



NORFOLK ISLAND REGIONAL COUNCIL

# Public Land Grazing Management Strategy

NORFOLK ISLAND



# Consultant Information

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  - Market development

# Document Information

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- Department of Infrastructure, Transport, Regional Development, Communications and the Arts (**DITRDCA**);
- Norfolk Island National Park (Parks Australia) (**NINP**);
- Department of Climate Change, Energy, the Environment and Water (**DCCEEW**);
- Norfolk Island Cattle Association (**NICA**); and
- Castles Environmental.

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## 1. Executive Summary

### 1.1. Scope

Cattle grazing on public land is a long-standing practice on Norfolk Island. However, cattle have been identified as one of several contributors to reduced surface water quality, including in catchments draining to sensitive receiving environments. This Public Land Grazing Management Strategy (**Strategy**) has been prepared for the Norfolk Island Grazing Project Working Group (**Working Group**) to support continued cattle grazing on public land while reducing environmental risk and improving the consistency and sustainability of grazing management over time.

This Strategy is limited to cattle grazing on public land (including public road reserves where grazing occurs). It provides practical recommendations to reduce environmental risk, improve pasture and grazing management, and refine Carrying Capacity estimates as monitoring data becomes available. It does not seek to address broader agricultural development initiatives that sit outside the scope of public land grazing management.

### 1.2. Method

The Strategy has been developed using stakeholder input, desktop assessment, aerial imagery, and limited on-ground observations. Current public land grazing is administered through the allocation of Pasturage Rights, with 190 Stock Tags issued in 2023-24 across five main Grazing Zones on Norfolk Island. For Strategy purposes, the Current Effective Grazing Area has been estimated at 128 ha, comprising 82.6 ha public land plus 45.4 ha effective grazed road reserves. These figures are indicative and will benefit from refinement through future verification and monitoring. The Strategy uses Carrying Capacity as a central decision-support tool to help align grazing pressure with pasture availability and recovery. It is intended to inform practical actions that protect environmentally sensitive areas while supporting cattle productivity.

### 1.3. Carrying Capacity

Carrying Capacity outcomes are dependent on mapped areas and assumed pasture utilisation rates. Using the Current Effective Grazing Area (128 ha) and an assumed high pasture utilisation of 75%, the Current Carrying Capacity was calculated at an average of 196 Cow/Calf Units.

Applying a more conservative, sustainable average pasture utilisation rate of 55%, the Target Carrying Capacity was calculated at an average of 144 Cow/Calf Units for the Current Effective Grazing Area of 128 ha. This provides a sustainable benchmarking basis for aligning stocking levels with pasture recovery and environmental risk reduction using the current available area.

To test an optimised scenario, the Strategy also considers removing the most environmentally sensitive locations from grazing (Reduced Grazing Areas) and progressively adding suitable nominated areas (Additional Grazing Areas). Under this scenario, an Optimised Effective Grazing Area of 137 ha was identified, comprising 91.6 ha public land plus 45.4 ha Current Effective Grazed Road Areas. This represents a net increase of 9 ha relative to the Current Effective Grazing Area of 128 ha. Using the 55% utilisation benchmark, the Optimised Carrying Capacity averaged 154 Cow/Calf Units under average conditions.

The following Strategy outputs are indicative only and reflect the assumptions and limitations described in this document:

- Using the Current Effective Grazing Area (128 ha) and a sustainable average pasture utilisation rate of 55%, the Target Carrying Capacity was estimated at 144 Cow/Calf Units. On this basis, existing island-wide Stock Tag allocations (190 Cow/Calf Units) were indicated as approximately 132% of the Target Carrying Capacity benchmark.

- Using the Optimised Effective Grazing Area scenario (137 ha, incorporating the proposed Reduced Grazing Areas and Additional Grazing Areas) and a sustainable average pasture utilisation rate of 55%, the Optimised Carrying Capacity was estimated at 154 Cow/Calf Units.
- At the time of this Strategy, cattle owners had reduced stock numbers to approximately 149 Cow/Calf Units, which equates to approximately 103.5% of the Target Carrying Capacity (Current Effective scenario) and approximately 97% of the Optimised Carrying Capacity.
- The Strategy indicates that additional Carrying Capacity may be achievable through improved pasture dry matter production and refined grazing management. Indicative uplifts of approximately 10 to 15% are noted, subject to implementation, seasonal variability and ongoing monitoring.

