



Government of **Western Australia**
Department of **Communities**
Housing

HOUSING

PART C: DESIGN AND CONSTRUCT SPECIFICATION

LANDSCAPING

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A. GENERAL**1 PROPOSAL REQUIREMENT AND CONDITIONS****1.1 GENERAL DESCRIPTION****Proposal**

Requirement: Provide a proposal for the design and installation of landscaping and associated site works. Include in the proposal all works required to fulfil the project program and the following:

- Conditions of contract.
- Local government authority (council/shire) requirements.
- This specification.
- The Western Australia Housing Authority's *Part A: Qualitative Brief* for the development type.
- The Western Australia Housing Authority's *Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings*; and *Part C: Construction specifications – BCA Class 2 and 3 buildings* (as appropriate for the project) for hardscaping requirements.

Work components: Include all site investigation and design work, labour, material, tools, transportation, equipment, plant, excavation, site modification, shoring, testing, inspection, commissioning and all other general conditions required to satisfy the scope of works.

Overall project objective

Requirement: In the proposal and implementation of the landscaping works, make sure the following objectives are met:

- Address landscaping design considerations early in the planning and design of the proposed development works.
- Eliminate or minimise any adverse effect the development may have on the surrounding environment.
- Promote environmentally sensitive design practices.
- Minimise future maintenance and risk hazards on both private and public land.

Definitions

Softscape: The animate and horticultural landscaping elements, including plants (lawns, flowers, shrubs, trees), soils, planting beds, mulch, seeding and other more transitory elements that continue to change. Components include:

- Irrigation: Although this is generally included under hardscape, for the purposes of this specification it will be included with softscape requirements.

Hardscape: The inanimate and permanent landscaping elements, including all built elements related to external areas around the building envelope. Components include:

- Hard surfacing: Pathways, paving, decking.

- Built forms: Water features, outdoor furniture, shade structure, fencing, walls, stones, rocks, signage, lighting and subsoil drainage.

Verge: The area bounded by the back of the kerb (or edge of the road if no kerb exists) and the property boundary.

Verge treatment: Any soft or hardscaping installed within the verge area, including street trees.

2 SCOPE OF WORKS**2.1 DESCRIPTION OF WORKS****General description**

Requirement: Design and install landscaping works to improve the visual appeal of the development and provide a comfortable outdoor living environment for the residents, including the provision of softscape and hardscape elements.

Project components: The complete project comprises the following components:

- Softscaping, including screening for service.
- Hardscaping, including walling, edging, fencing, paving (driveways and paths). Install to the Western Australia Housing Authority's *Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings*; and *Part C: Construction specifications – BCA Class 2 and 3 buildings*, as appropriate for the project.
- Site modification associated with landscaping works, including clearing, tree protection and earthworks (including mounds and batters).
- Irrigation systems and water supply.
- Stormwater management measures associated with landscaping works, including subsoil drainage.
- Supporting services such as wiring, electrical supply and controls.
- Landscaping works on public and private lands included as part of the project. This includes works within the project site and that required by the conditions of contract such as street trees and verge treatments.

Responsibilities

Requirement: The contractor is responsible for all unknowns and/or varying site conditions, including utilities, subsoil conditions and regulatory authority permits.

Regulatory approvals: Obtain permits or approvals from the regulatory authority as required for the completion of the project, including for the following:

- Traffic management.
- Use of pesticides/herbicides.

Liaise with the relevant authority to determine approval conditions and requirements, and address these to obtain approval, as required.

Designing the works: Conform to DESIGN DEVELOPMENT, **DESIGN REQUIREMENTS** and undertake document submissions required to obtain authority approval(s).

Site investigation and installation of works: Perform all works required to verify existing site conditions,

including site location, boundary and dimension; utility capacities and locations; clearances/restrictions and connection options of external utilities. Carry out works, including compile maps, surveys, traffic and geotechnical data, so that the landscaping works meet the requirements of this specification, conditions of contract, local government authority requirements, other design documents and the construction program.

Maintenance: Maintain plants during the contract period so that they will establish rapidly and grow to maturity.

Site monitoring: Carry out inspections to verify the completed landscaping works are satisfactory and consistent with the design intent. Certify the completed works after final inspection.

Post installation requirements: Provide ongoing plant management strategies to maintain healthy growth and as-constructed documents to DESIGN DEVELOPMENT, **DESIGN VERIFICATION, As-constructed drawings.**

Defects: Rectify defects that fall within the defects liability period including replacement of plants.

Errors or omissions in the contract documents: The contractor is responsible for all errors and omissions discovered. Notify the principal of errors and omissions and submit resolution proposals for approval.

2.2 DESIGN REQUIREMENTS

Standards, codes and regulations

Requirement: Design the project in compliance with the applicable federal, state and local government authority's codes, rules, regulations, ordinances, and standards, including those referenced in this specification.

Design development

Requirement: Develop and document the landscaping design for review and approval from the principal before installation. Conform to **DESIGN DEVELOPMENT.**

B. DESIGN DEVELOPMENT

1 DESIGN REQUIREMENTS

1.1 DESIGN CRITERIA

Design objectives and considerations

Requirement: As appropriate for the project, design landscaping works for the proposed development to meet the following:

- Universal access: Make sure the access provisions are equitable to, across and through the site. Comply with AS 1428.1.
- User safety and security: Minimise hazard risks for drivers, pedestrians and cyclists. Consider factors such as sightlines, lighting and trip hazards.
- Fire management: Minimise bushfire hazards through implementation of controls in compliance with the local government authority's and state planning department/state fire authority's requirements.
- Crime prevention: Provide for passive surveillance, for example, through placement of features and passive control to discourage entry by non-familiar parties.
- Landscaping buffers/screening: For visual, acoustic and wind requirements.
- Provision of shading: For the residents' health and safety.
- Sedimentation and erosion control: Minimise impact on downstream properties/vegetation, for example, through minimising stormwater run-off from the site.
- Stormwater management: Provision of control measures to minimise potential flooding and ponding.
- Retention of existing vegetation: Through the design and provision of protection measures during the construction period.

Compliance

Requirement: Design the landscaping works to comply with the requirements included in the following:

- Local government authority (council/shire) documents.
- This specification.
- The Western Australia Housing Authority's *Part A: Qualitative Brief* for the development type.
- The Western Australia Housing Authority's *Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings*; and *Part C: Construction specifications – BCA Class 2 and 3 buildings* (as appropriate for the project) for hardscaping requirements.

Definition

Tree wind resistance: The ability or capacity of a tree or shrub to survive (remain standing and living) intense wind force, without easily uprooting or breaking in the wind.

Local government authority requirements

Requirement: Comply with the authority's planning codes and design guidelines/manuals, including for the following:

- Irrigation and planting requirements.
- Stormwater drainage design.
- Verge treatment design.
- Plant selection: To the preferred/recommended planting species list and non-invasive species requirements.
- Soil and mulch treatment.
- Pest management, including termites.
- Quantity/area of soft landscaping required.
- Landscaping structures/fixtures, including fencing, walling, shade structures and pergolas.
- Paths and edging materials/finishes.

Bushfire attack level (BAL)

Design level: Prepare a Bushfire Attack Level assessment report with details of the design attack level required for the project and the design and installation requirements based on this assessed BAL.

Irrigation system

Irrigation system design: Design the system and select equipment based on the following:

- Safety requirements.
- Operation reliability.
- Watering uniformity.
- Effect of wind on maintenance.
- Water supply quality.
- The Water Corporation's watering roster (days) for watering calculating. Check with the Water Corporation for applicable reticulation exemptions, such as seasonal exemptions.

Integrated Water Supply Scheme (IWSS): Design the irrigation system as follows:

- Connected to and supplied by the existing water supply from IWSS.
- Verify system flow and pressure is adequate, tested from the metered supply.

Performance and efficiency of the system: Rectify if affected by inadequate flow and pressure.

Precipitation: Allow for minimum 40 mm precipitation per week throughout all sections of the irrigation system.

Additional requirements

Sustainability: Design landscaping to minimise water use once established by selecting plant to suit local climatic conditions, with the following characteristics:

- Drought resistance.
- Salt tolerance for sites in coastal regions.
- The shade coverage required.

Maintenance: Providing the following:

- Planting and finishes designed to minimise maintenance, including for required verges and paths outside the site boundary line.

- Easy access to elements, with the working clearances to facilitate maintenance.

Stormwater drainage: Liaise with the local authority for the preferred method of drainage and other design requirements. Address the following in the design:

- Disposal of stormwater generated on-site and flow paths required to alleviate flooding.
- Stormwater generated off-site which may impact the site.
- Potential overland flows across the site.
- Incorporation of landscaping design elements used to manage water flow.

