Dated 14 March 2023

SALE OF SITE
FOR RESIDENTIAL DEVELOPMENT
LAND PARCEL AT JALAN TEMBUSU

TECHNICAL CONDITIONS OF TENDER

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TECHNICAL CONDITIONS OF TENDER

PART I

1.0 GENERAL

1.1 The Urban Redevelopment Authority ("the Authority" or "URA"), acting as agent for and on behalf of the Government of the Republic of Singapore ("the Government"), is inviting offers for lease by tender for the Land Parcel at Jalan Tembusu ("Land Parcel") for a residential development.

1.2 The lease and development of the Land Parcel is subject to these Technical Conditions of Tender and the Conditions of Tender contained in the eDeveloper's Packet. In these Technical Conditions of Tender, where the context so admits, the expression "the Authority" includes the Government.

1.3 The Successful Tenderer shall in addition to the Conditions of Tender observe and comply with these Technical Conditions of Tender. The Conditions of Tender and these Technical Conditions of Tender are to be read together with the Control Plans and the Conditions and Requirements of Relevant Competent Authorities and Public Utilities Licensees supplied in the eDeveloper's Packet.

PART II

2.0 PLANNING CONCEPT

<u>Site Context</u>

2.1 The Land Parcel is located along Jalan Tembusu within the Marine Parade Planning Area.

2.2 Located near the upcoming Tanjong Katong MRT station along the Thomson-East Coast Line, future residents would be able to tap on the convenience of Mass Rapid Transit and enjoy easy access to the city centre. The Land Parcel is also served by bus services that provide good connectivity to key commercial and recreational nodes such as Paya Lebar Central and Singapore Sports Hub.

Amenities such as eateries along Tanjong Katong Road and educational institutions such as Chung Cheng High School, Tanjong Katong Girls School, Tanjong Katong Secondary School, and Tanjong Katong Primary School are also within easy reach by foot.

PART III

3.0 SUMMARY OF PLANNING REQUIREMENTS

3.1 A summary of the planning requirements is set out in Table 1. The detailed planning requirements are set out in Part IV.

Table 1 – Summary of Planning Requirements for the Land Parcel

PARAMETERS	PROVISIONS / REQUIREMENTS
Site Area [1]	20,572.1 m^2
Land use/Zoning	Residential
Type of Proposed Housing Development	The proposed residential development shall be for: a. Condominium; or b. Flats; or c. With prior written approval from the Competent Authority, a combination of flats and strata landed houses. Serviced Apartments will not be allowed.
Permissible Gross Floor Area (GFA)	Maximum GFA : 72,003 m^2 Minimum GFA : 64,803 m^2
Building Height [2]	Maximum 70m – 75m SHD
Building Setback	A minimum 10.0m building setback, including a 2.0m wide planting strip, along the strip of land zoned 'Open Space' to the south of the sale site is required. For the rest of the site, the proposed development must comply with Development Control Guidelines. The details are set out in Part IV, Condition 4.6 and as shown in the Control Plan.

[1] Subject to final cadastral survey
[2] Building Height is based on Singapore Height Datum (SHD)

PART IV

4.0 PLANNING AND URBAN DESIGN REQUIREMENTS

4.1 General Guidelines

4.1.1 The Planning and Urban Design Requirements as set out in Part IV are to be read in conjunction with the Control Plans and the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees provided in the eDeveloper's Packet.

Development Control

4.1.2 The Successful Tenderer shall comply with the Development Control (DC) Guidelines issued or may be issued by the Competent Authority under the Planning Act 1998, unless otherwise stated in the Technical Conditions of Tender.

4.1.3 In addition, regardless of when the development application is submitted to URA, the Successful Tenderer shall comply with the revised Gross Floor Area (GFA) and strata area definitions as set out in the circular "Harmonisation of floor area definitions by URA, SLA, BCA and SCDF" issued on 1 September 2022.

4.1.4 The Successful Tenderer's Qualified Person shall submit a Development Statement of Intent (DSI) together with their development proposal submitted to the Competent Authority under the Planning Act 1998 at the formal submission stage as per prevailing guidelines and circulars issued by the Competent Authority.

Access into State Land

4.1.5 For the purpose of entering State Land to do any works for the purpose of or in relation to the proposed development as may be required under these present Technical Conditions of Tender or Conditions of Tender, the Successful Tenderer shall obtain a Temporary Occupation Licence (TOL) from the Singapore Land Authority (SLA) for use of the State Land. The TOL may be granted on such terms and conditions and subject to the payment of such charges and fees as the SLA may determine. The TOL area shall not be used for other purpose and is to be kept free of obstruction, at all times. The Successful Tenderer shall allow public agencies, including contractors, agents and employees, access and use of the said TOL area at all times if required, without any charge, payment, hindrance, obstruction or restriction whatsoever.

Deviations from Planning Requirements

4.1.6 The requirements set out in this Part relating to location, height, size, area or extent of uses, etc. are specified with a view to achieve the relevant planning objectives as outlined or indicated in the provisions in this Part. The Successful Tenderer may submit for the Authority's consideration alternative proposal(s) to any such requirements. Where the Authority is satisfied that the alternative proposal(s) will also serve to achieve the planning objective relevant to the requirement, the Successful Tenderer may be allowed to adopt such alternative proposal(s) instead, in which event the relevant provisions in this Part shall be deemed to be complied with. The Authority however has the absolute discretion to decide whether to allow any alternative proposal(s) to be adopted.

Existing Underground Structures

4.1.7 The Successful Tenderer shall be responsible, at his own cost and expense, to carry out his own site investigation to verify whether there is any substructure or other obstructions e.g. footings, piles, tree roots, etc. in the ground of the Land Parcel, and ascertain their effect on the proposed development, including the removal of such sub-structure or obstructions, if necessary. The Successful Tenderer shall be deemed to have notice of any sub-structure or other obstructions in the ground of the Land Parcel and shall not raise any objection or requisition whatsoever in respect of any such sub-structure or other obstructions.

Existing Buildings on Land Parcel and Proposed Park

4.1.8 There are existing buildings located within the Land Parcel and on the land where the Successful Tenderer is to construct the proposed Neighbourhood Park (hereinafter referred to as "the existing buildings"). The Land Parcel will be sold with the buildings in its current conditions. The Successful Tenderer is required, at his own cost and expense, to demolish these buildings (as shown on the Control Plan) as part of the proposed development works for the Land Parcel.

4.1.9 The Successful Tenderer shall ensure that the buildings and services, if any, within the vicinity of the works are not damaged or in any way affected by the demolition and construction works at all times.

4.2 Presence of Asbestos in Existing Buildings

4.2.1 The existing buildings may contain asbestos. The handling of asbestos materials within the existing buildings shall conform with the Workplace Safety and Health (WSH) (Asbestos) Regulations 2014 (see Annex E).

4.2.2 The Successful Tenderer shall, at its own cost and expense, engage an asbestos surveyor to ascertain the presence of asbestos within the existing buildings and provide the site survey information with photos, including taking of asbestos samples for testing where required, submission of the reports to

the relevant Authorities e.g. Ministry of Manpower (MOM) and any other relevant agencies that the Contractor and the appointed asbestos surveyor have to liaise with, in relation to asbestos removal works prior to building demolition works.

4.2.3 In the event that asbestos containing materials (ACMs) are detected on site, the Successful Tenderer shall engage an Approved Asbestos Removal Contractor (hereafter known as AARCs) to remove the material at his own cost, including the proper disposal of ACMs to National Environment Agency (NEA)'s approved dumping grounds off site.

4.2.4 The Successful Tenderer shall also refer to the NEA website on "Guidelines on The Disposal of Asbestos Waste" and strictly conform to the guidelines listed for removal and disposal of asbestos materials.

4.3 Land Use and Quantum

4.3.1 The Land Parcel is to be developed for a Residential Development. The maximum permissible Gross Floor Area (GFA) for the proposed development is 72,003 m^2 and the total GFA to be built is not to be less than 64,803 m^2.

4.3.2 All tenderers are advised to carry out their own simulation studies to ascertain the achievable GFA for the proposed development, particularly if any additional bonus GFA allowable under the prevailing Development Control Guidelines can be included in the proposed development. Such simulation studies should take into account all relevant considerations including the technical height constraint, existing ground conditions of the Land Parcel as well as the possible need to provide basements.

4.4 Building Form and Massing

4.4.1 The building form and massing of the proposed development shall be designed to respond and relate sensitively to the surrounding context.

4.4.2 Consideration is to be given to the building form as viewed from Tanjong Katong Road, which is a corridor with rich identity and heritage, and the existing heritage terrace houses along the eastern boundary of the Land Parcel.

4.4.3 The overall form is to be well-articulated to maintain visual porosity. Hence, the proposed development shall not create a wall-like effect when viewed from all elevations. The Successful Tenderer is to refer to URA's circular "Sensitive Design and Development: An Industry Guide of Good Practices to Minimise Wall-Like Developments" dated 4 Mar 2010 for more information.

Site Porosity and No-build Zone

4.4.4 A minimum 20m-wide no-build zone shall be provided through the proposed development aligned with the centre-line of Jalan Beringin. This is to ensure that the proposed development remains visually porous when viewed from Jalan Beringin, which is lined with heritage terrace houses. The 20m-wide no-build zone will provide enough flexibility for towers to be provided on both sides of the view corridor within the proposed development, while ensuring sufficient visual porosity through the site.

4.4.5 The no-build zone will also function as a wind corridor for predominant northeast monsoon winds to flow between the adjacent low-rise Joo Chiat Road and Mountbatten Road areas. Landscape decks, if proposed, can be located within the no-build zone. No other building structures shall be within the no-build zone except small scale structures forming part of the landscaping, such as single-storey clubhouse, pavilions, seating, water features and playgrounds.

4.5 Building Height

4.5.1 The proposed development is subject to a maximum allowable technical height control of 70m - 75m SHD.

4.5.2 All construction equipment and temporary structures, such as cranes, piling rigs, etc., as well as permanent structures, such as water tanks, mechanical and electrical (M&E) equipment, lift motor rooms, TV antennae, etc., shall not exceed the maximum allowable height control of 70m – 75m SHD, and are to comply with the requirements of the relevant Competent Authorities. The Successful Tenderer shall obtain written approval from Civil Aviation Authority Singapore (CAAS) prior to mobilising and/or installing any construction equipment. In addition, the Successful Tenderer shall seek clearance from Republic of Singapore Airforce (RSAF) for the use of construction equipment and temporary structures above 52m SHD.

4.6 Building Setback

4.6.1 The Successful Tenderer shall provide a minimum 10m building setback from the strip of land zoned ‘Open Space’ along the southern boundary of the sale site, as shown on the Control Plan. For the rest of the site, the Successful Tenderer shall adhere to the prevailing DC guidelines for building setbacks.

4.6.2 The setback areas on all sides of the proposed development are to be designed to respond sensitively to the adjacent context.

4.6.3 No external-facing retaining walls are allowed within the building setback area along all frontages of the proposed development.

4.6.4 Submerged basement structures with protrusions are subject to prevailing Development Control guidelines.

Treatment of Building Setback Area along Southern Boundary

4.6.5 Along the southern boundary of the site, the minimum 10m building setback shall be designed to contribute to the sense of openness and greenery along the pedestrian thoroughfare connecting Jalan Tembusu to the Neighbourhood Park and Tanjong Katong Road. To provide a sense of openness along this thoroughfare, no structures, landscape decks and berms are allowed within the 10m building setback area along the southern boundary. The levels of the building setback area shall match the levels of the pedestrian throughfare as far as possible. Any footpaths proposed within the building setback area are allowed to be only 300mm above the adjacent levels of the public thoroughfare.

4.6.6 If Landscape Decks are provided for the proposed development, at least 50% of the landscape deck wall fronting the 'Open Space' thoroughfare along the southern boundary is to be well-screened with vertical greenery. If any external facing retaining walls are proposed after the building setback line fronting the 'Open Space' thoroughfare, they shall also be well-screened with at least 50% vertical greenery.

4.6.7 The building setback area along the 'Open Space' thoroughfare along the southern boundary is to include a 2.0m wide planting strip, which shall be lushly landscaped to provide screening for any exposed landscape deck wall or openings within the proposed development, if provided.

Treatment of Building Setback Area along Western Boundary

4.6.8 Along the western boundary of the site, the levels of the proposed development interfacing with the Neighbourhood Park and future Nursing Home shall be designed to match the levels of the adjacent developments seamlessly as far as possible, or be mitigated with landscaped berms. This is to create a pleasant frontage along the Neighbourhood Park and future Nursing Home.

Treatment of Building Setback Area along Eastern and Northern Boundary

4.6.9 Along the eastern and northern boundary of the site fronting Jalan Tembusu, 50% of each façade of the exposed landscaped deck wall / retaining wall area shall be covered by earth-berms / earthfills, with gradient of the earth berms / earthfills less than or equal to 1:2.5 and lushly landscaped. Substitution of the earth-berms / earthfills with vertical greening is not allowed. The remaining 50% of each façade of the basement wall area shall be treated with vertical greenery, as far as possible, to ensure that the openings are sufficiently screened and untreated hard wall surfaces are minimised. This is to ensure that the frontage along the heritage terrace houses is treated sensitively with landscape and provides a pleasant pedestrian experience.

4.7 Building Platform Level

4.7.1 The minimum platform level for the proposed development shall comply with the requirements of the relevant Competent Authority.

4.8 Boundary Fence

4.8.1 To create a pleasant streetscape along Jalan Tembusu, the proposed Neighbourhood Park, and the proposed footpath along the southern boundary that connects Tanjong Katong Road and Jalan Tembusu, the boundary fence of the proposed development on the Land Parcel is to be visually porous so that the lush landscaping within the green buffer is visible from the surrounding areas at street level. The design of the boundary fence is to be well integrated with the landscape design.

4.9 Vehicular and Servicing Access

Vehicular Access

4.9.1 Vehicular access to the Land Parcel shall be taken from Jalan Tembusu along the northern boundary of the parcel, as shown indicatively on the Control Plan.

4.9.2 The Successful Tenderer shall ensure that access to service areas (e.g. bin centre, electrical substation(s), loading / unloading areas, passenger drop-off / pick-up points) is taken from within the Land Parcel. Vehicular access to service areas taken directly from the public roads will not be allowed.

4.9.3 All vehicular lay-bys, ingress/egress and taxi stand and pick-up/dropoff (PUDO) points, external ramps to service areas, car parks and all associated structures to the car parking facilities, are to be located within the site boundary and be well-integrated with the overall architectural treatment and building form of the proposed development and visually well-screened, subject to the approval of LTA, the Authority and the relevant Competent Authorities at the formal submission stage.

4.9.4 The detailed proposal for the exact location, number and detailed proposal for the access point(s) and the traffic layout arrangement are subject to the requirements and approval of the Authority, LTA and the relevant Competent Authorities at the formal submission stage and as set out in Section 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

Service Areas

4.9.5 Sufficient service areas, including bin centre, loading / unloading areas, etc., are to be provided within the proposed development to meet the needs of the proposed uses.

4.9.6 Service areas shall not front Jalan Tembusu along the eastern boundary, the southern boundary along the ‘Open Space’ thoroughfare and the

Neighbourhood Park directly and shall be sensitively located within the Land Parcel such that it does not become a nuisance to residents in the surrounding developments.

