Practice Note 14.

Green Roofs for Auckland Transport's bus infrastructure

Supplement of Engineering Design Code – Bus infrastructure
Edition 01, July 2026

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1. Context and document purpose

Auckland Transport (AT) serves as the road controlling authority for all transportation services in the Auckland region, excluding state highways. AT manages more than 8,000 kilometres of roads, over 2,500 bus shelters, footpaths, cycling infrastructure, parking facilities, and public transport systems. With Auckland's population growing rapidly, the road network is continually expanding to meet the increasing demand for new residential and employment areas. This growth brings environmental challenges due to more housing developments, greater vehicle use, and the impacts of climate change.

AT's vision is to "*We tiaki all those who use transport in Tāmaki Makaurau."* The concept of tiaki highlights the deep connection between people and the environment, considering land, water, and air. This holistic perspective, inspired by Te Ao Māori, shapes the approach to Auckland's transport system. To support this vision, AT has developed and is delivering the AT Sustainability Strategy (2024-2031), which is centred around three main goals: addressing climate change, improving the environment, and achieving positive social and economic outcomes. The overarching aim is to build a resilient, convenient, well-connected, and accessible transport system that minimises environmental impact and preserves Auckland for future generations.

Green roofs are an innovative solution that offer significant benefits for the environment, economy, and people. Green roofs help AT meet its sustainability targets by intercepting stormwater, strengthening habitat connectivity and pollinator pathways, improving air quality, and increasing the permeability of the road corridor. Additionally, green roofs help reduce heat stress by lowering the amount of heat radiated from roofs and keeping the internal temperature of shelters cooler during summer.

The achievement of positive social, cultural and environmental outcomes should be considered. This is consistent with Auckland Transport and Auckland Council's approach, which is defined by strategic documents that include:

- Hīkina te Wero: AT's Environmental Action Plan 2021-2030;
- AT Sustainability Strategy 2024-2031;
- Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan;
- Auckland's Urban Ngahere (Forest) Strategy (2019);
- The Auckland Plan 2050;
- National Adaptation Plan (2022) - Nature-based solutions;
- National Infrastructure Plan (2026) - Nature-based solutions;
- Infrastructure NZ Policy Position (2025): Climate Resilient Infrastructure.

The main objective is to balance ecological benefits with operational efficiency. Incorporating green roofs helps CCOs like Auckland Transport address whole-of-life emissions and urban resilience requirements from Auckland's Climate Plan.

This document sets out minimum requirements for green roofs on new and existing canopies at our transport hubs and facilities, as well as within the road corridor on existing and new bus shelters across Tāmaki Makaurau. It outlines the key design considerations AT uses when assessing proposals for green roofs.

This specification is in line with several additional AT strategic documents, including but not limited to:

- Auckland's Regional Public Transport Plan
- Future Connect - Auckland Transport's Network Plan
- Roads and Streets Framework
- Auckland Transport Design Manual (2021)
- Urban Streets and Road Design Guide

2. Scope

This PN applies to green roof projects which aim to deliver safe, practical, and maintainable vegetated roof systems on Auckland Transport assets. It can also be used where new or renewed infrastructure, such as bus shelters, station canopies, or other roofed transport facilities, is inserted into an existing road corridor or transport environment where there are operational, structural, safety, maintenance, or environmental constraints. These cases include:

i. all AT projects initiated after implementation of this PN;

ii. all AT design applications under consent or Engineering Approval consideration at the time of implementation of this PN;

iii. all Consents or Engineering Approvals lodged after implementation of this PN where green roofs are proposed on new or existing transport assets;

iv. third-party developed infrastructure, including shelters, canopies, stations, or other assets, proposed to be vested to AT;

v. renewal, upgrade, or retrofit works where green roofs are being introduced, replaced, or reviewed on existing assets;

vi. projects where irrigation, safe maintenance access, or waterproofing integrity must be resolved as part of the design response;

vii. projects where green roofs are proposed to contribute to stormwater management, biodiversity, pollinator pathways, urban cooling, or visual amenity outcomes;

viii. any review of the suitability, safety, maintenance, inspection, or long-term performance of an existing green roof asset; and

ix. any review of whether a green roof is the appropriate solution where structural capacity, roof slope, passenger safety, or operational constraints may limit its use.

3. Overview of green roofs

Green roofs, sometimes referred to as living roofs, are vegetated systems installed on roofs. Green roofs serve an important function in establishing and reinforcing ecological corridors within urban areas. These corridors facilitate species movement and migration, thereby supporting increased biodiversity and ecosystem health. Incorporating green roofs into urban planning as part of a comprehensive green infrastructure strategy enables the

development of continuous ecological pathways that link parks, green spaces, and natural habitats. This connectivity allows both plant and animal life to prosper within an otherwise fragmented urban landscape.

