. EPBA "Two Steps Towards a Better Environment" http://www.styrax.org/demons/epba/EPBAinitiatives/plan.pdf
5. Enderle, David "AVESTOR(TM) Lithium-Metal-Polymer Batteries and the Environment" July 10 2002.
6. "MOLTECH Power Systems NiCd Product Safety Data Sheet", http://www.moltech.com/techdata/images/nicdpsds.pdf
7. Fisher, Michael M et al. "Characterization and Processing of Plastics from Minnesota's Demonstration Project for the Recovery of End-of-Life Electronics" American Plastics Council, 2000.
8. European Lamp Companies Federation (http://www.elcfed.org/lighting_material.html)
9. Remade Scotland "Glass Recycling Handbook: Assessment of Available Technologies" July 2003
10. Hong Kong Environmental Protection Department correspondence dated 31 October 2003.
11. "Recycling and Scrap Melting: Equipment" http:www.energysolutionscenter.org/HeatTre…/recycle_and_scrap_melting_equipment.html
12. "Technical Guidelines on the Identification and Management of Used Tyres", Technical Working Group of the Basel Convetion, December 1999
13. Hird, A.B. et al. "Tyre Waste and Resource Management: A mass balance approach", Viridis Report VR2, 2002
14. "Preliminary Study on Development of an EcoPark in Tuen Mun Area 38 - Final Report" Scott Wilson Ltd et al. for EPD, October 2002
15. http://www.toolbase.org/tertiaryT.asp?DocumentID=2059&CategoryID=1285

Appendix C

Implementation Schedule

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
General									
5.5.23 to 5.5.25, 10.2.24 and 10.2.37	4.2.5 to 4.2.8	The Operator shall develop and implement an Emergency Response Plan (ERP) that lists the procedures to be followed in case of fire, fuel or chemical spillage or other emergency within the EcoPark.	Throughout the duration of the operation.	Operator			✓		
12.2	7.2	No process shall be allowed to operate within EcoPark without approval from WFBU. Approval will be based on the ten-step Process Review, which may include a Design Audit if deemed to be necessary.	Throughout the duration of the operation.	ET IEC WFBU			✓		
	8.1.2	All reports (including Process Review Checklists and any Design Audits) shall be prepared and certified by the ET, verified by the IEC and approved by WFBU.	Throughout the duration of construction works until construction is substantially completed. Throughout the duration of the operation.	ET IEC WFBU		✓	✓		
12.3	7.3	The Operator shall prepare and implement an Environmental Management Plan (EMP) to define mechanisms for achieving the environmental requirements specified in the EIA, EP and in statutory regulations.	Throughout the duration of the operation.	Operator			✓		
Air Quality									
3.5.7	3.2.1	Ensure proper implementation of the dust control measures via regular site audit of the construction activities. Measures to include: • Restricting heights from which materials are dropped, as far as practicable to minimise the fugitive dust arising from unloading/loading; • All stockpiles of excavated materials or spoil of more than 50m3 should be enclosed, covered or dampened during dry or windy conditions;	Throughout the duration of construction works until construction is substantially completed.	Works Contractor Works Contractor Works Contractor		✓ ✓ ✓			Air Pollution Control (Construction Dust) Regulation

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
		• Effective water sprays should be used to control potential dust emission sources such as unpaved haul roads and active construction areas;		Works Contractor		✓			
		• Vehicles that have the potential to create dust while transporting materials should be covered, with the cover properly secured and extended over the edges of the side and tail boards;		Works Contractor		✓			
		• Materials should be dampened, if necessary, before transportation;		Works Contractor		✓			
		• Travelling speeds should be controlled to reduce traffic induced dust dispersion and re-suspension within the site from the operating haul trucks;		Works Contractor		✓			
		• Vehicle washing facilities will be provided to minimise the quantity of material deposited on public roads;		Works Contractor		✓			
		• Erection of hoarding of not less than 2.4m high from ground level along the perimeter of EcoPark site (tenants will also be responsible for implementing dust control measures within their allocated lots); and		Works Contractor		✓			
		• Dusty activities should be re-scheduled to avoid high-winds weather.		Works Contractor		✓			
	3.2.2	The ET should develop an audit checklist, with the agreement of the IEC, to ensure that each mitigation measure is implemented when appropriate and operated correctly when implemented.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
13.2		The Operator shall ensure that the EcoPark "base case" assumptions for air quality shown in Table 13.1 of the Final EIA Report are met by tenants, as a whole.	Throughout the duration of the operation.	Operator			✓		Table 13.1 of the Final EIA Report

