EXTENDING LIFE CYCLE OF ASSETS USING AUS-SPEC

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Abstract

AUS-SPEC is the national Local government specification system for the life cycle management of community assets. AUS-SPEC was founded in 1997 on the collective wisdom of many local councils with input from various industry bodies. Developed by the IPWEA and updated by NATSPEC, the AUS-SPEC master specification system, allows a uniform approach to design decisions, construction and maintenance of roads, buildings, urban and open spaces and public utilities.

This paper provides an overview of using the AUS-SPEC specification *Templates* for the design, construction and maintenance of local infrastructure assets. The sustainability requirements are addressed by documenting products, materials and methods of construction that permit reduced water, energy and resource consumption and fewer emissions that contribute to climate change. Integration of sustainable practices into the management of community assets ensures that community wellbeing, environmental protection and economic prosperity are maintained for current and future generations. The AUS-SPEC specification system also promotes financial sustainability by being adaptable to different procurement methods and contract types and allows asset owners to balance the level of service provided with the maintenance and operations budget.

Key Words: Assets, asset management, asset maintenance, climate change, design, construction, life cycle, maintenance, procurement, sustainability

Introduction

AUS-SPEC is the Local Government specification system for the life cycle management of assets. AUS-SPEC is a national documentation system that provides consistency and a uniform approach to design decisions, construction and maintenance for buildings and minor civil works across Australia whilst providing for implementation of local requirements. It is suitable for documenting local roads, stormwater drainage, water and sewerage systems, urban and open spaces and community buildings.

Life cycle management of assets

Asset life cycle activities start with planning and end with disposal of an asset. To deliver and maintain a physical asset during its life cycle, asset management, life cycle strategies, financial planning and forecasting is required. Asset management advances the sustainability of infrastructure services. The AUS-SPEC documents have been developed following the principles of asset management as outlined in the International Infrastructure Management Manual (IIMM).

Life cycle management in AS ISO 55000

AS ISO 55000 defines *Asset life cycle as stages involved in the management of an asset*. An Asset management plan is defined as *the documented information that specifies the activities, resources and timescales required for an individual asset or a grouping of assets to achieve the organisation's objectives*. It acknowledges that, assets exist to provide value to the organisation and its stakeholders and incorporates the principle of life cycle management approach to realise value from assets. Asset management translates the organisational objectives into technical and financial decisions, plans and activities. This includes the specification,

design and implementation of a supporting asset management system. The asset management plan can enable an organisation to link, its asset management system and a variety of specific, technical asset management requirements. These specific technical requirements are given in standards and provide information on design, construction, material and process information. The standards when cited in the specifications like NATSPEC and AUS-SPEC become part of the contract documents.

AS ISO 55000 clause 2.6 further states that using an integrated systems management approach allows an organisation's asset management system to be built on elements of its other management systems such as quality, environment, health and safety and risk management. AUS-SPEC's *0167 Integrated management* worksection can be used to implement an integrated approach and helps reduce cost, risks and improves cross functional coordination.

AUS-SPEC for life cycle management of assets

The development of standard processes of documentation, like AUS-SPEC, improves efficiencies and effectiveness.

AUS-SPEC focuses on the engineering and technical aspects and processes of 'how to' plan, design and construct new assets and maintain existing assets. AUS-SPEC also provides sample contract documents for different types of projects.

Figure 1: Asset Lifecycle Activities (Source: IIMM)

Figure 1 from IIMM, represents the asset life cycle activities. AUS-SPEC can be used for the following IIMM defined life cycle activities:

- Asset planning
- Asset creation
- Operations and maintenance
- Asset monitoring
- Renewal and rehabilitation.

AUS-SPEC cites the Australian Infrastructure Financial Management Guidelines (AIFMG) in the TECHguides to raise awareness of the financial aspects of Local government assets. This is to assist Councils to improve their asset management performance and financial sustainability. TECHnote GEN 017 provides a summary of *Using AUS-SPEC for asset management*.

AUS-SPEC is a joint venture between NATSPEC and IPWEA. IPWEA through NAMS.AU provides tools and templates to assist Local Government councils to develop integrated asset management systems and practices to keep a record of existing assets, integrate asset management with Council's corporate and financial planning systems.