In addition to biodiversity enhancement, there are several other benefits of green roofs that are particularly relevant for Auckland Transport:

- **Stormwater Management**: Green roofs absorb rainfall, reducing the volume and speed of stormwater runoff. This helps to ease pressure on Auckland's drainage infrastructure, lowering the risk of flooding and protecting waterways from pollution.
- **Urban Heat Island Mitigation**: By providing natural insulation and cooling, green roofs help to moderate urban temperatures, making transport hubs and surrounding areas more comfortable for passengers and staff.
- **Improved Air Quality**: Vegetation on green roofs filters airborne pollutants and dust, contributing to cleaner air in high-traffic transport zones.
- **Noise Reduction**: The soil and plants on green roofs act as a sound barrier, reducing ambient noise levels from traffic and trains, thereby improving the user experience at transport facilities.
- **Extended Roof Lifespan**: Green roofs protect the underlying roof membrane from UV radiation and temperature extremes, extending roof service life and reducing long-term maintenance costs. This is generally not factored into construction or maintenance budgets, yet this benefit still come with the installation of a green roof *(Technical Report 2013/045)*.**Enhanced Aesthetics and Well-being**: Integrating greenery into transport infrastructure creates more attractive, inviting spaces that promote mental well-being for commuters and staff.
- **Opportunities for Community Engagement**: Green roofs can be designed as accessible spaces or demonstration projects, fostering community involvement and environmental education around sustainable transport practices.
- **Habitat and pollinator pathways**: Green roofs on bus shelters can provide small but important habitat areas for insects and birds, helping weave nature into urban transport corridors. When used across the network, they can also create pollinator

pathways by linking habitat patches and supporting the movement of bees and other pollinating species through the city.

Figure 1: Green Roof Benefits on Bus Shelters

Implementing green roofs within the road corridor converts impermeable surfaces into areas capable of retaining water at its source, thereby preventing runoff resulting from frequent minor storms that would typically occur on non-porous surfaces. Green roofs can be incorporated through retrofitting existing structures such as bus shelters or included in new construction such as roof canopy at public transport interchange stations. These systems effectively manage annual surface runoff by absorbing recurring small rain events and contribute to mitigating peak runoff rates during larger, less frequent storms *(GD01, Amendment 2, 2017/002)*.

Evaluating the true value of a green roof presents challenges, particularly when considering stormwater management benefits solely at the roof level within Auckland Transport's existing permitting Transport Design Manual. Under these conditions, it may not appear economically viable. Green roofs usually absorb only the rain that falls on them, so extra stormwater measures may be needed for ground-level runoff (*Technical Report 2013/045*).

However, by using a green roof to treat roof runoff, the required size of other stormwater device(s) to manage the rest of the site is reduced, if such devices are implemented as part of an integrated stormwater management (i.e., treatment train approach).

Completed in 2022, the 500m² green roof on Auckland Central Library serves both as a sustainability initiative and a research site for urban green roofs in New Zealand.

Three years of monitoring show the green roof (Rooflink, The Living Proof 2025):

- *Captures up to 80% of rainfall during heavy storms and nearly all light rain, easing pressure on stormwater systems.*
- *During hot weather conditions, with temperatures exceeding 25 degrees Celsius, all types of green roof substrates tested were shown to lower rooftop surface temperatures by 32.4% to 55.7% (compared to conventional roofs). Boosts biodiversity by attracting birds, insects, and pollinators.*
- *Protects the roof membrane from UV and temperature extremes, prolonging its lifespan.*

These results confirm that green roofs provide practical benefits for stormwater management, energy savings, and urban ecological resilience.

At Auckland Transport (AT), a green roof trial on existing bus shelters is currently underway. While direct temperature and other parameter monitoring has not yet been undertaken, ongoing maintenance is being carried out by the contractor to support plant health and system performance. A methodology is to be developed for monitoring and assessing asset performance over time, with future plans to better understand local outcomes and inform future applications.

3.1 Types of Green Roofs

There are three types of green roofs, and these are classed in according to their substrate (soil) depth (GD01, Amendment 2 2017/017)

- Intensive
- Extensive
- Modular

Table 53: Design considerations of extensive, intensive and modular living roofs

	Extensive	Intensive	Modular
	Retro-fit	New, bespoke	Off-the-shelf
	Low profile with thin layers	High profile with deep layers	Low profile with thin layers in modular trays, pouches or bags
Plants	Shallow rooted growing in 20–150 mm of substrate. Drought tolerant species.	Wider plant variety, including herbaceous plants to shrubs or trees in >200 mm of substrate.	Shallow rooted growing in 20–150 mm of substrate. Drought tolerant species.
Runoff retention	Low	High	Low
Public access*	No	Yes	No
Additional irrigation	No	Yes	No
Saturated weight	70–170 kg/m²	300–1000 kg/m²	70–170 kg/m²
Cost and maintenance	Low	High	Low

* With associated health and safety requirements

Figure 2: Design Consideration of extensive, intensive and modular green roofs.[1]

[1] Source: Table 53; GD01 Amendment 2, 2017/017

Figure 3: Green Roofs in Puhinui Station Bus Shelter


Figure 4: Green Roofs in Te Atatu Bus Shelter and (44 Portage Road, New Lynn

4. Auckland Transport's Position

In Auckland Transport's previous shelter installation, modular systems have been used, with a typical loading requirement of approximately 90 kg/m^2.

This figure is based on the specific modular green roofs system (tray based) supplied to AT to date and reflects information provided by the manufacturer. Actual loading requirements will vary depending on the supplier, system design, roof specifications including load limitations and product specifications. This variability is important and must be confirmed for each project.