On the basis of the indicative analyses undertaken, protecting environmentally sensitive areas, improving grazing management and pasture monitoring, and progressively enabling suitable additional grazing areas can support more sustainable Carrying Capacity outcomes while reducing environmental risk. The Strategy provides an implementation framework to guide this transition, with governance and approvals as critical prerequisites.

#### 1.4. Recommended Actions

The Strategy recommends a coordinated package of management measures intended to reduce environmental risk while maintaining viable cattle grazing on public land. In summary, these measures include:

- improving grazing rotation practices across all Grazing Zones and introducing seasonal restrictions where required;
- implementing routine pasture assessment and monitoring, and applying practical pasture management actions to support pasture recovery and productivity over time;
- progressively enabling grazing in Additional Grazing Areas, where approvals allow, to support more sustainable stocking outcomes and reduce pressure on sensitive areas;
- restricting grazing in environmentally sensitive areas (Reduced Grazing Areas), supported by prioritised exclusion fencing and rehabilitation where required; and
- developing and implementing supporting plans to guide delivery, including fencing, stock water, erosion control, acid sulfate soils, pasture assessment, grazing rotations, pasture improvement, and potential adjustments to Stock Tag allocations. These plans should be developed by appropriately qualified personnel and overseen through an agreed governance process.

#### 1.5. Limitations

Successful implementation will require coordinated decision-making across the relevant land managers, regulators and stakeholder groups. The Strategy recommends establishing and maintaining a formal Working Group governance structure, including clear decision-making protocols and an approval process for implementing recommendations. Formal endorsement is recommended from NICA, NIRC and relevant Commonwealth agencies before commencing major works or changes to Stock Tag allocations. This Strategy is based on indicative mapping, limited on-ground verification, and assumptions regarding pasture growth and utilisation. Carrying Capacity results are therefore subject to refinement as pasture monitoring, grazing records and area verification improve. The Strategy should be treated as a living document, with annual review and updates to Carrying Capacity calculations and recommendations as monitoring data becomes available and implementation progresses.

## 2. Introduction

### 2.1. Cattle Grazing on Public Land

Agriculture has long played a key role on Norfolk Island, with livestock, including cattle, sheep and poultry, together with fruits and vegetables, comprising the primary commodities. The island has an established tradition of cattle production, with grazing on public land being a culturally significant practice dating back to the arrival of the Pitcairn Islanders (Hoare (1999) in Section 14 References). Cattle grazing on roadsides and reserves has occurred for generations and remains a significant component of Norfolk Island's agricultural productivity, cultural identity and local economy.

The island's finite land area, combined with its steep and erosion-prone landscapes and unique native vegetation communities and other ecological assets, necessitates careful management to prevent overgrazing, land degradation and other environmental impacts. Cattle grazing on both public and private land is consistently under pressure from competing land uses such as housing, industry, cropping, infrastructure, tourism and nature conservation efforts.

Today, cattle remain important for food security and local livelihoods, offering a primary source of beef in an environment where imports are restricted by logistical challenges and biosecurity laws (Pinion (2022)). Beyond providing food and income, communal grazing fosters a strong sense of shared responsibility within the Norfolk Island community and enhances the island's tourism appeal.

In addition, cattle grazing on public land can assist with the control of excess vegetation growth, providing practical benefits including improved access, weed control, reduced fire risk, reduced vermin harbour and improved drainage in some landscapes (by improving excess surface water management, particularly on roadsides). This can facilitate other public land uses and reduce land maintenance costs (such as slashing/mowing, weed control, drain clearing etc.). However, balancing this cultural practice with environmental conservation is crucial.

### 2.2. Adverse Environmental Impacts

Norfolk Island has a sensitive natural environment with areas consisting of native and vulnerable ecosystems with endemic species and unique biodiversity which is under constant threat from adverse environmental impacts (invasive plant and animal species, water pollution, land degradation, climate change etc.) both on land and in surrounding marine environments.

Previous studies (URS (2013), Aecom (2017), Monash & Newcastle Universities (2021), Pinion (2022), CSIRO (2020), CSIRO (2023), CSIRO (2024)) have highlighted significant environmental and water quality issues, particularly in sensitive ecosystems such as Emily and Slaughter Bays, which are part of the Norfolk Marine Park. Elevated nutrient levels (particularly nitrogen, phosphorous, potassium and sulphur) have been linked to the proliferation of harmful algal blooms and degradation of the marine environments. These studies identify excess surface water runoff from the island as a major contributor to poor marine water quality. This runoff often carries sediments, nutrients, salts and other pollutants and is frequently characterised by high turbidity, imbalanced pH levels, elevated cation levels and organic debris which, in combination, can result in high water chemical or biochemical oxygen demands.

