2 DESCRIPTION OF PROJECT

2.1 Key Project Requirements

The key project requirements for the WENT Landfill Extension are:

- Development of a sanitary landfill that covers an area of about 200 ha with an estimated landfill capacity of 81Mm^3;
- Provision of a liner system for the landfill to prevent contamination of land and water resources;
- Provision of a leachate collection, treatment and disposal facilities with sufficient capacity for handling the leachate arising from the landfill extensions;
- Provision of landfill gas collection, utilisation and management facilities;
- Provision of utilities, drainage and road network necessary for the proper operation of the Project;
- Provision of facilities (both civil works and electrical & mechanical equipment) for waste reception, inspection, charging, handling and compaction and plant maintenance;
- Provision of facilities for site administration;
- Operation of the landfill in compliance with all relevant engineering, geotechnical and environmental standards;
- Restoration of the landfill in compliance with all relevant engineering, geotechnical and environmental standards;
- Provision of aftercare for the landfill for a period of about 30 years;
- Carrying out environmental monitoring and audits throughout construction, operation, restoration and aftercare of the landfill; and
- Implementation of environmental measures necessary for the protection of the surrounding environment.

2.2 Need for the Project

2.2.1 Closure of Existing WENT Landfill

According to the Previous Study (CE45/99), the three existing strategic landfills are envisaged to be filled up from early 2010s to mid 2010s.

Based on latest waste forecast conducted in 2007 under this study, the Landfill Life Expectancy Model concluded that the existing WENT Landfill will be filled up by end 2010s, taking into account the following assumptions :

- Medium growth rates for MSW;
- Landfill charging implemented in end 2005;
- No growth recovery rate i.e. 45% recovery rate to be adopted;
- NENT Landfill and SENT Landfill closed in early to mid 2010s.

In accordance with the latest information on remaining void space in the existing WENT Landfill, more recent estimates suggest that the existing WENT Landfill will be filled up by end 2010s.

2.2.2 Justification of Developing Extension at WENT Landfill

Given that it will take many years to confirm suitability of a new landfill location and that land is scarce in Hong Kong, extensions of the existing landfills were considered a practicable,

necessary and urgent intermediate solution. Key advantages of the extension schemes include:

- Availability of existing supporting infrastructure and therefore more cost effective and hence less lead-time for the development.
- Availability of accurate information and hence lower level of risk in capital and operating costs estimation.
- Availability of existing environmental monitoring data and hence more reliable for confirming environmental acceptability of the Project.
- Availability of existing supporting infrastructure and therefore less requirement on land resumption for the development.
- Availability of existing supporting infrastructure and therefore potentially less impact on the environment in comparison with a new green field site scheme.
- Establishment of proven site-specific procedures for operation and environmental impact control.

These key advantages are recognised at the existing WENT Landfill for the proposed extension.

2.3 Consideration of Alternatives

2.3.1 Alternative Extension Layout

In working out the most desirable layout for WENT Landfill Extension, a number of layout options were formulated, evaluated and then compared for selection, based on various evaluation criteria and an evaluation framework agreed with relevant stakeholders in advance.

The key issues and constraints identified during the course of study were taken into account in formulation of landfill extension layout options. A total of 5 broad options were thoroughly evaluated and discussed at a Value Management Workshop on 12 June 2008, attended by relevant stakeholders. Key features of the various options are recapitulated below.

2.3.2 Broad Layout Option 1

This option adopts similar rationale as that proposed in the preliminary study under CE 45/99, ie 2 extension sites namely WENT A & WENT B achieving a total target capacity of 71Mm^3. The Landfill Extensions Layout for Option 1 is shown on **Figure 2.1**. The key features of this option are outlined below.

Table 2.1 Summary of Option 1

	WENT A	WENT B
Total area (ha)	25	135
Maximum fill level (mPD)	+190	+290
Actual waste capacity (Mm³)	6	65

2.3.3 Broad Layout Option 2

This Option enables WENT A to fill over the Tsang Kok Stream Outfall and this will slightly increase the capacity of WENT A with WENT B keeps nearly the same as Option 1. **Figure 2.2** shows the Landfill Extensions Layout for Option 2. The key features of this option are outlined below.

Table 2.2 Summary of Option 2

	WENT A	WENT B
Total area (ha)	47	124
Maximum fill level (mPD)	+190	+290
Actual waste capacity (Mm³)	12	62

2.3.4 Broad Layout Option 3

By optimizing the shape of waste management facilities and aligning the graves, temporary ash lagoons and the waste management facilities together along the same corridor and extend WENT A further towards west, this option allows WENT A to be larger, and WENT B to be implemented at later stage to allow more time to address the thorny issues. **Figure 2.3** shows the Landfill Extensions Layout for Option 3. The key features of this option are outlined below.