4.9.7 Service areas / structures, such as air-conditioning ledges, etc., if provided, are to be located internally within the proposed development, and shall not front Jalan Tembusu along the eastern boundary and the Neighbourhood Park directly. They are to be well-screened and integrated with the overall design of the building elevations.

4.9.8 All ventilation shafts to the basement levels of the proposed development are to be fully integrated within the overall envelope of the individual buildings and visually well-screened.

4.9.9 All loading / unloading areas are to be designed as sheltered and enclosed to minimize noise generated from the loading and unloading activities and to ensure that there is no conflict between collection of refuse and loading & unloading activities. Loading bay barriers are to be located within the proposed development to prevent traffic queuing from spilling onto the main roads.

4.9.10 The Successful Tenderer is encouraged to provide spaces for food delivery riders using motorcycles or active mobility devices (e.g. bicycles, power-assisted bicycles).

4.9.11 All service areas will be subject to the requirements and approval of the Authority and the relevant Competent Authorities at the formal submission stage.

<u>Construction access</u>

4.9.12 Access to the Land Parcel for construction shall be taken from Jalan Tembusu. The construction access is to be sited away from Tanjong Katong Rd and Haig Rd junctions as well as the access to the future Nursing Home to ensure that vehicles can manoeuvre to enter/leave the site. The Successful Tenderer is to refer to Clause 7.2.26 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees for details of the Construction Access location(s).

<u>Location of Bin Centre</u>

4.9.13 The bin centre shall not front Jalan Tembusu along the eastern boundary, the southern boundary along the ‘Open Space’ thoroughfare and the Neighbourhood Park directly and shall be sensitively located within the Land Parcel such that it does not become a nuisance to residents in the surrounding developments. The entrance of the bin centre, including any parking area for the refuse trucks shall face inwards within the proposed development.

4.9.14 The service driveway for the bin centre is to be integrated within the Land Parcel and the length of the service driveway must be able to accommodate all service vehicles.

4.9.15 Lush planting and/or screening shall be provided to screen the bin centre and service areas from view of the residents in the adjacent developments and users of the surrounding public roads and walkways.

4.10 Car, Motorcycle and Bicycle Parking Provision

4.10.1 The Successful Tenderer shall comply with LTA's requirements for car, motorcycle and bicycle parking provisions as set out in Section 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees, and will be subject to the evaluation and approval of the Authority and other relevant Competent Authorities.

4.10.2 In line with Singapore's move towards a car-lite society, the Successful Tenderer shall apply to LTA to provide car parking provision at the lower bound of LTA's Range-based Parking Provision Standards (RPPS).

4.10.3 At-grade and / or above-grade carpark structures are not allowed along Jalan Tembusu, the eastern boundary of the Land Parcel and the Neighbourhood Park.

4.10.4 Any at-grade and / or above-grade carpark structures are to be designed to be well-integrated with the overall building design and fitted out with screening trellis and panels to provide additional layer of visual screening. The prevailing guidelines on carpark screening would apply for this site and can be found in the circular URA/PB/2022/01-CUDG dated 1st March 2022.

4.10.5 The motorcycle parking lots and associated parking facilities shall be located within the proposed car parking areas of the proposed development.

<u>Electric Vehicles (EV) charging infrastructure provision</u>

4.10.6 To future-proof new development sites in Singapore, the Successful Tenderer shall ensure active and passive provision of EV charging points for the proposed development as set out in Section 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

4.11 Pedestrian Side Gate

4.11.1 The Successful Tenderer shall consider the provision of a pedestrian side gate(s) for the proposed development to connect to the future bus stop as shown on the Control Plan.

PART V

5.0 OTHER REQUIRED WORKS

5.1 Neighbourhood Park

5.1.1 The Successful Tenderer shall at his own cost and expense, design and construct the proposed Neighbourhood Park abutting the western boundary of the Land Parcel, at the location shown indicatively on the Control Plans. The Successful Tenderer shall refer to the Park Design Brief in Annex F prepared by NParks and comply with the requirements as set out in Section 8 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

5.1.2 There is an existing open space car park located within the proposed Neighbourhood Park that will be left in "as-is, where-is" condition. The Successful Tenderer is required, at his own cost and expenses, to demolish the open space car park and remove any abandoned service and/or divert any existing services as part of the development works for the Neighbourhood Park, except for the existing car park access which shall be retained as the maintenance access for the park. The Successful Tenderer shall ensure that the trees, buildings and services, if any, within the vicinity of the works are not damaged or in any way affected by the demolition works at all times. The trees (T268, T269, T270, T271, T273, T274, T275, T276, T373) as shown in the Control Plan are to be conserved and to be integrated with the Park. Please note that the said trees must not be cut or damaged unless the Commissioner's express approval is granted under section 14 of the Parks and Trees Act.

5.1.3 The Successful Tenderer is to work closely with the National Parks Board (NParks) and URA during the early design stage of the park. The proposed layout, design, and facilities within the park is to take into consideration the existing vegetation as well as the heritage, natural environment, and demographic profile of Tanjong Katong estate, and shall be subject to detailed evaluation and approval by NParks, URA, and other relevant agencies.

5.1.4 The park is envisioned as a senior friendly park that offers various recreational experiences catering to users of different age groups, such as a therapeutic garden, nature playgarden, lawn/activity area, seating plaza, and a 3G fitness corner.

5.1.5 The proposed park is located in a low-lying area. The levels of the park shall be topped up to slope upwards gently from Tanjong Katong Road to the west and the Reserve Site to the south, in order to integrate seamlessly with the Nursing Home to the north as well as the proposed residential development to the east. The Successful Tenderer shall consult PUB on the detailed platform levels scheme of the park before making submissions to the relevant authorities at the Development Control/ Building Plan stages of the proposed development. The Successful Tenderer shall coordinate with the Nursing Home on the relevant works to integrate the levels between the park and

nursing home seamlessly and avoid the need for duplicative retaining walls at the boundary. The design of the park shall cater to the less ambulant, referring to BCA's Barrier-Free Access Code and Universal Design Guidelines.

5.1.6 The design of the park shall include a minimum 3.5m wide footpath, complete with lightings and fittings, to connect the footpath abutting the southern boundary of the Land Parcel to the existing footpath and bus stop along Tanjong Katong Road. The finishes and footpath alignment are subject to detailed evaluation and evaluation by the Competent Authorities.

5.1.7 The Successful Tenderer is required to obtain a Temporary Occupation Licence ("TOL") from SLA in accordance with Condition 4.1.3 to carry out the proposed works related to the said Neighbourhood Park.

5.1.8 The Successful Tenderer is required to hand over the completed Neighbourhood Park to NParks before the issuance of the Temporary Occupation Permit for the residential development. The Successful Tenderer may wish to commence early consultations with NParks on its requirements for the handover of the park before obtaining the Temporary Occupation Permit. As a guide, successful handover of a completed park to NParks will generally take about 6 months from the date of official completion of the park (as certified by the Qualified Person in charge of the development).

5.1.9 The Successful Tenderer shall maintain the completed Neighbourhood Park as part of the development at his own cost and expense, and to the satisfaction of NParks and other relevant Competent Authorities until such time when it is handed over to NParks.

5.1.10 To avoid doubt, as the developer of the Land Parcel (including the Park), the Successful Tenderer shall be fully responsible for the rectification and resolution of any defects in relation to the park for the time period stated in the relevant construction contract(s), as entered into between the Successful Tenderer and its contractor(s) for the proposed development of the Land Parcel (including the park).

5.2 Construction of Dedicated Cycling Path abutting Northern Boundary of Land Parcel

5.2.1 The Successful Tenderer shall at his own cost and expenses, widen the existing 1.8m-wide footpath along the northern boundary of the Land Parcel to 3.5m, consisting of a 2m-wide dedicated cycling path and 1.5m-wide footpath along Jalan Tembusu; as shown indicatively in the Control Plan and as set out in Section 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

5.2.2 The Successful Tenderer is required to obtain a TOL from the SLA in accordance with Condition 4.1.3 for the area required for construction of the proposed cycling and foot path.

5.2.3 The proposed cycling path shall be completed before the issuance of Temporary Occupation Permit for the proposed development.

5.3 Construction of Pedestrian Thoroughfare abutting Southern Boundary of Land Parcel

5.3.1 The Successful Tenderer shall, at his own cost and expense, construct a 4m permanent pedestrian thoroughfare comprising a 2m-wide footpath-cum-covered drain with 1m-wide green verge on both sides, with lightings along the southern boundary of the proposed development as shown on the Control Plan. NParks' recommended planting palette for the pedestrian thoroughfare (shrub species) and planting strip within the sale site abutting the pedestrian thoroughfare (tree species) is provided in Annex D of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees. The pedestrian thoroughfare shall be kept at the existing levels to allow the new drain beneath the thoroughfare to drain westwards from Jalan Tembusu to Tanjong Katong Road as shown in Annex A1 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees. The details of the design and alignment of the thoroughfare are subject to the approval of the relevant Competent Authorities at the detailed design stage.

5.3.2 The thoroughfare shall connect to the existing footpath along the south of Jalan Binjai, which shall be widened to at least 2m clear width by filling up the 6 rectangular turfed areas to concrete to match the existing footpath. The existing zebra crossing near the junction of Jalan Tembusu and Jalan Beringin shall be relocated to the location before the junction of Jalan Tembusu and Jalan Binjai to complete the pedestrian connectivity from the southern boundary of the proposed development to Haig Road.

5.3.3 The Successful Tenderer is required to obtain a TOL from the SLA in accordance with Condition 4.1.3 for the area required for construction of the proposed pedestrian thoroughfare.

5.3.4 The proposed pedestrian thoroughfare shall be completed before the issuance of Temporary Occupation Permit for the proposed development.

5.4 Reconstruction of Open Drain and Roadside Table along Jalan Tembusu abutting Eastern Boundary of Land Parcel

5.4.1 There is a 0.3m-wide open drain and existing access to 29 Jalan Tembusu that are partially encroaching into the eastern portion of the Land parcel. The Successful Tenderer shall, at his own cost and expense, seal off the unused

access and reconstruct the drain and the adjoining road sidetable along the eastern boundary of the proposed development (as shown in the Control Plan). The typology of the reconstructed roadside table shall match the northern section of the sidetable which is to be retained, i.e. ~1.2m-wide footpath-cum-covered drain abutting the proposed development boundary/road reserve line with planting verge next to the road carriageway.

5.4.2 The Successful Tenderer shall refer to the Control Plans and Clauses 3.2.4 and 7.2.5 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees for the detailed requirements of the reconstruction.

PART VI

6.0 OTHER REQUIREMENTS

6.1 Site Works

6.1.1 Clearance from SLA, LTA, NParks and the relevant Competent Authorities shall be obtained prior to commencement of any construction works affecting State land. All State land affected by the construction works associated with the proposed developments on the Land Parcel shall be reinstated to the requirements and satisfaction of SLA, LTA, NParks and the relevant Competent Authorities upon completion of the works.

6.1.2 The portions of the road sidetables and carriageways affected by the construction works shall be upgraded to the requirements of LTA and the relevant Competent Authorities based upon the relevant road category and maintained until such time when they are taken over by the LTA.

6.1.3 All construction works are to be hoarded up and visually screened at all times. Any inconvenience and disturbance to the residents in the surrounding developments shall be minimised and pedestrian access along all existing sidetables outside the site boundary shall be maintained at all times.

6.2 Public Communications Plan

<u>Proposed Development</u>

6.2.1 The Successful Tenderer shall carry out a public communications plan as part of the efforts to keep the local community informed of the proposed development plans for the Land Parcel.

6.2.2 The local community is defined as the following that fall within a 100m (approximate) radius of the Land Parcel:

a) All residents of HDB flats, private condominiums/ flats and landed houses;
b) Management Corporation Strata Title (MCST) Committee of private residential developments and Neighbourhood Committees; and
c) Administration of schools and other institutions.

In addition, it shall include the local Member of Parliament (MP), Constituency Director of the Constituency, and General Manager of Town Council.

Stage 1: Prior to submission of application for Written Permission

6.2.3 Prior to the erection of any hoarding or commencement of any clearance and/ or tree-felling on the Land Parcel, the Successful Tenderer shall distribute flyers to the local community containing the following information and ensure they are accurately presented:

a) Project information (e.g. type of development, number of units/beds, storey height, vehicular access);
b) Location map showing hoarding, construction access etc.;
c) Infrastructure and improvement works to be carried out, such as any road improvement works or removal of existing facilities;
d) Design and provisions for the neighbourhood park and related works;
e) Key milestones in the construction programme (e.g. site clearance, hoarding works, commencement and duration of piling works, commencement of the park construction, expected date of issuance of Temporary Occupation Permit (TOP));
f) Details of proposed measures to mitigate the impact of proposed development to the surrounding environment and users including plans to manage construction vehicles and vehicular routing;
g) Contact details of the Successful Tenderer for the community to highlight issues such as noise and dust arising from the construction activities, and to provide feedback on the proposal; and
h) The hotline numbers of the relevant departments in the Building and Construction Authority ("BCA"), the Ministry of Manpower ("MOM") and the National Environment Agency ("NEA").

6.2.4 Prior to the distribution of the flyer, the Successful Tenderer shall ensure that information as outlined in Condition 6.2.3 above is included in the flyer and inform the Authority on the distribution date by completing and submitting a copy of Form A (as shown in Annex A) and the flyer.

6.2.5 After the distribution of the flyers, the Successful Tenderer shall submit to the Authority a duly completed Form B (as shown in Annex B) verifying that the requirements set out in Condition 6.2.3 above have been complied with. Upon confirming that the declaration provided by the Successful Tenderer is in order, the Authority will give written consent for the Successful Tenderer to proceed with the submission of an application to the Competent Authority under the Planning Act 1998 for Written Permission ("development application") for the proposed development on the Land Parcel. The Successful Tenderer shall not submit any development application for the proposed development on the Land Parcel without the prior written consent of the Authority as mentioned above.

6.2.6 Upon receiving the Authority's written consent, the Successful Tenderer may proceed with the erection of hoarding, on which the contact details of the Successful Tenderer and the hotline numbers of the relevant departments in BCA, MOM and NEA shall be prominently displayed.

Stage 2: Prior to resubmission of application for Written Permission

6.2.7 After the grant of Provisional Permission by the Competent Authority under the Planning Act 1998, the Successful Tenderer shall distribute additional flyers to the local community containing detailed information on the proposed development. The flyers shall be translated in all four official languages of Singapore. The information to be provided shall include those stated in Condition 6.2.3 as well as (but not limited to) the following:

a) Schematic site layout showing the location of building blocks and facilities such as the bin centre, electrical substation. BBQ pits etc.; and
b) Indicative timeframe for the community to respond to the proposal, which shall be at least 2 weeks from the date the flyers are distributed.

The Successful Tenderer shall submit a copy of the flyer for the Authority's approval before the distribution to the local community.

6.2.8 At least 2 weeks after the date of distribution of flyers, the Successful Tenderer shall submit to the Authority a duly completed Form C (as shown in Annex C) verifying that the requirements set out in Condition 6.2.7 have been complied with and detailing the preliminary feedback received from the local community for the Competent Authority's information, if any. Upon confirming that the declaration provided by the Successful Tenderer is in order, the Authority will give written consent for the Successful Tenderer to proceed with the resubmission of the application for Written Permission, which shall be made no earlier than 3 weeks from the date the flyers are distributed. The Successful Tenderer shall not resubmit any application without the prior written consent of the Authority as mentioned above.