Extending life cycle of assets through sustainability

Local government infrastructure assets must be maintained throughout their lifecycle. The delivery, maintenance and repair of roads, parks, public buildings and amenities is a major responsibility and challenges local government to provide these services in a sustainable manner, maintaining the financial capital and the infrastructure capital over the long term.

Sustainability is about ensuring that the wellbeing of current and future generations of Australians is maintained or improved over time.

Wellbeing is a combination of community liveability, environmental sustainability and economic prosperity. *Sustainability is also the ability to maintain certain values, assets or* capabilities over the long term. Garry Bowditch, Director and CEO SMART

Infrastructure facility, University of Wollongong states, *Infrastructure is not an engineering artefact but an agent of change, is it possible to imagine infrastructure systems that can meet the needs of double today's population with half of today's resources while providing twice the liveability?*

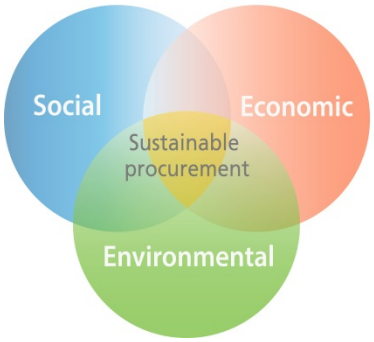

Figure 2: Sustainable procurement

Considering sustainability at an early stage of procurement decision-making process can identify opportunities to:

- Reduce energy consumption.
- Identify whether there is a more sustainable alternative readily available.
- Rethink and revise specifications in order to improve sustainability outcomes.

Sustainable procurement as shown in Figure 2 can be aligned with the general stages of the procurement process to reduce the adverse environmental, social and economic impacts of purchased products and services throughout their life cycle. Specification *Templates* can be customised to provide either minimum or desirable sustainability requirements.

Procurement for sustainable construction

The overall objective of good design is to ensure that buildings, infrastructure, public spaces and places are buildable, fit for purpose, resource efficient, sustainable, resilient, adaptable and attractive. Good design is synonymous with sustainable construction.

Sustainable procurement can be defined as:

A process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, while minimising damage to the environment.

The focus of sustainable procurement is not just on asset delivery but also on the environmental impact of the asset throughout its life cycle, including avoiding unnecessary consumption as illustrated in Figure 3

Figure 3: Objectives of sustainable procurement in construction

More details on sustainable procurement are discussed in the NATSPEC TECHreport *TR06 Procurement – past and present*.

AUS-SPEC documents assist in defining the different stages of project delivery providing a clear project scope and a platform for quality design documentation for the selected procurement system. Requirements are defined clearly and unambiguously and specified before proceeding with any procurement. This will ensure that prospective suppliers/contractors can offer to provide the goods, services, or works requested by the Local Government Councils.

Most aspects of sustainability relating to buildings and infrastructure are design decisions. The primary function of the specification is to give effect to design

decisions. A specification addresses sustainability requirements by documenting products, materials and methods of construction that permit the implementation of ecological sustainable development (ESD). Most of the worksection *Templates* include sustainability requirements through choice of materials, and energy and water conservation measures for example, including integrated management, water sensitive urban design, stormwater harvesting, control of erosion and sedimentation, demolition for re-use, recycled and durable materials.

Sustainability requirements addressed in specifications focus on:

- Giving effect to design decisions not shown on the drawings.
- Specifying sustainable materials and methods of construction.
- Specifying components and products that permit the implementation of sustainable design.
- Meeting mandatory sustainability requirements to the extent that these can be handled through the specification process.

Asset maintenance strategies which address sustainability requirements such as social and environmental factors provide significant savings in life cycle costs. The maintenance strategy will bridge the development phase and the operation phase. Maintenance is an on-going process and the Plan, Do, Check and Act (PDCA) cycle provides a framework for life cycle maintenance as shown in Figure 4.