Table 2.3 Summary of Option 3

	WENT A	WENT B
Total area (ha)	66	122
Maximum fill level (mPD)	+190	+290
Actual waste capacity (Mm³)	16	63

2.3.5 Broad Layout Option 4

Instead of dividing WENT Landfill Extension into WENT A and WENT B, this option will combine WENT A and WENT B such that the capacity of the whole landfill extension can be increased further by filling the valley between WENT A and WENT B. Moreover, this option also increases the flexibility of site formation, operation and afteruse planning. **Figure 2.4** shows the Landfill Extension Layout for Option 4. The key features of this option are outlined below.

Table 2.4 Summary of Option 4

	WENT A + B
Total area (ha)	188
Maximum fill level (mPD)	+290
Actual waste capacity (Mm³)	81

2.3.6 Broad Layout Option 5

For the graves including the Tang's clan-grave, DLO/TM have advised that in view of the lengthy negotiation time and the amount of ex-gratia allowance/compensation involved, the clearance/removal of the graves should be avoided as far as practicable.

This option models the scenario that the Tsang Tsui Archaeological Site (TTAS) and Clan Grave (CG) cannot be resumed. The boundary of this option excludes TTAS, CG and Hung Shing Temple. The waste capacity of this option is reduced. In order to minimize the reduction in capacity, this option will combine WENT A and WENT B. **Figure 2.5** shows the Landfill Extension Layout for Option 5. The key features of this option are outlined below.

Table 2.5 Summary of Option 5

	WENT A + B
Total area (ha)	150
Maximum fill level (mPD)	+250
Actual waste capacity (Mm³)	39

From the result above, it is noted that keeping the graves will reduce WENT Landfill Extension' waste capacity substantially. In particular, the clan grave is located right in the heart of the WENT Landfill Extension. The consequence of not carrying out clearance/removal of clan grave is that approx. (71 – 39 =) 32 Mm³ of landfill space will need to be formed by much more costly method which should be much higher than the ex-gratia allowance/compensation referred to in DLO's advice.

2.4 Selection of Preferred Layout Options

2.4.1 Evaluation Criteria

These options were evaluated / assessed in accordance with the following factors and main criteria:

- Waste management needs of at least 71Mm^3 target void space for the WENT Landfill Extension;
- Engineering considerations including site formation complexity, constructability, drainage impact and maintenance;
- Environmental issues such as noise, air quality, ecology, landscape and visual, waste management, cultural heritage, water quality, etc.
- Community aspects such as afteruse flexibility, cost of disposal, land resumption and graves clearance.

2.4.2 Waste Management Needs

Under the previous study "Agreement No. CE45/99, Extension of Existing Landfills and Identification of Potential Waste Disposal Sites, Final Strategic Environmental Assessment Report", the "Strategic Plan" for the development of WENT Landfill Extension required a void space (landfill capacity) of 71Mm^3 to be provided. All options can achieve this target except Option 5.

Cost-effectiveness is another aspect to be considered in waste management. According to the territory-wide study in 2000, due to the limit of available waste capacity, any lost to the waste capacity will need to be compensated for, by increasing the size of another landfill. In view of the issues/constraints that other land-based landfills are facing, the compensatory landfill space will probably need to come from a reclamation-based landfill site, even if the site formation costs involved are much higher (due to the costly seawalls & reclamation involved). The cost of a reclamation-based site is approx. $290 per m³ of waste-capacity, whereas the cost of a land-based site is approx. $60 per m³ of waste-capacity. It follows that the cost losing 1m³ of land-based landfill and replaced by reclamation-based landfill is HK$(290 – 60) ie HK$230/m³.

The target capacity of WENT Landfill Extension accordingly to the Brief is 71Mm³. Any options which exceed this target will have a saving on waste management cost. On the contrary, any options which cannot meet the target will induce extra cost due to reclamation-based landfill.

The landfill gas generated from the landfill extension could be used as an energy source for electricity production by the Black Point Power Station nearby. With proper landfill gas purification and treatment system, the landfill gas could be converted to the power supply

grid. It is obvious that the more the waste capacity, the more the landfill gas produce and the more commercial viable for the energy recovery scheme.

The larger the waste capacity, the higher the cost savings, the greater the waste-to-energy potential and hence the higher the score. Thus, Option 4, with the highest waste capacity, is preferred.

2.4.3 Engineering Considerations

The major engineering considerations relate to site formation complexity, construction practicability, engineering impacts to downstream and requirements on operation and maintenance of the various facilities are discussed as follows:

2.4.3.1 Site Formation Complexity

Factors affecting the grading of this criterion are related to balanced cut and fill volume. The optimum engineering design of a landfill site is to maintain a balance in cut and fill material over the entire construction and operation periods. Importing or exporting construction material is not preferred. In this regard, all options can achieve this requirement except Option 1 as over 3Mm^3 of surplus materials are required to be disposed off site.

2.4.3.2 Construction Practicability

According to the recent GI data, there is no particular geological constraint in the proposed landfill extension site. Site formation and retaining structures for all options are feasible to construct without major engineering constraints. All options will experience the same founding conditions and reinforced structures will be adopted for retaining height greater than 10m.