6.2.9 The Successful Tenderer shall submit a duly completed Form D (as shown in Annex D), which is a final collation of the feedback received on the proposed development, if any, as part of the resubmission application. The Successful Tenderer shall explain how the development proposal seeks to sensitively address the concerns raised by the local community, if any.

6.2.10 The Successful Tenderer shall not commence structural works until the Authority has given written consent for the Successful Tenderer to proceed to apply to BCA for the permit to commence structural works or has granted Written Permission under the Planning Act 1998.

Closure of Existing Car Park

6.2.11 The Successful Tenderer is required to carry out a public communications plan to inform the surrounding building owners/occupiers and existing car park users on the closure of the existing car park abutting the western boundary of the Land Parcel. The location of the existing carpark is as shown in the planimetric survey plan.

6.2.12 The Successful Tenderer shall distribute flyers to the surrounding building owners/occupiers at least 6 weeks before the closure of the car parks. In addition, the Successful Tenderer shall place a copy of the flyer on the windscreens of the cars parked at the existing car park on the 3 Fridays and 3 Saturdays during lunch and evening peak hours before the car park closure.

6.2.13 The Successful Tenderer shall submit to the Authority a copy of the flyer, the proposed dates of distribution and the details of the surrounding building owners/occupiers which will receive the flyer, for the Authority's prior approval. The flyer shall include but not limited to the following:

a) Date of car park closure;
b) Location plan showing the Land Parcel and surrounding alternative car parks; and
c) URA general email address at www.ura.gov.sg/contactus

6.2.14 The Successful Tenderer shall submit to the Authority after the distribution of flyers a written declaration that the requirement under Condition 6.2.12 have been complied with. Upon confirming that the declaration provided by the Successful Tenderer is in order, the Authority will then proceed with the car park closure on the proposed date as stated in the flyers.

6.3 Productivity

6.3.1 The Successful Tenderer is required to adopt the minimum level of use of Prefabricated Prefinished Volumetric Construction (PPVC), Prefabricated Mechanical Electrical & Plumbing (Prefab MEP) Systems and System Formwork as stipulated under the Building Control (Buildability and Productivity) Regulations 2011 for the development on the Land Parcel as set out in Clause 10.3 of the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees.

6.3.2 For the purpose of adopting the PPVC method of construction, the Successful Tenderer is required to set aside some space within the Land Parcel for storage and/ or holding area for PPVC modules. No additional space outside the Land Parcel will be granted on TOL basis for this purpose.

Annex A

URBAN REDEVELOPMENT AUTHORITY

FORM A

PUBLIC COMMUNICATIONS PLAN

Details of Developer Company Name: Address: Tel no: Email:	**To:** Group Director Land Sales & Administration Urban Redevelopment Authority 45 Maxwell Road The URA Centre Singapore 069118	**INSTRUCTION:** This form is to be duly completed and submitted to the Authority prior to distribution of the Stage 1 flyer.

Parcel Reference Number:_____

Proposed Development:
_____

Lot/Parcel Reference: _____ TS/MK: _____

	Key milestones **(Refer to Condition 6.2 of the Technical Conditions of Tender)**	**Proposed date of commencement***
1.	Send Stage 1 flyer to local (MP)	(dd/mm/yy)
2.	Distribution of Stage 1 flyer containing brief project information and contact details of parties specified	
3.	Submission of Form B	
4.	First submission of development proposal	
5.	Erection of hoarding and site clearance	
6.	Obtain grant of Provisional Permission	
7.	Send Stage 2 flyer to local (MP)	
8.	Distribution of flyers containing detailed project information	
9.	Submission of Form C	
10.	Submission of Form D	
11.	Construction schedule a) Piling b) Sub-structure c) Superstructure d) M&E works e) Finishes	
Name, Designation & Signature of Developer's representative		

* *The Authority shall be kept informed of any changes to the public communications plan.*

The Successful Tenderer shall ensure the minimum periods stated below are adhered to:

NO	KEY MILESTONES	MINIMUM PERIOD
1	a) Item 1 (Send Stage 1 flyer to local MP) and Item 2 (Distribution of Stage 1 flyer); and b) Item 7 (Send Stage 2 flyer to local MP) and Item 8 (Distribution of Stage 2 flyer)	1 week
2	Item 2 (Distribution of Stage 1 flyer) and Item 3 (Submission of Form B)	1 week
3	Item 4 (First submission of development proposal) and Item 8 (Distribution of Stage 2 flyer)	6 weeks
4	Item 8 (Distribution of Stage 2 flyer) and Item 9 (Submission of Form C)	2 weeks
5	Item 8 (Distribution of 2nd flyer) and Item 10 (Submission of Form D)	3 weeks
6	Item 10 (Submission of Form D) and Item 11(a) (Commencement of piling)	4 weeks

Annex B

URBAN REDEVELOPMENT AUTHORITY

FORM B

DECLARATION BY THE DEVELOPER (PRIOR TO APPLICATION FOR WRITTEN PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Authority prior to submission of an application to the Competent Authority under the Planning Act 1998 for Written Permission.

If the written consent of the Authority is not submitted together with the development application to the Competent Authority, the development application will be returned.

Details of Developer	**To:**
Company Name:	Group Director Land Sales & Administration
Address:	Urban Redevelopment Authority 45 Maxwell Road
Tel no:	The URA Centre Singapore 069118
Email:	

Parcel Reference Number: _____

Proposed Development: _____

_____

Lot/Parcel Reference: _____ TS/MK: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 6.2.3 of the Technical Conditions of Tender, flyers containing brief information on the project and the contact details of the parties specified in the said Condition have been distributed to the local community* on _____ (Date).

We have enclosed supporting documents to show that the flyers have been distributed.

Signature: Date:

* *Local community is defined and includes the parties specified in Condition 6.2.2 of the Technical Conditions of Tender.*

URBAN REDEVELOPMENT AUTHORITY

FORM C

DECLARATION BY THE DEVELOPER

(FOR RESUBMISSION OF APPLICATION SUBSEQUENT TO THE PROVISIONAL PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Authority prior to resubmission of development application and no later than 2 months after the grant of Provisional Permission. Upon confirming that the form is in order, the Authority will give written consent for you to proceed with the resubmission of the development application, which shall be made no earlier than 3 weeks from the date the flyers were distributed. If the written consent of the Authority is not submitted together with the resubmission of the development application, the development application will be returned.

Details of Developer	**To:**
Company Name:	Group Director
	Land Sales & Administration
Address:	Urban Redevelopment Authority
	45 Maxwell Road
Tel no:	The URA Centre
Email:	Singapore 069118

Parcel Reference Number:_____

Proposed Development:_____

_____

Lot/Parcel Reference: _____ TS/MK: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 6.2.7 of the Technical Conditions of Tender, flyers containing detailed information on the development project and the contact details of the parties specified in the said Condition have been distributed to the local community* on _____ (Date).

We have enclosed supporting documents to show that the flyers have been distributed.

Details of preliminary feedback received from the local community (if any):** 1) 2) 3) 4)
Signature: Date:

* *Local community is defined and includes the parties specified under Condition 6.2.2 of the Technical Conditions of Tender.*

** *This should include all feedback received up to the point of the submission of this form. If this space is insufficient, additional information should be provided on a separate page and submitted as part of Form C.*

Annex D

URBAN REDEVELOPMENT AUTHORITY

FORM D

CONSOLIDATED FEEDBACK ON PROPOSED DEVELOPMENT

(FOR RESUBMISSION OF APPLICATION SUBSEQUENT TO THE PROVISIONAL PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Competent Authority as part of the resubmission of the development application subsequent to the grant of the Provisional Permission.

Details of Developer	**To:**
Company Name:	Group Director Development Control
Address:	Urban Redevelopment Authority 45 Maxwell Road
Tel no:	The URA Centre Singapore 069118
Email:	

DC Reference:_____

Submission Number:_____

Proposed Development:_____

Lot Number: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 6.2.9 of the Technical Conditions of Tender, the table below has included all feedback that has been received from the local community, up to the date of this resubmission of the development application.

Feedback received from the local community and how the development proposal has sensitively addressed the feedback raised**:	
Feedback Received from Local Community	**Proposed Measures to Address the Feedback**
1)	1)
2)	2)
3)	3)
4)	4)
Signature:	Date:

* *Local community is defined and includes the parties specified under Condition 6.2.2 of the Technical Conditions of Tender.*

** *This must include all feedback received up to the point of this resubmission of the development application. If this space is insufficient, additional information should be provided on a separate page and submitted as part of Form D.*

Workplace Safety and Health Guidelines

Management and Removal of Asbestos

WSHCOUNCIL

Year of issue: 2014

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1. Introduction

Asbestos had been widely used in buildings, plants and ships due to its excellent fire, heat and chemical resistance properties. However, exposure to asbestos, such as through inhalation of asbestos fibres, can lead to serious diseases. In response to these health risks, the use of asbestos in buildings was banned in Singapore in 1988 by the Building Control Division (now the Building and Construction Authority [BCA]).

Many old buildings in Singapore still contain asbestos or asbestos-containing materials (ACMs). These asbestos and ACMs can be released into the air when disturbed, affecting building occupants. It is therefore important to manage asbestos in buildings and workplaces to prevent harmful exposure. Precaution and care must be taken when conducting work activities involving ACMs. These activities include building structural works (e.g., repair, dismantling, demolition, renovation, maintenance and alteration) and other related operations (e.g., handling, sawing, cutting, grinding, drilling, lagging and delagging).

This set of guidelines was developed to provide guidance on the proper management of ACMs and how to work with them safely. It is primarily aimed at contractors, occupiers and building owners, especially those in the construction sector, shipyards and petrochemical facilities.

The guidelines will first discuss some health effects of asbestos exposure and list examples of ACMs. It will then elaborate on the management of ACMs and good industry practices. This is followed by a description of the various aspects of asbestos-removal work. Salient points on air monitoring, training and medical surveillance will also be covered.

After reading this guide, contractors, occupiers and building owners should be able to:

- identify ACMs in workplaces;
- understand the health risks of work involving asbestos; and
- manage the risk of ACMs through appropriate controls.

2. Asbestos and Asbestos-containing Materials

Asbestos
Asbestos is a naturally-occurring mineral. Asbestos fibres have excellent physical and chemical properties which made them popular as construction materials and useful for fireproofing, thermal, electrical or sound insulation and heat or chemical resistance.

There are six types of asbestos fibre and they are classified into two groups: amphibole and serpentine (see Table 1). Amphibole is generally more brittle and tends to be straighter, whereas serpentine, that is, chrysotile is more flexible and less likely to be friable. Crocidolite, amosite and chrysotile are the three most common types of asbestos. Crocidolite and amosite are known to be more hazardous than chrysotile.

Types of asbestos	
Amphibole • Crocidolite (blue asbestos) • Amosite (brown asbestos) • Anthophyllite • Tremolite • Actinolite	Serpentine • Chrysotile (white asbestos)

Table 1: Types of asbestos.

Asbestos-containing Materials
ACMs are any material, substance, product or article containing asbestos. ACMs are either friable or non-friable. The degree of friability of an ACM determines its classification and the potential that it will release respirable fibres. To classify whether the ACMs are friable or non-friable, the densities of the materials need to be determined. Established methods to determine density can be found in the *British Standards BS 4624: 1981* and *BS 3536 Part 2: 1974*.

A list of materials that may contain asbestos is provided in **Annex A**.

2.1 Non-friable Asbestos Materials

Generally, non-friable ACMs are less hazardous than friable ACMs. Non-friable asbestos materials are cementitious, resinated, plastic or bituminous. In their dry form, they cannot be crumbled, pulverised or reduced to fine particles by hand, thus it is harder for them to produce the asbestos fibres that constitute a serious health risk. In these materials, asbestos fibres are generally locked or embedded in the base material matrix. Therefore under normal usage conditions or in the course of normal handling, they usually do not release enough asbestos fibres to constitute a health risk.

In a dry state, non-friable asbestos materials usually have a density greater than 1 tonne per cubic metre (1000 kg/m^3). They are hard, light grey and generally contain 10% to 15% asbestos fibres, but occasionally they can contain up to 40% asbestos fibres.

Examples of non-friable asbestos materials include:

- corrugated asbestos roof sheets;
- asbestos wall cladding;
- asbestos floor tiles;
- asbestos vinyl sheets;
- asbestos cement piping; and
- asbestos friction products.

2.2 Friable Asbestos Materials

Friable asbestos materials can be crumbled by hand, and their fibres are readily released into the air when disturbed. To completely contain airborne asbestos fibres, total enclosure for the work area and other strict control measures are necessary.

Any non-friable material in poor condition that has a high probability of being crumbled or pulverised during removal operations should be considered friable (e.g., roof sheets that are damaged or have been infested by mold or algae, and old gaskets that require scraping off during removal).

Examples of friable asbestos materials include:

- asbestos fibrous sprayed-on materials used for fire protection, anti-condensation and acoustic control purposes;
- asbestos thermal insulation on boilers and pipes;
- asbestos ceiling boards or wall panels; and
- cable penetrations.

3. Health Risks of Asbestos Exposure

Asbestos is a confirmed human carcinogen and all types of asbestos can cause cancer. Asbestos fibres can enter a body when inhaled as airborne dust or when contaminated materials are ingested. These fibres are retained in respiratory or digestive tissues, leading to diseases such as asbestosis, mesothelioma and lung cancer. These diseases often have a long latency period, and symptoms generally do not appear until 15 to 50 years after initial exposure.

Asbestosis
Asbestosis is a scarring of the lung tissue which leads to decreased lung volume and increased resistance in the airways. It is normally associated with high levels of exposure for many years. Symptoms include shortness of breath, persistent coughing, tiredness and nausea.

Mesothelioma
Mesothelioma is a cancer of the lining of the lungs (pleura) and abdominal organs (peritoneum). Persons diagnosed with this disease usually have a short survival span. It does not normally require a threshold of exposure before ill effects occur, however the risk of contracting mesothelioma generally increases with the frequency, duration and level of exposure to asbestos. Symptoms include weight loss, fever, night sweats, chest pain and breathlessness on exertion.

Lung Cancer
Lung cancer, which can be caused by a number of inhaled carcinogens, including asbestos, is a malignant tumour in the lungs' air passages. Like mesothelioma, lung cancer does not require a threshold of exposure before ill effects occur. The synergistic effect of asbestos exposure and smoking can increase the risk of lung cancer by at least 50 times. Symptoms include a chronic cough, breathlessness, chest pain, haemoptysis (coughing up blood), hoarseness of the voice and wheezing.

4. Risk Management of Asbestos-containing Materials

Proper risk management of ACMs in buildings and workplaces can protect the safety and health of both occupants and workers. Putting in place a proper asbestos management plan can help prevent exposure to airborne asbestos fibres (see Figure 1) for a flow chart for the managing of ACMs.)

Figure 1: Flow chart for managing ACMs.

4.1 Identification of Asbestos-containing Materials

The first step in managing the risk of asbestos exposure is to determine the presence and location of all ACMs at the workplace, as well as the types and conditions of these ACMs.

Asbestos may be found in numerous building materials, typically for the purposes of fire protection, heat and sound insulation, such as partition walls, refuse chutes, roofing sheets and ceiling boards (see Figure 2).

The type of ACMs which may be found in a typical building include:

- corrugated roof sheets (e.g., roofing, wall cladding);
- insulation boards or tiles (e.g., wall partitions, ceiling boards, fire protection boards);
- flooring materials (e.g., vinyl floor tiles or sheets);
- insulation materials (e.g., fire doors, rubbish chute columns, brake linings); and
- asbestos cement products (e.g., gutters, water tanks, underground pipelines).