1.2 CYCLONE AFFECTED REGIONS AND FLOOD PRONE AREAS**Cyclone/flood mitigation**

Requirement: For sites located in cyclone and flood prone areas, design landscaping to minimise cyclone/flood vulnerability and damage in event of cyclone or storm surge.

Tree species selection

Requirement: Design flood and wind-tolerant landscaping which addresses the following criteria:

- Minimising wind damage to trees: Show measures included in the design to address this, taking into consideration trees and shrubs with even spaced, spreading branches, low centres of gravity and strong, deep penetrating root systems fare better in strong winds. Measures to consider include the following:
 - . Tree species: Select wind resistant species.
 - . Planted tree quality: Select high quality trees with central leaders and good structure for planting.
 - . Canopy foliage density: Select trees/shrubs with canopies of the density required to allow winds to flow freely through the branches.
 - . Trees under or near power lines: Select species with mature heights lower than heights of the power lines.
 - . Pruning requirements: Select the trees appropriate for the location to avoid poor pruning practices. Poor pruning practices make trees more susceptible to decay and fungi and consequently more susceptible to wind failure.
- Minimising flood damage to trees: As storms can bring large amounts of salt water inland and create flooding, select trees/shrubs species with the following characteristics:
 - . Able to tolerate low water periods and long periods of standing water in event of a storm.
 - . Salt tolerance.

Planting layout

Planting arrangement/location: Consider the following criteria in planning the planting layout:

- As trees planted in groups survive cyclonic winds better than individual trees, consider planting trees and shrubs grouped together in well-defined garden beds rather than spot planting.

- The spacing between trees and other building elements such as kerbs, pavement, foundations and paths to provide enough soil space to support root growth of the tree. Use the **Minimum soil requirements for trees based on tree size at maturity table** as guidance.
- Mature trees: Avoid interference with fences, buildings and power lines. Use the **Guidelines for planting trees within 12 m of wires or street lights table** as guidance.

Vegetation as cyclone protection: Show measures used to achieve this, including:

- Shelterbelts: Planting single row trees as windbreaks or shelterbelts, to reduce air filtration and wind velocity.
- Sand fencing/catchers: In areas adjacent to the coast, sand binding species can be used to trap sand and to reduce wind speed. This provides protection against floods.
- Grass drains and dust breaks.

Non-fixed items: Avoid items which may become projectiles in high winds, e.g. potted plants.

Minimum soil requirements for trees based on tree size at maturity table

Tree size at maturity	Total soil area**	Distance from paved surface*
Small: Height shorter than 9 m	3 x 3 m	0.6 m
Medium: Height or spread < 15.25 m	6 x 6 m	1.8 m
Large: Height or spread > 15.25 m	9 x 9 m	3 m

* Distance from tree trunk.
 ** Measurements for when rootable soil depth is 1 m or more. For soil less than 1 m deep, smaller maturing trees are recommended.

Guidelines for planting trees within 12 m of wires or street lights table

Distance from wires or light	Tree size at maturity
0 – 2 m	Planting is not recommended unless trees remain under 7.5 m tall
2 – 12 m	Recommended tree height: - Maximum 3 m; or - Shorter than wire/light; or - Canopy diameter less than twice the distance to wire/light
More than 12 m	Any tree can be planted

Existing trees on site

Mature existing trees: Older trees are more vulnerable to winds as they are less flexible and more susceptible to disease and insects. Consider the inherent life span of the tree and its wind resistance, and whether over-mature trees should be removed and replaced.

Drainage and soils

Flood prone area minimisation: Show design measures such as stormwater drainage, sedimentation and erosion control, maintenance of site stability (e.g. for sites with clay soils).

Soil anchorage

Subsoil drainage: Include measures required to promote anchorage, e.g. in areas where soils have poor drainage, such as areas with heavy clay soils.

Supports for young trees: Show measures required to provide solid anchorage so that root systems can establish, e.g. placing large stones or boulders around the tree and stakes driven 200 mm minimum into the ground.

Hardscape and ground cover

Paving/mulch material: Select material to suit purpose, e.g. permeable pavers for areas prone to flooding to allow water to permeate for more even distribution and help reduce run-off problems. Consider impact during storms, e.g. gravel, rocks or pea gravel allow root growth and expansion but may become windborne debris in storms. Soft mulch or shredded bark may be a safer alternative.

Tree management/maintenance plan

Requirement: Include as part of the cyclone mitigation design strategy, a tree maintenance plan with recommended mitigation measures, including the following:

- Preventative pruning requirements, e.g. foliage thinning before cyclone season and removal of dead limbs, especially those close to fencing, the building or utility lines.
- Regular tree inspection regime to determine the health of trees to reduce risk of failure.
- Irrigation/watering regime, e.g. to promote root growth.
- Drainage system maintenance regime to minimise debris in swales and systems so that water can flow freely from the site property during storm surge.

2 DESIGN DOCUMENTATION

2.1 GENERAL

Landscaping design and documentation approval process

Site evaluation/analysis: Investigate the project site elements, opportunities and constraints and review the design brief. Before proceeding with the concept/schematic design, consult with the principal to clarify and review the design and documentation requirements. Consider project specific requirements and submissions, including statutory submission requirements.

Preliminary vegetation management planning:

Prepare documents showing the locations of existing vegetation to be retained, relocated or removed and other actions considered. These documents may be included as part of the initial site evaluation stage.

Concept/schematic documents: Provide schematic design drawings and reports for design review and approval by the principal before proceeding to detailed design.

Detailed design drawings: Provide drawings which adequately describe the main design detailing intent for approval from the principal and the local government authority (development approval),

including planting (softscape), hardscape and exterior fixtures detailing.

Construction documentation: Following approval of the detailed design, provide construction documentation for approval from the principal.

2.2 PREPARATORY DESIGN REQUIREMENTS

Site evaluation

Requirement: Before starting design, assess the above-ground and below-ground site conditions.

Above-ground conditions: Consider the following environmental factors:

- Light exposure: Hours of direct sunlight in summer, seasonal changes, and reflected light from other building elements.
- Slope exposure: Direction of slope, wind and sun exposure.
- Wind: Direct wind exposure, direction of wind and evaporation rate.
- Salt: Airborne salt or ground deposits which may penetrate into the soil.
- Trees: Existing established tree location, height, age and condition.
- Overhead wires and street lighting: Location and height of existing utility and lighting installations.
- Building: Location of building elements including signs.

Below-ground conditions: Consider the following soil conditions affecting planting selection:

- Rooting space restrictions: The soil volume available for root growth.
- Soil pH: Conduct pH tests in several areas of the site, wherever soil colour or texture vary. Conform to the following for the soil condition:
 - . If the soil pH is less than 4.8: Select trees tolerant of acidic soils.
 - . If the soil pH is greater than 7.2: Select trees tolerant of alkaline soils.
- Soil/subsoil compaction and drainage: If soil/subsoil is compacted and poorly drained, select plant species with root systems which can survive in difficult soils or of appropriate size for the loose soil available.
- Soil depth and distance to the water table: Determine the water table depth during the coolest and wettest season. Select plants appropriate to the distance, e.g. if plants will be close to the water table, trees tolerant of wet sites may be required.
- Underground utilities: Determine the location of underground utility services and conform to the utility authority's requirement for planting distance restrictions.

Maintenance practices: Evaluate the maintenance requirements for the site after plant establishment, including ability to deliver irrigation, pruning, fertilising and pest control.

Site evaluation report: Include the site assessment in a report, justifying the design approach adopted.

Preliminary vegetation management plan

Requirement: Prepare a detailed survey showing all existing trees numbered. Assess the trees/vegetation to determine which are suitable for retention and mark on a plan. Other items to show on the plan include site and planning constraints, vegetation protection and weed management measures.

Tree assessment criteria: For each tree, consider the following:

- Correct botanical identification and common name.
- Vigour.
- Structure.
- Dimensions, height, crown spread and trunk diameter measured at 1.4 m above the ground.
- Age class.
- Estimated life expectancy.
- Heritage and/or cultural issues.
- Ecological and habitat issues, such as threatened species.
- The location relative to existing site features, such as its function as a screen or as a landmark feature.
- Other matters relevant to the site, such as surface roots.
- Retention value.
- Risks/hazard posed, e.g. if exposed to strong winds.

Schedules and report: Submit a schedule of the existing vegetation. If required by the principal, provide a preliminary tree assessment report.