For AT's infrastructure, modular green roofs are the recommended and preferred system type. This is because:

- AT's bus shelter and stations are lightweight structures with limited load-bearing capacity.
- Modular systems minimise structural upgrades, reducing cost and installation complexity.
- Maintenance requirements are significant lower compared to intensive systems.

AT should maintain the prioritisation of modular green roofs for both existing and forthcoming shelter designs. Intensive and extensive systems currently present challenges for most AT assets due to structural load limitations, higher costs, increased complexity, and ongoing maintenance requirements. Nonetheless, future innovations and advancements in structural engineering or technology may enable AT to consider alternative green roof

systems in the near future. Where proposed, appropriately qualified specialists should be engaged from project inception to address structural design, waterproofing, maintenance, and whole-of-life considerations.

AT applies a structured assessment process to determine whether a green roof is suitable for a particular bus shelter or station. This begins with a site-specific feasibility assessment, undertaken by AT subject matter experts (SMEs).

AT's intent is to install green roofs where feasible across the network; however, feasibility varies by site and structure. A green roof may not be appropriate where structural capacity is insufficient, maintenance access is restricted, or environmental conditions prevent vegetation from thriving. Therefore, a detailed feasibility and options analysis must be completed before committing to installation.

Any proposed departure from this practice note shall be supported by project-specific justification and approved through the relevant design governance and asset owner processes. Designers shall demonstrate that any alternative solution maintains or improves safety, maintainability and whole-of-life performance.

5. What does Auckland Transport want?

Auckland Transport's overarching design approach for bus shelters and transport facilities centres on integrating sustainability and functionality, and community engagement to deliver resilient, attractive, and efficient infrastructure. This strategy prioritises the use of green roofs and environmentally responsible materials to enhance urban biodiversity, manage stormwater, and extend asset lifespan, while promoting the well-being of commuters and staff while ensuring these assets can be easily maintained throughout their life.

Key principles guiding the design include:

- **Sustainable Integration**: Green roofs are incorporated early in the design process to maximise ecological benefits, such as reducing impervious surfaces, supporting native biodiversity, and contributing to water conservation and pollution reduction.
- **Asset Integrity and Safety**: Asset Integrity and Safety: Structural capacity assessments ensure that both existing and new shelter roofs can support the saturated weight of green roof systems. For new assets, design specifications incorporate enhanced load-bearing capabilities and integrated green roof infrastructure from the outset. In all cases, careful attention is given to proper drainage, secure edging, and compliance with building codes and standards to protect asset longevity and passenger safety. These measures collectively ensure that both current and future transport facilities are resilient, safe, and equipped to support sustainable green roof installations.
- **Low-Maintenance Design**: Selection of drought-tolerant, climate-appropriate plant species minimises ongoing maintenance requirements, while accessible design features facilitate safe routine inspection and upkeep.

- **Community Engagement and Visual Impact**: Green roofs are designed to enhance public spaces aesthetically and serve as educational or demonstration projects, fostering community involvement and environmental awareness.
- **Operational Efficiency**: Balancing ecological advantages with cost-effectiveness and long-term performance ensures the infrastructure delivers lasting value and aligns with Auckland Transport's sustainability goals and legislative requirements.
- **Future Proofing.** Designs must accommodate future climate conditions, technological advancement, and evolving operational needs to maximise long-term resilience and adaptability. This reduces the likelihood of costly retrofits and aligns with AT's asset management principles.

This comprehensive approach ensures that bus shelters and transport facilities not only meet current transport needs, but also support Auckland's environmental objectives, enhance urban liveability, and promote community stewardship of public infrastructure.

6. What does Auckland Transport consider?

If a green roof(s) is deemed to be appropriate via a justified and suitable options assessment, Auckland Transport will consider not only the effectiveness of the green roof's stormwater and nature-based resilience functions, but also asset integrity and maintenance requirements, life cycle costs, and health and safety (to network users and during maintenance etc.). Consideration is given not only to internal design elements, but also to implications for the construction, maintenance and safety around the infrastructure.

6.1 Key consideration

When assessing suitability, AT considers the functionality, safety, environmental value, and long-term performance of the green roof system. Key factors include the structure's ability to carry the saturated weight, the adequacy of drainage to prevent pooling or leaks, and the effectiveness of edging to contain the growing medium. Reliable access to irrigation or water supply must be available to support plant growth and establishment and ongoing resilience during dry periods. Safe and practical maintenance access must be available, and plant species must be suited to Auckland's climate and low maintenance requirements. These considerations ensure green roofs deliver environmental benefits without compromising operational efficiency or asset integrity.

6.2 Feasibility Assessment Requirement

Feasibility consideration different for existing versus new infrastructure.

Existing Infrastructure

The Figures below present different type of existing bus infrastructure where green roofs system can be added.

Figure 5: AT Minor Bus Shelter Schematic. (Auckland Transport)

Figure 6: AT Intermediate Bus Shelter Schematic. (Auckland Transport)

Figure 7: AT Major Bus Shelter Schematic. (Auckland Transport)

The table below provides the size and dimension of existing bus shelters across the Auckland road network.