ACMs may also be found in ships and plant facilities. They include:

- asbestos sheets, ropes and cloths (e.g., gaskets, insulation, seals, fire blankets);
- spray-on thermal insulation (e.g., fire protection in ducts and structural steelwork, ceilings);
- lagging (e.g., thermal insulation of pipes and boilers; see Figure 3);
- insulation boards or tiles (e.g., wall panels, ceiling boards, fire protection boards, refractory linings); and
- electrical circuits (e.g., panels, wiring insulation, seals, cable penetrations; see Figure 4).

An asbestos survey can be carried out by a competent person to identify all the ACMs in the workplace. (See **Annex B** on how to conduct an asbestos survey.) The competent person must exercise care and diligence in conducting the survey to ascertain the presence of asbestos or ACMs. See below for general steps on how to identify asbestos in buildings.

Figure 2: Asbestos used in building roof sheets and ceiling boards.

1. Roof sheets.
2. Celling panels.

Figure 3: Asbestos cloth wrapping with asbestos lagging of exhaust pipe.

Figure 4: Asbestos-containing cable penetrations used on ships.

Step 1: Check the age of the building.

If the building was constructed before 1991, it is likely to contain asbestos since the use of asbestos in building materials was banned in Singapore in 1988.

Step 2: Check building plans.

Some building plans may indicate the use of ACMs. However, it should not be assumed that the buildings do not contain asbestos just because the building plans do not indicate the presence of ACMs.

Details of any extension, adaptation, renovation or refurbishment to the building in the building plans must be examined.

Step 3: Conduct an asbestos survey.

There are two types of asbestos survey, Asbestos Management Survey and Building Refurbishment or Demolition Survey.

- An Asbestos Management Survey is conducted to locate, as far as reasonably practicable, any materials suspected of containing asbestos and assess their condition. It enables proper management of ACMs by preventing ACMs from being disturbed during building maintenance. Any inaccessible structure or material which may contain asbestos should be clearly indicated in the report.
- A Building Refurbishment or Demolition Survey is required if major renovation (alteration, addition or repair work) or demolition of the building needs to be carried out. This may involve destructive inspections to ensure that all areas are accessed and thoroughly checked. Condition assessment of the ACMs may be unnecessary if ACMs are soon to be removed. The report may indicate areas of damage or locations where asbestos debris may be present.

An asbestos survey must be carried out for buildings due for demolition or renovation if the building was built before 1 Jan 1991 (based on its temporary occupation permit date). A competent person must be appointed to carry out the survey to ascertain the presence of asbestos or ACMs before commencement of the work.

See **Annex A** for examples of materials that may contain asbestos.

All identified ACMs must be removed by an Approved Asbestos-Removal Contractor (AARC) before demolition work is carried out (see Chapter 6 on Removal of Asbestos-containing Materials).

Step 4: Take samples for analysis where appropriate.

Samples of materials suspected to contain asbestos should be sent to an accredited laboratory for analysis. Sample taking must be performed by a competent person and necessary precautionary measures should be taken. Samples should be analysed using the NIOSH 9002 Polarised Light Microscopy (PLM) Method of asbestos fibre identification. The analysis result should report the type of asbestos present in the sample. If any asbestos fibres are found in the sample, the material is taken to contain asbestos.

4.2 Exposure and Risk Evaluation

After ACMs in the building are identified, the risk of exposure to the ACMs is evaluated. The risk of exposure is determined by the potential of release and likelihood of disturbance of the ACMs. Factors to consider when evaluating the exposure risk are illustrated in Figure 5 and further elaborated in the paragraphs that follow.

Figure 5: Factors affecting the risk of exposure to ACMs.

Condition of Material
The condition, extent of damage or deterioration of the ACM can influence how fast and how easily it releases asbestos fibres into the immediate environment. This factor is usually associated with the quality of the installation work, the adhesion of the friable material to the underlying surface, and the integrity of the material. Water can also affect the condition of the ACM by dislodging and disturbing the asbestos in the material. Asbestos fibres can be dislodged by water and deposited elsewhere after the water has evaporated.

Exposed Surface Area
The greater the exposed surface area of the friable material, the higher the potential for fibres to be dislodged or released. The release potential and risk of exposure are further increased if the friable material is exposed.

Accessibility and Activity
If a material can be accessed or reached easily, it may be subject to increased contact and hence possible damage. The amount and/ or type of activity or work happening in the vicinity of the ACM, such as vibration and air movement, can also result in potential damage and fibre release.

Friability and Content
Different ACMs have varying degrees of friability – the more friable the material, the greater the potential for asbestos fibres to be released. In addition, a higher asbestos content in a material also increases the likelihood of fibres being released.

4.3 Control Methods

Having evaluated the risk of exposure of ACMs, appropriate control measures need to be put in place. There are four methods of control.

Removal
Removal of ACMs should be considered if ACM damage is extensive and repair is not justifiable. Major changes or remodelling made to the building may also disturb ACMs present and warrant their removal. Asbestos-removal work poses a great risk of fibre release and should only be carried out by an AARC (see Chapter 6 on Removal of Asbestos-containing Materials).

Encapsulation
Encapsulation involves treating the ACM with a sealant that either binds the asbestos fibres together or coats the ACM so that fibres are not released. Encapsulation should be limited to areas where damage due to contact will not occur, so that the ACM will retain its bonding integrity. This method is usually used as an interim measure. It is necessary to ensure that the person carrying out the encapsulation work is adequately protected from exposure to asbestos fibres.

Enclosure
For the enclosure method, a barrier such as a suspended ceiling is usually constructed between the ACM and the building's environment. As the ACMs still remain, asbestos fibres and fallout can accumulate behind the enclosure. However, the accumulated fibres can be released into the building's environment if the enclosure is damaged. It is therefore important to include provision for access to the ACMs during the design and installation of enclosures so they can be inspected regularly.

Leave-in-place
ACMs that are in a good condition should be left undisturbed as they are less likely to release asbestos fibres into the surrounding air. The risk of exposure is normally low or negligible in such instances, and remedial action and assessment can be deferred to a later time when necessary.

The conditions of existing ACMs can change with time, making it necessary to periodically inspect and monitor ACMs. An inspection regime can be established to ensure that the risk of asbestos exposure does not endanger the health of building occupants. It can also indicate the need for further corrective actions such as ACM removal.

5. Good Practices in Managing Exposure to Asbestos-containing Materials

Asbestos Register
Based on the findings of the asbestos survey, an asbestos register can be maintained to keep a record of identified ACMs or those likely to be present.

The asbestos register should indicate the location, type and condition of the ACMs. It should also include inaccessible locations where materials may contain asbestos. The asbestos register has to be maintained, kept up to date, and made available to occupants and any other persons who may be exposed to ACM. The following should be done regularly to help maintain the asbestos register.

Information and Labelling
Wherever possible, ACMs in the workplace should be labelled with warning signs to warn workers or occupants of asbestos hazards. These help prevent people from disturbing the ACMs unknowingly and exposing themselves unnecessarily.

Training and Awareness
Training can be provided for workers or occupants to heighten their awareness of hazards caused by asbestos when working with or near ACMs. Persons who conduct activities in areas with ACMs or who are likely to be exposed to the asbestos in the building must also be informed and educated about the presence of ACMs and their potential hazards.

Isolate or Restrict Access
Restrict and control access to areas where ACMs may pose a risk. Only authorised persons wearing proper personal protective equipment (PPE) should be allowed access to these areas.

Asbestos Monitoring Programme
A programme can be implemented to inspect ACMs periodically (e.g., every six or 12 months depending on the condition of the ACMs) and monitor the concentration of asbestos in the air when necessary.

Reporting Procedures
Procedures can be established for workers or occupants to report any damage or deterioration of the ACMs so that timely and appropriate corrective actions can be implemented to minimise the risk of exposure.

Some Do's and Don'ts

- In areas with damaged ACMs, do keep activities to a minimum if unable to avoid the areas completely.
- Do wear appropriate PPE when working in areas where ACMs may be disturbed.
- Don't dust, sweep, or vacuum debris that may contain asbestos.
- Don't saw, sand, scrape, or drill holes in ACMs.

6. Removal of Asbestos-containing Materials

The Workplace Safety and Health (WSH) (Asbestos) Regulations define asbestos-removal work as any work that entails the removal of asbestos or ACMs that are fixed or installed in a building, plant, ship, machine, equipment or workplace, so that the asbestos or ACMs are no longer fixed or installed in that building, plant, ship, machine, equipment or workplace.

Asbestos-removal work is a high risk activity, and should only be carried out by AARCs. It is important to properly plan, effectively communicate and adequately prepare the site before starting asbestos-removal work.

Asbestos-removal work includes total or partial removal of any type of ACM. Examples of asbestos-removal work include:

- removing asbestos corrugated roof sheets or ceiling boards from buildings or factories;
- removing asbestos insulation or laggings from pipelines or boilers;
- removing asbestos gaskets from piping, flanges, boilers or heat exchangers;
- removing part of damaged asbestos roof sheets, ceiling boards or pipe insulations;
- cutting an opening in asbestos roof sheets or ceiling boards for installation of exhaust fans or pipelines; and
- cleaning up asbestos debris, including decontamination of the worksite or workplace.

6.1 Roles and Responsibilities

The occupier of a workplace should ensure that asbestos-removal work is carried out by an AARC.

An AARC should:

- Submit a notification of asbestos-removal work at least seven calendar days before commencement of the work;
- Appoint a competent person to supervise the asbestos-removal work;
- Ensure that the work is carried out under the immediate supervision of the competent person;
- Ensure that the asbestos-removal plan of work prepared by the competent person is implemented; and
- Ensure that asbestos-removal work is carried out in accordance with the requirements in the WSH (Asbestos) Regulations.

The competent person for asbestos-removal work should:

- Prepare an asbestos-removal plan of work and ensure that it is adequate, suitable and effective;
- Advise on all methods and measures related to asbestos-removal work;
- Ensure that the asbestos-removal work is carried out in accordance with the asbestos-removal plan of work;

- Coordinate or manage asbestos-removal work activities;
- Supervise the entire asbestos-removal work; and
- Ensure that only trained persons carry out asbestos-removal work.

6.2 Notification of Asbestos-removal Work

Under the WSH (Asbestos) Regulations, AARCs carrying out asbestos-removal work must notify the Commissioner for Workplace Safety and Health (WSH) at least seven calendar days prior to the commencement of work. This notification should be submitted through the e-service portal available on MOM's website.

AARCs have to update any change to the notification submitted. A copy of the notification should also be made available at the workplace and must be produced upon request by MOM inspectors.

6.3 WSH Risk Assessment

A proper and thorough WSH risk assessment (RA) must be conducted prior to the start of asbestos-removal work. The RA should identify all potential hazards, establish all the risks associated with asbestos-removal work (e.g., working at height, working in confined spaces), and propose measures to prevent or minimise these risks. Available asbestos registers and survey reports should be referred to when conducting the RA.

For more information about WSH risk assessment, see *Approved Code of Practice for WSH Risk Management*.

6.3.1 Other Hazards Associated with Asbestos-removal Work

Working at Heights

Contractors should avoid working on top of asbestos roofs or ceiling boards. As much as possible, asbestos-removal should be carried out from underneath the roof using suitable work platforms such as mobile elevated work platforms and scaffold platforms. Work platforms must be of safe design, sound material, good construction and adequate strength.

If working on a roof cannot be avoided, safety harnesses, lifelines and anchorage points have to be adequately provided to ensure that the work can be carried out safely. A proper fall prevention plan has to be developed and implemented for working at heights.

For more information on working at height, refer to the following:

- *WSH (Work at Heights) Regulations;*
- *Code of Practice for Working Safely at Heights;*
- *WSH guidelines: Working safely on roofs;*
- *WSH guidelines: Anchorage, lifelines and temporary edge protection*; and
- *Technical advisory for scaffolds*.

Working in Confined Spaces

For asbestos-removal work carried out in confined spaces, entry permits must be obtained prior to entry into the confined space(s). All requirements for work in confined spaces apply.

For more information on work in confined space, refer to the following:

- *WSH (Confined Spaces) Regulations;*
- *SS 568:2011 Code of Practice for confined spaces; and*
- *Technical advisory on working safely in confined spaces.*

Working in a Hot Environment

Outdoor asbestos work causes heat exhaustion due to the hot and humid environment, heavy physical work and non-breathable protective clothing. Heat-related hazards also result from working in enclosures and confined spaces.

However, heat-related disorders can be prevented by:

- ensuring workers are acclimatised;
- ensuring that workers drink plenty of water;
- ventilating the work area; and
- implementing a work-rest schedule.

Removal of asbestos from hot pipelines or machinery should be scheduled to take place during shutdowns, thus allowing sufficient time for the pipelines or machinery to cool. If this cannot be avoided, the plan of work has to take into consideration additional heat stress hazards arising from the pipelines or machinery. Appropriate PPE and control measures have to be put in place to ensure that the work can be carried out safely.

For more information on working in hot environment, refer to *WSH guidelines: Managing heat stress at the workplace*.

6.4 Plan of Work

Before undertaking any asbestos-removal work, it is important to develop a proper plan of work. A written plan of work will guide and establish details on how asbestos-removal work is to be carried out. The plan will vary according to the nature of the task, and the type, location, quantity and condition of the ACM to be removed. Other work activities in the vicinity should also be considered when developing the plan.

The plan of work must be readily available on site. A copy should be made available upon request by MOM inspectors and to others who may be affected by the work. Any change to the plan of work should be documented and updated.

The plan of work shall include, but should not be limited to, the following:

a) Scope of work:
   - nature of work;
   - estimated duration of work;

- date of work commencement;
- type(s) of asbestos fibres involved;
- type of ACM(s) involved (attach photos if possible);
- quantity of ACM(s) involved (estimated amount); and
- the condition of the ACM(s).

b) Location and address of asbestos-removal work.

c) Particulars of person(s) involved in the work:
- stakeholders involved in the project (e.g., developer, main contractor, sub-contractors, consultants, AARCs);
- competent person(s):
  - who advises on the establishment of the plan of work; and
  - who supervises the asbestos-removal work.
- workers:
  - total number of workers involved in the project;
  - workers register;
  - summary reports for medical examinations;
  - fit testing records of respiratory protection devices; and
  - safety orientation course certificates of workers (in the relevant industries).

d) Method(s) of removal and measures to minimise the release or spread of asbestos:
- method statement (see Chapter 6.6 on Removal Methods);
- details of enclosures (see Chapter 6.5.3 on Enclosure):
  - size and dimensions;
  - structure and materials used for construction; and
  - calculations of air extraction flow rate requirements.
- tools and equipment (including PPE) used:
  - specifications of equipment; and
  - checking and maintenance records of equipment.

e) Decontamination facilities (see Chapter 6.5.4 on Decontamination Facilities):
- size, structure and material used (if it is to be constructed); and
- manufacturer specifications (if the facility is a purchased unit).

f) Site layout:
- demarcation of asbestos work area;
- location of air extraction units;
- location of the hygiene facility;
- location of the asbestos waste storage area;
- transit route; and
- waste route.

g) Decontamination procedures (where applicable, see Chapter 6.5.4 on Decontamination Facilities for more information) for:
- the workplace;
- tools and equipment;
- personnel; and
- soil.

h) Disposal arrangement (see Chapter 6.9 on Waste Disposal):
- procedures for waste handling;
- National Environment Agency (NEA) approved asbestos disposal contractor; and
- certificate of waste disposal receipt.

i) Monitoring of asbestos levels (where applicable; see Chapter 6.10 on Air Monitoring):
- background level (before starting work);
- workers' exposure level (during work);
- check for spread of asbestos outside work area;
- air clearance check (after completion of work); and
- monitoring or test reports (where applicable).

j) Emergency procedures (where applicable):
- breaches in integrity of enclosure during removal work;
- unplanned ACM disturbance;
- fire emergencies; and
- rescue of personnel.

k) Other hazards (where present, see Chapter 6.3 on WSH Risk Assessment).