Detailed site survey: Include the following details on a detailed topographical survey:

- Date, north point, scale bar.
- Project description and location.
- The principal's name and details.
- Street name, lot number.
- Location of existing services and easements.
- All existing site features, including streams, creeks, buildings, retaining wall, structures, adjoining buildings/outdoor living areas and below ground levels.
- Location of individual trees, group of trees and other vegetation, including trees over 3 m high.
- Crown spread.
- Existing site dimensions, 0.5 m contours, spot levels and tree heights, including levels at boundaries and the base of trees for evaluating changes in soil levels.

Schematic design

Requirement: Submit site evaluation report, landscaping layout plans and materials boards (and approximate costing implications) for approval before producing detailed design drawings. Submit five coloured sets of the following for review and approval:

- Landscaping layout plans.
- Sections.

- Perspective.
- Colour schemes and material selections.

Landscaping layout plans: Include the following details on the plans:

- Proximity to the buildings.
- Condition of trees.
- Location of services and roads.
- Level changes.
- Building operation space.
- Long term management requirements.

2.3 DETAILED DESIGN AND CONSTRUCTION DOCUMENTATION

Submissions

Requirement: Submit landscaping works plans showing the landscaping design, irrigation plan and tree protection measures, and associated specifications. If required by the local government authority, submit the plans for development approval. If appropriate for the project, submit separate external works (landscaping works construction plan) and planting plans.

General drawing requirements

Requirement: Include the following information on all drawings:

- Date, north point, scale bar.
- Project description and location.
- The principal's name and details.
- Landscape designer's details.
- Locality plan.
- Issuance details.

Detailed landscaping plan requirements

Landscape layout/planting plan: Provide drawings of minimum 1:200, when printed at A3, scale showing the following:

- Property boundary line and any easements, including proposed site area boundaries of any strata lots.
- Contextual information, including street name, lot numbers and adjacent building locations.
- Streets, roads, driveways and pavement alignments.
- Overall dimensions of the proposed building and any existing structures.
- Location of above ground and below ground infrastructure, e.g. sewers, electricity, water, telecommunications.
- Construction set-out dimensions.
- Contours and relative levels, including existing and finished surface levels.
- Gradients and direction of falls.
- Proposed and existing planting locations, trees to be relocated and planting setbacks.
- Plant quantities.
- Landscaping surface treatment: Include material and size (m²) for all treatments, including:
 - . Mulched planting beds.
 - . Turfed areas.

- . Paving or hard surface areas, including vehicular access.
- . Area included as Private Open Space.
- Irrigation details, including water take-off points, valve locations and backflow prevention devices. Hydraulic calculations for the system
 - . Hydraulic calculations for sprinkler operating pressure and pressure loss through valves, mainline piping, laterals, backflow prevention devices and elevations.
- Ditches, swales and berm locations, if applicable.
- Subgrade compaction density.
- Exterior fixtures including parking areas, paved areas, walkways, steps, ramps, kerbs and edging, retaining walls, fences/screens/gates, clothes hoist, letterboxes and other equipment.
- Sections through the site, as appropriate.
- Ramps and other provisions for disabled access to AS 1428.1 and AS 1428.2.
- Proposed/existing building(s), floor levels and position of building openings.

Staking plan: Provide plan if critical dimensions are required to successfully implement the proposed design.

Stormwater management drawings

Stormwater management plan: Provide drawings of minimum 1:200 scale showing the following:

- Existing and proposed contours, grades and site drainage method.
- Overland drainage paths and subsurface drainage details associated with the landscaping works.
- Flood mitigation measures.
- On-site sediment and erosion controls associated with the landscaping works.
- Stockpile areas for materials.
- Stormwater drainage calculations.

Plant list/schedule requirements

Requirement: Include with landscape planting plans a plant list with the following details:

- Total quantities of each plant.
- Common name and botanical name.
- Root treatment required, e.g. balled, burlapped, tree spade, bare root or potted.
- Plant material height and/or spread at planting.
- Minimum caliper.
- Maximum caliper/height.
- Special installation requirements.

Large scale detail drawings

Landscape construction details: Provide drawings to an appropriate scale (e.g. 1:20, 1:50) and cross referenced with the landscaping and/or engineering plans of landscaping elements such as kerbing, irrigation, screens, fences, walls and gutters, root barriers, staking, planting beds.

Planting bed preparation details: Include topsoil depths, mulch type and depth, and subgrade preparation.

Ongoing management strategy

Requirement: Provide a post construction maintenance strategy for the implemented landscaping works. Include in the strategy instructions for the following:

- Maintenance period for landscaping works.
- Fertiliser type used and application requirements.
- Maintenance regimes for protecting vegetation areas.
- Irrigation requirements.
- Tree management procedures, including pruning requirements.
- Weed and pest management.
- Maintenance of built form and hard surfacing.

Materials boards

Requirement: Provide samples of all the finish materials listed in the materials/colour schedule mounted on presentation boards for review and approval from the principal.

3 DESIGN VERIFICATION**3.1 SUBMISSION****Detailed design documentation review**

Requirement: Submit detailed design documentation for review and approval on 50% and 100% completion of documentation. Provide documentation as required to verify that the design complies with DESIGN DEVELOPMENT, DESIGN REQUIREMENTS, the CONSTRUCTION SPECIFICATION and other conditions of contract, including drawings and certification.

Submission format: Submit drawings and specification, including irrigation plan in pdf format and hard copies if requested.

100% complete documentation: Incorporate all agreed changes from the 50% complete review.

As-constructed drawings

Electronic copies/format: Provide at minimum files in pdf, dxf and dwg format. Additional file formats may be provided.

Hard copies: Provide drawings in the same size, format and scale to those approved for construction.

Drawing content: Show the installed softscape and hardscape components, including the installed irrigation system details and reticulation plans. Include details and position of all mainline piping and control valves.

C. CONSTRUCTION SPECIFICATION**1 ON-SITE SUPERVISION****1.1 REQUIREMENTS****Construction phase of the landscaping works**

Documentation compliance: Arrange for a suitably qualified person to monitor the landscaping works installed on site during the construction and maintenance period so that the completed works satisfy the design intent and comply with the detailed design documents.

Inspections

Authority inspection: On completion of the landscaping works, arrange for certification by the relevant authorities, including final landscaping approval by the local government authority and network services authority for hardscape, stormwater drainage, irrigation, lighting, structures and softscape.

Final inspection: After the final inspection, certify the completed works comply with DESIGN REQUIREMENTS, DESIGN CRITERIA, Compliance and other agreed requirements.

Traffic management

Requirement: Provide work zone traffic control throughout the project site for the duration of the construction/installation period (for both active and inactive work zones). Make sure there is safe and efficient movement of all traffic, whilst minimising construction impact on the public, cyclists, pedestrians and residents.

1.2 PRODUCTS AND MATERIALS**Prohibited materials**

General: Do not provide the following:

- Materials, exceeding the limits of those listed, in the Safe Work Australia *Hazardous Chemical Information System* (HCIS).
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

1.3 SUBMISSION**Products and materials**

Safety data sheets (SDS): Submit SDS for products and materials conforming to the *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS).

2 GENERAL LANDSCAPING REQUIREMENTS**2.1 CROSS REFERENCES****Site preparation**

Specification reference: Comply with the following worksections in the Western Australia Housing Authority's *Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings*; and *Part C: Construction specifications –*

BCA Class 2 and 3 buildings (as appropriate for the project):

- 0221 Site preparation: For erosion and sediment control, site clearing and tree protection requirements.
- 0222 Earthwork: For removal of topsoil, excavation fill and stone pitching requirements.
- 0223 Service trenching: For trenching requirements, including excavation and backfilling.

Hardscaping

Specification reference: Comply with the following worksections in the Western Australia Housing Authority's Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings; and Part C: Construction specifications – BCA Class 2 and 3 buildings (as appropriate for the project):

- 0241 Landscape – walling and edging: For landscape free and retaining walls, edgings and kerb installations.
- 0242 Landscape – fences and barriers: For fencing and gate installations.
- 0271 Pavement base and subbase: For base and subbase course requirements of flexible pavements including for supply, spreading, compaction and trimming.
- 0274 Concrete pavement: For concrete pavements, paths and driveway installations.
- 0276 Paving – sand bed: For proprietary paving on sand bedding installations including for vehicular pavements, paths, landscaped areas, over unbound base or subbase layers.

2.2 SITE ESTABLISHMENT

General design/installation requirements

Mowing edges: Provide as follows:

- Construction: Constructed from material that conforms to AS 1379, grade N20.
- Dimension: Minimum 150 (wide) x 90 (deep) mm.
- Expansion joints: Minimum every 6 m lengths.
- Finished appearance: Uniform in width and shape, with smooth concrete surface finish.