Table 1: Size and Dimension of existing Bus Shelter within AT.

Type	Type	Size (LxWxH)
Minor	AT Minor 600	4679x1600x 2520.7mm
	AT Minor 800	4679x1440x2530mm
	AT Minor 1300	4900x1980x4900mm
	AT Minor 1500	4900x1980x2530mm
Intermediate	AT Intermediate 800	8497x1440x2529mm
	AT Intermediate 1300	8497x1980x2529mm
	AT Intermediate 1500	7900x1980x (N.A)
Major	AT Major 800	11540x1440x2649.9mm
	AT Major 1300	11540x1980x2895mm
	AT Major 1500	11540x1980x2893mm

Source: Auckland Transport Shelter Suite – General Information, 2017

Assessment must confirm:

6.2.i. Whether the site contributes to an existing ecological corridor or provides measurable biodiversity value and benefits. This information shall be verified using the GIS_Maps_Ecological Road Corridor Link dataset (shown below).[2]

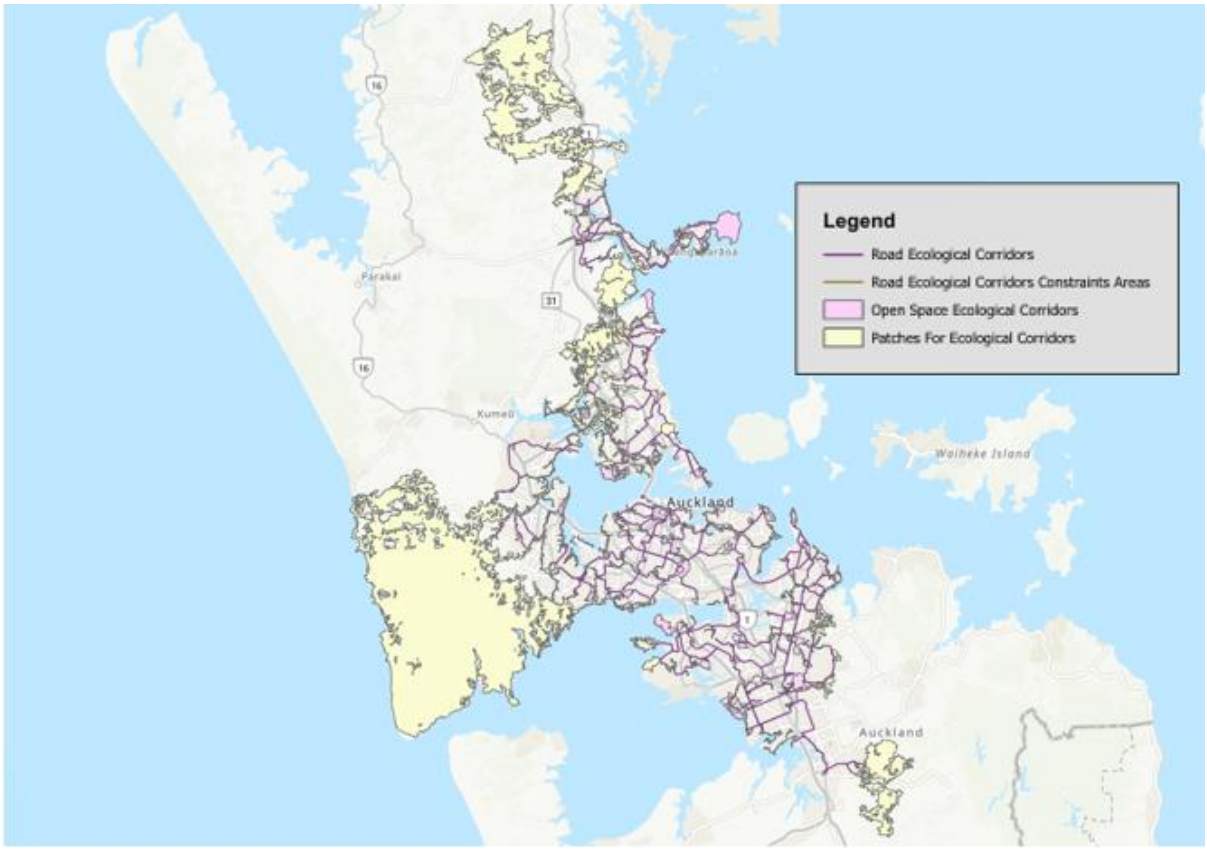

Figure 8: Ecological Road Corridors within Auckland.

6.2.ii. The existing climatic conditions around the existing shelter (such as temperature, wind, shade etc).

6.2.iii. Whether the existing shelter roof has sufficient load-bearing capacity to support the saturated weight of the proposed green roof system, without requiring substantial structural strengthening.

6.2. iv. Whether the existing roof form and the roof slope (≤10°), can accommodate the green roof system and associated components in accordance with manufacturer and engineering requirements.

6.2.v. Whether installation can be scheduled alongside planned shelter renewals or upgrades to optimise timing, reduce disruption, and ensure -cost-effective delivery.