6.5 Site Preparation

A visual inspection should be carried out to verify that the area is not contaminated before setting up the site for asbestos-removal work. If necessary, air monitoring can be conducted to establish the level of asbestos concentration in the air to determine if respiratory protection is necessary during site preparation.

Prior to covering the asbestos work area with a polyethylene sheet, the area should be pre-cleaned using a high efficiency particulate air (HEPA)-filtered vacuum cleaner or wet wiped. Dry sweeping must never be used to collect asbestos debris under any circumstances. All movable objects such as furniture should be removed from the work area to prevent them from being

contaminated with asbestos. Non-movable objects which are to remain within the work area such as circuit boxes and switch gears should be pre-cleaned thoroughly with an industrial vacuum cleaner equipped with a HEPA filter, or wet-wiped. They should then be sealed with two layers of polyethylene sheets and securely taped down to protect them from contamination. Any ventilation system serving or connected to the asbestos work area should be disabled and the ventilation ducts leading to and from the work area should be sealed for the whole duration of the asbestos-removal work.

6.5.1 Site Control and Arrangement

No person is allowed to enter the asbestos work area, except for those involved in the asbestos-removal work or authorised to enter the work area. The owner, occupants and employees in the workplace and anyone who may be affected by the asbestos-removal work should be advised to stay away from the asbestos work area during the period of work. Barriers or barricades should be erected to control the entry and exit of persons in the asbestos work area. Arrangement for alternate walking path is necessary to prevent unauthorised people or the public from going through or near the asbestos work area.

Signs should be put up at all entry and exit points of the work area to warn the occupants and public of the hazards of asbestos work (see Figure 6). The warning or hazard statements on the signs must be in languages that any person who may be exposed to the hazard can understand. The signs should also be weatherproof and secured in place until the asbestos-removal work is completed. Other signs should enforce site disciplinary rules such as mandatory PPE and no eating, drinking or smoking in the work area.

Figure 6: Example of a warning sign.

Scaffolds, lifelines and other work equipment required for asbestos-removal work have to be arranged and set up. During equipment installations, the ACMs should not be disturbed, to prevent unnecessary asbestos exposure. Workers performing the installations must wear appropriate PPE and be able to recognise work hazards such as falling through asbestos roofs or ceilings.

Arrangements should be made for other operations or work to stop during asbestos-removal work. Where possible, avoid work activity in the vicinity of the asbestos work area.

6.5.2 Tools, Materials and Equipment

The following are some tools, materials and equipment that may be required for asbestos-removal work:

- Polyethylene Sheets

  Polyethylene sheets of 0.20 mm (or 8 mils) thickness should be used to enclose and seal the asbestos work area. These sheets are impermeable and impervious and can prevent asbestos dust and waste from spreading to the surrounding environment.

- Wetting Agent

  ACMs need to be properly wetted with a suitable wetting agent to suppress asbestos fibres. Water can be used as the wetting agent for ACMs that contain hydrophilic chrysotile fibres, but is less effective for hydrophobic asbestos fibres such as amosite or crocidolite. For the latter, surfactants (e.g., detergent) will be a more effective wetting agent. Whenever possible, surfactants should be used for all types of asbestos-removal work. Surfactants used should be diluted to a specific concentration based on the manufacturer's instructions. For example, a wetting solution can be applied by an airless type portable water spray.

- Water-based Polyvinyl Acetate Adhesives

  Water-based polyvinyl acetate (PVA) adhesives may be sprayed onto exposed surfaces to bind traces of asbestos that may still be around during the clean-up of the work area. The adhesives should be dyed to indicate where (and whether) they have been applied to facilitate cross-checking at a later stage. Such adhesives can also be used during decontamination work, by spraying them onto asbestos debris to minimise the release of asbestos fibres.

- Industrial Vacuum Cleaner

  An industrial vacuum cleaner can collect asbestos dust and debris during the clean-up of the asbestos work area. The vacuum cleaner used should be of Type H or equivalent, fitted with a HEPA filter. Unless the vacuum cleaner is designed for wet application, it should not be used to vacuum wet materials as this will damage the HEPA filter. Domestic or general purpose vacuum cleaners should not be used as they do not meet the requirements needed to remove asbestos dust which is hazardous to health.

6.5.3 Enclosure

Depending on the type of ACMs to be removed, a partial or total enclosure needs to be provided.

Non-friable ACM Removal

Partial enclosures are required for non-friable ACMs removal. If the precautionary measures to suppress dust release during the removal work are found to be inadequate after assessment, total enclosures may be necessary. It is advisable to use polyethylene sheets to cover all openings to the asbestos work area as the sheets act as a barrier to prevent the spread of asbestos fibres to other areas in the workplace.

At the asbestos work area, the floor should be covered with polyethylene sheets extending up to at least 1.5m away from the work activity area. The edges of the polyethylene sheets should extend at least 30cm upwards, and should be sealed to the wall with adhesive tapes (see Figure 7). All wall openings such as windows should be covered and sealed with two layers of polyethylene sheets.

Figure 7: Flooring to be covered with polyethylene sheets at the asbestos work area.

For asbestos-removal work on roofs, a barricade at least 2m high should be erected 5m around the work area to prevent unauthorised entry (see Figure 8). If the minimal distance of 5m is not possible, the barricade should be high enough to prevent any ACMs or debris from falling out.

Figure 8: Example of how barricades for non-friable ACM removal work can be set up.

Friable ACM Removal

For removal of friable ACMs, the concentration of airborne asbestos fibres is expected to be high and total enclosure is necessary to prevent the spread of asbestos beyond the asbestos work area. Some factors to consider when designing the enclosure include location, size and shape of the work area, number of workers involved and the use of an air extraction unit to maintain sufficient negative pressure.

Enclosure Design

The enclosure should be of a suitable size based on the work requirements. (An oversized enclosure may not be practical as it increases the amount of ventilation required.) A common type of enclosure used is a self-supporting temporary unit built to accommodate the work area (see Figure 9). It consists of a frame to which polyethylene sheets are securely fixed.

Figure 9: Example of a self-supporting temporary enclosure.

The choice of materials for the construction of the enclosure is determined by a number of factors, including duration and location of the work. The sheets used must be thick enough to withstand wear and tear. In situations where fire hazards are a concern, fire-retardant polyethylene sheets must be used. Wherever possible, operating processes should not be enclosed as this may introduce additional hazards such as plant overheating, heat stress and fire hazards.

The construction of an enclosure may either make use of parts of the existing building structure or self-supporting temporary structures built around the asbestos working area. Where existing walls, ceilings and floors are used to form part of an enclosure, they should have smooth impervious surfaces that can be thoroughly cleaned after the asbestos-removal work. If any part of the surface is rough, damaged or friable, it should be lined with polyethylene sheets, after pre-cleaning has been done. Any openings (e.g., doors, vents, windows, holes) should be sealed using tape or proprietary sealing compounds and/or covered with two layers of polyethylene sheets. Care should also be taken to ensure that openings through which pipes or ducts pass are properly sealed. All the joints in the polyethylene sheeting need to be adequately sealed using adhesive tape.

The enclosure should be provided with a negative pressure unit (NPU) to prevent asbestos fibres from escaping. Airlocks should be constructed to allow a one-directional air flow between compartments (see Figure 10).

Figure 10: **Air locks between compartments allow one-directional air flow.**

Where a large plant such as a power station is to be stripped of asbestos, it is recommended that the whole area be compartmentalised into multiple smaller enclosed work areas for easier management of the asbestos-removal work. Suitable clear plastic "viewing panels" can be provided so that work activities can be supervised from outside the enclosure.

The enclosure must not obstruct any fire exits. (Where this is unavoidable, alternative arrangements should be made and clearly communicated to the occupants and workers in the premises.)

Air extraction equipment

Air extraction equipment such as an NPU is used to ensure that any asbestos released during the removal work is contained within the enclosure by maintaining the enclosure at negative pressure relative to the surrounding air (5 pascals or 0.5 mm water gauge). The integrity of the negative pressure system can be gauged from the effect of pressure on the plastic sheet. Negative pressure will pull the plastic sheet inwards. This indicates that air flow through any leaks is inwards rather than outwards, preventing asbestos fibres from spreading to the outside of the enclosure. This allows a supply of clean air to the enclosure.

The type of job, layout of the building, and enclosure size and volume need to be considered when determining ventilation requirements. The air extraction unit should be located where it can provide an effective airflow throughout the enclosure. The unit should be placed opposite of or furthest from the entrance to the enclosure so that air can be purged through the entire enclosure (see Figure 11). For large enclosures or those with complex shapes, more than one air extraction unit may be needed to achieve effective airflow.

Figure 11: **Illustration of an enclosure with an NPU.**

It is recommended that the extraction flow rates should result in eight air changes per hour in the enclosure. The air extraction unit must be fitted with a HEPA filter of at least 99.97% efficiency. The air extraction unit should be located outside the enclosure where possible.

The following formula is used to determine the capacity of the NPU required:

(Required NPU capacity (m^3/hr) = Volume of enclosure (m^3) x no. of air changes per hour)

Example: For an enclosure that is 10m x 5m x 3m; the
NPU capacity required = 10m x 5m x 3m x 8 air changes per hour
= 1200 m^3/hr

The air extraction unit must be correctly installed and checked by a competent person before use. Safe work procedures for changing of filters should be put in place where there is potential for exposure to asbestos. The air extraction unit should be examined and maintained at least once every six months to ensure that it is in good working condition and operating at its specified efficiency. The maintenance record must be kept updated and available for inspection.

- Inspection and Testing of Enclosure
  A thorough visual inspection of the enclosure is required to check for any leakage prior to the start of each shift. Smoke testing by releasing smoke from a smoke generator inside the enclosure can be done to detect leakages. All air extraction units should be switched off during the smoke testing. Leakages can be detected by observing the smoke flow patterns from outside the enclosure. Any leakage detected must be rectified before work starts.

Additional testing can be performed externally using smoke tubes with the air extraction units running. Smoke tube testing should be carried out at around particular seals and joints to ensure they are effective. Smoke should be drawn into the enclosure during smoke tube testing.

The enclosure must also be maintained in negative pressure during work. Differential pressure monitors can be used to provide a continuous indication of whether or not the enclosure is in negative pressure. A pressure difference of about 5 pascals (0.5 mm water gauge) or above should be maintained. The pressure gauge on the air extraction unit should also be checked to ensure that sufficient airflow is maintained at all times during the work.

6.5.4 Decontamination Facilities

Decontamination or hygiene facilities should be provided to enable workers to:

- change into protective clothing and wear safety equipment such as respirators before entering the asbestos work area; and
- decontaminate themselves before leaving the work area.

The decontamination facility should be positioned adjacent to the work area as shown in Figure 12. Where it is not possible to provide the facilities adjacent to the work area, an alternative known as "transit facilities" should be provided. These transit facilities allow workers to decontaminate themselves partially before moving to the main decontamination facilities for complete decontamination. The route that connects the transit facilities to the decontamination facilities should not pass through occupied areas and allow public access.

Figure 12: Illustration of a decontamination facility.

The size of the facilities is dependent on the number of workers who will be using them. These facilities should only be used by workers involved in asbestos work.

Design and Construction

Decontamination facilities consist of three separate compartments. They are clean, shower and dirty areas (see Figure 13). At minimum, each compartment should be 1m x 1m x 2m in dimension.

- Clean Area

  There should be provisions for hanging workers' clothing and safe keeping their personal belongings. Decontaminated PPE are to be stored in the clean area. Battery charging points can also be provided in this area.
- Shower Area

  Proper showers should be provided for friable asbestos-removal. The shower area should be between the clean and dirty areas.
- Dirty Area

  There should be storage and disposal bags available in the dirty area for contaminated clothing and asbestos waste respectively. The disposal bags should be labelled to indicate that they contain asbestos waste.

Figure 13: A decontamination facility consisting of three separate compartments (clean, shower and dirty areas).

Decontamination facilities should be constructed such that the facilities can be easily cleaned and no accumulation of asbestos dust in inaccessible areas is possible. Some features and considerations for the facilities include:

- impervious surfaces for all internal walls and ceilings;
- floors completely covered with impervious floor coverings;
- avoiding ledges and grooves;
- covering all corners for easy cleaning;
- providing drainage holes on the floor; and
- capping all poles or tubing used for structure construction.

Two or more overlapping polyethylene sheets between the compartments should be used to ensure that an airlock is maintained as the worker passes through the decontamination facility or unit.

An air extraction unit is needed in the dirty compartment to ensure proper airflow and supply replacement air. Waste water from the decontamination facility should pass through a high efficiency particulate filter (less than 5 microns) before the water can be discharged into the sewer mains (see Figure 14).

Figure 14: **Illustration of a decontamination facility equipped with a high efficiency particulate filter and air extraction unit.**

Cleaning and Maintenance

Decontamination facilities should be cleaned at the end of each working day. The daily cleaning regime should include the vacuuming of the entire facility followed by a thorough washing down of any exposed surfaces. The water filtration system should also be drained, and debris traps in the shower area emptied. Debris and asbestos waste collected should be put in labelled disposal bags for subsequent disposal. Maintenance workers cleaning the decontamination facilities should wear the appropriate respirator and PPE.

6.6 Removal Methods

The removal technique chosen for asbestos-removal work is usually determined by the nature of the ACMs and their location. Regardless of the technique chosen, the release of asbestos fibres during removal must always be kept to a minimum. Care must be exercised when handling ACMs to minimise breakage. Only non-powered hand tools should be used during the removal process, as the vibration from powered tools will cause more asbestos fibres to be released. Local exhaust ventilation or shadow vacuuming[1] may be used to control asbestos release.

The removal procedures for the different types of ACMs are provided in **Annex C**.

To select the appropriate asbestos-removal method, the following factors should be considered:

- the need to minimise the amount of asbestos fibres generated at the point where ACM is being stripped;
- the type of ACM present (e.g., impervious cement layer on pipe lagging resists wetting whereas lagging such as blankets is better wetted using sprays rather than injection);

[1] Shadow vacuuming applies local exhaust by placing the hose opening of a vacuum cleaner close to the task. The hose opening may be held by a second worker or directly attached to a tool.

- the presence of live electrical equipment that will prevent or restrict the use of controlled wet stripping (wet method);
- the presence of chemicals may present a direct risk to workers or prevent the use of controlled wet stripping methods; and
- the use of wetting agents can result in slips and falls. This is especially important when workers are working at heights.

6.6.1 Wet Method

The wet method refers to water or another wetting agent being used to minimise the release of asbestos. This method is suitable for ACMs that are not covered with other materials (e.g., metal cladding, coated with paint). The wetting agent is sprayed onto the ACM, and sufficient time is given to allow the agent to be absorbed into the material. Over-wetting would result in excess agent seeping out, causing a slip hazard and creating a runoff that may be difficult to handle. The wet ACMs should be removed and placed in a disposal bag, labelled and sealed.