However, the construction of extensive retaining wall costs time, money and maintenance concerns though it can increase void space for the landfill. The longer the retaining wall it has, the lower the score for this criterion will be. All options requires construction of about 300m retaining wall to the west of the WENT Landfill Extension. However, Option 1 requires construction of another approx. 280m long retaining wall between WENT A and WENT B for the site formation of waste reception area and leachate treatment facilities. Therefore, Option 1 is less preferred.

2.4.3.3 Engineering Impacts to Downstream

All the proposed options will interface the existing landform and may have impact to adjacent drainage system, especially to Tsang Kok Stream, in short and long term. However, according to the Drainage Impact Assessment, the impact is considered acceptable. Among the five options, Option 1 is considered having less impact to existing drainage system as the Tsang Kwok Stream outfall is not affected. However, for Option 2 to Option 5, the Tsang Kwok Stream outfall will be decked and replaced by box culvert. Therefore, Option 1 is preferred in this regard.

As the leachate discharge will be kept as the same as existing WENT Landfill, there would be no impact to the sewerage network downstream. All five options will have the same score in this aspect.

2.4.3.4 Operation and Maintenance

Maintenance is important, as any built elements/structures cannot be operated without a proper maintenance. The operation and maintenance works such as treatment facilities, drainage system, E&M equipment, water quality, leachate and landfill gas monitoring equipment, etc. for all options are similar.

The recommended grading for Option 2 to Option 5 with one single retaining wall is preferred whilst Option 1, which requires extra maintenance effort for the additional retaining wall and associated drainage system, is less preferred.

2.4.4 Major Environmental Issues

The major environmental considerations relate to air quality, noise, water quality, ecology, archaeology and cultural heritage, landscape and visual etc. at various project phases are discussed as follows:

2.4.4.1 Air Quality and Noise

Noise impact and air quality impact (including odour and LFG hazard) are considered to have the same impact for the various layout options. The existing sensitive receivers are located at least 700m away from the waste boundary of various landfill extension layout options. No matter which option is selected, the potential air quality impact and noise impact would be similar in magnitude and significant impacts are not anticipated.

2.4.4.2 Water Quality Impact

The landfill extension may encroach onto both Tsang Kok Stream and its outfall. There may be certain degree of influence of water flow/yield on Tsang Kok Stream and its outfall.

Leachate collection, treatment and disposal system will be provided for all options. There would be no water quality impact to the downstream network.

Option 1 affecting only Tsang Kok Stream, is preferred whilst Option 2 to Option 5, with encroachment to both Tsang Kok Stream and its outfall, are therefore less preferred.

2.4.4.3 Landscape and Visual Impacts

All the options will have the similar maximum landfill level of +250mPD to +290mPD. The restored profiles are very similar and thus the impact due to all the options is similar. As the proposed landfill extension will be restored and vegetated to match with its surrounding landform and vegetation patterns in the restoration and aftercare stages, the overall landscape and visual impact of the WENT Landfill Extension is acceptable with mitigation measures implemented at the restoration and aftercare stages.

2.4.4.4 Archaeological and Heritage Impacts

Option 1 to Option 4 will encroach onto Tsang Tsui Archaeological Site (TTAS) and removal of the clan grave and Hung Sing Temple are required.

As for the TTAS, a rescue excavation shall be conducted before the commencement of the construction.

As the cultural heritage value of these built heritage structures is relatively low, before the relocation of these structures, it is unnecessary to take further mitigation measures on the two graves; the Hung Shing Temple, however, should be duly surveyed for record purpose prior to the relocation.

Option 5 has no impact to the TTAS, the clan grave and the Hung Sing Temple. It is therefore preferred.

2.4.4.5 Ecological Impact

All options would result in loss of the ash lagoons, Tsang Kok Stream, Tsang Kok Stream Outfall, pitcher plant and young natural woodland as well as associated flora and fauna. The ecological impacts are ranked as minor to moderate and mitigation including transplantation of flora of conservation interest and compensatory planting would be proposed.

The surface area of the landfill upon completion of operation is similar. The constraints and opportunities, if any, for ecological enhancement or habitat restoration would also be similar for each option. Nevertheless, since Option 5 will encroach onto smaller area of natural woodland, it is preferred.

2.4.4.6 General Environmental Impact at Territorial Level

As Hong Kong is running out of landfill space far earlier than expected, the remaining landfill space will only last until mid 2010s' if waste levels continue to increase at current levels.

Unless solutions are identified immediately, we could face a crisis in the next decade of having nowhere to put the thousands of tonnes of waste thrown away each day. New landfill sites must be identified to maintain the continuity of waste disposal resulting in additional environmental impacts on many more sensitive receivers near to the new landfill sites. To this, layout options providing the greatest void space undoubtedly are preferable in terms of waste capacity and would defer such impacts. In view of this consideration, Option 4 will be the most preferable option since it has the greatest waste capacity.