It has been recognised that a range of land management factors on the island contribute negatively to this poor surface water quality. Whilst human effluent management, groundwater contamination, earthworks, refuse management, domestic and municipal excess stormwater runoff and acid sulfate soils have also been identified as possible contributors to poor surface water quality, agriculture (and agricultural land management) has also been identified as a contributor. Some of the above studies implicate agricultural stock and associated land management practices in the redistribution and mobilisation of potential

surface water contaminants through pathways such as faeces deposition, supplementary feeding, direct disturbance of waterways and riparian zones, and soil disturbance leading to runoff, erosion and sedimentation. Whilst public land cattle grazing is only one aspect of these contributors, the management of cattle grazing on public land has been identified as an issue which can be more readily addressed, with solutions practically implemented, to help improve surface water quality in key areas of the island by comparison with other contributors. It is important to note that the removal of cattle alone will not be a complete solution to the environmental challenges faced by Norfolk Island. A holistic approach addressing multiple land use factors, including human effluent management, stormwater infrastructure, and broader agricultural practices, will be required to achieve meaningful improvements in water quality and ecosystem health.

### 2.3. Objectives

This Norfolk Island Public Land Grazing Management Strategy (**Strategy**) has been prepared for the Norfolk Island Grazing Project Working Group (**Working Group**). It aims to support continued roadside cattle productivity while addressing cattle grazing factors that contribute to elevated risks to surface water quality on and adjoining Norfolk Island. Focusing on public land, the Strategy seeks to reduce impacts on the most sensitive environmental areas through recommended exclusion and restriction areas (Reduced Grazing Areas) and the progressive inclusion of suitable additional grazing areas (Additional Grazing Areas), while promoting sustainable grazing practices that support pasture productivity and herd health. The Strategy recognises the importance of maintaining cultural practice while improving environmental outcomes, and is intended to contribute to improved water quality and protection of sensitive terrestrial and marine environments. It also acknowledges practical limitations, including finite grazing land availability, resource constraints, and the need for coordinated stakeholder collaboration, which will influence implementation and effectiveness over time. Overall, the Strategy seeks to support Norfolk Island's cattle grazing tradition while improving environmental outcomes to help sustain the island's natural resources in the long term.

### 2.4. Methodology

In compiling this Strategy, the Consultants have collated information provided by various stakeholders and representatives from the following organisations:

- Norfolk Island Regional Council (**NIRC**);
- Norfolk Island Cattle Association (**NICA**);
- Department of Infrastructure, Transport, Regional Development, Communications and the Arts (**DITRDCA**) (Australia);
- Norfolk Island National Park (Parks Australia) (**NINP**);
- Department of Climate Change, Energy, the Environment and Water (**DCCEEW**);
- Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) (Australia);
- Castles Environmental; and
- Regional Development Australia (**RDA**).

Following the collation and assessment of supplied information and data, along with desktop review of relevant material, the Consultants visited the island from Tuesday 20 August to Friday 23 August 2024 inclusive. During this visit, the Consultants liaised with stakeholders and inspected areas of public land currently managed with cattle grazing (Current Grazing Areas), along with public land with the potential to be grazed by cattle (Potential Grazing Areas).

The Consultants then prepared a draft Strategy, which was circulated to relevant stakeholders for review and feedback in February 2025. Following this, the Consultants revisited Norfolk Island from Tuesday 25 February to Thursday 27 February 2025 (inclusive) to re-examine key areas and receive and discuss feedback on the draft Strategy with as many stakeholders as possible. The draft Strategy was subsequently amended and, in consultation with the Working Group, a final version dated 12 May 2025 was issued. Following additional written feedback from key stakeholders, this final version (v2) of the Strategy was completed. An account of the main consultations undertaken during Strategy compilation is provided in the appendices (Appendix A - Main Strategy Consultation Phases).

The methodology used to compile this Strategy centred on assessment of the supplied and collected information to calculate public land cattle Carrying Capacity. This included calculation of the Current Carrying Capacity based on existing productive grazed public land (Current Effective Grazing Areas) and current management practices. The Working Group and other stakeholders also identified areas of public land with the potential to be grazed by cattle that are not currently grazed (Potential Grazing Areas), and highlighted areas of concern in relation to adverse environmental impacts from cattle grazing. Assessments of Carrying Capacity were then undertaken under various management scenarios to facilitate comparison of Current, Target and Optimised public land grazing.