6.6.2 Glove Bag Method

The glove bag is made of strong clear plastic material and can be used in the removal of asbestos-containing gaskets. Generally, the top of the glove bag fits around the material to be removed while the bottom keeps tools and asbestos waste (see Figure 15). The glove bag should have an entry port to allow a spray nozzle to wet the ACM before removal. The bag must not be reused. Procedures to remove the tools and asbestos waste from the glove bag after the removal work have to be established.

Figure 15: **Glove bag containing asbestos waste.**

6.6.3 Injection

Injection methods can be used when the outer surface of the ACM is sealed, covered or coated with impervious material. Where lagging is covered by a cement-like layer, holes can be drilled to allow access for injection heads. The holes should be 10 to 15 cm apart so that the wetting agent is able to reach all areas.

6.6.4 Other Methods

Asbestos can be found in vinyl floor tiles or mastic used to glue tiles to the floor. Hand tools such as scrapers should be used to remove such ACMs. Power tools or abrasive methods such as sanding must not be used during the removal process.

6.7 Personal Protective Equipment

Workers whose work involves asbestos should always put on the appropriate PPE such as disposable protective clothing and respirators.

6.7.1 Disposable Protective Clothing

Workers carrying out asbestos-removal work should use disposable protective clothing. The protective clothing should not have pockets, to prevent asbestos fibres from collecting in them. Also, it should not readily retain or allow the penetration of asbestos fibres. Clothing made of wool or other materials can attract fibrous dusts and must not be worn in the asbestos work area. A Type 5 (BS EN ISO 13982-121) disposable coverall is the appropriate clothing for asbestos work.

The disposable protective clothing must be removed upon leaving the work area (e.g., when the worker goes for meal breaks). It has to be stored in sealed labelled containers to prevent asbestos fibres from getting into the surrounding environment. The worker should refrain from blowing or shaking dust and debris off the clothing as this can dislodge the asbestos fibres. At the end of each shift, the clothing must be disposed of in sealed impermeable bags that are properly labelled.

6.7.2 Respirator

For friable ACM removal work where the exposure is likely to exceed the Permissible Exposure Level (PEL) of 0.1fibre/cc, workers should be provided with powered air-purifying respirators or other high performance equipment (self-contained breathing apparatus or airline respirators). Full-facepiece air-purifying respirators may be used if the exposure is not likely to be above the PEL. On the other hand, for non-friable ACMs removal work and low risk ancillary tasks (e.g., scaffold erection, site set-up, enclosure dismantling, waste handling outside enclosure), provisions should be made for half-facepiece air-purifying respirators equipped with HEPA filters.

Workers should be issued with personal respirators, and they have to ensure that their respirators are regularly cleaned and properly maintained. Fit tests for respirators must be conducted for all users to determine their suitability. Users should also be advised to have their faces clean-shaven to ensure a good fit.

The filter cartridges of the respirators should be replaced when damaged or clogged with dust (e.g., when breathing resistance increases). Workers are reminded to wash their faces and respirators when they leave the work area. The selection, use and maintenance of respiratory protective devices (RPDs), should be in accordance with *SS 548:2009*.

See **Annex D** for the selection and use of RPDs and filter cartridges, and fit test requirements.

6.8 Decontamination

Decontamination is an important step in minimising workers' exposure to residual asbestos fibres during asbestos-removal work processes. The asbestos work area, tools, equipment and PPE need to be decontaminated. Workers should carry out personal decontamination.

Work Area

Decontamination of the work area should be carried out after the asbestos-removal work. The wet-wiping method (e.g., using damp rags to clean the contaminated area[s]) can be used. This is followed by vacuuming to remove asbestos dust. The rags used must be disposed of properly after cleaning. Where wet-wiping is not feasible, sealing agents such as PVA may be used to bind asbestos fibres or dust. After decontamination, a visual inspection should be carried out to ensure that the area has been thoroughly cleaned.

Areas to be decontaminated should include the following, as asbestos debris or residue can be deposited in these areas:

- window sills, ledges, shelves;
- any rough or porous surface;
- support brackets, clamps and pipe hangers;
- nuts and bolts of flanges and hatches of vessels;
- backs of pipes and vessels;
- round conduits and inside cable trays, especially when they are made of metal mesh;
- holes in walls or partitions where pipes, cables or ducts pass through;
- undersides of boilers and tanks;
- folds or overlaps in the polyethylene sheets used to construct the enclosure; and
- electrical installations such as fuse and switch boxes and the inside of light-fitting enclosures.

After decontamination of the work area, an air clearance test should be carried out (see Section 6.10 Air Monitoring for details). The enclosure at the asbestos work area can be dismantled once satisfactory air sampling results are obtained. The sheeting materials used should be taken down, folded inwards, placed and sealed in appropriate disposal bags. The materials used in the construction of the enclosure may be contaminated and they may have to be disposed of as asbestos waste unless they can be effectively cleaned or sealed. All contaminated materials, including cleaning rags, plastic sheeting, timber scaffolds, and PPE must be disposed of properly as asbestos waste.

Tools and Equipment

All tools and equipment used during asbestos-removal work should be properly cleaned and decontaminated before they are removed from the asbestos work area. Otherwise, they would have to be disposed of as asbestos waste depending on the level of decontamination and ease of replacement. Tools and equipment can be cleaned by wet-wiping followed by vacuuming (where practicable) to ensure that all asbestos dust has been removed. Tools that cannot be completely decontaminated or are to be reused should be put in appropriate containers or bags, sealed and labelled.

Personnel

Workers have to carry out personal decontamination in the decontamination facilities at the asbestos work area. They must be trained in decontamination procedures, and adhere to the procedures for using the facilities to avoid contaminating the facilities and creating a health risk to themselves and others.

See **Annex E** for procedures for entering and leaving the asbestos work area.

Soil
In situations where the soil is contaminated with asbestos, for example, due to accidental breakage of ACMs or improper removal of ACMs, the contaminated area should be cordoned off and appropriate steps taken to mitigate the situation.

Decontamination can take the following steps:

- Wet the top layer of soil to minimise generating dust;
- Pick up all visible pieces of ACM debris;
- Remove contaminated topsoil to a depth that has no contamination or asbestos debris (a depth of 10cm is usually sufficient for most cases); and
- Dispose of the contaminated soil as asbestos waste.

6.9 Waste Disposal

Asbestos-containing waste, debris and contaminated clothing should be collected in sealed and impermeable bags or closed containers. The outer surface of these bags or containers should be wet-wiped or vacuumed before they are transported out of the asbestos work area. Bulky asbestos waste such as cement sheets, pipes or insulating boards should be wrapped twice in heavy duty plastic. All asbestos waste should be double-bagged, preferably using a coloured bag on the inside and a clear transparent bag outside. Asbestos waste must be sealed and affixed with labels that clearly indicate the presence of asbestos wastes.

All bags or containers used for asbestos-containing waste should be stored in a designated asbestos waste area. This area should be distinguished from other areas with warning signs. If waste bins or skips are used, wastes must be packed and sealed so that when bins and skips are emptied, there is no residual asbestos contamination.

All asbestos waste should be removed and disposed of accordingly by an approved asbestos disposal contractor regulated by NEA. An application for written permission to dispose of the asbestos waste should be made to NEA. A copy of the receipt issued by the NEA when asbestos waste is disposed off at a landfill should also be kept.

For more information on disposal of asbestos waste, visit www.nea.gov.sg

6.10 Air Monitoring

Air monitoring is conducted to ascertain:

- the airborne concentrations of asbestos fibres so that the correct choice of respirators has been made;
- that there is no measurable spread of airborne fibres to areas adjacent to the asbestos work area; and
- that the work area was adequately cleaned before it was returned to normal use.

Air monitoring is important when:

- large quantities of ACMs have been handled;
- work involves the use of abrasive power or pneumatic tools, and/ or breaking ACMs; and
- significant contamination has occurred.

Air samples collected should only be sent to accredited laboratories for analysis. See **Annex F** for information on air sampling.

6.10.1 Initial Exposure Assessment

To ascertain initial air exposure concentration, air monitoring can be done for friable asbestos before asbestos-removal work starts. The initial exposure assessment can help establish the condition of the work site and ensure that adequate preventive measures have been put in place to protect workers.

6.10.2 Exposure Assessment During Operation

For friable asbestos-removal work, contractors or employers must carry out exposure assessment for workers working in the asbestos work area unless there is:

- reliable data showing that the removal activity will not release airborne fibres in excess of the PEL; and
- historical data from prior monitoring for similar asbestos jobs conducted under similar conditions.

For non-friable asbestos-removal work conducted indoors, contractors or employers must carry out exposure assessment for workers working in the asbestos work area unless the contractor is using the control methods and removal methods recommended in the guidelines. If the contractor uses other control methods, the assessment must be carried out even when workers use supplied-air respirators.

The assessment can be terminated if the results show that the exposure is less than the PEL and there is no change in the conditions, for example, in the work method or equipment used.

6.10.3 Post-operation Assessment

Air or clearance monitoring is necessary after asbestos-removal work is completed for friable ACMs and non-friable ACMs indoors. The monitoring should only be carried out when the area has been cleaned and dried after a visual inspection of the work area.

When the results from the monitoring and visual inspection are satisfactory, the enclosure can then be removed. If any contamination is found during the dismantling of the enclosure, further cleaning must be carried out and the process of visual inspection and air monitoring repeated. For clearance monitoring, the concentration of airborne asbestos fibres in the air should not exceed 0.01 fibres/cc.

7. Training of Workers

Workers involved in asbestos work must be adequately trained not earlier than 12 months before they start any asbestos work and retrained once every 12 months after the completion of the last training.

The training programme must include instructions on the following:

- the harmful properties of asbestos and their hazardous effects on health;
- materials, substances, products and articles which contain or are likely to contain asbestos;
- work, processes or operations which may result in exposure to asbestos and preventive measures to minimise such exposure;
- safe work procedures and use of PPE;
- proper use, maintenance and limitations of respiratory protective equipment;
- asbestos decontamination procedures;
- asbestos waste handling procedures; and
- purpose and requirements of medical examinations as specified in the WSH (Medical Examinations) Regulations.

Training programmes must be reviewed periodically to take into account any significant changes in the type of work and/ or work methods used. The training record shall include information on the syllabus and content of the training programme and the start and end dates of the training programme. The training record must be updated, made readily available and kept for at least two years.

8. Medical Surveillance

Under the WSH (Medical Examinations) Regulations, workers involved in asbestos work must be sent for a pre-placement medical examination not later than three months after their employment commences, and every three years thereafter for regular medical examinations.

The medical examination includes a clinical examination and a large-size chest X-ray, and must be conducted by a designated workplace doctor, The contractor or employer is required to submit a register of all workers involved in asbestos work together with their medical summary reports to MOM. The contractor or employer is also required to update MOM if any asbestos worker has resigned or left employment.

The medical examination reports should be kept by the contractor or employer for at least five years, and should be made available upon request by MOM inspectors. It is recommended that these medical records should be retained as long as possible due to the long latency period of asbestos-related illnesses. Employees could also be given a copy of their medical report.

9. Annexes

Annex A – Materials That May Contain Asbestos

The following are materials that may contain asbestos. The list is not exhaustive.

- Bituminous adhesive or sealant
- Boiler insulation
- Brake disc pad
- Brake or clutch lining
- Caulking or putty
- Ceiling board or panel
- Cement board or panel
- Cement pipe
- Corrugated roof sheet
- Corrugated wall cladding
- Electric wiring insulation
- Electrical cloth
- Electrical panel partition
- Elevator brake shoes
- Fire blanket
- Fire curtain
- Fire door insulation
- Fire proofing cloth
- Fire proofing gloves
- Fire-rated wall
- Fire-resistant board
- Floor vinyl sheet
- Floor vinyl tile
- Gasket
- Gland packing
- Insulation block
- Joint sheet or compound
- Mastic
- Millboard
- Pipe cladding
- Pipe insulation
- Plaster (acoustical or decorative)
- Refractory lining or tile
- Roof gutter
- Roofing felt
- Rubbish or refute chute
- Sprayed insulation
- Textured paint or coating
- Thermal insulation lining
- Thermal paper product
- Ventilation panel or pigeon hole ventilation block

Annex B – How to Conduct an Asbestos Survey

Below are general guidelines on asbestos surveys.

a. Survey Planning

Information you need before conducting an asbestos survey:

- number of buildings to be surveyed;
- description and use of building(s);
- age, type and construction details of building(s);
- details on any extension or refurbishment carried out after the building(s) was completed;
- building plans, floor layout or drawings of the site (to record location of samples taken and indications of ACM presence);
- safety and health hazards on site; and
- the location of heating and ventilation ducts, plant rooms, riser shafts, lift shafts, and so on.

Figure 17: A core sampler.

A list of equipment for asbestos survey work:

Equipment for taking samples	Other ancillary/ auxiliary items	PPE
• Pliers • Screwdrivers • Hammer • Core samplers (see Figure 17) • Tapes • Penknife • Fillers • Hand-spray containing PVA or surfactant • Sampling bags	• Site plan • Step ladder • Camera • Torch • Sampling labels • Type H vacuum cleaner • Asbestos waste bags • Wet wipes • Polythene sheeting	• Disposable clothing • Disposable shoe covers • Disposable gloves • Respirators (where appropriate)

b. Bulk Sampling

Surveys should be carried out systematically to ensure that all areas are inspected and no ACMs are missed out. Each area and room should be thoroughly examined to identify the materials and locations to be selected for sampling.

Below are some good sampling practices:

- Materials should be inspected for apparent differences and variation in appearance;
- Samples of approximately 3 to 5 cm^2 surface area and covering the entire depth of the ACM should be taken;
- For homogenous materials, one or two samples will normally be sufficient. For non-homogenous materials, more samples may be required;
- Repaired or patched materials should be sampled in addition to the original material;
- Materials should be wetted with suitable wetting agent to control any release of airborne asbestos during sampling, and if necessary, shadow vacuuming[2] should be adopted;
- Sampling points, or locations where samples are taken, should be sealed with tapes or fillers to prevent the release of asbestos fibres after sampling; and
- The sampling area should be thoroughly clean, leaving no evidence of debris from the sampling operation.

c. Survey Report

The asbestos survey report should follow the format below:

- Executive summary:
  - brief description of scope and type of survey; and
  - summary of findings and conclusion.

- Introduction:
  - scope, purpose and objectives of survey;
  - type of survey (e.g., management, refurbishment or demolition survey);
  - number of buildings involved in survey; and
  - type and age of building(s).

- Site information:
  - details of surveyor (name of survey company, address, name of surveyor, contact email or number, etc.);
  - details of client (name of company, address, contact person, contact email or number, etc.);
  - name and address of premises surveyed;
  - date of survey;

[2] Shadow vacuuming applies local exhaust by placing the hose opening of a vacuum cleaner close to the task. The hose opening may be held by a second worker or directly attached to a tool.

- date of report;
- areas accessed/ included in the survey;
- inaccessible areas and the reasons why access is not permitted; and
- survey method used.

- Survey results:
  - sample number;
  - location description;
  - product type;
  - photographs of ACM;
  - quantity;
  - test result (asbestos type);
  - condition[3];
  - surface treatment[4]; and
  - building plans indicating the location of ACMs.