2.4.4.7 Environmental benefits and dis-benefits

Based on the above, the environmental benefits and dis-benefits of the five options are summarised in **Table 2.6**.

Table 2.6 Summary of Environmental Benefits and Dis-benefits of the Extension Options

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5
Environmental Benefits	Tsang Kok Stream Outfall not affected.	Less chance than Option 1 for forming new landfill site due to larger waste capacity than Option 1.	Less chance than Option 1 and 2 for forming new landfill site due to larger waste capacity than Option 1 and 2.	Least chance for forming new landfill site due to the largest waste capacity among all the options.	TTAS, clan grave and Hung Shing Temple not affected.
Environmental Dis-benefits	• Encroach onto TTAS; • Removal of the clan grave and Hung Sing Temple; • Loss of Tsang Kok Stream, woodlands and pitcher's plants.				Least waste capacity meaning earlier forming new landfill site, generating additional environmental impact at territorial scale.
Can Environmental Dis-benefit be avoided / mitigated	Environmental impacts can be mitigated by: • Rescue excavation for TTAS before construction starts; • The affected graves and temple will be surveyed and recorded before relocation; • The affected woodlands and pitchers plant will be compensated during the restoration and aftercare phases and by transplant.				Additional environmental impact at territorial scale cannot be avoided because there are no other landfill sites and new landfill site needs to be formed.
Conclusion	• Relatively greater environmental impact at local scale but can be mitigated. • Will encroach TTAS, woodland, pitcher plant etc with low to moderate ecological value but can be mitigated by rescue excavation and compensatory woodland plantation. • No unacceptable environmental impact anticipated.				• Least environmental impact at local scale as the waste boundary does not encroach onto TTAS, clan grave and Hung Shing Temple. • Relatively larger environmental impact at territorial scale because forming new landfill site will be required at the earliest time due to least waste capacity. • No unacceptable environmental impact anticipated.

2.4.5 Impact on Community

The major community considerations relate to flexibility for afteruse, unit cost per disposal, needs for land resumption and needs for graves clearance at various project phases are discussed as follows:

2.4.5.1 Flexibility for Afteruse

The proposed extension will be operated for about 10 years. The options with fewer constraints to the potential afteruse of landfill and have a better planning flexibility for the afteruse of the landfill will be graded higher. As such, considerations should be given to the landfill areas and the overall landfill profiles.

The landfill extensions of Options 1 to 3 are divided by two areas, namely WENT A and WENT B. These options may impose restriction/limitation to the afteruse planning as the project boundaries of the two landfills are separated and two ridgelines are formed. The afteruse planning as a whole development is considered less flexible.

On the other hand, the landfill extension for Options 4 and 5 are combined together with single high point, the planning of the afteruse of the landfill can be more flexible. Therefore, these two options are preferred.

2.4.5.2 Unit Cost per Disposal

The unit cost per disposal is the capital cost divided by the actual landfill capacity, which is the cost required to produce a $1m^3$ landfill capacity. The higher the unit cost per disposal, the higher the chance of illegal dumping.

The anticipated unit cost per disposal (m^3) for Options 2, 3 and 4 are of similar order, which is about half of that for Options 1 and 5. Based on the above cost estimation, Options 2, 3 and 4 are “preferred”; while Options 1 and 5 are “less preferable”.

2.4.5.3 Needs for Land Resumption

All options except Option 5 will affect the same number of private lots whilst Option 5 will affect fewer private lots.

Option 3 to Option 5 also affect a Government Triangulation Station Site (GLA). Nevertheless, clearance of this survey station will not impose any additional difficulties to the overall land resumption process.

Hence, all options except Option 5 is the same whilst Option 5 is preferred.

2.4.5.4 Needs for Graves Clearance

According to recent survey, there are a large number of graves including some old graves lying within the extension site. All options affect the same number of graves including clan grave except for Option 5 which clan grave is not affected. As such, Option 5 is preferred.

2.4.6 Overall

A summary of the various layout options selection is tabulated below.