Planting area levels: Install planting areas to finish as follows:

- 30 mm below paths, kerbs, slabs and driveways.
- Minimum one brick course below the damp-proof course of the building.
- Flush with the finished surface of the bitumen pavement.

Landscaping finish: Generally free of undulations, irregularities and wheel ruts.

Before planting area establishment

Requirement: Make the following landscaping site preparation arrangements before establishing planting areas:

- Earthworks: If required, inspect the site to determine how much soil removal and imported soil is required.
- Pesticides and herbicides: Determine at a site meeting with the principal if use is suitable or

required, depending on site conditions. If required, use pesticide/herbicide in compliance with the Health (Pesticides) Regulations 2011 (WA), including for spraying and warning sign provisions. Before spraying, check if permits are required from the relevant authority. If required, obtain permit.

Weed eradication: Remove weeds as follows:

- Regularly remove by hand, rubbish and weed growth throughout grassed, planted and mulched areas. Continue eradication throughout the course of the works and during the planting establishment period.
- If required, spray to the manufacturer's recommendations, with a herbicide approved by the principal. Do not disturb sprayed area two weeks after application.

Existing vegetation removal: Liaise with the principal before removing.

Excess soil: Spread evenly over the site or dispose off-site.

Fill: Provide as required to establish designed levels.

Waste disposal: Remove unwanted material waste and vegetative spoil, and dispose off-site at a licensed waste facility. Do not burn.

Delivery storage and handling

Deliveries: Make arrangements for a controlled site delivery point to receive and unload materials, including planting.

On-site storage facilities: Arrange for suitable storage with the necessary irrigation requirements to maintain plant condition.

3 SOILS

3.1 STANDARDS

Soils

Site and imported topsoil: To AS 4419.

Potting mixes: To AS 3743.

Composts, soil conditioners and mulches: To AS 4454.

3.2 TOPSOIL - MATERIAL

Source

General: If the suitable topsoil cannot be provided from material recovered from the site, provide imported topsoil.

Soil composition

Fill and imported topsoil properties: Provide fill/soil free of the following:

- Clay material.
- Refuse or materials toxic to humans, animals or plants.
- Stumps, roots or stones larger than 50 mm.

Topsoil composition: Provide soil with the following properties:

- Minimum 3% (by mass) organic content.
- pH value: 5.5 to 7.5.
- Maximum 0.06% (by mass) soluble salt content.

Topsoil particle size table (% passing by mass)

Sieve aperture (mm)	Soil textures		
	Fine	Medium	Coarse
2.36	100	100	100
1.18	90 – 100	95 – 100	95 – 100
0.60	75 – 100	75 – 100	70 – 90
0.30	57 – 90	55 – 85	30 – 46
0.15	45 – 70	38 – 55	10 – 22
0.075	35 – 55	25 – 35	5 – 10
0.002		2 – 15	2 – 8

Topsoil nutrient level table

Nutrient	Unit	Sufficiency range
Nitrate-N (NO ₃)	mg/kg	> 25
Phosphate-P (PO ₄) – P tolerant	mg/kg	43 - 63
Phosphate-P (PO ₄) – P sensitive	mg/kg	< 28
Phosphate-P (PO ₄) – P very sensitive	mg/kg	< 6
Potassium (K)	mg/kg	178 - 388
Sulphate-S (SO ₄)	mg/kg	39 - 68
Calcium (Ca)	mg/kg	1200 - 2400
Magnesium (Mg)	mg/kg	134 - 289
Iron (Fe)	mg/kg	279 - 552
Manganese (Mn)	mg/kg	18 - 44
Zinc (Zn)	mg/kg	2.6 - 5.1
Copper (Cu)	mg/kg	4.5 - 6.3
Boron (B)	mg/kg	1.4 - 2.7
Method References		
pH in H ₂ O (1:5), pH in CaCl ₂ (1:5) and Electrical Conductivity (EC) by Rayment & Higginson (1992) method 4A2, 4B2, 3A1 Soluble Nitrate-N by APHA 4500 Soluble Chloride by Rayment & Higginson (1992) modified method 5A2 Extractable P by Mehlich 3 – ICP Exchangeable cations – Ca, Mg, K, Na by Mehlich 3 – ICP Extractable S by Mehlich 3 – ICP Extractable trace elements (Fe, Mn, Zn, Cu, B) by Mehlich 3 - ICP		

3.3 INSTALLATION PREPARATION

Embankments

Maximum gradient: 1:4. Grade embankments to an even slope.

Embankment stabilisation

General: Where necessary to prevent erosion or soil movement, stabilise embankments.

Method: Either matting overlay or hydromulching.

Matting generally: Biodegradable fibre reinforced with lightweight polymer mesh. Provide lightweight material for seeding, medium or heavy weight material for planting.

Matting in high erosion zones: Flexible carbon black UV stabilised interwoven nylon mesh.

Matting installation: Sow before matting is installed, where planting is required. Plant-after matting is installed. Peg the matting into 300 x 300 mm anchor trenches at top and bottom, backfill the trenches with soil and compact.

Matting pegs: U-shape galvanized steel, at 1000 x 1000 mm intervals generally, 250 mm at overlaps.

Binders

Notice and approval: If binders are required, seek approval from the principal before applying.

Application: To the manufacturer's recommendations.

3.4 SUBSOIL - INSTALLATION

Planting beds

Excavated: Excavate to bring the subsoil to at least 300 mm below finished design levels. Shape the subsoil to fall to subsoil drains where required. Break up the subsoil to a further depth of 100 mm.

Unexcavated: Remove weeds, roots, builder's rubbish and other debris. Bring the planting bed to 75 mm below finished design levels.

Cultivation

Minimum depth: 100 mm.

Services and roots: Do not disturb services or tree roots. If required cultivate these areas by hand.

Cultivation: Mix in materials required to be incorporated into the subsoil. Cultivate manually within 300 mm of paths or structures. Remove stones exceeding 25 mm, clods of earth exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during cultivation. Trim the surface to design levels after cultivation.

Additives

General: Apply additives after cultivation and incorporate into the upper 100 mm layer of the subsoil.

Gypsum: Incorporate at the rate of 0.25 kg/m².

Organic soil improver: Add to each new planting area.

3.5 TOPSOIL - INSTALLATION

Site topsoil preparation

Screening: By a power hydraulic screen capable of handling 100 tonne per hour, with sieves grading from 20 mm to 15 mm.

Waste: Remove from site all clay lumps, balled compacted particles greater than 20 mm, stones and trash foreign to the normal composition of soil.

Contamination: If diesel oil, cement or other phytotoxic material has been spilt on the site topsoil, excavate the contaminated soil and dispose of it off the site.

Admixtures: During the screening process add the following:

- 15% by weight coarse sand minimum particle size 0.2 mm.

Additives program: 8 weeks before stolonizing or turfing.

Placing topsoil

Site topsoil: Do not incorporate site topsoil into the works until soil testing certification has been approved. Remove unauthorised material from the site.

General: Spread the topsoil on the prepared subsoil and grade evenly, making the necessary allowances to permit the following:

- Required finished levels and contours may be achieved after light compaction.
- Grassed areas may be finished flush with adjacent hard surfaces such as kerbs, paths and mowing strips.

Spreading: On steep batters, if using a chain drag, make sure there is no danger of batter disturbance.

Finishing: Feather edges into adjoining undisturbed ground.

Topsoil depths

General: Spread topsoil to the following typical depths:

- Excavated planting areas:
 - . If using organic mulch: 225 mm.
 - . If using gravel mulch: 250 mm.
- Irrigated grassed areas generally: 150 mm.
- Irrigated grassed areas, heavy use (e.g. playing fields, playgrounds, and public parks): 200 mm.
- Non-irrigated grass areas: 100 mm.
- Earth mounds:
 - . Mass planted surfaces: 300 mm.
 - . Grassed surfaces: 100 mm.
- Top dressing: 10 mm.

4 GRASS SURFACES

4.1 GRASS

Turf

Description: Cultivated turf of even thickness, free from weeds and other foreign matter.

Supplier: A specialist grower of cultivated turf.

Quality: Provide turf of even thickness, free from weeds, pests, disease and other foreign matter.

Turf properties: Provide turf with the following properties:

- Consisting of 25 mm deep dense, well-rooted, vigorous grass growth in 25 mm deep topsoil.
- Species: Couch grass (*Cynodon dactylon*) runners, including the Wintergreen variety.

Turf dimension:

- Roll width: Minimum 300 mm, in sound unbroken condition.
- Length: Minimum 1.5 m.

Certification: Provide certification verifying turf is pest free.