- Conclusions and recommendations:
  - summary of findings (list samples that contain asbestos and type of asbestos found); and
  - recommendations and actions to be taken.

- Appendix:
  - bulk analysis results of the samples tested (provided by the laboratory);
  - building plans or floor layout indicating sample locations and areas that contain ACMs; and
  - photographs of the site.

[3] not needed for Demolishment Survey.

[4] not needed for Demolishment Survey.

Examples of ACMs and their locations that could be provided in the survey report:

Sample no	Location	Product type	Quantity	Photo	Test result (asbestos type)
1.	Living room	Ceiling board	Whole ceiling		Amosite
2.	Roof	Corrugated roof sheets	Entire roof		Chrysotile
3.	Backyard roof	Corrugated roof sheets	50m^2		Chrysotile

Annex C – Removal Procedures for Asbestos-containing Materials

Removal Procedures of Non-friable ACMs

- **Manual Dismantling Method**

  If asbestos cement sheets are in a good condition and it is reasonably practicable to provide safe access, they should be taken down in their entirety without breakage. It is best to:

  – Remove them intact;
  – Use wet methods where possible;
  – Immediately vacuum all loose dust along the cut;
  – Lower the roof sheets to the ground as soon as possible or by the end of the work shift;
  – Wrap or bag the removed material before hoisting;
  – Transfer unwrapped materials to a closed receptacle to prevent dispersion of the dust when lowered; and
  – Isolate roof-level ventilation air intakes or shut down the ventilation system.

  Roof sheets should preferably be removed from underneath with mobile elevating work platforms such as scissor lifts or cherry pickers. When using this method, the sheets should not be dropped or damaged. The equipment used should be thoroughly cleaned.

- **Remote Dismantling Method**

  If the sheets are disintegrating or the risk of falls is too great, remote dismantling or demolition methods such as deliberate controlled collapse should be used. Remote demolition could expose equipment operators or waste disposal workers to asbestos fibres.

  When the remote method is used, the work area must be continually sprayed with water to suppress the release of asbestos fibres. The roof sheets should be dismantled in a controlled manner, for example, using excavators fitted with suitable demolition attachments. The area should be cleared of other materials before work commences. The work should be designed to minimise breakage of sheets. Before and while loading the broken sheets onto lorries, keep the sheets damp by spraying them with water. Lorries should be securely covered to prevent the asbestos waste from drying out and dispersing during transportation.

  In some cases, the public may be alarmed by the remote method of demolition as it can be noisy, dusty, or appear uncontrolled, and potentially spread dangerous fibres from asbestos roofing and/ or roof sheets. To alleviate these concerns, contractors can keep members of the public informed about the work and carry out background air sampling at the perimeters of the site.

- **Removal of Floor Tiles**

  To remove asbestos-containing floor tiles, such as vinyl floor tiles, individual tiles should be lifted by scraping manually at their bases. As underlying mastic adhesives may also contain asbestos, any adhering remnant of tiles should be completely removed from the floor slab by manual scraping and wetting.

  To remove asbestos floor coverings, a continuous 1 m high dust barrier sealed to the floor around the work area is required, and mechanical chipping should not be carried out unless in a negative pressure enclosure. Dry sweeping and sand flooring are not allowed.

- **Removal of Gaskets**

  When removing asbestos-containing gaskets, contractors or employers must ensure the following are carried out:

  – Enclose gaskets in glove bags before removal if they are visibly deteriorated and unlikely to be removed intact;
  – Thoroughly wet the gaskets with wetting solutions or water prior to removal;
  – Immediately place the wet gaskets in a disposal container; and
  – Scrape using wet methods to remove residue.

- **Removal of Cement Pipes**

  In most cases, asbestos-containing pipes are considered non-friable. They should not be shattered, crumbled, and/ or pulverised as they will release asbestos fibers. Asbestos-containing pipes should not be sanded, sawed, ground and/ or chipped under any circumstances, such as when using power tools.

  When removing the asbestos containing pipes, contractors or employers must ensure the following are carried out:

  – Excavate the soil to expose the pipes;
  – Use manual tools to clear away the soil surrounding the pipes;
  – Wet the material during removal using a water hose, garden sprayer, spray bottles, or any method that keeps the material wet;
  – Cut the pipe using hand-operated blade cutters or snap cutters and pull the pipe up out of the ground in easy to handle lengths (1 to 1.5 m or 3 to 5 feet); and
  – Do not use compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner.

Removal Procedures for Friable Asbestos-containing Materials

- **Removal of Lagging and Sprayed Coating**

  If the material is thick (greater than 1 cm), and covered with a coating which can be punctured by injection heads, low-pressure injection can be used.

  If the material is unsealed and relatively thin (less than 1 cm), controlled low-pressure sprays can be used to wet the materials. If there is an impermeable layer which cannot be punctured by injection heads, such as a pipe lagging with a hard cement coating, injection holes can be made by drilling.

  When pipework is redundant, wrap and cut can be applied.

- **Removal of Boards**

  For surfaces which are painted and accessible, shadow vacuuming must be applied while unscrewing the board. Controlled low-pressure sprays should be used on unpainted surfaces, followed by surface vacuuming while unscrewing the boards.

- **Soaking Method (Controlled Wetting Using Injections)**

  If the ACM is so thick that the spray method will not suppress the dust significantly, the soaking method should be used to ensure the material is completely saturated. First, the insulation is soaked in water or another wetting agent through an appropriate applicator which feeds the wetting agent to the insulation via numerous side holes or outlets. To facilitate rapid wetting of the insulation material, holes or cuts should be made in the outer covering to enable water or wetting agents to be injected. It is important to note that the ACM should be saturated with the wetting agent, not just washed out through a liquid passage.

  Where access to ACM is obstructed by coating or cladding, the coating or cladding should be removed carefully to avoid dust generation. Before removal, the surfaces should be vacuum cleaned or where practicable, sprayed with water. The quantity of water or wetting agent and soaking time will depend on the thickness of material, access and location of holes. Water or wetting agent application should be controlled to prevent slurries and/ or surface run off. The saturated ACM should be removed in sections and placed in properly labelled and sealed containers before it is disposed of as asbestos waste.

  The most useful technique for achieving good control of asbestos fibres at the point of removal is multi-point injections, using injection heads which penetrate the outer layer of ACM such as sprayed coatings or lagging. Injection heads with holes only at the tip allow thin layers (1 cm or less) of sealed sprayed coatings to be injected. Alternatively, angled injection heads which help the lateral movement of the wetting agent can be used. However, injection methods may not be appropriate for unsealed sprayed coatings where the injection heads can dislodge asbestos during application.

- **Spray Method**

  The spray method should be used on ACM which is not covered or coated by other materials such as paint and/ or cladding which requires prior removal. The water spray should be applied so that the entire surface of ACM is wet while also minimising runoff. A manually controlled low-pressure water spray could be used. The spray should be both copious and fine so that the water droplets do not generate dust on the surface of the insulation material upon impact. The ACM should be wet through the entire cross section of the ACM.

  The spray should be directed at the cutting-up operation in progress and the wet material removed. The wet ACM should be removed in sections and placed in labelled containers, then suitably sealed. All removed ACM should be properly wet and small sections which may be dislodged should be properly disposed of. Suitable respiratory protection is still necessary when using a water spray method because asbestos dust may not be fully suppressed or eliminated.

Annex D – Selection and Use of Respiratory Protective Devices

Respiratory Protective Devices must be adequate (i.e., provide the level of protection required) and suitable (i.e., matched to the user, job and working environment).

- **Selection**

  The selection of RPD for asbestos work should take into consideration:

  – Expected Level of Exposure

    The expected level of exposure should be established during risk assessment. Results from pre-job or previous air monitoring may be used as a guide in determining expected exposure levels.

  – Protection Factor

    Protective factor determines the effectiveness of the respirator in reducing the concentration of asbestos particles in breathing air.

    See *SS 548: 2009 Code of practice for selection, use and maintenance of respiratory protective devices* for more information on the protection factor of the different RPDs available.

- **Fitting**

  Users must undergo fit testing to ensure they have been outfitted with the right respirator in the right size for their job. A good facial seal is important to ensure optimal respirator performance. Fit testing should be conducted by the manufacturer or manufacturer-accredited representatives.

  A qualitative or quantitative fit test method may be employed to determine if a satisfactory fit has been achieved. A fit test shall not be conducted if there is any hair growth between the face and sealing surface of the respirator, such as a beard or moustache.

  See *SS 548: 2009 Code of practice for selection, use and maintenance of respiratory protective devices* for more information on the fit test procedures.

  A fit test must be conducted before the first use of a respirator and subsequently at least once every 12 months, or whenever there is a change in the user's facial characteristics. Records of fit testing must be kept for at least two years.

- **Maintenance and Storage**

  All respirators must be inspected for defects before each use. Fit checks must be done every time a respirator is used to ensure that the respirator is in good condition and that it is a good fit. Both a negative and positive pressure check should be performed. Respirators must be placed in a clean, sealable plastic bag when not in use.

- **Filter Cartridge**

  For asbestos-removal work, a HEPA filter should be used.

  Under the AS/NZS 1715:2009 and BS EN 143:2000 classification, the Type P3 particulate filter should be selected as it has a 99.95% efficiency.

  Under National Institute of Occupational Safety and Health (NIOSH) classification, a P100 particulate filter should be used where 99.97% filtering efficiency is expected.

Annex E – Procedures for Entering and Leaving Asbestos Work Area

i. Procedure for entering the work area with decontamination facility:

- Enter the "clean area" of the decontamination facility.

- Inspect the respirator to ensure that it is in good working condition.
- Replace filter if/ when necessary.
- For positive pressure powered respirators, ensure that a fully charged battery has been fitted.

- Remove all personal clothing.
- Put on clean protective clothing if provided[5].
- Put on the respirator and carry out a fit check.

- Pass through the "shower area" (without showering) into the "dirty area".

- Enter work area.

[5] If protective clothing was left in the "dirty area" from a previous shift, put it on there.

ii. Procedure for leaving the work area with a decontamination facility:

- Before entering the decontamination facility, while still in the work area, remove all visible dust and fibres from protective clothing, respirator and footwear using vacuum cleaning equipment fitted with a HEPA filter.
- A shoe bath can be provided where there is contamination by wet materials.

- Enter the "dirty area" of the decontamination facility.
- Remove protective clothing and place them in the storage region orplastic bags for disposal.
- Do not remove the respirator.

- Enter the "shower area".
- Shower thoroughly while wearing the respirator.
- Remove the respirator and continue showering.

- Remove filter from respirator and place it into a plastic bag, then leave the bag in the "shower area" for disposal later.
- Ensure that the inside and outside of the respirator is clean.

- Enter the "clean area".
- Dry and change into personal clothing.

- Leave the respirator in the "clean area".
- Charge the battery (if necessary).

- Exit the decontamination facility.

iii. Procedure for entering a work area that uses a transit facility:

- Put on protective clothing and respirator in the "clean area" of the decontamination facility.

↓

- Pass through the "shower area" (without showering) into the "dirty area".
- Wear transit coveralls and foot covers.

↓

- Exit the "dirty area" and walk to the transit facility via designated route.

↓

- Enter the transit facility.
- Remove transit coveralls and foot covers.
- Containers or hooks can be provided in the transit facility for coveralls and foot covers.

↓

- Enter work area.

iv. Procedure for leaving the work area that uses a transit facility:

- While still in the work area, remove all visible dust and fibres from protective clothing, respirator and footwear using vacuum cleaning equipment fitted with a HEPA filter before entering the transit facility.
- A shoe bath can be provided where there is contamination by wet materials.

↓

- Enter the transit facility.
- Remove protective clothing and place them in the storage region or plastic bags for disposal.
- Do not remove the respirator.

↓

- Put on transit overalls and foot covers.

↓

- Exit the transit facility and walk to the decontamination facility via designated route.

↓

- Enter the "dirty area" of the decontamination facility.
- Remove transit overalls and foot covers and place them in plastic bags for disposal.
- Do not remove the respirator.
- Follow **Annex E**: Procedure for leaving work area (main decontamination facility) from showering onwards.

Annex F – Air Sampling

Air sampling involves collecting airborne particles, including asbestos fibers and other fibres by drawing air though a filter using a sampling pump operating at a known flow rate for a measured period of time.

Static sampling is undertaken with the filter holder positioned between one to two meters above ground. The points of measurement should cover likely sources of fibres and places where many people gather.

For personal sampling, the sampling pump should be light and portable so that the worker can wear it on his/ her belt. The filter holder should be positioned within the breathing zone. If the worker is wearing a respirator, he/ she should take care to position the filter holder facing away from the filtered air exhaust outlet of the respirator.

Application	Sampling flow rates (litres/min)	Sample volume (litres)	Graticule areas examined	Limit of quantification (fibres/cm³)
Compliance sampling	1 – 4	240	100	0.04
Assessment of respiratory protection	1 – 4	240	100	0.04
Clearance sampling	2 – 16	480	200	0.01
Background	2 – 16	480	200	0.01
Leak and reassurance	2 – 16	480	200	0.01

Figure 18: **Recommended flow rates, volumes and limits of quantification.**

The sampling flow rate should be adjusted to produce a fibre density of 100 to 1300 f/mm^2 on the filter. For clearance or background leak sampling, the number of graticule areas inspected may be reduced if the collected air volume is increased. In relatively clean atmosphere where targeted fibre concentrations are much lower than 0.1fibre/cc, larger sample volumes are needed to achieve quantifiable loadings. A minimum sample volume of 1200 litres is recommended for air clearance sampling.

Details of the sampling should include the:

- date of sampling;
- type of sampling carried out (e.g., personal, leak, background);
- sampling location;
- details of the worker and type of work he/ she undertook at the time (only applicable for personal sampling);
- identification numbers of equipment used (e.g., sampling pumps, flow measurement devices, filters and sampling heads);
- individual sample details of each sample in the form of:
  - unique identifier;
  - specific sample position; and
  - start and finish time for each sample.

Analytical Methods

NIOSH 7400 Phase Contrast Microscopy Method

The air sample should be analysed using Phase Contrast Microscopy (PCM) to determine the asbestos fibre concentration in the air. However, PCM does not differentiate between asbestos and other types of fibres. All fibres are counted and assumed to be asbestos. Results are expressed in fibres per cubic centimeter (f/cc).

NIOSH 7402 Transmission Electron Microscopy Method

The air sample can be analysed using Transmission Electron Microscopy (TEM). TEM is able to distinguish asbestos from other fibres, expressing results as an asbestos fibre count with the type of asbestos present also reported. The air sample can be analysed using TEM if the analysis result using PCM method exceeds PEL. This method is intended to complement the results obtained by PCM.

10. Further Information

Workplace Safety and Health (WSH) Act

WSH (Asbestos) Regulations

WSH (General Provisions) Regulations

WSH (Risk Management) Regulations

WSH (Medical Examinations) Regulations

WSH Council Code of Practice for WSH Risk Management

WSH Council Code of Practice for Working Safely at Heights

Singapore Standard SS 548: 2009 – Code of Practice for selection, use and maintenance of respiratory protective devices

UK Health and Safety Executive (HSE). Asbestos health and safety.