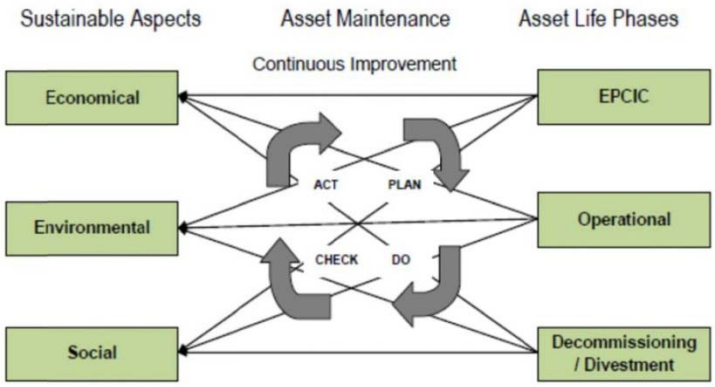

Figure 4: Continuous improvements in asset maintenance for sustainability [7]

EPCIC in the figure refers to Engineering, Procurement, Construction, Installation, and Commissioning.

Sustainability requirements in AUS-SPEC

AUS-SPEC addresses the sustainability issues by embedding the requirements in the design, construction and maintenance worksections to create specifications for infrastructure projects including, roadworks, urban and open spaces, buildings and public utilities. Life cycle management of assets are covered by the following AUS-SPEC worksections:

- Planning and Design worksections: These worksections form a basis for uniform design processes for civil infrastructure works. These worksections can be used for Council capital works as well as developmental works.
- Construction worksections: These specifications are for Quality control and Integrated management systems and contracts associated with most Councils' engineering activities.
- Maintenance worksections: The AUS-SPEC maintenance system recommends a proactive approach to asset maintenance and includes maintenance and operations specifications for parks and recreations areas, buildings and facilities, road reserves and public utilities.

The sustainability requirements covered in planning and design, construction and maintenance worksections are listed in Appendix B. However, these are only minimum requirements; additional

sustainability requirements can be added to the worksection *Templates* as appropriate.

Sustainability requirements for buildings

The AUS-SPEC *Complete* package includes the NATSPEC *Building basic* and the NATSPEC *Building landscape* package. The sustainability requirements for building works are covered by NATSPEC packages. The sustainability requirements for local government infrastructure assets are covered by AUS-SPEC packages. Together they provide a whole system for creating a sustainable specification.

The ways in which the specification can be used to implement specific ESD principles can be divided into a number of broad categories:

- Energy conservation and greenhouse gas reduction.
- Conservation of other consumables (like water).
- ESD appropriate materials e.g. materials with low volatile organic compounds (VOC) emissions.
- Quality environment, both inside and outside the building, using ESD principles.

NATSPEC provides a framework in which clients and designers who wish to incorporate ESD principles and consider life cycle costs can do so, while also enabling appropriate choices to be made for clients whose priority is lowest initial cost. NATSPEC addresses the ESD provisions in the NATSPEC TECHreport TR01 *Specifying ESD*.

AUS-SPEC provides a number of TECHreports and TECHnotes listed in Appendix A with additional information on sustainability requirements and how NATSPEC and AUS-SPEC addresses them in the specifications.

Specifying refurbishment with NATSPEC

Refurbishing presents an opportunity to reposition a building in the marketplace, improve environmental performance, reduce running costs and increase occupant comfort. Whether it is a minor, major or total upgrade, a well written specification can ensure the required quality level is achieved.

NATSPEC TECHreport TR04 *NATSPEC for refurbishment, retrofitting and adaptive reuse* outlines how the NATSPEC specification system may be used for refurbishment, retrofit and adaptive re-use projects.

Extending life cycle of assets through maintenance management

Asset life cycle covers planning, investment/procurement, management-in-use and disposal of assets such that their service delivery potential is maximised and that risks and costs are managed over their entire life.

Strategic asset management framework - Life-cycle planning, Qld Department of Housing and Public works.

If appropriate design and construction techniques are adopted during the asset creation phase then minimum maintenance is required. To extend the life cycle of assets, proactive maintenance management system should be in place. Maintenance aims to preserve an asset and includes regular checking, repairs and minor improvements to remove the cause of any defects and avoid excessive repetition of maintenance effort. Each council needs to have a maintenance policy and strategy to effectively manage and maintain their assets at an appropriate level of service and structural integrity at the lowest possible cost to the asset owner and users. Delayed or neglected maintenance may incur additional direct and indirect costs and shorten the life of an asset.