This Strategy outlines practical strategies to enhance pasture management, livestock health and beef production. It also sets out strategies and recommendations to minimise the risk of adverse environmental impact from cattle grazing on public land and to protect and enhance environmental features on or in the vicinity of public land utilised for cattle grazing, including by recommending the removal of certain locations from the Current Grazing Areas (Reduced Grazing Areas) and the addition of new areas for cattle grazing from the Potential Grazing Areas (Additional Grazing Areas) (together, Optimised Grazing Areas).

## 2.5. Strategy Structure

This Strategy begins with a summary characterisation of Norfolk Island, including key environmental features and land uses. This summary is intentionally brief, and Strategy users seeking more detailed background are referred to other reports, such as Pinion (2022), which provide more comprehensive characterisation. See Section 3 Norfolk Island Site Characterisation Summary.

The Strategy then identifies public land grazing areas, including the indicative Current Grazing Areas and Current Effective Grazing Areas, followed by an outline of cattle numbers and distribution across the identified five (5) Grazing Zones. Refer to Section 4 Public Land Grazing Areas and Section 5 Cattle Numbers & Stock Tags. The Strategy goes on to provide an overview of current grazing management practices and pasture condition, production and utilisation. See Section 6 Grazing Management and Section 7 Pastures & Pasture Assessment.

Using these inputs, the Strategy presents a set of Carrying Capacity calculations (Current and Target scenarios) based on the Current Effective Grazing Areas and variable assumptions of pasture production and utilisation. This supports comparison between stocking rates and estimated Carrying Capacities, to inform where changes in management and/or stocking may be required to improve sustainability and reduce environmental risk. Refer to Section 8 Cattle Carrying Capacity.

The Strategy then identifies environmentally sensitive locations recommended for removal or restriction from grazing (Reduced Grazing Areas), as well as suitable locations proposed for inclusion (Additional Grazing Areas) (together, Optimised Grazing Areas). It outlines recommended changes to public land grazing and measures to manage sensitive environmental features, before presenting the Optimised Carrying Capacity scenario and summarising outcomes. See Section 9 Changes to Public Land Grazing,

Section 10 Management of Sensitive Environmental Features, Section 11 Optimised Carrying Capacity and Section 12 Carrying Capacity Summary.

The Strategy concludes with an implementation and monitoring framework, including governance and supporting plans, and recommendations for ongoing review and adaptive management as monitoring data becomes available (Section 13 Implementation & Monitoring).

References cited in the Strategy are provided in Section 14 References, followed by definitions of key terms and acronyms used (Section 15 Glossary & Acronyms) and supporting material (Section 16 Appendices).

## 2.6. Limitations

This Strategy is limited to registered cattle only (as opposed to other forms of livestock) and is confined to the areas of land outlined in Section 4 Public Land Grazing Areas and Section 11 Optimised Carrying Capacity. It is intended to guide the management of beef cattle grazing on public land and the protection of sensitive environmental features from cattle grazing on or adjoining those areas, and should not be used for any other purpose. The Consultants disclaim responsibility to any person other than the Working Group for issues arising in connection with this Strategy and exclude implied warranties and conditions to the extent legally permissible.

This Strategy relies on informed assumptions and the information available at the time of compilation to support analysis, conclusions and recommendations. Accordingly, the Strategy reflects conditions encountered and information reviewed during Strategy development, and the Consultants have no responsibility or obligation to update the Strategy to account for events or changes occurring after the date of finalisation.

Public land cattle grazing and environmental protection are influenced by seasonal variability, operational constraints and other factors outside the immediate control of stakeholders. Determining an appropriate long-term grazing approach that balances productivity, cultural practice and environmental protection is inherently complex. In addition, public land areas considered in this Strategy support multiple land uses, and implementation actions will need to be undertaken with regard to these potentially competing uses.

Successful implementation will require formal endorsement and sustained commitment from key stakeholders, including NICA, NIRC, DITRDCA and NINP. Implementation may be influenced by regulatory complexity (including overlapping Commonwealth and local frameworks), reliance on voluntary compliance, resource constraints, long-standing grazing practices, and data limitations (including limited historical pasture and grazing records).