4.2 TURFING

Planting area

Requirement: Keep free of rubbish, rubble stones and roots.

Watering: Keep moist to 100 mm deep before planting.

Planting area preparation: Prepare planting area for turfing as follows:

- Rotary hoe: To a minimum depth of 150 mm and provide runners with minimum 50 mm soil cover.
- Light rolling: Lightly roll to form an even, levelled surface without wheel ruts.

Supply

Elapsed time: Deliver the turf within 24 hours of cutting, and lay within 36 hours of cutting. Prevent turf from drying out between cutting and laying. If not laid within 36 hours of cutting, roll turf out on a flat surface with the grass up, and water as required to maintain a good condition.

Application

General: Lay the turf as follows:

- In stretcher bond pattern with the joints staggered and close butted. Make sure the turf is uniform in colour and thickness.
- Parallel with the long sides of level areas, and with contours on slopes.

Strip turf: Close butt the end joints and space the strips 300 mm apart. Layer top dressing between the turf strips. Finish with an even surface.

Tamping: Lightly tamp to an even, levelled and consistent surface immediately after laying. Do not use a roller.

Stabilising on steep slopes: Peg the turf (on steep slopes) to prevent downslope movement. Remove the pegs when the turf is established.

Watering

General: Water immediately after laying until the topsoil is moistened to its full depth. Maintain moisture to this depth.

Establishment

Requirement: Maintain turfed areas until there is a dense continuous sward of healthy grass over the whole turfed area, evenly green and of a consistent height.

Failed turf: Lift failed turf and replace with new turf.

Levels: If levels have deviated from the design levels after placing and watering, lift turf and regrade topsoil to achieve design levels.

Mowing: Mow to maintain the grass height within the required range. Do not remove more than one third of the grass height at any one time. Carry out the last mowing within 7 days before the end of the planting establishment period. Remove grass clippings from the site after each mowing.

Top dressing: After the first mowing, remove cuttings and lightly top dress to a depth of 10 mm. Rub the dressing well into the joints and correct any unevenness in the turf surface.

Fertilising

Requirement: Mix the fertiliser thoroughly into the topsoil before placing the turf with a slow release fertiliser applied to the manufacturer's recommendations. Apply lawn fertiliser at the completion of the first and last mowing, and at other times as required to maintain healthy grass cover.

4.3 SYNTHETIC TURF

Materials

Material: Proprietary matting made from synthetic fibres tufted into a woven backing.

Installation

Preparation: Excavate to required levels and compact subgrade. Place and compact minimum 50 mm cement stabilised crusher dust as bedding layer for synthetic turf or prepare bedding layer to the manufacturer's recommendations.

Laying: Cut to shape and spread without wrinkles.

Joints: To the manufacturer's detail.

4.4 GRASS REINFORCING**Materials**

Grass pavers: Lightweight interlocking plastic cellular paving system capable of sustaining pedestrian and occasional vehicular traffic including emergency vehicles.

Installation

Preparation: Excavate to required levels and compact subgrade.

Base course: Place and compact either of the following:

- Non-calcareous, free draining washed sand, comprising 80% 0.1 mm to 1.0 mm grading.
- 1.0 mm to 5.0 mm gravel aggregate.

Base course depth:

- Pedestrian walkways: 100 mm.
- Passenger vehicles: 150 mm.
- Heavy vehicles: 250 mm.

Growing media: 80:20 (sand:organic sandy soil) mix.

Pavers: Place and interlock grass pavers on base course and spread growing media over pavers to heights as follows:

- Turf: 5 mm.
- Hydroseeded: 15 mm.

Protection: Exclude traffic until the root system becomes established and anchored to the base course.

5 PLANTS**5.1 REQUIREMENTS****Plant properties**

Requirement: Supply trees with the following properties:

- Nursery grown. True to species, variety, cultivar, stem form and other features required in the Plants list/schedule.
- Free from injury.
- Self-supporting.
- With calliper at any given point on the stem greater than the calliper at any higher point on the stem.

Supply and delivery: Supply plants from a nursery with Nursery Industry Accreditation Scheme Australia (NIASA) accreditation and deliver to site with a label displaying the botanical name.

Health: Fully branched. Foliage size, texture and colour at time of delivery consistent with that of healthy specimens for the nominated species.

Vigour: Extension growth consistent with that exhibited in vigorous specimens of the species nominated.

Damage: Free from damage from restricted habit due to growth in nursery rows and defects such as knots, sun scalds, abrasions and disfigurement.

Stress: Free from stress resulting from inadequate watering, excessive shade or excessive sunlight experienced at any time during their development.

Site environment: Grown and hardened off to suit anticipated site conditions at the time of delivery.

Root development: Healthy root systems developed by transplanting or root pruning and grown in their final containers for the following periods:

- Plants < 25 L size: More than 6 weeks.
- Plants > 25 L size: More than 12 weeks.

Pests and disease: Free from attack by pests or disease, eggs or larvae.

Native species with a history of attack by native pests: Restrict plant supply to those with evidence of previous attack to less than 15% of the foliage and ensure absence of actively feeding insects.

Labelling

General: Clearly label individual plants and batches.

Label type: Waterproof tag able to withstand transit without erasure or misplacement.

Label information: Include the following:

- Common name and botanical (full scientific) name.
- Include for hybrids, variety or cultivar.

Root system

Requirement: Supply plant material with a root system as follows:

- Well-proportioned in relation to the size of the plant material.
- Conducive to successful transplantation.
- Free of any indication of having been restricted or damaged.

Root inspection: If inspection is by the removal of soil test, such as destructive inspection, sample as follows:

- For > 100 samples: Inspect 1%.
- For < 100 samples: Inspect 1 sample.

Sample plants: Replace plants used in inspection.

Rejection: Do not provide root bound stock.

Shrubs and ground cover

Pot size: Minimum 175 or 200 mm to the Landscaping plan.

Trees planted on site

Minimum size: 45 litre bag.

6 PLANTING**6.1 REQUIREMENTS****General planting requirements**

Requirement: Provide planting to the Landscaping plan as follows:

- Plant supply: By an approved nursery or source.

- Removing plants from containers: Remove plants without damaging or disturbing the roots.
- Root bound plants: Do not use.
- Variation from the plan: Do not provide plants which vary from the Landscaping plan in species or size without approval from the principal.
- Plants delivered to and planted on site: Display a label with the plants botanical name.

Planting areas

Fertilising: Fertilise all new planting areas with an organic fertiliser and pelleted fowl manure.

6.2 TRANSPLANTING

General

Conditions: Select a time for transplanting appropriate to the season, time of actual operation, rootball diameter and depth, lifting methods and weather conditions.

Preparation

Watering: Establish a temporary trickle irrigation system, or manually water the intended trees for a period of two weeks before ball excavation work.

Fertilising: Apply one application of liquid fertiliser mix to the foliage and root as appropriate to the species. Apply sufficient liquid fertiliser mix to allow the spray to drip from foliage and soak into the rootball. Do not spray the fertiliser mix on excessively hot, dry or windy days.

Rootball

General: Minimise the cutting of roots. Use only sharp tools, water blasting or water cutting.

Initial cut: Conform to the following:

- Manually or using chain trenching machine. Replace trees where rootballs have been excavated by backhoe or an excavator.
- Cut 250 mm beyond the required finished rootball dimensions of each side to allow damaged roots to be trimmed back to final dimensions and sealed.

Hand trimming: To 100 mm less than the required finished rootball dimension. Cut back all roots greater than 25 mm diameter.

Rootball cutting: Conform to the following:

- Symmetrical about the trunk and in proportion to the overall size of the tree except where the limitations of individual tree planter openings require specific tailoring of the rootball dimension.
- Cut the rootball to a size which maximises the rootball for each specimen.

Backfilling

Trench: Backfill and lightly compact with clean sand, free of any foreign matter, pathogens or any substances which may be deleterious to future root growth. Apply root inducing formulation to the manufacturer's recommended concentration, to effectively saturate the backfill in the trench.

Maintenance of on-site plant material

Watering: Maintain a trickle irrigation system around each tree, located within the trenched rootball perimeter. Program the system to supply water at an optimum rate to encourage healthy growth and avoid desiccation through excessive transpiration

following the pruning of the roots. Monitor the system continuously until the tree is lifted and removed to its final destination.

Fertilising: Submit a program for regular fertiliser application continued over this period.

Responsibility: Take all necessary precautions to safeguard the health and well-being of all on-site plant material before the lifting and transplanting into their finished location.

Above ground

Pruning: If pruning of branches is required to balance root loss, obtain approval.

