Potential Impact on Development and Construction of Landfilled Site

The Phase 1 Desk Study prepared by Fairhurst covers the main points in the Executive Summary. However, it is worthwhile identifying and expandingon what the potential effect on the development (and that will effect the cost of development) would be, based on the information presented at this early stage.

There are two principle scenarios, both leading to additional costs or 'abnormals' arising from the landfill layer (note: the thickness of the landfill layer is between 3.2m to 5.85m and is protected by a capping layer of sand and gravel of between 0.2m and 1.4m thick). The first scenario would be that the landfill layer is capable of supporting an increase in the thickness of the capping layer; the second scenario is if it is not capable of supporting an increase in the capping layer or if there would be a risk of extensive localised compression.

In summary (if capping layer can be increased in depth):

- Piled substructure required
- Potential limitations on heights of buildings
- Additional imported capping and stabilisation of capping layer
- Vented gas / chemical membrane protection under buildings
- Additional temporary construction platforms
- Excavations kept to a minimum depth
- Shallow services (with protection from imposed loads) and perhaps pumping of drainage system
- Steel / ductile iron mains potable water installation
- Shallow groundwater attenuation system
- Also note likely requirement for pumped main of foul drain to main sewer

In summary (if capping layer cannot be increased in depth):

- Piled substructure / fully suspended floor slabs required
- Potential limitations on heights of buildings
- Vented gas / chemical membrane protection under buildings (possibly more extensive)
- Excavations kept to a minimum depth
- Additional temporary construction platforms (more extensive) and excavation protection
- Shallow services (with additional support and protection) and perhaps pumping of drainage system
- Steel / ductile iron mains potable water installation (with additional support and protection)
- Shallow groundwater attenuation and treatment system
- Extensive use of geogrids and suchlike across site external areas to increase load bearing capacity and reduce effects of settlement
- Alternative of site wide, sealed services duct system
- Significant health and safety issues that will affect the construction processes
- Health and safety issues that may affect maintenance of external services

- Restrictions on future development
- Restrictions on use of land for horticulture
- Also note likely requirement for pumped main of foul drain to main sewer

Note: A further alternative may be the 'Dynamic Compaction' or 'Surcharging' of the development area. This involves compacting the landfill layer using heavy specialised machinery and importing large quantities of material to further compress the landfill, thus stabilising the development site and reducing risk of differential settlement or the formation of voids. However, there are significant time and cost issues with this process.

<u>Scenario One: Increasing Capping Layer</u>

A piled solution to the substructure will be required. The infilled ground will not provide any support so bearing capacity would be determined from strata starting at a depth of 4m to 6.2m below existing ground levels. The extent and type of piling will require to be determined by the assessment of further intrusive investigations including deep boreholes. Records of previous investigations indicate that only depths to 6.4m have been surveyed. At this depth the underlying strata is sand and gravel. There are no records of the depth of the underlying solid geology. If this is excessive, there may be limitations on the potential height of buildings achievable in the development of the site.

It is probable that additional imported capping material would be required across the development area. The report suggests that existing capping material (sand and gravel) is between 0.2 and 1.4m thick (but not present across entire area) with an additional top layer of top soil 0.15 to 0.4m thick. The previous Atkins report referenced in the Fairhurst report states an average capping thickness of only 200mm and therefore is inconsistent with the Fairhurst report. Atkins suggests that the capping layer is increased to 500mm thick. It may be that they are referring to the topsoil rather than the sand and gravel which is the more likely landfill capping material. In any case, the top soil will require to be removed from the development area (to be reused or spread over other non-developed areas) and a suitable capping material imported to increase overall thickness. This layer is likely to require consolidation treatment to increase bearing capacity for external areas or under floor slabs and would act as a crust to provide a generally stable construction platform. Main foundations would be supported on the piling constructed through this 'top crust' layer. The stabilised top layer is often additionally protected by further imported material at a depth of between 400mm to 150mm and the design of the stabilisation would normally take into consideration surface water run off requirements.

Further localised increased bearing capacity may be required during construction (crane or piling rig mats) or for specific areas within the prison such as emergency vehicle or tanker parking, storage areas and suchlike.

It is likely that a vented gas / chemical protection membrane will be required under any floor slabs. This may additionally extend to hardstanding areas dependant on the assessment of risks from the landfill.

The design of external services would aim to keep all installations within the imported / existing capping layer. Surface water and foul drains would ideally be kept to a shallow depth with main sewers and pipelines, again installed at a minimum depth with additional protection from surface loads. This may also result in certain sections of pumped mains. Design of any groundwater attenuation would ideally utilise systems close to the surface rather than attenuation tank or deep trenches. It would likely be a requirement that any run off does not affect any undeveloped areas which may give rise to migration of contaminants from the landfill.

Potable water services will require to be constructed of steel or ductile iron pipelines.

The DIA also identifies the possible requirement for a pumped foul drain to the main sewerage system.

<u>Scenario Two: Limitations on increasing capping layer</u>

Piling as above.

The drainage impact assessment report indicates that there is a risk that additional loading imposed on the landfill by any increase in the thickness of the capping layer may overload the landfill leading to compressed areas. If this is indeed the case, alternative methods of ground stabilisation may be required and there would be further impacts on protection of the buildings from potential contaminants, (potentially) significant health and safety issues to be taken into account during construction and during the life of the establishment eg any future installations of services / excavations / use of land for horticulture.

During construction excavations would require to be kept to a minimum with additional protective measures in place to provide stability and reduce exposure to potential contamination. Additional and possible extensive temporary measures may be required to allow for craneage, piling and other construction activities.

As the potential contaminants will be closer to the surface it is likely that any membrane system under buildings will require to provide a higher level of protection, particularly against chemical interaction. This may require to be extended to other external areas such as under hardstanding areas.

Likewise, there is likely to be a requirement for extensive use of geo-grids under external areas and restrictions imposed on loading.

The DIA indicates that drainage installations will require to be at shallow depths and additional support and load protection be provided. This would also apply to other services. In addition, in this scenario, the trenching for services themselves may act as a conduit for the migration of any contamination resulting in additional treatment / control of surface water. An alternative may be an extensive fully sealed services ducting system which would offer structural protection and protection from contamination. This may also provide for future provision / maintenance.

Potable water services will require to be constructed of supported and protected steel or ductile iron pipelines.

The DIA also identifies the possible requirement for a pumped foul drain to the main sewerage system.