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
Water Quality									
5.4.3	4.1.5	Prior to any dewatering, the Works Contractor should carry out water quality testing to confirm that any discharge to stormwater drains or direct to the sea will meet the standard for COD.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			WPCO-TM Standards for Standards for Effluents Discharged into the Inshore Waters of NWWCZ
5.4.4		Portable chemical toilets be used by construction workers on site.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
5.4.5		Soakaways and other similar drainage systems will not be permitted within EcoPark.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
5.4.8		Industrial Wastewater (from tenant's lots) that meets the influent standards of the WTF will be connected into a dedicated internal sewer leading to the WTF.		Consultant for follow-on D&C consultancy	✓				
5.4.8		Domestic Wastewater (from washrooms, kitchens, etc.) will be connected into a dedicated internal sewer leading to TMSPS		Consultant for follow-on D&C consultancy	✓				
5.4.11 & 5.6.7		To minimise the chance of accidental spillage during loading and unloading, and thereby reduce marine water quality impacts, well established cargo handling guidelines should be followed.	Adjacent to EcoPark marine frontage when loading or unloading goods.	Operator Operators of bulk carriers			✓		Sections 5 and 6 of *IMO Code of Practice for the Safe Loading and Unloading of Bulk Carriers*
5.5.19		A stop-log should be installed at a suitable location(s) in the perimeter drainage system so that contaminants can be contained in the event of a spill.		Consultant for follow-on D&C consultancy	✓				
5.5.19		Contaminated water collected in the surface drainage systems shall be treated at the WTF or other appropriate treatment facility.	Within EcoPark throughout the life of the facility.	Operator			✓		
5.5.22		The marine frontage area shall be constructed on a slight gradient such that any water flows away from the sea and towards the surface drains at the edge of the access road		Consultant for follow-on D&C consultancy	✓				

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
5.5.23 to 5.5.25	4.2.5 to 4.2.7	An Emergency Response Plan (ERP) will be formulated to address various accident scenarios. The ERP will be certified by the Environmental Team (ET) and verified by the Independent Environmental Checker (IEC) under the operation EM&A programme.	Within EcoPark throughout the life of the facility.	Operator			✓		
5.6.1	4.2.1	The following control measures are stipulated in the *Practice Note for Professional Persons* with regard to site drainage and shall be implemented to minimise water quality impacts :	Throughout the duration of construction works until construction is substantially completed.						Practice Note for Professional Persons with regard to site drainage (ProPECC PN 1/94)
		• All wastewater generated on the site shall be collected, removed from site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. Chemical or mulching toilets for tankering away the effluent shall be provided where there is no provision for making connection to the sewerage system.		Consultant for follow-on D&C consultancy Works Contractor	✓	✓			
		• The Works Contractor shall construct, maintain, remove and reinstate, as necessary, temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the works. The Works Contractor shall also provide adequate precautions to ensure that no spoil or debris of any kind is allowed to be pushed, washed down, fall or be deposited on land or on the seabed adjacent to the site.		Works Contractor		✓			

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
		• The Works Contractor shall not permit any sewage, waste water or other effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the site onto any adjoining land or allow any solid waste to be deposited anywhere within the site or onto any adjoining land and shall have all such materials removed from the site.		Works Contractor		✓			
		• The Works Contractor shall not discharge directly or indirectly (by runoff) or cause or permit to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling water without the prior consent of the relevant Authority who may require the Works Contractor to provide, operate and maintain at the Works Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.		Works Contractor		✓			
		• All Works Contractor's equipment shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.		Works Contractor		✓			
5.6.1		The *Water Quality Objectives* also provide measures to reduce water quality impacts from construction sites : • Reduce the amount of water used to dampen any surfaces or stockpiles. • Prevent uncontrolled runoff from site by provision of perimeter drains at the seaward extremity of the site.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			Water Quality Objectives