To support practical implementation in this context, the Strategy recommends:

- establishing a formal Working Group governance structure with clear decision-making authority and stakeholder representation;
- obtaining formal endorsement (for example, endorsement letters or memoranda of understanding) from NICA, NIRC and relevant Commonwealth agencies prior to commencing major works or system changes;
- prioritising initiatives that deliver measurable benefits promptly, without requiring substantial regulatory reform or major capital expenditure; and
- adopting a staged implementation approach to build stakeholder confidence progressively.

## 2.7. Acknowledgements

The information obtained in preparation of this Strategy would not have been possible without the inputs from the stakeholders and representatives who provided responses, information and evidence in support of the claims being made. Stakeholders from a range of groups and agencies provided information which has been essential in compiling this Strategy and this, along with the hospitality provided, was much welcomed by the Consultants. The Consultants would like to acknowledge the assistance provided, particularly from NICA, NIRC, NINP, DITRDCA, CSIRO, Castles Environmental and the Norfolk Island community.

## 3. Norfolk Island Site Characterisation Summary

### 3.1. Location

Norfolk Island, now an external Australian territory, is in the southwestern Pacific Ocean, approximately 1,600 km northeast of Sydney. Covering an area of roughly 35 km<sup>2</sup>, Norfolk Island is of volcanic origin, featuring a unique landscape dominated by rolling plains, coastal cliffs, and two prominent peaks; Mount Pitt and Mount Bates, the latter being the island's highest point at 319 m above sea level.

### 3.2. Climate

The island experiences a subtropical marine climate, characterised by mild temperature variations throughout the year. Average daily temperatures range from 13-19 °C in winter and 18-25 °C in summer. Norfolk Island receives an annual average rainfall of around 1,280 mm, with most rain falling during the winter months. This stable, temperate climate allows for a variety of agricultural activities, including the cultivation of both temperate and tropical crops. Since 1970, the climate has reportedly been experiencing climate change impacts including reduced rainfall, differing annual rainfall patterns, increasing temperatures and increasing evaporation.

### 3.3. Topography

Norfolk Island's topography is mainly composed of rolling hills and coastal cliffs, interspersed with narrow valleys. The island's volcanic origins contribute to its fertile soils and well-drained landscapes, making it suitable for both grazing and crop production. While the island's terrain is generally undulating, certain areas, particularly along the coastlines, have steep slopes that are prone to erosion.

### 3.4. Soils

The island's soils are derived from volcanic ash and basalt and are mapped as Ferrosols grading down the soil profile from clay loam surface soils to medium clay subsoils. Whilst these soils are described as relatively well structured and well drained, they are reportedly susceptible to erosion, particularly on steeper slopes, which is exacerbated by human and animal induced soil disturbance, heavy rainfall and/or vegetation removal. In addition, in the low-lying coastal and estuarine areas, acid sulfate soils are present, posing a risk of soil acidification if disturbed (CSIRO (2023)). When exposed to air through excavation or drainage, these soils can generate sulfuric acid, leading to environmental issues such as acidification of waterways and leaching of heavy metals (Section 10 Management of Sensitive Environmental Features).

It is important to have healthy, well-structured soils as these will provide a sound substrate for pastures to grow optimally; the management of soils and the pastures they sustain is critical for successful grazing management and the optimisation of cattle production systems. The maintenance and protection of soil physical and chemical characteristics are crucial for agricultural productivity and preventing environmental degradation. Careful soil management such as minimising disturbance, maintaining/increasing soil organic matter levels, the prevention of plough pan formation, compaction and pugging, and mitigating the adverse impacts of acid sulfate soils are all critical for agricultural production and for environmental protection (Section 10 Management of Sensitive Environmental Features).

There is only very limited soil chemistry information and therefore little is available in the way of information on soil nutritional constraints. Visual assessment revealed the presence of active dung beetles and whilst the species, prevalence and impact were not assessed, these are likely to enhance soil nutrient retention and cycling. The soils, and subsequently the pastures, are likely to benefit from fertilisation and soil amelioration which will enhance soil chemical characteristics and soil structure however, there are significant constraints in accessing fertilisers, lime and gypsum. As mentioned in Section 10, it will be important to maintain soil structure, enhancing soil organic matter levels, minimising soil structural degradation and appropriately manage the risk of acid sulfate soils to help minimise the risk of adverse environmental impact and to help maximise agricultural production.