Table 2.7 Summary of Reasons for Options Evaluation

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5
(A) Waste Management Considerations					
Waste capacity	71Mm³	74Mm³	79Mm³	81Mm³	39Mm³
Cost-effectiveness	Target capacity is 71Mm³ is met, no extra cost for reclamination-based landfill	Saving ~HK$0.69b (3Mm³ reclamation-based landfill can be saved)	Saving ~HK$1.84b (8Mm³ reclamation-based landfill can be saved)	Saving ~HK$2.30b (10Mm³ reclamation-based landfill can be saved)	Extra $HK7.36b for reclamination-based landfill (32Mm³ reclamation-based landfill is required)
Waste-to-energy potential	Proportion to waste capacity	Proportion to waste capacity	Proportion to waste capacity	More waste-to-energy potential	Less waste-to-energy potential
(B) Engineering					
Flexibility of site formation	Export fill ~ 3.1 Mm³	Imported fill ~1.5Mm³	Export fill ~ 0.7 Mm³	Balance cut and fill	Export fill ~1.2 Mm³
Construction Practicability	~580 m retaining wall required	~300m retaining wall required			
Drainage Impact to Downstream	Without decking over of Tsang Kok Stream outfall	Decking over of Tsang Kok Stream outfall is required			
Operation and Maintenance	Maintenance of longer retaining wall	Similar operation and maintenance amongst the four options			
(C) Environmental Issues					
Air Quality	Air quality impact can be mitigated				
Noise	Noise impact can be mitigated				
Water Quality Impact	Impact to Tsang Kok Stream	Impact to both Tsang Kok Stream and its outfall			
Landscape & Visual	Restored landfill high is +290mPD				Restored landfill high is +250mPD
Archaeological and Heritage Impact	Encroachment to TTAS and removal of Clan Grave and Hung Sing Temple required				No impact to TTAS, Clan Grave and Hung Sing Temple
Ecology Impacts	Encroachment to woodland, middle ash lagoon and Tsang Kok Stream	Encroachment to woodland, middle ash lagoon, Tsang Kok Stream and Tsang Kok Stream outfall			Encroachment to less extent of woodland, middle ash lagoon, Tsang Kok Stream and Tsang Kok Stream outfall
(D) Community Aspects					
Flexibility for afteruse	Separate site less afteruse flexibility			WENT A and WENT B combined to single development more flexibility for afteruse	
Unit Cost per Disposal	~HK$89/m³	~HK$36/m³	~HK$40/m³	~HK$40/m³	~HK$110/m³
Need for Land Resumption	Some private lands need to be resumed				Less private lands need to be resumed
Need for Graves Clearance	Nine graves including one Clan Grave need to be cleared				The Clan Grave is excluded from the extension

It is understood that there is a public need for landfill space. The loss of waste capacity as a result of not maximising the use of this extension site would require void space to be provided at other landfills, resulting in a shortfall of space at other landfills or at other new landfill site, generating additional environmental impact at territorial scale. As such, when balancing all the above considerations and taking account of the recommended benefits and dis-benefits of all the Options, Option 4, which gives the largest waste capacity whilst avoiding prolonged adverse environmental impacts, was evaluated as a preferred option and is recommended for detailed environmental impact assessment. See **Figure 2.4** for the layout of Option 4.

2.4.7 Alternative Construction Methods and Sequences of Works

2.4.7.1 Construction Methods

The construction methods that could be used for the different extension options are summarised in **Table 2.8.**

Table 2.8 Summary of Various Construction Methods

Construction Method	Environmental Benefits	Environmental Dis-benefits	Can Environmental Dis-benefit be avoided / minimised / mitigated	Other Considerations	Evaluation
(A) Excavation using hydraulic rock breakers					
Using conventional hydraulic rock breaker to break the rock into fragment to allow it to be removed by excavation plant.	Less dusty and lower vibration than blasting method.	Need longer construction time with continual use of noisy hydraulic breakers.	Noise can be minimised by reducing the number of hydraulic rock breakers to be used at any one time. Mobile plant should be sited as far away from sensitive receivers as possible and practicable.	Require more time than the blasting method and less cost effective.	• Magnitude of environmental impacts is less than the blasting method but the impact duration is much longer. • Impact can be minimised by controlling the number of plant working on-site at any one time.
(B) Blasting using explosives					
The blast will ensure the rock to be adequately fragmented to allow it to be removed by excavation plant.	Impact restricted to instantaneous noise, dust and vibration (ie short impact duration).	Relatively high dust and vibration during the blast.	By appropriate design of the blasting operations and adopting the following well proven control measures, no adverse environmental impacts are anticipated for the blasting method: • No storage of explosive within the extension site. • The quantity of explosive used and the dimensions and spacings of shotholes can be carefully desinged to minimise air overpressure, flyrock generation and groundborne vibration. • Remove loose material and stones in the site before blasting. • Wet the blasting area prior to blasting to minimise dust. • Use of fine blast nets, screens and other protective covers to prevent the projection of flying fragments and material resulting from blasting.	• Relatively quick and more cost effective. • Well proven method used in the site formation works.	• The magnitude of environmental impact is the highest but the duration is very short. • Impact can be minimised by careful design of blasting method. • Proven and cost effective method used in the site formation works.

In general, the construction methods to be used for all extension options will be the same. It is recommended to adopt a balanced cut-and-fill site formation for constructing the landfill cells within the project site. The other construction activities involve construction and demolition of infrastructure and construction of base liner and leachate and landfill gas collection systems. Typical construction practices will be adopted. With the implementation of standard pollution control measures, no adverse environmental impacts are anticipated. Therefore, alternative construction methods were not identified.