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[2] *The GIS_Maps_Ecological Road Corridor Link dataset not currently available on Future Connect at the time of writing. This footnote shall be updated once released.*

6.2.vi. Whether access to irrigation or reliable water supply is available and can be practically implemented to support plant establishment and ongoing performance, particularly during dry periods.

Additionally, Auckland Transport evaluates potential impacts on passenger safety, including risks associated with falling debris and obstructions to sight lines, while ensuring adherence to applicable building codes and standards. The primary objective is to achieve a balance between ecological advantages and operational efficiency, thereby developing sustainable infrastructure that aligns with environmental goals and delivers lasting value to the city's transport system. This comprehensive strategy integrates a variety of environmental and impact-related goals set forth by the Resource Management Act (1991), as well as asset management and value for monetary considerations specified under the Local Government Act (2002) and AT Transport Design Manual.

New Infrastructure

Green roofs should be included in new shelters and stations unless specific constraints make them unsuitable, including:

- Overshadowing or insufficient sunlight for plant growth.
- Maintenance access limitation such as in constrained rail environments.
- Limited ecological connectivity.

6.3 Consultation Requirement

Consultation is required throughout the design process to ensure alignment with Auckland Transport's technical, sustainability, and operational expectations for green roof implementation.

Requirements

6.3.i. Undertake mandatory consultation with Principal Environment & Nature-based Resilience Specialist at the design philosophy stage and prior to progressing any design work involving green roofs.

6.3. ii. Confirm site suitability at an early stage through consultation, ensuring proposals align with Auckland Transport's sustainability objectives.

6.3.iii. Facilitate collaboration between the stormwater engineer, structural engineer, and, where necessary, the landscape architect with AT SME(s) to address key design aspects, construction feasibility, and long-term maintenance strategies.

6.3. iv. Ensure that where a green roof is intended for stormwater management (e.g., to meet retention requirements under the AUP(OP)), its performance is not compromised by aesthetic considerations or the placement of other infrastructure.

6.3.v. Obtain formal written approval from the AT SME(s) before progressing the green roof design to the detailed design stage.

Disclaimer

AT encourages green roofs on advertising shelters; however, implementation will be determined on a case-by-case basis in consultation with the approved advertising partner. Any inclusion is subject to formal agreement, with maintenance responsibilities assigned to the advertising partner.

6.4 Further consideration during design stage

During the design stage, Auckland Transport must consider a range of factors to ensure the effective, safe, and sustainable integration of green roof systems on transport infrastructure.

Requirements

6.4.i. Assess the effectiveness of green roof functions alongside asset integrity, maintenance requirements, life cycle costs, and health and safety considerations during maintenance activities.

6.4. ii. Consider both internal green roof elements and the broader implications for applicability, maintenance, and long-term performance on bus shelters and transport facilities.

6.4.iii. Evaluate structural capacity to support the saturated weight of green roof systems, considering the materials used in existing shelter roofs.

6.4. iv. Ensure adequate drainage design to prevent water pooling and potential leaks.

6.4.v. Incorporate appropriate edging solutions to contain the growing medium, prevent soil loss or plant displacement, and mitigate risks of vandalism or theft.

6.4.vi. Provide safe and practical accessibility for routine maintenance, including inspection, irrigation, and plant replacement.

6.4.vii. Select plant species suited to Auckland's climate and the specific environmental conditions of transport hubs, prioritising low-maintenance and drought-tolerant varieties to minimise upkeep costs.

6.4. viii. Consider visual impact and opportunities for community engagement, ensuring green roofs enhance both the aesthetics and functionality of public spaces.

7. Green Roof Design Elements

7.1 Internal Design Elements

The internal design elements of a green roof define the layered system that ensures its structural integrity, waterproofing performance and long-term durability. These layers can be incorporated during the original construction of the bus-shelter or installed later as a retrofit system placed above the completed roof structure. These elements include (but are not

limited to) the waterproofing membrane, root barrier, drainage layer, filter layer, growing substrate, edging systems, irrigation, and the selected plant species. Referred to together, these components must be designed and integrated to function as a cohesive system that meets Auckland Transport's operational, safety, and sustainability requirements.

These layers are critical to the performance of the green roofs as they govern structural load distribution, waterproofing integrity, thermal regulation, water retention and drainage, root protection, and substrate stability. (Auckland Council , 2003)

Figure 9: Typical Green Roof Composition (Auckland Council , 2013)

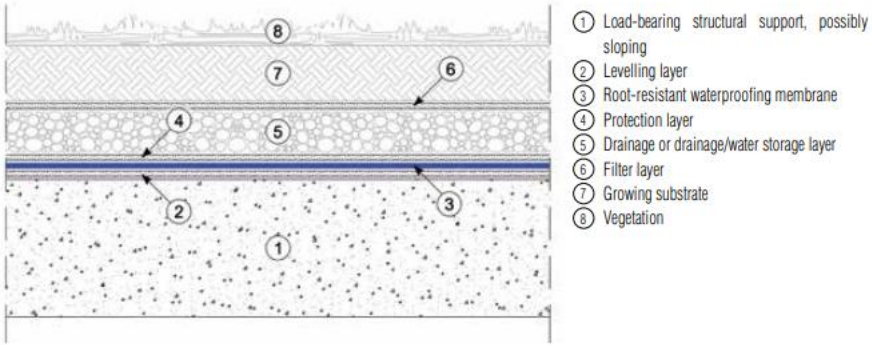

Figure 10: Layers of Green Roofs.