AUS-SPEC maintenance system

The AUS-SPEC maintenance system is based on quality management, competitive principles and programmed maintenance. It reflects the move from predominantly direct control, responsive maintenance and operations to the proactive approach outlined in the National Sustainability Frameworks for Asset Management for Local Government, and developed in the International Infrastructure Management Manual (IIMM) and the Australian Infrastructure Financial Management Guidelines (AIFMG). The system allows asset owners to balance the level of service provided with the maintenance and operations budget available, and prepare documentation for in-house and/or external maintenance

contracts. It includes records of asset inspections, defects registers, programmed and prioritised works and periodic reports of completed works. These records and reports improve the maintenance history and asset inventory and also provide a defence against possible litigation.

Asset maintenance plans

The management of assets in AUS-SPEC is on an asset by asset basis. Each asset is managed against an Asset maintenance plan that defines the activities required by that asset, includes maintenance, refurbishments, and ultimate replacement and is the heart of the asset management process. Each of these activities has an associated expected cost. Therefore, the Asset maintenance plan is both an activity plan and a financial plan. Asset maintenance plans are routinely updated through ongoing condition monitoring and become increasingly accurate.

Asset maintenance plans are defined by time period and, when combined, provide a financial plan for all asset-related activities at an organisation level that looks forward many years. This financial plan supports both short-term budgeting and long-term financial planning processes.

These asset plans are also the primary keys to the substantial savings available from asset management. Asset management depends on continuous measurement, feedback, and updating of asset plans. The level of effort involved in allocating costs to specific assets, tracking these costs, assessing asset conditions, and updating asset plans and asset-related activities is far from trivial. Asset management assists in organising resources responsible for procurement decisions, IT systems, capital management, and Operations & Maintenance (O&M). Engineering, planning, finance, O&M, and information systems must work together cooperatively, on a day-to-day basis. A whole of council approach is essential so that everyone involved in the maintenance of different assets are aware of the asset maintenance and management requirements.

The benefits of asset maintenance plans:

- Improved regulatory compliance.
- More meaningful financial reporting.
- Increased system reliability.
- Long-term system integrity.
- Potentially, eligibility for federal infrastructure funding.
- Significant cost savings.

AUS-SPEC maintenance worksections cover routine, periodic and urgent maintenance for local government infrastructure assets. AUS-SPEC design and construction worksections can be incorporated into the documentation for projects requiring reconstruction and rehabilitation.

The AUS-SPEC maintenance system includes maintenance and operations of parks and recreations areas, buildings and facilities, road reserves and public utilities. See attached TECHnote GEN 018*, Using AUS-SPEC for asset maintenance*.

Asset data collection

Establishing an effective proactive maintenance system requires an inventory of all assets. The form and type of data required by the AUS-SPEC maintenance system is consistent with Pavement Management Systems (PMS) and Maintenance Management Systems (MMS).

Specialised systems and technology can also be used for data collection e.g. GIS, digital photography, GPS equipment and satellite navigation, mobile communications and electronic data acquisition equipment. These systems provide several benefits for efficient and improved means of data collection for maintenance purposes.

Application of the AUS–SPEC Maintenance System

The critical elements of the AUS-SPEC Maintenance Plan are the Maintenance Defects Register (MDR), Recording Levels and Response Times. The MDR drives the maintenance system. The nominated Response Times are resource dependent. Response Times and Compulsory Intervention Levels are the key factors that impact the maintenance budget and can be edited to suit the project and asset owner.

Upon reaching a nominated Recording Level a defect is recorded on the MDR and is either rectified or scheduled for rectification within the given Response Time. This provides the asset owner with data which indicates:

- Current condition of the assets.
- Specific maintenance activities required.
- Amount of work required to bring the asset to an acceptable standard.

The asset owner is also able to:

- Track the condition of defects with time.
- Estimate the total cost to repair all defects.
- Rank projects for capital works.

Climate change – a future challenge

Climate change is the most significant sustainability challenge we face today and has significant potential to disrupt or damage existing and future infrastructure.