2.4.7.2 Works Sequence

The WENT Landfill Extension will be developed in six phases to allow progressive use of the overall landfill area. Each phase will have similar waste capacity and require about 2 to 3 years for the site formation works to meet the need of waste delivery. Nevertheless, each phase will be constructed, operated and restored at a rate dependent on the actual delivery of waste and sufficient areas should be maintained to stockpile the excavated materials for subsequent filling process to avoid disposal of surplus excavated materials by vehicles resulting in additional environmental impacts on other sensitive receivers en-route. Simultaneous construction, operation and capping activities will occur in different parts of the site.

The WENT Landfill Extension's development-phasing and landfilling-sequence is designed to keep CG to be resumed in the latest phases. This allows ample time for the negotiation process for clearance/removal of this grave. On the other hand, as the ash lagoons have been leased to CLP until 2047 and are currently occupied by CLP for storage of coal ash. For prudence sake, the implementation of WENT Landfill Extension could be planned in such a way that the west lagoon (the one nearest to CLP's Black Point Power Station) is given more time for land acquisition. To this, the site formation works will commence at the eastern perimeter. The site formation for all options except Option 5 will be divided into six phases as shown on **Figure 2.6**. As Option 5 is for the scenario that the TTAS and CG cannot be resumed, phase 6 is omitted.

2.5 Site Location and Site History

2.5.1 Site Location

The Project Study Area is located on a north-westerly facing natural hillslope, which is situated immediately to the west of the existing WENT Landfill site. The majority of the Study Area is bounded by the natural topography. The eastern and southern boundaries of the site are formed by natural ridgelines. These ridgelines merge into a major east-west trending ridgeline that defines the southern boundary of the site. Nim Wan Road cuts diagonally through the study area and has been formed along a north-easterly trending valley. A series of cut slopes have been formed on either side of the road. The northern portion of the site is currently occupied by the China Light & Power Company Ltd (CLP) Black Point Power Station Ash Lagoons and the sea is situated beyond these, see **Figure 1.1**.

2.5.2 Site History

The aerial photos indicate that the study area predominately comprises natural terrain hillside, with relatively little indication of anthropogenic activity before the early 1980s. However, some cultivated areas and village houses were formed along the coastal areas, in the vicinity of Tsang Tsui and Tsang Kok, prior to 1963.

Development in the northern portion of the study area was observed in the late 1980s. This included the construction of the Tsang Tsui Ash Lagoon in 1988 with the construction of a seawall and reclamation area. The hillslope in the western portion of the study area was utilized as a borrow area to provide material for reclamation and seawall. The excavation within the borrow area was carried out between 1986 and 1989 and it appears that the slopes within the borrow area were upgraded after the excavation. The village houses and

farmlands in Tsang Tsui were demolished around this time as a result of the works. A BBC Relay Station was constructed in the area of the former cultivation at Tsang Tsui around 1986. This Relay Station was subsequently demolished in 1998.

Nim Wan Road, which runs across the study area following the alignment of a natural valley, was constructed between 1988 and 1990. A series of man-made slopes were formed either side of the road alignment and the lower portions of these slopes appear to have largely been formed within rock.

Other works undertaken in the vicinity of the study area include the site formation of the existing WENT Landfill site and the construction of the CLP Black Point Power Station. The site formation works for the existing WENT Landfill, located immediately to the east of the study area, were carried out in the late 1980s and landfilling works commenced in the mid 1990's and are still on-going at present. Construction of the CLP Black Point Power Station, which is situated to the west of the study area, was carried out in the early 1990s.

No further development within the study area was apparent from the late 1990s to present.

2.6 Scope of the Project

2.6.1 Scope of the Project

The scope of the Project is to provide a landfill extension site of about 188 hectares with a void space of 81Mm³ on the western side of the existing WENT Landfill. On top of site formation and preparation works, there will be provision of installation of liner system, leachate collection, treatment and disposal system, gas collection and management, utilities provisions, drainage diversion, restoration and aftercare. Environmental mitigation measures, monitoring and auditing are provided.

The development of the WENT Landfill Extension will involve the following works:

- site formation and preparation.
- installation of liner system.
- installation of leachate collection, treatment and disposal facilities.
- Backfill the existing Tsang Kok Stream Outfall and relocate infrastructures of existing WENT Landfill including LFG treatment plant, site office etc to the backfilled area.
- utilities provisions.
- Nim Wan road diversion.
- design and operation of landfill.
- restoration and aftercare in subsequent stages.
- measures to mitigate environmental impacts as well as environmental monitoring and auditing to be implemented.

2.7 Size, Scale, Shape and Design of the Project

The landfill extension site is a bowl-shape area with a large void space in the middle for waste filling. The total project area is about 245 ha including 188 ha for the development of the WENT Landfill Extension and the final height of the landfill would be about +290mPD.