Lifting: Thoroughly irrigate to the full depth of the rootball two days before transplanting of each specimen. Do not fracture the ball of soil around the root system. Maintain ball in firm condition during transplanting by wrapping in hessian or other appropriate open weave material, securely tied.

Storage: Transport transplanted trees to a designated nursery site. Store and maintain until ready for planting.

Planting: Avoid disturbing the rootball during moving and planting. After placement, remove the rootball wrapping and ties by cutting.

Watering: At completion of transplanting, water the rootball thoroughly and continue to water until established.

6.3 MULCH

Material generally

Requirement: Provide mulch which is free of deleterious and extraneous matter such as soil, weeds and sticks. Do not include fine mulch.

Mulch type: Composted or pasteurised organic material to AS 4454 and free of stone, including brush chippings and leaf litter recovered from site clearing, if available. If not available other types such as pine bark may be used.

Standard:

- Particle size, physical and chemical contaminants: To AS 4454 Table 3.1(A).
- pH, electrical conductivity, ammonium, chlorine and other nutrients: To AS 3743 Table 2.1 for regular mix.

Organic mulch properties

Brush chippings and leaf litter: Vegetative material processed through a chipper to pieces not larger than 75 x 50 x 15 mm as follows:

- Material permitted: Leaf matter and tree loppings from Eucalyptus, Tristania and Pinus species.
- Material not permitted: Leaf matter and tree loppings from privet, camphor laurel, coral tree, poplar, willow, and noxious weeds.

Pine bark: From mature trees, graded in size from 50 x 50 x 25 mm to 25 x 15 x 15 mm, free from wood slivers.

Pine flake: Pinus species sapwood slivers of size range 250 x 25 mm to 30 x 3 mm, including fragments of pine bark.

Straw: Cereal straw, wood fibre, or other suitable vegetative material (but not meadow hay) free from

weeds and seeds, applied in conjunction with a bitumen emulsion or polymer binder.

Inorganic mulch used as ground cover

Ground cover spreading depth:

- Generally: 75 mm.
- Gravel: 50 mm.

Washed river pebble: Uniform size or graded material in the size range 6 to 10 mm.

Decomposed granite gravel: Uniform size or graded material in the size range 5 to 20 mm, of uniform colour and low plasticity. Keep clear of plant stems.

Crushed quartz: Uniform size or graded material in the size range 5 to 20 mm, of uniform colour.

Marble chip gravel: Uniform size or graded material in the size range 5 to 20 mm, of uniform colour.

Slate: Plum slate slivers in the size range 5 to 20 mm.

Shale: Uniform size or graded material, no particles smaller than 0.1 mm diameter.

Scoria: Uniform size or graded material.

Binders

Generally: Provide materials suitable for cold spray application to stabilise mulched or seeded surfaces on banks or high erosion areas.

Placing mulch

General: Place mulch to the required depth, clear of plant stems, and rake to an even surface flush with the surrounding finished levels. Spread and roll mulch so that after settling, or after rolling, it is smooth and evenly graded between design surface levels, sloped towards the base of plant stems in plantation beds, and not closer to the stem than 50 mm in the case of gravel mulches.

In mass planted areas: Place after the preparation of the planting bed but before planting and other work.

In smaller areas (e.g. planter boxes): Place after the preparation of the planting bed, planting and other work.

Extent: Provide mulch to 750 mm diameter, to surrounds of plants planted in grass areas.

Depths: Spread organic mulch to a depth of 75 mm.

6.4 PLACING PLANTS

Individual plantings

Method: Excavate a hole twice the diameter of the rootball and at least 100 mm deeper than the rootball. Break up the base of the hole to a further depth of 100 mm, and loosen compacted sides of the hole to prevent confinement of root growth.

Depression around roots: Provide 80 cm diameter depression around the plant. Make sure roots are covered and protected with soil.

Top of rootball: Finish 100 to 200 mm below soil level.

Individual plantings in grassed areas

Requirement: Fit with plastic stem protectors.

Locations

General: If it appears necessary to vary plant locations and spacings to avoid service lines, or to

cover the area uniformly, or for other reasons, give notice.

Planting conditions

Weather: Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend excavation when the soil is wet, or during frost periods.

Watering

Timing: Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress.

Placing

Removal from container: Remove the plant from the container with minimum disturbance to the rootball. Prune roots so that all circling roots are severed or aligned radially into the surrounding soil. Make sure the rootball is moist.

Planting: Place plant in its final position, in the centre of the hole, with the topsoil levelled with the finished surface of the surrounding soil. Compact lightly to minimise subsidence without compacting the backfill. Avoid mixing mulch with topsoil.

Fertilising

Pellets: Place fertiliser pellets around the plants, at the time of planting, in planting beds.

Backfilling

Requirement: Backfill with a topsoil mixture. Lightly tamp and water to eliminate air pockets. Make sure the plant stem remains the same height above ground as it was in the container.

Watering basins for plants in grass

Method: Except in irrigated grassed areas and normally moist areas, construct a watering basin around the base of each individual plant, consisting of a raised ring of soil capable of holding at least 10 L.

6.5 SPRAYING

Notice

General: Immediately give notice of evidence of insect attack or disease amongst plant material.

Spraying

Product: Spray with insecticide, fungicide or both, as required to the *Health (Pesticides) Regulations 2011 (WA)*.

6.6 STAKES AND TIES

Stakes

Requirement: Provide for all new trees and shrubs.

Material: Hardwood, straight, free from knots or twists, pointed at one end.

Installation: Drive stakes into the ground at least one third of their length, avoiding damage to the root system. Position stake on the prevailing wind side of the plant.

Stake sizes:

- For plants ≥ 2.5 m high: Three 50 x 50 x 2400 mm stakes per plant.
- For plants 1 to 2.5 m high: Two 50 x 50 x 1800 mm stakes per plant.
- For plants < 1 m high: One 38 x 38 x 1200 mm stake per plant.

Ties

General: Provide ties fixed securely to the stakes, one tie at half the height of the main stem, others as necessary to stabilise the plant. Attach ties loosely so as not to restrict plant growth.

Tie type: Durable, non-abrasive plastic ties.

Trunk protection

Collar guards: 200 mm length of 100 mm diameter agricultural pipe split lengthways.

6.7 COMPLETION**Product certification**

Certification: Submit the supplier's written statement certifying that plants are true to the required species and type, and are free from diseases, pests and weeds.

Cleaning

Stakes and ties: Remove those no longer required at the end of the planting establishment period.

Temporary fences: Remove temporary protective fences at the end of the planting establishment period.

7 IRRIGATION**7.1 REQUIREMENTS****General**

Requirement: Provide and commission automatically controlled, fixed irrigation systems.

Performance

Irrigation systems: Provide systems as follows:

- That achieve the documented flow rates over the irrigated area.
- Meet statutory requirements for backflow prevention.

Irrigation controllers

Controllers: Provide automatic controllers that are easily programmed and include the following:

- Valve boxes.
- Manual cycle and individual control valve operation.
- Manual on/off operation of irrigation without loss of program.
- ≥ 4 on/off cycles per day.
- Day omit.
- 240 V input and 24 V output capable of operating 2 control valves simultaneously.
- ≥ 24 hour battery program backup.
- Power surge protection.
- Lockable cabinet in external locations with minimum IP 54 protection to AS 60529.
- Electrical connection: Where connected to wall outlets, provide 3 core 10 A, 240 V flexible cord and plug. Provide an isolating switch at the controller.

Power supply: For developments with multiple dwellings, connect to the common power source, not the power supply of individual dwellings.

- Metering: Connect to the common supply meter.

Number of stations in the controller: \geq number of stations in the reticulation systems.

Number of controllers: Do not use more than one controller without the approval of the principal.

Controller type/product: Do not install without approval from the principal.

Reticulation control cabinet

Location: Next to the dwelling meter box.

Construction Lockable aluminium box.

Wiring: Make sure solenoid wires can run from the cabinet to the mains water supply meter without being obstructed by concrete, paving or walls.

Power socket outlet: Install a 10 amp 250 V socket outlet at the bottom right hand corner of the cabinet.

Socket outlet labelling: SUPPLIED BY COMMON SERVICES POWER CIRCUIT.

Warranty

Requirement: Provide 12 months warranty for the irrigation system against faulty materials and workmanship from the date of practical completion.

7.2 WATER SUPPLY AND SERVICES**Compliance**

Standard: To AS/NZS 3500.1.

Authority requirements: To the Western Australian Water Corporation and local water restriction requirements.

Connection to services

Connection to the water supply: Installed by a licensed plumber as follows:

- Connection location: Supply from a cut within 2 m of the master mains water meter.
- Connection component: 25 mm gate valve fitted with backflow prevention device approved by the principal.