### 3.5. Hydrology / Hydrogeology

The island's water resources consist of rainfall, groundwater and more recently a small desalination plant. Since 1970, climate change impacts have resulted in reduced rainfall and a proportionally significant larger reduction in groundwater recharge and an associated reduction in surface water streamflow. Most rainfall infiltrates and is either utilised by vegetation (evapotranspiration) or recharges groundwater systems with little overland runoff contributing to watercourse flow. The island has historically consisted of significant groundwater resources replenished through rainfall infiltration, particularly from elevated areas like Mount Pitt and Mount Bates. Over the past 200 years, groundwater extraction has been significant and likely because of over-extraction and reduced recharge due to climate change, many groundwater extraction bores/wells are now dry.

The island sustains a network of short perennial and intermittent watercourses conveying water from more elevated central areas of the island and discharging to the surrounding ocean at various points around most of the coast. Most of the streamflow in these watercourses is derived from groundwater discharge. There is little surface water storage on the island which is limited to several small dams (<250 ML in capacity). Limited irrigation, utilising groundwater, occurs on the island and the potential for additional irrigation is limited due to limited water availability. Due to the risk of consequential potable water shortages to the community on island, a study was conducted and a number of options were put together to mitigate the "water emergency" (CSIRO (2020)).

As mentioned above, previous studies have also highlighted the likelihood of water contamination from agricultural activities, particularly cattle grazing, which reportedly contributes to sediment and nutrient redistribution and mobilisation adversely impacting surface water bodies and in particular watercourses (CSIRO (2024)).

### 3.6. Land Use

Norfolk Island is reported to have a permanent resident population of approximately 2,188 (ABS (2021)) and tourism, which is the island's largest industry, sees approximately 30,000 tourists visit the island each year (average tourist visit duration estimated at one (1) week).

Over the last 200 years, extensive clearing of native vegetation has occurred across the island to facilitate development and agricultural production. However, a significant proportion of the island comprises native vegetation which consists of sensitive and vulnerable ecosystems. The island's biodiversity, including its endemic species, is under constant threat from invasive species and land degradation.

Land use across Norfolk Island reportedly consists predominantly of rural residential areas (48%), conservation areas (21%) and rural farmland (16%) with remaining areas consisting of the airport and industrial, business or residential land uses. The brief provided to the Consultants quotes an extract from GHD's "Report for The Administration of Norfolk Island – Calculation of Stocking Rates on Public Land" (GHD (2016)) which notes the "effective area of common grazing land" was approximately 183.5 ha. Further details on the public land to which the Strategy applies are provided below.

## 4. Public Land Grazing Areas

Information on the areas of public land grazed by cattle is vague. The areas of land grazed by roadside cattle generally include public reserves and roads, but more specifically consist of a combination of:

- Commonwealth Crown Land;
- Commonwealth "Kingston and Arthur's Vale Heritage Area" (**KAVHA**) Land;
- Norfolk Island Regional Council Public Land;
- Norfolk Island Regional Council Public Reserves;
- Norfolk Island Regional Council Road Reserves;
- Norfolk Island National Park Forestry Zone; and
- privately owned land, made available to roadside cattle.

The ownership and management of the grazed areas of public land varies and includes areas managed by the Norfolk Island Regional Council (**NIRC**), by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (**DITRDCA**) (Australia), by the Norfolk Island National Park (Parks Australia) (**NINP**) and by the Australian Government (**Commonwealth**) generally.

The initial information provided to the Consultants was based on the GHD (2016) report which is now outdated, used assumptions and recommended further analysis to confirm the accuracy of the effective public land area for grazing. GHD (2016) reported a public land effective grazing area of 92 ha and an additional 91.5 ha of public road reserves, totalling 183.5 ha of public land available for grazing. This figure was provided by the Working Group at the commencement of this project together with a list of locations grazed by cattle within each of the five (5) broad Grazing Zones (formed by the typical locations that each of the five (5) distinct herds of cattle graze) (Section 5 Cattle Numbers & Stock Tags). As part of Strategy development, verification as to the grazing locations within the Grazing Zones was sought from relevant stakeholders however, the information collected was limited. The combination of available information is tabulated in *Table 1* and includes:

- the five broad public land Grazing Zones (Kingston, Headstone, Anson Bay, Cockpit and Ball Bay) (GHD (2016));
- the 2016 effective grazing areas (in ha) within each of the five Grazing Zones (GHD (2016));
- an indicative list of the Current Grazing Areas within each of the five Grazing Zones and the approximate area (in ha) (identified through the development of this Strategy);
- a calculation of the Current Effective Grazing Areas (in ha) within each of the Current Grazing Areas (identified through the development of this Strategy); and
- a calculation of the Current Effective Grazed Road Areas (in ha) within each of the Grazing Zones (identified through the development of this Strategy).