7.1.1 Structural Support

Structural support means the roof and its supporting structure can safely resist all loads imposed by the green roof system damage, or loss of performance. The roof structure must safely support the full green roof system under all expected loading conditions.

Requirements

7.1.1.a. The maximum saturated system weight must be confirmed with the manufacturer or supplier.

Advise Note: The current design of the bus shelters must be assessed for the additional weight due to the green roof including whether the current design needs any structural alternations to accommodate the proposed green roof elements.

7.1.1.b. A structural assessment is required to confirm that:

- For new installation, the roof is designed to accommodate the specified loads.
- For retrofit installations, the existing structure can safely support the specified loads.

7.1.1.c. All structural capacity assessments must be verified and approved by a qualified structural engineer before installation proceeds.

Disclaimer: Where bus shelter designs are confirmed to be identical in form, materials, and structural specifications to those previously trialled and structurally assessed, additional structural assessment may not be required. However, this approach is only acceptable where AT's structural engineers undertake and formally verify that the installed shelter is consistent with the previously assessed bus shelter in all respects. Responsibility for this verification shall sit with AT's internal engineering team. Consultation with engineers experienced in green roofs design experience is recommended where applicable.

7.1.2 Waterproofing Layer

This waterproofing, also known as moisture protection layer, shall be provided beneath the modular green roof trays to protect the roof surface and protect the underlying roof structure from moisture-related deterioration. It facilitates drainage, minimises prolonged contact between retained water and the roof substrate, and provides an accessible layer that can be inspected maintained, repaired or replaced throughout the asset life.

Requirements

7.1.2.a. A moisture protection layer shall be installed beneath all green roof trays to protect the roof surfaces and underlying structure from prolonged moisture exposure and deterioration.

7.1.2.b. This layer shall be compatible with the roof and may comprise of waterproof liner, geotextile, membrane, or similar suitable for the intended application.

7.1.2.c. This layer shall not impede the roof's designed drainage system and must allow water to freely drain to drainage channels and gutters.

7.1.2.d. The system shall allow for the removal and reinstatement of modular trays to facilitate inspection, maintenance, repair, and replacement of the moisture protection layer throughout the asset life.

Disclaimer: These requirements apply to modular tray green roofs systems only. Any other type of green roof system may require more robust waterproofing layer, protection testing, and certification requirements. Any departure from these requirements, or use of different green roof system shall be subjected to review and approval by Transport Design Manager (TDM).

7.1.3 Root-barrier Layer

A root barrier layer is required to prevent plant roots from penetrating or damaging the waterproofing membrane and the roof structure beneath it. This barrier may be achieved through chemical or physical means or may be integrated into proprietary drainage or waterproofing systems designed for green roofs.

Requirements

7.1.3.a. The layer shall prevent root penetration into the waterproofing layer for the entire service life of the green roof system.

7.1.3.b. The system shall allow for inspection, maintenance, and repair where required, without compromising the continuity or performance of the layer.

7.1.3.c. The layer shall be compatible with adjacent system components, including the waterproofing membrane, drainage layers, and any maintenance requirements.

7.1.3.d. Provide continuous protection across all roof areas, including edges, joints, penetrations, and transitions, ensuring no gaps where roots could compromise the roof structure.

7.1.4 Drainage Layer

The drainage layer is required to manage excess water, protect the roof structure and ensure healthy plant growth. Its function is to manage surplus rainwater and irrigation runoff, preventing water accumulation that could damage the roof or harm plant growth. This layer is important because effective drainage protects the waterproofing membrane, prevents structural stress from ponding, and maintains a healthy balance of moisture for vegetation.

Requirements

7.1.4.a. The layer shall allow excess water to flow freely, preventing pooling and undue pressure on the roof structure.

7.1.4.b. Drainage outlets must remain accessible and unobstructed for inspection and maintenance.

7.1.4.c. The layer shall retain enough moisture to support plant health without drying out too quickly.

7.1.4.d. Materials used must be compatible with adjacent components and suitable for long-term rooftop conditions.

7.1.5 Substrate

A substrate is an engineered growing medium that supports plant, retains water, provides nutrients, balances drainage with the structural load. The main types are extensive substrates (20–150 mm) and intensive substrates (typically >200 mm) (ASTM, 2006). Extensive substrates are lightweight, shallow and low maintenance whilst, intensive substrates are deeper, heavier, capable of supporting shrubs and tree. However, modular

green roof systems consist of vegetated trays, usually made of plastic, which are placed closely together on the roof. These trays are pre-planted and grown off site before being installed to create an instant vegetated cover.

Requirements

7.1.5.a. The substrate for a tray modular green roof shall be a lightweight, engineered green roof growing medium specifically designed for modular systems. It shall provide adequate support for plant growth while maintaining good drainage, aeration, and water retention.

7.1.5.b. The substrate shall support the use of specialist, lightweight green roof substrates rather than conventional soils.