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
		• Any liquid generated on-site shall be treated and disposed of in accordance with the provisions of the WPCO-TM. • Any special works areas which may be provide for material storage or mixing, shall be surrounded by bunds and have drainage collection systems to contain any spillages.							WPCO-TM on Standards for Effluents Discharged into Drainage, Sewerage, Inland and Coastal Waters
5.6.3		Any covered areas within lots will be connected directly to the WTF through the foul sewers.		Consultant for follow-on D&C consultancy	✓				
5.6.4		For uncovered areas where recovery process identified as causing potentially high level of contamination are located, stop-logs will be installed in the perimeter drainage system to isolate contamination.	Within EcoPark throughout the life of the facility.	Consultant for follow-on D&C consultancy Operator	✓		✓		
	4.2.2	The ET should develop an audit checklist, with the agreement of the IEC, to ensure that each mitigation measure is implemented when appropriate and operated correctly when implemented.	Throughout the duration of construction works until construction is substantially completed. Within EcoPark throughout the life of the facility.	ET IEC		✓	✓		

Waste Management

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Des	Con	Op	Dec	Relevant Legislation and Guidelines
6.3.8	5.2.1	Prepare an enhanced Waste Management Plan to minimise C&D Material generation.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			ETWB TC(W) No. 15/2003
6.3.8	5.2.1 & 5.2.2	A trip-ticket system should be included to monitor the disposal of C&D and solid wastes at public filling facilities and landfills and to control fly-tipping	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			ETWB TC(W) No. 31/2004
6.5.2 to 6.5.4		Ensure a material balance in terms of excavated C&D Materials in the design of EcoPark. The contract documents should specify that no excavated materials shall be removed from the site, but should instead be reused as appropriate.		Consultant for follow-on D&C consultancy	✓				

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
6.7.6	5.2.1	The Works Contractor shall register with EPD as a chemical waste producer.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			Waste Disposal (Chemical Waste) (General) Regulation
6.7.11		Any stockpiled material will be covered (e.g. by a tarpaulin) until used in order to prevent wind-blown dust during dry weather, and to reduce muddy runoff during wet weather.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
6.8.7	5.2.4	The Operator should register with EPD as a chemical waste producer.	Within EcoPark throughout the life of the facility.	Operator			✓		Waste Disposal (Chemical Waste) (General) Regulation
6.8.16		The dust collected by any air pollution control equipment installed by tenants must be tested to ensure compliance for landfill disposal.	Within EcoPark throughout the life of the facility.	Operator			✓		Practice Note for disposal of dusty waste at landfill sites and the Admission Ticket System
6.8.18 & 6.8.22	5.2.4	Sludge will be disposed of at WENT landfill, or at any future dedicated sludge treatment facility. Sludge will be collected by a Licensed collector at regular intervals, as determined by the operation of the WTF	Within EcoPark throughout the life of the facility.	Operator			✓		
6.8.21	5.2.4	Chemical wastes shall be stored in appropriate containers in a covered area. "No Smoking" signs will be clearly displayed to prevent accidental ignition of any flammable materials. Drip trays capable of storing 110% of the volume of the largest container will be used to mitigate possible leakage.	Within EcoPark throughout the life of the facility.	Operator			✓		Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
	5.2.3 & 5.2.5	The ET should develop an audit checklist, with the agreement of the IEC, to ensure that each mitigation measure is implemented when appropriate and operated correctly when implemented.	Throughout the duration of construction works until construction is substantially completed. Within EcoPark throughout the life of the facility.	ET with IEC		✓	✓		

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
Prevention of Contaminated Land									
7.3.1	5.3.2	Any spillages of contaminating material shall be cleaned up immediately through the use of an absorbent. Any such used material should then be considered chemical waste and disposed of appropriately.	Within EcoPark throughout the life of the facility.	Operator			✓		
7.3.3		Any areas within the lot to be used for recycling processes shall be concrete paved before recycling activities commence.	Within EcoPark throughout the life of the facility.	Operator			✓		
5.5.23 & 7.3.4		Petrol interceptors/grease traps will be used prior to discharge of surface water off-site.		Consultant for follow-on D&C consultancy	✓				
7.3.5	5.3.2	During operation, the greatest risk of land contamination will come from the storage of chemical wastes, therefore the following measures should be followed : • All chemical storage areas shall be provided with locks and be sited on sealed areas. The storage areas shall be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled oil and chemicals from contaminating the ground.	Within EcoPark throughout the life of the facility.	Operator			✓		
		• Management of chemical waste is implemented through the control of waste storage, labelling of waste, transportation and treatment of chemical waste at an appropriate facility. • Chemical wastes will be collected, stored and disposed of in accordance with the Regulation. Disposal of other construction waste will be undertaken by Licensed contractors in accordance with applicable statutory requirements in the WDO.							Waste Disposal (Chemical Waste) (General) Regulation