Following the release of the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, Alex Baitch, Ex-President, Engineers Australia, commented that *Australia has assets worth over $200 billion in coastal areas that support the livelihoods of 85% of the community, saying that as a nation, "we should be designing those assets to withstand the climate of the future not the climate of the past."*

Some 560 Councils in Australia are responsible for the management of a range of assets worth $212 billion. Most of the assets have a life span of more than 50 years and will be affected by climate change.

If sustainable practices are integrated into the life cycle of an asset, they provide numerous benefits to the environment, including reduced water, energy and resource consumption and fewer emissions that contribute to climate change.

The adaptation measures for climate change include:

- Structural measures including the analysis of infrastructure failures, regular infrastructure maintenance and retrofitting of existing assets.
- Non-structural measures including changes to contracts, planning instruments and policy, implementing disaster management planning.

The principal materials used in the construction of Council owned assets such as stormwater drains, roads and buildings are concrete, steel and bitumen. Climate change may increase salt concentration in the coastal environment due to gradual sea level rise or more frequent and severe storm surges, as a result concrete and steel structures may experience higher deterioration rates. This may cause the asset to deteriorate and shorten the design life, affect the level of service and require alterations to the maintenance schedules.

Climate Adaptation Manual for Local Government – Embedding resilience to climate change Volume 2, provides a range of models for embedding climate resilience in local government. The case studies provide examples from councils leading the way in climate adaptation and embedding activities for climate change within different functional areas e.g. asset management, maintenance contracts, procurement etc. Some case studies in the manual reflect how councils using the AUS-SPEC documents have embedded the climate change requirements in their maintenance contract documentation.

Conclusion

AUS-SPEC enables sustainability aspects to be embedded in the design decisions, construction and maintenance of community assets. AUS-SPEC specifications are a system of *Templates* and supporting information used by local government for the life cycle management of assets.

AUS-SPEC supports Councils in improving the sustainability of their infrastructure assets in the following ways:

- Social: AUS-SPEC covers design, construction and maintenance of infrastructure to serve the communities by providing roads, public utilities, urban and open spaces and buildings.

- Ecological: AUS-SPEC is concerned with life cycle management of infrastructure by looking at the whole-of-life, rather than the parts.
- Economic: AUS-SPEC is a national specification system which promotes standardisation and consistency across Council areas and is aligned to the National Sustainability framework, IIMM and AIFMG.

AUS-SPEC maintenance system and the sustainability aspects embedded in the design, construction and asset maintenance *Templates* assist the councils in extending the life of their current as well as future infrastructure assets.

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Author Biography

Nandini Mehta is the AUS-SPEC Manager at NATSPEC, publisher of the National Building Specification of Australia and has been responsible for the integration of AUS-SPEC specifications into the National Classification System. A civil/structural engineer by profession, she has been involved in the design and construction industry for over 20 years. Nandini joined NATSPEC, 10 years ago and has worked on various publications including TECHguides, TECHnotes and TECHreports, and has developed a number of new NATSPEC/AUS-SPEC specification worksections. Before joining NATSPEC she was a Design Engineer working in the Middle East on several prestigious projects in the UAE with many international organizations. She has a wide range of expertise in the construction of high rise buildings and civil works.

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Appendix A

Publications covering maintenance requirements in AUS-SPEC:

TECHguides

- TG 401 – Guide to parks and open space maintenance system and documentation
- TG 403 – Guide to buildings and facilities maintenance system and documentation
- TG 405 – Guide to road reserve maintenance system and documentation

TECHnotes

- GEN 017 Using AUS-SPEC for asset management
- GEN 018 Using AUS-SPEC for asset maintenance

Publications covering sustainability requirements in AUS-SPEC/NATSPEC:

TECHreports

- TR01 Specifying ESD
- TR03 Specifying design and construct – mechanical
- TR04 Using NATSPEC for refurbishment and adaptive reuse
- TR05 Selection and design of building IT systems
- TR06 Procurement: past and present
- TR07 Access for maintenance