The key design features are listed as follows:

- Bottom liner system - to separate rubbish and leachate from groundwater;
- Storm water drainage system - to collect surface runoff generated from the landfill;
- Leachate collection system - to collect liquid leaching from the waste mass and convey it to a on-site leachate treatment plant prior to discharging to downstream outfall chamber and Urmston Road Submarine Outfall;

- Landfill gas collection system - to collect gases formed during the decomposition of waste. These gases will be treated and utilised for production of electricity on-site;
- Covering and capping - to seal off the top of the landfill with a gas venting layer, an impermeable mineral layer, a drainage layer and top soil.

Various activities during construction, operation, restoration and aftercare of landfill are discussed in the following sub-sections.

2.7.1 Construction Phase and Activities

Simple excavation and slope formation works will be carried out during the construction stage. The permanent works comprise cut and fill earthworks, slope formation, earth bund and earth wall construction. The temporary works will involve the formation of temporary ditches along the sides of the excavations and associated drainage works and material storage areas.

During site formation, sediment will be contained in permanent detention ponds/silt traps that will be constructed according to landfill phasing. Final design and location of silt traps are yet to be decided, but are likely to be down gradient of each landfill phase. Where possible they will be maintained during the operation stage of each phase to ensure the effective control of operational soil erosion problem.

Landscaped berms will be created and tree planting will be provided along the site boundary for aesthetic purpose.

2.7.2 Operation Phase and Activities

During operation, waste will be disposed of at individual landfill cells. Deposited waste will be compacted to thin layers. The works will be maintained at a gradient of not greater than 1 in 3 to ensure the effectiveness of the compaction equipment. Daily cover (about 150mm soil cover) will be applied to control environmental nuisances such as windblown litter, odour, vermin, flies and birds.

Temporary cover (such as impermeable plastic sheets) will also be provided for inactive tipping phases. It helps to control environmental nuisances as well as to minimize the generation of leachate and high suspended solid runoff.

2.7.3 Restoration Phase and Activities

Restoration is a process to restore a landfill site to a condition suitable for afteruse.

After completion of waste filling, final capping will be applied to minimise infiltration of rainwater into the waste body thus reducing the amount of leachate generated. The capping system normally includes a number of components including topsoil, subsoil, drainage layer and barrier layer.

After placement of the final capping system, the areas will be landscaped. Vertical landfill gas extraction wells will be drilled during restoration. The restoration work will also include the construction of permanent surface water drains.

2.7.4 Aftercare Phase and Activities

Upon completion of site restoration, the period of aftercare will begin and last for 30 years. During the aftercare period, by-products from waste disposal will continue to be generated including leachate and landfill gas. The established leachate and landfill gas management control and treatment facilities will continue to operate throughout the aftercare period.

Regular site maintenance will be required during the aftercare period to keep the incorporated systems functioning as designed. Site monitoring during the aftercare period will continue in accordance with the monitoring plan, but may be decreased if warranted and approved by the EPD.

During the aftercare period, afteruse(s) could be developed on the restored landfill for beneficial uses. However, the scope and extent of the afteruse development is not yet determined at this stage, thus a separate feasibility study and environmental study will be carried out for the development of the afteruse(s) if required.

2.8 Contractual Arrangements

It is anticipated that the DBO (Design-Build-Operate) contract form, which has hitherto worked well for the existing waste management contracts (notably the three strategic landfill contracts and the refuse transfer station contracts), will be adopted for WENT Landfill Extension. Detailed design and formulation of technical details for the construction, operation, restoration and aftercare of the WENT Landfill Extension will be carried out by the DBO Contractor, in accordance with requirements stipulated in the Specification and other documents of the DBO Contract.

Even though there will not be any overlapping in operation between the existing WENT Landfill and the landfill extension, the two contracts will still overlap. Clearly the initial development for the WENT Landfill Extension will overlap and hence interface with the final operation period of the existing WENT Landfill as well as part of its restoration & aftercare, whereas the early operation period of the WENT Landfill Extension plus continuation of its development works will overlap/interface with the remaining restoration of the existing WENT Landfill and the main part of its aftercare.

In general, the two broad categories are considered :

(A) The same contractor will manage both the existing WENT Landfill and the Extension.

(B) The existing WENT Landfill and the Extension will be managed by two separate contractors.

Under the “one contractor” scenario, the two landfills (i.e. the existing WENT Landfill and its extension) will become one landfill. It would be more cost-effective to adopt one leachate treatment plant and one landfill gas treatment plant for share use between the two landfills.

For the “two separate contractors” option, management of the two landfills (eg. collection and treatment of leachate and landfill gas) will be completely separated.

The environmental implications of the different contractual options are evaluated as below.

Table 2.9 Difference of Environmental Implications Associated With Different Contractual Options

Environmental Aspects	Differences
Air Quality and Noise	“Two contractors” option is considered the worst case scenario due to the two separate ammonia stripping plants and two separate landfill gas flares for two separate landfills.
Water Quality	No difference as the total leachate quantity will not be affected and the Discharge License to Urmston Road Submarine Outfall is kept remain unchanged.
Waste	No difference.
Landfill Gas Hazards	No difference to the LFG consultation zone.
Landscape and Visual	No difference to the landscape resources to be affected.
Culture Heritage	No difference to the archaeological findings to be affected.
Ecology	No difference to the ecological resources to be affected.