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
		• Chemical wastes shall be handled according to the relevant code of practice. Spent chemicals shall be stored and collected by an approved operator for disposal at a licensed facility in accordance with the relevant regulation.							Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes Chemical Waste (General) Regulation.
	5.3.3	The ET should develop an audit checklist, with the agreement of the IEC, to ensure that each mitigation measure is implemented when appropriate and operated correctly when implemented.	Within EcoPark throughout the life of the facility.	ET with IEC			✓		

Landfill Gas

8.7.10	6.1.2	• Cut-off barrier to seal any service trench entering the site. Figure B.6 in the *Guidance Note* provides details of a suitable design. • Service entries into buildings should be made above ground level. • Prefabricated offices should be elevated from the ground(raised floor of 500mm).		Consultant for follow-on D&C consultancy	✓				Guidance Note on Landfill Gas Hazard Assessment
8.7.10	6.1.2	• All workers should be aware of potential presence of LFG. • Safety precautions should be made available during trenching and excavation. • Train and provide breathing apparatus and gas detection equipment for confined spaces or deep trenching.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
8.7.10 & 8.7.11	6.1.2	• Alert workers and visitors of possible LFG hazards • Prohibit smoking and open fires on site • Conduct regular (quarterly) LFG monitoring at mobile offices, equipment stores, etc.	Within EcoPark throughout the life of the facility.	Operator			✓		

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
	6.4.1	During construction excavations of 1m depth or more shall be monitored before entry and periodically during the works. If drilling is required, the procedures for safety management and working procedures described in the *Guidance Note* shall be adopted.	Any excavation >1m in depth	Works Contractor		✓			Guidance Note on Landfill Gas Hazard Assessment
	6.4.3	Following construction, routine monthly monitoring may be required at service voids and utility boxes. The monitoring requirement and specific locations of monitoring points shall be established based on the findings of the monitoring carried out during construction (i.e. if no LFG is detected during construction then no routine monitoring is required). The need for continued monitoring shall, however, be reviewed through discussion with EPD.	Within EcoPark throughout the life of the facility.	Operator			✓		

Hazard to Life

10.4.3		Building height limit within EcoPark shall be applied to structures within which people may work at elevated levels.	Within EcoPark throughout the life of the facility.	Consultant for follow-on D&C consultancy Operator	✓		✓		EIA Report Table 10.2

Landscape and Visual

9.4.1		Ensure all site compounds and works areas are shielded from view during construction, e.g. by use of standard site hoardings as typically used in Hong Kong.	Throughout the duration of construction works until construction is substantially completed.	Works Contractor		✓			
9.4.2		The design intention of EcoPark should promote harmony between the low-rise buildings to be constructed and the landscaped areas.		Consultant for follow-on D&C consultancy	✓				
9.4.3		Measures to be considered in the design should include :		Consultant for follow-on D&C	✓				

EIA Ref.	EM&A Ref.	Environmental Protection Measures	Location / Duration of Measures / Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation and Guidelines
					Des	Con	Op	Dec	
		• Designing the landscape hard works to blend in with the existing environment (this will include the natural landscape of the area north of Lung Mun Road). • Proposed landscape slope/strip should be at an appropriate angle suitable for landscape planting. • Allow a landscaped buffer in front of each lot that will provide screening from the internal roads and median strip planting within the main access road, if appropriate. • Provide landscaped grounds around the Administration Building and perimeter planting along the northern boundary, eastern boundary (after decommissioning of the Fill Bank) and north of the marine frontage access road to provide screening of EcoPark from all directions. • Incorporate effective landscape design and treatments to ensure that the landscaped environment can be easily maintained during the operation phase by the Operator.		consultancy					
9.4.4		It is recommended that consideration be given to developing a commonality in the architectural design and a harmonised colour theme.		Consultant for follow-on D&C consultancy	✓				
9.4.4		It recommended that this commonality be promoted throughout EcoPark by the Operator and adopted by tenants, if practicable.	Within EcoPark throughout the life of the facility.	Operator			✓		