Connection to the electrical supply: Installed by a licensed electrician.

Metering: Allow for metering for water supply and other services as follows:

- Separate meters for individual dwellings.
- Common meter for common landscaped areas.

Reticulation

Reticulation sleeves: Provide to the landscaping area as follows:

- Below driveways: Install 100 mm PVC-U sleeve 300 mm below the finished design level at junctions of driveway and carport floor.
- At each end: Provide 90° elbow at 300 mm below the ground level.
- Sleeve installation: Run in one straight length under the driveway, so that draw wires can easily be drawn through.

Backflow prevention device

Product/type: A Water Corporation approved brass dual check valve device installed immediately below a Water Corporation approved isolation valve.

7.3 AUTOMATIC CONTROL VALVES

Type and construction

Type: 24 V solenoid actuated hydraulic valves with flow control and a maximum operating pressure rating of at least 1 MPa.

Product: Do not install without the principal's approval.

Size: The same as the line in which they are installed or smaller providing that the water flow restriction does not affect the sprinkler operation.

Construction: Stainless steel bonnet holding down bolts and internal metal parts of stainless steel, able to be serviced without removal from the line.

Isolating valve: Provide a gate valve of the same size immediately upstream of each automatic control valve.

Housing: House both valves in the same valve box.

Installation

Location: In a secure position.

Field wires: Protect with electrical conduits or strap beneath PVC-U piping.

Regional areas: Provide flow control valves to each station.

Valve protection: Protect valves and wire junctions from foot and vehicular traffic. Avoid using sand to cover the valves and wire junctions.

Wiring

Requirement: Provide low voltage solenoid wiring as follows:

- Solenoid wiring: Minimum 1 mm multi-strand cable.
 - . Common wire: Black.
- Wiring and pipes: Lay wiring in trenches under pipes and attached to pipes with insulation tape at regular intervals of maximum 3 m.
- Wiring in areas with no piping: Install in conduits.
- Wiring run: Continuous unbroken lengths from the controller to the solenoid valves, with 1.5 m of spare cable coiled at the valve.

Wiring protection: Use multi-core wire protected with PVC sheaths, with wires further protected by conduits or pipes (attached or below pipes).

Valve boxes

Construction: UV-resistant high impact plastic with high impact snap lock plastic cover.

Location: Support on bricks at each side. Install with top at the finished ground level.

Valve box components: Provide the following in each valve box:

- Automatic control valve.
- Isolating valve.
- Filter: 100 µm for drip irrigation systems and 200 µm for micro-irrigation systems.
- Pressure-reducing valve with 170 kPa outlet pressure.

7.4 UNDERGROUND SERVICES

Underground piping and PVC-U fittings

PVC-U pipes: To AS/NZS 1477.

PVC-U pipe system installation: To AS/NZS 2032.

Mainline piping: Minimum Class 12 PVC-U.

Lateral piping: Minimum Class 9 PVC-U.

PVC-U fittings: Minimum Class 18 PVC-U. Allow for changes in pipework direction using fittings. Do not install pipes with excessive bending.

Low density polyethylene pipes: Minimum 19 mm when used with drippers.

Trenching

Trench depth: Allow for minimum 300 mm cover in areas in front of dwellings and 200 mm in rear areas for mainline pipework and PVC-U garden bed piping trenching.

Trench properties: Straight, level, free of rock and sharp objects before installing piping.

Backfilling, compaction and levelling: As required to prevent subsidence after completion and to

PLACING FILL in *0222 Earthworks*, in *Part C: Construction specifications – BCA CLASS 1a, 1b and 10 Single and Grouped Dwellings*; and *Part C: Construction specifications – BCA Class 2 and 3 buildings* (as appropriate for the project).

Pipes and conduits

Conduit installation: Install to the following:

- AS/NZS 2032.
- ACIF C524.
- AS/CA S009.

Pipes and conduits across pavement or paths: If installation across roadways, driveways or paths are required, install under the pavement/path 90° to the road/path alignment using trenchless methods. Do not cut sealed surface without the principal's approval.

- Subsidence: If subsidence occurs, repair and reinstate pavement/path with no additional cost to the contract.

7.5 FIXED LOCATION SYSTEMS - PRODUCTS

Heads

Performance: Provide heads which conform to the following:

- Maintain a preset arc of throw.
- Adjustable for radius during watering operations
- Vandal-resistant.
- Protected from damage in normal operation.

Pop-up type heads:

- Type: Designed to rise at least 50 mm out of their housings under supply pressure and return to flush position on removal of pressure.
- Construction: Provide wiper seals, stainless steel return springs and removable internal filters.
- Product: Do not install without the principal's approval.

Sprinkler heads:

- Type: Gear driven and spray sprinklers with required precipitation rates for the various areas of throw.
- Product: Do not install without the principal's approval.

- Flow rate: Adjustable down to zero.

Impact sprinkler heads: Bronze bodies in high impact plastic cases with drainage holes.

Restrictions: Do not use microsprays or black polyethylene piping.

Drippers

Type: Pressure compensating type with the capacity to apply the required water volume to the shrubs/trees.

Features: Able to be installed directly online, buried or laid on the surface, with provisions for fitting the flexible riser tube to the online dripper and placed at the base of the shrubs/trees.

Valves

Check valves: If a rotating head is more than 300 mm below the highest head on the same automatic valve, fit an internal or external anti-drain check valve to prevent low head drainage.

Pressure regulating valves: Provide pressure regulating valves at off-take points as follows:

- Adjustable between 100 and 700 kPa.
- Complete with 800 µm filter sized to suit the flow and installed immediately upstream from the pressure regulating valve.
- Installed with isolating valves upstream from the filter and downstream from the pressure regulating valve.
- Fitted for backflow prevention.
- Mount the assembly in an accessible position in a valve box, access pit or adjacent building.

Soil moisture sensors

Type: Fixed ceramic moisture sensors.

Connection: Fit to the irrigation controller via moisture control units.

7.6 FIXED LOCATION SYSTEMS - INSTALLATION

Sprinkler application and location

Type: Use sprinkler types as follows:

- Grassed areas (large and small): Gear driven sprinklers.
- Rolled on turf: Sprinklers with pop-up heads.
- Garden beds adjacent to lawn areas and paths: Pop-up sprinklers, not ridged risers to prevent tripping.
- Trees: Bubblers or high flow drippers.
- Garden beds adjacent to driveways and paths: Pop-up sprinklers with minimum rise of 150 mm to prevent tripping and vandalism.

Sprinkler location restrictions: Conform to the following:

- Sprinklers along buildings: Position minimum 60 mm from the building.
- Sprinklers in verge areas: Do not install along kerbs facing back into the development site.

Prevention of overspray: Position sprinklers so that:

- Those in verge areas do not overspray onto roads.
- There is no overspraying onto buildings.
- Those in garden beds do not overspray onto driveways.

Sprinkler spacing: As recommended by the manufacturer for the pressure and water volume.

Concrete surrounds

Sprinklers along kerbs: For those installed along roads, driveways or parking areas, set sprinkler head in 90 mm thick concrete, extending minimum 300 mm diameter around the head.

Sprinklers in lawn/grassed area: Set sprinkler head in 80 mm thick concrete, extending minimum 200 mm diameter around the head.

Northwest and Gold fields region

Sprinkler installation: Provide plastic sprinkler surrounds to all sprinklers to protect from lawn mower damage.

Control wiring

General: Connect the automatic control valves and soil moisture sensors to the controller as follows:

- Cable type: Double insulated.
- Cable runs: Underground in PVC conduit to AS/NZS 3000 and laid alongside piping where possible.
- Connectors: Waterproof.
- Jointing: Loop cables and join only at valves, sensors and controllers.
- Movement provision: Provide expansion loops at changes of direction and at joints.

Quick coupling

General: Provide DN 20 double lugged bronze quick coupling valves with neoprene seats mounted on DN 20 copper risers offset at least 150 mm from the supply pipe. Install in valve boxes.

Heads

Impact sprinkler heads: Provide granular fill for at least 75 mm around the base of the case.

Risers: Mount as follows:

- Above ground heads: Mount on fixed risers.
- Galvanized steel risers: Set in 300 x 300 x 200 mm deep concrete blocks.
- In-ground heads: Mount on reticulated risers.

Risers: Install all sprinklers, other than pop-up types, on rigid PVC-U or flexible, semi-rigid risers.

Bubblers

Type: Pressure compensating.