In relation to the public road reserves, the Working Group stated that most public road reserves across Norfolk Island are utilised for cattle grazing. The area of grazed road reserves is estimated in the GHD (2016) report by initially adopting a figure of 133 ha for all public roads and crown land, subtracting 27 ha of crown land and then further subtracting another 15 ha of road reserves which are not grazed. This equated to 91 ha of public road reserves utilised for grazing (that is,  $133 - 27 - 15 = 91$  ha) adopted in the GHD (2016) calculations. It does not appear that the GHD (2016) report took into consideration the “effective” grazing area of these road reserves. The road reserves vary in width ranging from approximately 10 to 20 metres wide however, it is assumed that some of this area consists of paved and gravel roadways which do not provide effective grazing, and that the cattle predominately graze the road verges along the sides of the road reserves. For Strategy development, it has been estimated that only 50% of public road reserve land facilitates effective grazing for cattle. This equates to an estimated 45 ha of Current Effective Grazed Road Areas across public road reserves (that is,  $91 \times 50\% = 45$  ha).

Initial mapping prepared by Castles Environmental, based on information available at the time and limited feedback from the broader Working Group, indicated the area of grazed public land was approximately 120 ha (excluding road reserves). Revised mapping prepared by Castles Environmental following additional input from the Working Group and key stakeholders indicated the area of grazed land was approximately 139 ha (excluding road reserves).

Notwithstanding ongoing limitations in the available information and verification of grazing extents, this Strategy adopts the revised mapped grazed land extent of 139 ha for the purposes of the Carrying Capacity calculations. The Strategy then estimates a Current Effective Grazing Area of 128 ha, comprising 82.4 ha of effective public/private land grazing and the 45.4 ha of effective road reserve grazing as identified above. Current Effective Grazing Areas were estimated using aerial imagery, limited on-ground observations and informed professional judgement to account for areas with reduced or no effective grazing (for example, sealed surfaces, heavily eroded or forested areas, and waterways) (*Table 1*; Appendix B – Mapped Current Grazing Areas; Appendix C - Photos of Grazing Areas).

It must also be noted that grazing patterns vary across the year, and some of the grazing locations listed in *Table 1* may not be continuously and/or regularly grazed. Accordingly, mapped grazing extents and effective grazing estimates should be treated as indicative and are expected to be refined as additional verification and monitoring data becomes available.

In later Sections of this Strategy (Section 10 Management of Sensitive Environmental Features and Section 11 Optimised Carrying Capacity), the Current Effective Grazing Areas are adjusted to accommodate the recommended removal of environmentally sensitive areas from cattle grazing (Reduced Grazing Areas) and addition of areas proposed to be opened to cattle grazing (Additional Grazing Areas) to determine an optimised grazing scenario (Optimised Grazing Areas). The Optimised Grazing Areas are also mapped in the appendices (Appendix J – Mapped Optimised Grazing Areas).