TECHnotes

- GEN 020 Building commissioning
- DES 001 Slip resistance performance
- DES 002 Moisture content in timber
- DES 003 Fire hazard properties of insulation materials
- DES 004 Air, moisture and condensation
- DES 005 Preventing condensation on ducts and air handling
- DES 010 Atmospheric corrosivity categories for ferrous products
- DES 011 Rainwater harvesting
- DES 013 BCA Energy efficiency protocol and software for housing
- DES 014 Voluntary environmental rating schemes for buildings
- DES 015 BCA - NCC Volume One Energy efficiency provisions
- DES 016 BCA - NCC Volume Two Energy efficiency provisions
- DES 017 Selection of sealants
- DES 018 Bushfire protection
- DES 019 Pipe support spacing
- DES 020 Fire behaviour of building materials and assemblies
- DES 021 Site electricity supply
- DES 022 Microbial control
- DES 023 Mechanical services pipe and vessel insulation
- DES 024 Water sensitive urban design (WSUD)
- DES 025 Mechanical design and install HVAC checklist
- DES 026 Living walls and roofs
- DES 027 Impact sound insulation
- DES 028 Grass seeding and turfing
- DES 029 Native grass lawns
- DES 030 Seismic design actions on non-structural components
- DES 031 Specifying R-Values
- PRO 001 CCA (copper chrome arsenate) treated timber
- PRO 002 Mineral wool
- PRO 003 Warranties for steel protective paint coatings
- PRO 004 Ceramic tile and adhesive selection
- PRO 005 Formaldehyde - indoor air quality
- PRO 006 Glass types used in buildings

Appendix B

The AUS-SPEC worksections include the following sustainability requirements for consideration at the planning and design, construction and maintenance stages:

Planning and Design worksections ***(Workgroup 00)***	***Construction worksections*** ***(Workgroups 02, 03, 11 & 13)***	***Maintenance worksections*** ***(Workgroups 14-18)***
- Legislative requirements - Environment Protection and Biodiversity Conservation Act 1999 - Environmental impact statement (EIS), review of environmental factors (REF) and statement of environmental effects (SEE) and other state specific legislative requirements. - Natural and built environment impact assessment. - Social and economic impact assessment. - Protection of trees. - Identification and protection of sites of Aboriginal and heritage significance. - Identification of natural hazard areas including bushfires and flood prone land. - Identifying sensitive environments e.g. estuarine wetlands, rainforests etc. - Cost benefit report, marine biology report and environment report for waterfront development. - Protection of marine flora and fauna. - Control of erosion and sedimentation. - Flood control measures. - Environmental considerations including construction materials, noise and light pollution, ecological footprint, environmental management report for construction. - Climatic conditions, environmental considerations including moisture and temperature changes, specific location effects e.g. mine subsidence, freezing, snow and ice removal. - Surface noise considerations. - Salinity prevention. - Water sensitive urban design (WSUD) principles. - Water cycle management including stormwater harvesting and reuse, stormwater collection, storage, treatment and distribution and stormwater management. - Minimise environmental impact by using trenchless technology.	- Environmental Management Plan and environmental assessment. - Control of erosion and sedimentation. - Dust control. - Water erosion. - Environmental impact statement. - Weed management and control. - Preservation and protection of trees. - Treatment of cleared vegetation. - Disposal of materials. - Protection of environment and heritage areas. - Protection of property and environment. - Bushland restoration. - Implementation and maintenance of environmental protection measures before disturbing the natural surface on site. - Use of recycled materials for the construction of flexible and concrete pavements. - Use of Reclaimed asphalt pavement. - Use of Warm mix asphalt. - Geopolymer concrete **The sustainability requirements for buildings are covered in Workgroups 1-9 and in TECHreport TR01 Specifying ESD.**	- Environmental Management Plan and additional Local or State requirements to promote conservation of the natural environment and cultural heritage. - Environmental protection measures related to use of herbicide and chemicals. - Minimisation of noise, smoke and other nuisances and green waste. - Minimisation of disturbance and clearance of flora and fauna. - Minimisation of dust generated from disturbed areas. - Prevention of weed infestation, especially into undisturbed native flora areas. - Minimisation of interruption or modification of natural or pre-existing drainage paths. - Minimisation of removal or lopping of trees. - Protection of soil and water from contamination. - Minimisation and control soil erosion. - Protection of native fauna habitats. - Provision of appropriate tools and well maintained machinery. - Protection of sites of cultural and natural heritage significance. - Maintenance of the aesthetics of an area. - Use of waste minimisation management techniques. - Off-site green waste processing.