Quantity: Install as follows:

- 45 litre trees in non-irrigated areas: 1 bubbler per tree.
- 45 litre trees in irrigated areas: 1 bubbler per tree.
- 100 litre trees in non-irrigated areas: 2 bubbler per tree.
- 100 litre trees in irrigated areas: 1 bubbler per tree.
- 200 litre trees in non-irrigated areas: 2 bubbler per tree.
- 200 litre trees in irrigated areas: 1 bubbler per tree.
- 500 litre trees in non-irrigated areas: 4 bubbler per tree.
- 500 litre trees in irrigated areas: 2 bubbler per tree.

- Mature plants in non-irrigated areas: 6 bubbler per tree.
- Mature plants in irrigated areas: 4 bubbler per tree.

Piping

Mainline and submains: Install 600 mm below the finished surface and lay marker tape along the top of the line.

Lateral piping for planting areas: Install below the topsoil profile and anchor at 1.5 m maximum centres with U-shaped stakes.

Valve boxes

Installation: Install with top surface flush with the surrounding surface.

Base: Concrete plinth.

7.7 MICRO-IRRIGATION SYSTEMS**Tubing**

Type: Polyethylene micro-irrigation pipe.

Fittings

Type: Barbed fittings rated for the pressure class of the pipe, fastened with ratchet type clamps.

Installation

Connections: Connect micro-tube laterals with proprietary push-in or screw-in fittings.

Drippers: Connect directly into piping or provide appropriately sized micro-tubes.

Microsprays: Mount microsprays 300 mm above ground on stakes and connect to the piping with appropriately sized micro-tubes.

Piping: Lay polyethylene micro-irrigation pipe on finished ground surface under planting bed mulch and anchor at 1.5 m maximum intervals with U-shaped stakes.

7.8 DRIP IRRIGATION SYSTEMS**Integrated drip line systems**

Construction: Tubing with integral drippers inserted into the tube during manufacture.

Discrete drip emitter systems

Tubing: Polyethylene micro-irrigation pipe.

Drippers: Turbulent flow types, easily dismantled for cleaning.

Installation

Discrete drippers: Connect directly into piping or provide appropriately sized micro-tubes.

Piping: Lay polyethylene micro-irrigation pipe on finished ground surface under planting bed mulch and anchor at 1.5 m maximum intervals with U-shaped stakes.

Air release valves: Provide at the highest point in each section to drain the system when flow stops.

7.9 SUBSURFACE DRIP IRRIGATION SYSTEMS**Tubing**

Collector and distributor mains: LDPE or PVC pipe.

Dripline: LDPE pipe.

Installation

Piping: Install at least 150 mm below ground.

Automatic line flushing valve:

- Location: At the furthest point from the valve on the collector main.

- Discharge point: Locate in same plane as the pipe leading to it, so water can easily be flushed out.

- Gravel bed: Install a 0.3 m³ minimum volume gravel bed in valve box. Maintain 50 mm clearance between gravel bed and the lowest discharge point of the valve.

Filter: Install in horizontal plane (or to prevent material entering mainline on cleaning) with 100 mm clearance from soil level.

Valve boxes: Provide 100 mm minimum clearance from filters and 50 mm min clearance from valves.

8 VERGES AND STREET TREES**8.1 REQUIREMENTS****Verge treatment**

Street trees: Provide to the local government authority's requirements, including for species selection.

Acceptable verge ground cover materials: Dust free, moisture retentive and erosion resistant.

Verge design and installation: Make sure pedestrian access is not impeded.

Existing services: Before landscaping the verge, locate existing and position new services in the verge, including contact DIAL BEFORE YOU DIG to identify locations of underground utility services pipes and cables.

8.2 VERGE GROUND COVER**Dimension and level**

Level and grade: Do not alter from existing levels.

Setback: Set verge 1.5 m from the road frontage, including for verges without footpaths.

Planting

Turf species: Use a species approved by the local government authority for verge treatments.

Plant dimensions: Select plant varieties that meet the following requirements:

- Maximum height: 0.75 m.
- Impact on the public: The plant does not pose a hazard to (such as is toxic or an irritant) or obstruct pedestrians.

Irrigation: Install as follows:

- Water source: From a point beyond the water meter and inside the site boundary, passing through a backflow prevention device.
- Reticulation pipes: Provide piping installed at minimum 300 mm below the surface ground level and pop-up sprinkler system with conduits installed under footpaths.

Inorganic ground cover

Stone/rock mulch treatments: Conform to the following particle size distribution:

- River washed rounded stone: $D_{50} < 40$ mm.
- Crushed rock: $D_{50} < 40$ mm.
- Crusher dust: $D_{50} < 10$ mm.

Stone aggregates, loose pea gravel or crushed brick: If proposed, obtain approval from the local government authority before including in the design.
Gravel treatments: Do not install if not allowed by the local government authority. If allowed, install as follows:

- Depth: 75 mm.
- Edging: Make sure edging depth is sufficient to prevent loose gravel spreading onto roads, footpaths or neighbouring properties.
- Geotextile or weed matting: Lay for the full extent of the verge where gravel is to be installed, allowing for plant/tree penetrations. Fold edges so that they will be covered from the surface.
- Sand layer: Cover geotextile/matting with sand. Water and lightly compact.
- Gravel cover: Place over compacted sand.

Other ground cover materials: To **PLANTING, REQUIREMENTS, Inorganic mulch used as ground cover.**

9 LANDSCAPE MAINTENANCE

9.1 REQUIREMENTS

Maintenance during the contract period

Requirement: Maintain plants so that the growth is healthy and the plants are well established for the duration of the contract period.

Plant replacement: Remove plants which are unhealthy or dead and replace with plants which are of a similar size and quality, and of identical species and variety.

Weed and grass growth in mulch areas: Control with a herbicide, approved by the principal, to the manufacturer's recommendations. Prevent herbicide contacting the new plants.

Plant protection: Protect plant damage from landscape operations and the operations of other trades. Maintain protection during the installation and maintenance periods. Treat, repair, or replace damaged plantings.

10 COMPLETION

10.1 REQUIREMENTS

Irrigation

Commissioning: On completion of the irrigation system installation, carry out the following:

- Flush system thoroughly, check heads, sprays and drippers and clean if blocked.
- Clean strainers.
- Adjust for even distribution with no dry areas.

Automatic controllers: Program the controls in conformance with the Water Corporation and the local water restriction requirements, including seasonal variation requirements.

Operations manual: Provide one copy to the residents and facilities manager.

Cleaning

Stakes and ties: Remove those no longer required at the end of the planting establishment period.

Temporary fences: Remove temporary protective fences at the end of the planting establishment period.

Site condition: At the completion of all landscape works, leave the site clean and tidy; free of rubbish, rubble, stones and roots.

Warranties

Parties: Supplier(s) to the principal.

Warranty conditions: All the plants supplied under these works are true-to-species and type, and free of disease, fungal infection and/or any other impediment to their future growth and that they have been fully acclimatised for the conditions of the site.

Submission of warranty: At the time of each delivery.

Record documents and handover

After practical completion: Submit 4 sets of electronic files (on CDs or DVDs) of the following:

- Operation and maintenance manual: Operation and maintenance manuals of operation components, e.g. irrigation system requirements, softscape maintenance and hardscape on-going cleaning and maintenance procedures.
- Product and material technical data sheets, including for plants.
- List of suppliers of all equipment, major materials and plants used.
- Copies of certification documents, including local government authority approvals.
- Warranties.

Drawing format: To **DESIGN DEVELOPMENT, DESIGN VERIFICATION, As-constructed drawings.**

CDs and DVDs: Submit in durable plastic covers with printed labels.

Maintenance strategy

Handover meeting: Arrange a meeting with the principal for handing over the maintenance documents and explaining any required actions.

REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS/CA S009	2013	Installation requirements for customer cabling (Wiring Rules)
AS 1379	2007	Specification and supply of concrete
AS 1428		Design for access and mobility
AS 1428.1	2009	General requirements for access - New building work
AS 1428.2	1992	Enhanced and additional requirements - Buildings and facilities
AS/NZS 1477	2017	PVC pipes and fittings for pressure applications
AS/NZS 2032	2006	Installation of PVC pipe systems
AS/NZS 3000	2007	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.1	2015	Water services
AS 3743	2003	Potting mixes
AS 4419	2003	Soils for landscaping and garden use
AS 4454	2012	Composts, soil conditioners and mulches
AS 60529	2004	Degrees of protection provided by enclosures (IP Code)
ACIF C524	2013	External Telecommunication Cable Networks. Industry Code
Safe Work Australia	2016	Hazardous chemical information system
WA Gov S.R. Pesticides	2011	Health (Pesticides) Regulations
UN GHS	2011	Globally Harmonized System of Classification and Labelling of Chemicals (GHS)



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