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Website: www.wshc.sg
Email: contact@wshc.sg

ANNEX F

Project Brief for Park at Tanjong Katong Road

1. GENERAL PURPOSE OF THE PARK

The proposed Neighbourhood Park is envisioned as a park that creates a healing and restorative environment providing respite for all. The Successful Tenderer ("ST") is encouraged to develop a naturalistic landscape proposal for the park which may comprise multi-tiered diverse native plantings, non-manicured landscapes and ABC waters drainage features. The park design shall take into consideration the expected user demographic, which is expected to be mainly clients, caregivers and staff from the adjacent nursing home, pedestrians along Tanjong Katong Road, and multi-generational families from the surrounding neighbourhoods. The proposed layout, design and facilities within the proposed Neighbourhood Park shall interface sensitively with its surroundings.

2. SITE CONTEXT

The site for proposed Neighbourhood Park is currently partly a surface carpark and partly the Canadian International school. Abutting the said proposed park is a nursing home site to the north, future residential development to the east, and the conserved building to the south. (see figure 1)

There are 11 rain trees (*Samanea Saman)* existing on the site of the proposed park, of which 9 are to be retained (Fig 1). These trees must not be cut or damaged unless the Commissioner of Parks and Recreation's express approval is granted under section 14 of the Parks and Trees Act. Currently, the site is relatively flat.

Figure 1: Location and context of proposed Tanjong Katong Rd Park

3. CONCEPTUAL PARK DESIGN

3.1 Design Overview

The 0.52 ha proposed park (see Fig 2) will be located south of a proposed nursing home. When completed, it will serve as an extension for the nursing home and provide a semi-active rehabilitative environment, conducive for the visitors from the nursing home as well as a recreational space for the residential community in eastern side of the park. The park is envisioned as a new Neighbourhood park which is senior friendly and creates a healing and restorative environment providing respite for all. It will offer users various therapeutic and recreational experiences that provide unique intergenerational interaction opportunities.

Figure 2: Proposed connections with the surrounding developments

3.2 Proposed Site Topography

The levels of the proposed park shall be topped up to slope upwards gently from Tanjong Katong Road to the west and the Reserve Site to the south, in order to meet the boundary levels with the proposed nursing home on the north and residential development on the eastern side of the proposed park for seamless connection with the surrounding developments (See figure 3). The Successful Tenderer must consult PUB on the detailed platform levels scheme of the park before making submissions to the relevant authorities at the Development Control/ Building Plan stages of the development. The Successful Tenderer must coordinate with the Nursing Home on the relevant works to integrate the levels between both the park and nursing home seamlessly and avoid the need for duplicative retaining walls at the boundary. The design of the park shall cater to the less ambulant, referring to BCA's Barrier-Free Access Code and Universal Design Guidelines.

Figure 3: Indicative Topographic Integration with Surrounding Developments

3.3 Zoning

Spatial zoning and configuration for the proposed park shall be strategised in a way to segregate quieter and more active activities especially near the nursing home and residences. (See figure 4)

Figure 4: Conceptual Zoning Plan

The ST shall study the user groups of the proposed park, and accordingly propose to NParks the location of the facilities within the proposed park. Planted buffers shall be proposed along Tanjong Katong Road and the residences to create a restorative environment. Shade shall be provided along the paths, and seating area to create respite. (See figure 5)

Figure 5: Indicative Park thematic zoning

3.4 Facilities to Be Introduced in The Park

The ST is reminded to obtain NParks' approval at the concept design and construction stages of proposed park, including the concept design, detailed design and construction of the Nature Playgardens and the Therapeutic Gardens component of the proposed park.

3.4.1 Park Entrance and Access

ST shall propose pedestrian accesses into the park from Tanjong Katong Road, the future residential development and the pedestrian thoroughfare. ST shall also account for a direct access from the Nursing Home proposed by MOHH. All entrances and park access shall be BFA compliant. The entrances shall be welcoming with standard NParks entrance signage. Entrances should be designed to discourage entry by motorcycles, bicycles, and personal mobility devices.

The ST is required to ensure pathways are well shaded upon completion of the park.

3.4.2 Therapeutic Garden

A themed therapeutic garden not less than 1000sqm to emphasise and cater for quality respite zones that provides health-related benefits. The ST shall provide sufficient spaces and at least one shelter and toilet for therapeutic related activities to occur within the therapeutic garden. ST shall provide a unique theme by following the 'Design Guidelines for Therapeutic Gardens in Singapore.'

3.4.3 Nature Playgarden

The ST shall be required to create a Nature Playgarden which caters to children aged between two (2) to five (5) years old. The design shall utilise natural environments that offer open-ended play for children with natural elements that allow free play such as sand, logs & twigs, leaves, rocks & stones. The Playgarden shall not be less than 1000 sqm and shall be designed in a way that stimulates children to explore the natural elements and play features as well as encourage imagination and explorative play. The Playgarden will take reference from the 'Nature Playgarden Guidebook' and propose suitable elements for adoption at the proposed site. The ST shall engage a Certified Playground Safety Inspector (CPSI) at its own cost, to design and thereafter develop the Nature Playgarden, so as to ensure that it meets the relevant playground standards required by NParks.

Standard Nature Play & Playground signs must be installed to guide the user. The ST's attention is drawn to clause 3.4.

Other play areas shall be proposed to cater for children of different age groups and physical abilities. The ST must consider multi-generational use, whereby parents and grandparents can also be engaged in activities with the children. The existing terrain should be integrated with the proposed play elements or facilities.

The play area shall be located away from any of the residential boundaries in the vicinity of the Proposed Park and buffered with comprehensive planting to minimise noise disturbance to the residents.

3.4.4 Community Garden

The ST must provide, within the Proposed Park, for the potential for the staging of a community garden in the future. Such staging shall include the provision for power point, water points and related facilities required for the establishment of a Community Garden.

3.4.5 3G Fitness Area

The proposed park shall be equipped with a multi-generational fitness area for both young adults and seniors. The fitness area must be designed to make use of natural materials and elements. The fitness area shall be of a minimum area of 100sqm.

3.4.6. Lawn & Activity Area

A lawn and activity area must be designed to support group exercises or events, such as yoga, Zumba, etc, with seating areas located around the activity lawn to encourage community gatherings and bonding activities with sufficient pockets of sitting areas located around the activity lawn.

3.4.7 Water Sensitive Urban Design

The ST shall study the feasibility of incorporating a blue layer to serve water-runoff after regrading the site. Part of the water feature edges should have sufficient width to function as seats allowing users to have close interaction with the water. The use of natural materials such as rocks, is highly encouraged.

3.5 Interfacing with Thoroughfare

The ST is required to implement a pedestrian thoroughfare (see figure 6) of 1m planting strip + 2m footpath + 1m planting strip, along the southern boundary of the residential development. The pedestrian thoroughfare is to be extended through the park to provide a link to Tanjong Katong Road, with a typology of 3.5m footpath + 2m planting strip, to be aligned with the southern boundary of the proposed park.

Figure 6: Location and context of proposed Pedestrian connection

4. TECHNICAL REQUIREMENTS

4.1 Environmental Sustainability Safe Distancing Measures

The ST must consider incorporating Safe Distancing requirements in the overall design of park amenities and spaces. It shall illustrate to NParks how the park could be safely utilised in the event of extended social distancing measures considering the recent global pandemic.

Sustainable ecological design and development techniques shall be employed, including water management, eco-friendly materials, and recycling of on-site materials.

4.2 Wayfinding System and Signage

The ST shall develop and provide a comprehensive set of design recommendations and wayfinding solutions for seamless connectivity and integration between the proposed park and Nursing Home. It should include a comprehensive way-finding concept plan consisting of accessibility and circulation analysis plan, possible integration solutions, signage, typology, design, quantity and location.

The ST shall be aware and sensitive to the mental and psychological effects of colours and scale of elements in the outdoor environment that affects different groups of users. Proposals should reflect according to the zones and themes identified.

Pedestrian circulation connecting to the Nursing Home shall be studied in detail and appropriate, paths provided for a seamless connection between bus stops, Nursing Home, residences, and the proposed park. Signage typology includes but not limited to provision of signs, map boards, directional signs, etc.

The ST shall then develop the concept into technical shop drawings and graphical artworks for production purposes. All signs shall take reference from the Singapore Standards SS

599:2014 for signs, and relevant signage from the Active Mobility Act shall be included, subject always to the use of such signs being approved by NParks pursuant to clause 3.4, as well as approval from the relevant agencies having purview over such signs. The master copy of all the concept and detail designs (inclusive of editable text and graphics) shall be saved into CD and submitted to NParks upon completion of the project.

Graphical artworks include, but are not limited to:

- propose detail map graphics
- layout designs
- way finding proposal for different site typologies
- photo/image sourcing (copyright free)
- photo/image editing
- illustration works, and
- submitting colour visuals for approval

4.3 Open Lawn

Open lawn areas shall be provided by the ST and any of the open spaces within the proposed park shall not have a gradient steeper than 1:25. Appropriate measures for slope stability shall be carried out and suitable/sufficient drainage system should be implemented to channel away surface water, prevent floating and water ponding. There shall be visual screening between the lawn and the residential areas to maintain the sense of privacy for the residents. At the same, there should be adequate shade coverage for selected gathering spots. Please refer to specifications published by the Centre for Urban Greenery & Ecology (CUGE) for reference:

a) Guidelines for Tropical Turfgrass Installation and Management – CS B01: 2010

b) Specification for Soil Mixture for General Landscaping Use – CS A01: 2009

c) Specifications for Composts and Mulches – CS A02: 2009

4.4 Circulation

There shall be one main pedestrian path in the proposed park, which form the key circulation path. The main path width of at least 3.5m shall be designed to cater for maintenance vehicle access. The paving material shall be a slip resistant material for example, concrete or equivalent. The access of the existing car park (from Tanjong Katong Road) shall be retained and adapted to serve as the access for park maintenance vehicles.

All Fire Engine Access Road floor finish provided must be able to withstand a minimum of 30-tonnes firefighting appliance and vehicular load.

4.5 Fitness Equipment

The ST shall also ensure that all fitness equipment installed at the proposed park (pursuant to paragraph 3.4.5 above) shall also be accompanied by clear and relevant instruction signboards to educate users on the correct use of the said equipment. It shall also be barrier-free, accessible by the physically challenged and comply with the existing specification standards used locally. The ST must consider multi-generational use; whereby young active enthusiasts could share the same space as active elderlies.

Subsoil drainage shall be provided for the fitness area and linked to the nearest drain.

NParks' approval shall be obtained for the detailed design or construction drawings of the fitness area, prior to installation.

The ST must ensure that it obtains a five (5)-year warranty over the fitness equipment installed in the proposed park, and that such warranty shall be transferable to NParks and at no cost to NParks.

4.6 Park Furniture

Standard Park furniture including benches, railings, bollards, and signage shall be provided in the proposed park. The design of the park furniture should cater for people with physical disability and promote inclusiveness. Benches shall be well connected to footpaths.

4.7 Framework or Principles for Parks Naturalisation

The ST shall consider the following guidelines as part of the design:

• To adopt biophilic designs to integrate nature and greenery seamlessly with infrastructure.

• To incorporate natural elements and materials, where feasible.

• To achieve a hybrid ecosystem and conserve biodiversity by restoring/curating floral/fauna habitats to serve as ecological linkages for the region through curated and naturalistic landscapes.

• To achieve connectivity by overlaying the larger ecological, historical, cultural, social, and physical layers to ensure the connectivity of the park.

• To create multi-tiered planting with non-manicured landscapes.

4.8 Planting Scheme

The nine trees indicated for retention in the Control Plan should be included as part of the park landscape. The ST's attention is also drawn to section 14 of the Parks and Trees Act 2005.

The ST shall propose a planting plan that maximises the greenery within the park. It shall consist of trees and shrubs to provide shade, maximise natural surveillance throughout the park and at the same time, provide visual barriers for privacy for the long-term care residents. Pursuant to clause 3.4, the ST shall propose a planting scheme in line with City In Nature principles to restore natural habitats for NParks' approval.

4.9 Drainage

The ST shall propose drainage systems to suitably drain all areas of the park and ensure that waterlogging does not occur. The ST shall address and provide adequate surface drainage for parkland areas.

4.10 Safety railings

Safety railings of 1.0m height shall be provided where edges of the open space, park or main circulation paths border a slope that is steeper than 1:2.5. They shall be provided for open drains more than 1m deep as well, installed within the drainage reserve, and comply with the technical requirements of PUB Catchment and Waterways Department.

4.11 Security

All equipment, built structures and paths should also be hazard free and robust to deter vandalism. Adequate lightings should be installed, and the ST must ensure that these lightings meet the minimum lux standard required for the proposed park.

4.12 Universal Design & Certification

The design of the proposed park shall provide access throughout the park with graded levels and finishes suited for the physically challenged. Please refer to BCA Barrier-Free Access code and Universal Design Guidelines for further information.

The ST shall prepare and consolidate all relevant documentation, write-ups, specifications, drawings, etc, to facilitate the submission to relevant authorities to achieve targeted recognition for Green Mark for Buildings from BCA. The ST shall also facilitate submission to PUB for the ABC Waters Certification Programme and NParks' Landscape Excellence Assessment Framework Certification.

4.13 Lighting

A lighting scheme for the proposed park shall take into consideration that the main circulation path should have an average illumination of 5 lux level and a minimum of 1 lux. The fitness and play area shall have an average illumination level of 20 lux with a minimum level of 5 lux. The glare from the installed lights must not cause disturbance to the healthcare facility patients and residents around the park. The lighting throw direction of the light shall be downward facing unless it is on pole which focuses on the trees. Some feature trees or elements shall also have a unique lighting strategy to give the space a distinctive appeal.

Other than providing sufficient lighting for safety reasons, lights shall be used to create a lively ambience for the various gathering spaces and play areas. The light posts shall be able to mount additional WiFi port supplied by the healthcare facility. CCTVs with supporting infrastructures must be installed at entrances and/or key areas in the proposed park, and the ST shall ensure that the provision of the CCTV is in such a manner so that it would be transferable and at no cost to NParks,

4.14 Promoting Environmental Sustainability and Compliances

1. Tanjong Katong Rd Park must uphold values of environmental sustainability rigorously, as a clear reflection of NParks' practices and direction for all other parks under her purview.
2. Where hard surfaces are introduced, permeable materials for paving should be chosen to maximise water infiltration and retain soil moisture.
3. Compliance with the latest version of the following must be attained:
i. BCA Accessibility Code (Latest)
ii. BCA Universal Design Guide (Latest)
iii. NParks Nature Playgarden Design Guidebook
iv. Design Guidelines for Therapeutic Gardens in Singapore
v. City in Nature guidelines

4.15 Coordination & Agency Approvals

The ST is expected to liaise and coordinate with, from time to time, with other project Consultants who are working on developments and/or infrastructures in the vicinity, in order to mitigate conflict in design and construction.

The ST's attention is drawn to clause 3.4 of this Appendix C. It is reminded that it must work with NParks for the design of specialised facilities such as Therapeutic gardens & Nature Playgarden.

4.16 Operations Maintenance Manual

At the end of the project implementation, the Successful Tenderer shall prepare and submit a full set of Operations Maintenance Manual (OMM) for NParks' review. The OMM shall include the following:

- Finalised design concept for the proposed park
- Topography plans and as-built drawings
- Planting and landscape plans
- All services drawings, electrical single line drawings
- Facilities catalogues and warranty
- Any other documents or information as deemed necessary by NParks.

ADDITIONAL NOTES

- All Plans are indicative drawings and are not drawn to Scale.
- All distances and areas are only approximate measurements.
- The items reflected within this Appendix C shall not be taken as the actual presence of the same upon completion of the proposed park.