7.1.5.c. The substrate shall be free-draining and capable of retaining sufficient moisture to sustain vegetation between rainfall events, while allowing excess water to drain to prevent waterlogging.

7.1.5.d. The substrate shall be low in organic content and formulated to suit the intended planting type, such as sedum or other modular green roof vegetation.

7.1.5.e. The substrate depth shall be consistent within each tray and appropriate for the selected vegetation and system design.

7.1.5.f. The substrate shall be tested and specified in accordance with relevant green roof standards and supplier requirements, including project-specific structural loading, water retention, drainage, and vegetation performance criteria.

7.1.6 Vegetation

The vegetation layer is the living component of a green roof system. It consists of plants specifically selected to thrive in shallow, lightweight substrates and exposed rooftop conditions. This layer is important because appropriate plant selection ensures long-term system resilience, reduces erosion, and maintains healthy vegetation under variable weather conditions.

Requirements

7.1.6.a. Vegetation shall be suited to modular tray-based green roof systems.

7.1.6.b. Vegetation shall comprise hardy, low-growing, shallow-rooted species suitable for shallow substrate depths.

7.1.6.c. Species shall be tolerant of exposed sun, wind, heat and intermittent dry periods.

7.1.6.d. Species shall be drought tolerant, low maintenance and capable of long-term survival with minimal irrigation once established.

7.1.6.e. Species shall be non-invasive and shall not obstruct drainage or damage the tray system.

7.1.6.f. Vegetation shall be capable of forming stable, durable and predominantly continuous vegetation cover.

7.1.6.g. Species shall be proven for Auckland/site specific local climate conditions.

7.2 External Design Elements

The external design elements of a green roof define how the system interacts with the surrounding environment and how it is safely accessed and maintained. These components including edging, drainage systems, in-built irrigation (where required), and access provision to ensure the green roof remains stable, well drained, and maintainable throughout its service life. Together, these elements support substrate containment, effective water management, vegetation health, and safe maintenance activities. Proper integration of these external elements is essential to achieving long-term performance, durability, and compliance with operational and safety requirements.

7.2.1 Edging

Edging around the bus shelter roof is required to contain the system in place and ensure stability of the layered components. Edging is the perimeter component installed around the roof to contain the green roof system and prevent lateral movement of materials. Its purpose is to keep the substrate, vegetation, and drainage layers securely in place under wind, water flow, and general environmental conditions. This component is important because it maintains the stability of the layered system, prevents substrate loss, protects the waterproofing membrane, and ensures the roof performs effectively over its service life.

Requirements

7.2.1.a. Edging shall provide a secure and continuous perimeter that fully contains the green roof system within the roof footprint.

7.2.1.b. Materials shall be durable, compatible with the roof structure, and shall not compromise waterproofing integrity or resistance to wind uplift.

7.2.1.c. The design shall allow safe and unobstructed access for inspection, maintenance, and drainage system checks.

7.2.1.d. Edging shall be installed in accordance with manufacturer recommendations and industry best practice.

7.2.2 Drainage System

The drainage system is the existing roof drainage infrastructure that removes excess water from the bus shelter or station. Its purpose is to ensure that rainwater and runoff from the green roof are efficiently directed away from the roof surface. This system is important because effective drainage prevents water pooling, reduces structural stress, protects the waterproofing membrane, and supports healthy long-term green roof performance.

Requirements

7.2.2.a. No component of the green roof assembly shall obstruct, restrict, or interfere with existing drainage pathways.

7.2.2.b. All layers, including substrate, vegetation, and edging, shall be arranged to always maintain free-flowing drainage.

7.2.2.c. Routine inspection and maintenance shall be undertaken to prevent blockages and ensure stormwater is effectively managed under all operating conditions.

7.2.3 In-built Irrigation System

An in-built irrigation system is an optional component designed to supply supplemental water to the green roof, particularly for bus stations where roof areas are larger and water access is available. Its purpose is to minimise manual watering, maintain consistent moisture levels during dry periods, and support long-term plant health. This system is important as it reduces maintenance hours, improves vegetation resilience, enables irrigation scheduling, and can utilise harvested rainwater to minimise potable water use.

Requirements

7.2.3.a. The system shall be designed to minimise potable water consumption; where feasible, it shall be connected to a rainwater harvesting tank.

Advice note: An in-built irrigation system is highly recommended for bus stations but is generally not suitable for bus shelters due to the lack of an accessible water source. Discussion and approval with Maintenance team will be required.

7.2.3.b. The system shall provide automated or timer-controlled irrigation to eliminate the need for regular manual watering.

7.2.3.c. The irrigation system shall include water use metering and data logging (e.g., inline flow meter with totaliser), with data retained in the asset record and available for maintenance review and performance reporting.

7.2.3.d. Metering shall distinguish between potable and non-potable sources where both are present.

7.2.3.e. An Operation and Maintenance (O&M) Plan specific to the irrigation system shall be provided, covering inspection frequency, seasonal scheduling, trigger thresholds for adjusting run times (e.g., rainfall/temperature), meter reading and reporting procedures, filter/strainer cleaning and leak checks, and standdown procedures where applicable.

- Irrigation system design, control settings, metering, and O&M requirements shall be confirmed in consultation with Suitably Qualified Experienced Asset Maintenance Professional during early project stages.
- Installation shall be integrated so it does not compromise the performance of other green roof components.