For the purpose of assessing the worst case scenario for this EIA, the “two contractors” option, which is technical and contractual more complex, has been assumed.

2.9 Project Timetable

The WENT Landfill Extension will start receiving waste-deliveries only when the existing WENT Landfill has ceased operation. The timing of this has yet to be determined, depending on the rate of waste-deliveries in the forthcoming period. As a preliminary prediction, the existing WENT Landfill will probably have its capacity run out by end 2010s, by which time the WENT Landfill Extension shall start operation.

Taking account of the time needed for mobilization and preparatory works prior to commencement of receipt of waste, it may be necessary to award the WENT Landfill Extension contract towards in mid 2010s, in order to ensure that new landfill space will be available before the capacity of the existing landfill runs out.

As discussed in Section 2.4.7.2, the WENT Landfill Extension's development-phasing and landfilling-sequence is designed to be divided into six phases as shown on **Figure 2.6**. A tentative outline programme for implementation of the WENT Landfill Extension is shown in **Appendix 2.1**. **Table 2.10** below summaries the tentative implementation period for each phase of the WENT Landfill Extension. The stated period includes site clearance, site formation and site preparation works as mentioned above.

Table 2.10 Preliminary Implementation Programme for WENT Landfill Extension

Phases	Construction	Operation	Completion
1	2016	2018	2028
2	2017	2019	2028
3	2018	2020	2028
4	2020	2022	2028
5	2021	2023	2028
6	2022	2024	2028

Nevertheless, the exact timing of the various activities may vary, depending on actual volume of waste to be delivered in the forthcoming years.

2.10 Concurrent Projects

The possible potential concurrent projects in the vicinity of the WENT Landfill Extension are identified, including the following:

- Existing / restored WENT Landfill
- Sludge Treatment Facilities
- Integrated Waste Management Facilities

Existing / Restored WENT Landfill

During the construction of the WENT Landfill Extension, the existing WENT Landfill would still be under waste tipping operation. During the operation of the WENT Landfill Extension, the existing WENT Landfill would be under restoration and aftercare phases.

The works involved in the restoration and aftercare phases of existing WENT Landfill would include:

- Placing protective soil layer over the waste;
- Placing final cap including non-woven geotextile, HDPE geomembrance and geocomposite drainage layer;
- Placing final top soil , with sufficient depth to prevent damage to the liner from vegetation root;

- Drilling vertical gas extraction wells and construction permanent surface water drains;
- After placement of the final cover system, the areas will be landscaped with grass and shrubs to blend with the surrounding environment;
- Continuous environmental monitoring and auditing during the aftercare period.

Cumulative environmental impact will be assessed in the various sections.

Sludge Treatment Facilities

To the north of the east lagoon, a Sludge Treatment Facilities (STF) is planned to be built. According to the best available information, the STF will adopt incineration technology for treating sludge collected from the Stonecutters Island Sewage Treatment Works (STW) and 10 other regional STWs in the territory.

The construction period is tentatively between 2010 and 2012. Given that the construction and operation phases are implemented with proper site management and good housekeeping practices, no adverse impact is anticipated from the STF project. As the time-frames for the construction of STF and WENT Landfill Extension do not overlap and therefore no cumulative construction impact is expected.

Integrated Waste Management Facilities

The other potential concurrent project is the Integrated Waste Management Facilities (IWMF). It is however still undergoing the site selection process, and the detailed design and works programme are yet to be available. Hence, it is not considered as a concurrent project under the EIA for the WENT Landfill Extension.

Even if IWMF is located in the middle lagoon, the construction period is tentatively between 2014 and 2016. Similar to the STF, given that the construction and operation phases are implemented with proper site management and good housekeeping practices, no adverse cumulative impact is anticipated for the IWMF and therefore no cumulative construction impact is expected.

2.11 "What if IWMF not proceed"

The implementation of Integrated Waste Management Facilities (IWMF) is stipulated in the "Policy Framewrok Plan 2005-2014". Based on the latest information from EPD, the Government has identified Tsang Tsui in Tuen Mun and Shek Kwu Chau to the south of Lantau Island as potential sites for the development of the IWMF.

If the IWMF is finally placed in Shek Kwu Chau, the WENT Landfill Extension could further extend the northern boundary to cover the middle lagoon. This will result in an increase in total waste capacity.

Using the recommended option (Option 4) as basis, the overall layout of the WENT Landfill Extension is depicted on the **Figure 2.7.** This new option, namely, Option 4A (If IWMF is not in middle lagoon), will have a total waste capacity of 88Mm³. The environmental impact of this extended layout will be further discussed in the various sections of this EIA Report.