7.2.4 Safe Access

Access in this context refers to how maintenance personnel can safely reach the green roof for inspection, servicing, and upkeep. It is critical all routine and periodic maintenance activities are carried out in accordance with appropriate workplace safety protocols, enabling risks to be effectively managed and minimised during access and maintenance.

Requirements

7.2.4.a. A safe and clearly defined access route to the roof shall be provided for all assets with a green roof.

7.2.4.b. Access provisions shall comply with relevant health and safety regulations.

7.2.4.c. The access method shall allow maintenance personnel to safely carry tools and equipment required for routine servicing.

7.2.4.d. Access points shall be unobstructed, secure, and designed to prevent unauthorised entry.

7.2.4.e. For bus stations, access shall be specifically designed to support regular maintenance activities; for bus shelters, feasibility of safe access must be confirmed during the design stage.

7.2.4.f. All access provisions shall be documented in the Operation and Maintenance (O&M) Plan for the green roof system.

8. Inspection and Compliance Verification

Requirements

8.a. The green roof works must be supported with signed copies of “A” series producer statements PS1/A, PS4/A including PS3 by the green roof installer.

These documents shall be submitted to AT as part of asset vesting procedure.

9. Operational and Maintenance

Requirements

9.a. The ongoing maintenance of the green roofs shall be undertaken in accordance with the requirements of Auckland Transport Facilities Management team including the activities outlined in Appendix 3 – Green Roof Maintenance Checklist.

9.b.

9.1 Reporting and Escalation

Procedure

Where structural damage, water ingress, instability, or any safety risk is identified during inspection, maintenance, or works, the Contractor shall take the following actions:

i. Immediately cease works where conditions are assessed as unsafe.
ii. Collect photographic evidence as soon as practicable, and only where it is safe to do so.
iii. Notify the Auckland Transport Maintenance Team within 24 hours of identification, including photographs and a brief description of the issue.
iv. Escalate the matter to the Green Roof Subject Matter Expert (SME) within one (1) working day for technical assessment and recommended corrective actions.
v. Where an immediate or imminent risk to public safety is identified, notify Auckland Transport Operations (ATOC) immediately and take all reasonable measures to mitigate risk until further direction is provided by AT.

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11. Definitions

Term	Definition
Green Roofs (Bus Shelter)	*A vegetated roof system installed on a bus shelter to provide stormwater, amenity, biodiversity or climate resilience benefits, including the associated growing media, drainage, waterproofing and planting components.*
Extensive green roof	*A lightweight green roof system with shallow growing media and low-profile vegetation, typically selected where weight, access and maintenance constraints apply.*

Intensive green roof	*A green roof system with deeper growing media and a broader planting palette, typically requiring greater structural capacity, higher maintenance input and more intensive irrigation than an extensive green roof.*
Modular system	*A green roof system made up of trays, modules or units that can be installed, removed or replaced individually.*
Growing media	*The engineered substrate used to support plant growth, water retention and drainage performance within the green roof system.*
Establishment period	*The initial period following installation during which more frequent irrigation, inspection, weed control and plant replacement may be required to achieve successful establishment.*
Maintenance access	*The safe and practical means by which personnel can inspect, maintain, repair or replace green roof components throughout the life of the asset.*
Waterproofing system	*The membrane and associated components that prevent water ingress into the bus shelter structure.*
Overflow	*The controlled discharge pathway that conveys excess water when the green roof storage or drainage capacity is exceeded.*
Whole-of-life performance	*The expected performance of the green roof system over its full life cycle, including design, construction, operation, maintenance, renewal and replacement.*

12. Supporting Information

Supporting documents	• Hīkina te Wero: AT's Environmental Action Plan 2021-2030. • AT Sustainability Strategy 2024-2031. • Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan. • Auckland's Urban Ngahere (Forest) Strategy (2019). • The Auckland Plan 2050. • National Adaptation Plan (2022) - Nature-based solutions. • National Infrastructure Plan (2026) - Nature-based solutions. • Infrastructure NZ Policy Position (2025): Climate Resilient Infrastructure. • Health and Safety at Work Act 2015
Related documents	• Appendix 1 – List of Bus Shelter with Green Roofs • Appendix 2 – Pre and Post Installation Checklist • Appendix 3 – Maintenance Checklist This practice note should be read alongside relevant Auckland Transport design guidance, technical specifications, asset

	management requirements, health and safety requirements, and any project-specific structural, waterproofing and maintenance documentation for bus shelter assets.

13. Approval

Practice Note Contact	Parampara Koirala Decarbonisation and Fleet Specialist Abby Sharma Principal Environment & Nature Based Resilience Specialist	Signed by: Para Koirala BF43D913C2124A8... Signed by: F30C03222B7D476...	28 July 2026
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Endorsed by:	Edward Wright Infrastructure and Fleet Specification Manager	DocuSigned by: EPN Wright 81E780559C83499...	06 August 2026
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Effective date	1st August 2026		

AT reserves the right to review, amend or add to this Practice Note at any time upon reasonable notice to users of the Transport Design Manual and related documents.