**Table 1: Areas of land grazed by cattle, data sources and Current Effective Grazing Areas.**

| GRAZING ZONES          | GHD (2016)                            |              | CURRENT GRAZING AREAS  | STRATEGY    | CURRENT EFFECTIVE GRAZING |             |
|------------------------|---------------------------------------|--------------|--|-------------|---------------------------|-------------|
|                        | GRAZING AREAS                         | (ha)         |  |             | AREA (ha)                 | AREA (ha)   |
| KINGSTON               | Cemetery Reserve                      | 0.3          | Kingston Common Reserve  |             | 18.2                      | 13.8        |
|                        | Kingston Common Reserve               | 25.1         | Commonwealth FH (b/w Country Rd and Middlegate Rd)                 |             | 2.1                       | 0.8         |
|                        | Midleridge Reserve, Middlegate & 44a  | 7.2          | Crown (Pound Paddock)  |             | 1.8                       | 1.5         |
|                        |                                       |              | Crown (hill between Rooty Hill Rd and Quality Row)                 |             | 9.8                       | 8.8         |
|                        |                                       |              | Crown (Middlegate Rd near Guide & Community Hall)                  |             | 1.1                       | 0.8         |
|                        |                                       |              | Crown (Middlegate Rd near Banyan Park)                             |             | 1.1                       | 1.0         |
|                        |                                       |              | Public Land (opposite Central School)                              |             | 5.3                       | 2.1         |
|                        |                                       |              | Public Land (Portion 44a)  |             | 3.7                       | 1.9         |
|                        |                                       |              | Kingston Road Reserves   |             | 21.6                      | 10.8        |
|                        | <b>SUBTOTAL:</b>                      |              | <b>32.6</b>  |             | <b>64.9</b>               | <b>41.6</b> |
| HEADSTONE              | Portion 183 (New Farm Road (Airport)) | 2.0          | Portion 183 (New Farm Rd (Airport))                                |             | 2.0                       | 1.9         |
|                        | Headstone Reserve                     | 4.2          | Headstone Reserve (part)   |             | 4.6                       | 3.9         |
|                        | OTC Block                             | 1.5          | Airport Douglas Dr   |             | 3.3                       | 3.0         |
|                        | Stock Reserve                         | 0.5          | Stock Reserve Lot 2 Section 28                                     |             | 0.7                       | 0.6         |
|                        |                                       |              | Headstone Reserve (northwest)                                      |             | 0.1                       | 0.1         |
|                        |                                       |              | Headstone Road Reserves  |             | 15.6                      | 7.8         |
| <b>SUBTOTAL:</b>       |                                       | <b>8.2</b>   |  | <b>26.2</b> | <b>17.2</b>               |             |
| ANSON BAY              | Portion 110c (Anson Bay Road)         | 0.7          | Public Land (Kingfisher Paddock)                                   |             | 11.8                      | 10.6        |
|                        | Anson Bay Reserve                     | 0.4          | Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)      |             | 0.4                       | 0.3         |
|                        | Kingfisher Paddock                    | 10.6         | Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)     |             | 2.9                       | 0.3         |
|                        | Portion 109a Gun Club (Anson Bay Rd)  | 5.5          | Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                  |             | 7.2                       | 2.2         |
|                        | Selwyn Reserve                        | 3.0          | Selwyn Reserve (Anson Bay Rd)                                      |             | 2.2                       | 0.2         |
|                        |                                       |              | National Park Forestry Zone  |             | 3.7                       | 1.5         |
|                        |                                       |              | Anson Bay Private Land   |             | 11.9                      | 6.0         |
|                        |                                       |              | Anson Bay Road Reserves  |             | 19.0                      | 9.5         |
| <b>SUBTOTAL:</b>       |                                       | <b>20.2</b>  |  | <b>59.1</b> | <b>30.5</b>               |             |
| COCKPIT                | Quarantine & Cascade                  | 21.6         | Cascade Reserve Lot 28 Sec 10 (south)                              |             | 6.3                       | 5.7         |
|                        |                                       |              | Cascade Reserve Lot 28 Sec 10 (north)                              |             | 7.4                       | 6.0         |
|                        |                                       |              | Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)     |             | 4.2                       | 0.8         |
|                        |                                       |              | Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)     |             | 4.1                       | 3.7         |
|                        |                                       |              | Cockpit Road Reserves  |             | 20.8                      | 10.4        |
|                        | <b>SUBTOTAL:</b>                      |              | <b>21.6</b>  |             | <b>42.9</b>               | <b>26.6</b> |
| BALL BAY               | Ball Bay Reserve & 48e                | 9.0          | Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)      |             | 1.1                       | 0.6         |
|                        | Two Chimneys Reserve (part)           | 0.4          | Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                    |             | 18.8                      | 3.8         |
|                        |                                       |              | Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic) |             | 0.1                       | 0.1         |
|                        |                                       |              | Two Chimneys Reserve (part) (second picnic area)                   |             | 0.5                       | 0.2         |
|                        |                                       |              | Ball Bay Private Land  |             | 2.4                       | 0.5         |
|                        |                                       |              | Ball Bay Road Reserves   |             | 13.8                      | 6.9         |
| <b>SUBTOTAL:</b>       |                                       | <b>9.4</b>   |  | <b>36.8</b> | <b>12.0</b>               |             |
| <b>LAND SUBTOTAL:</b>  |                                       | <b>92</b>    |  | <b>139</b>  | <b>82.4</b>               |             |
| <b>ROADS SUBTOTAL:</b> |                                       | <b>91.5</b>  |  | <b>91</b>   | <b>45.4</b>               |             |
| <b>TOTAL (ha):</b>     |                                       | <b>183.5</b> |  | <b>230</b>  | <b>128</b>                |             |

## 5. Cattle Numbers & Stock Tags

The Norfolk Island Cattle Association (**NICA**) estimate that in 2023 there were approximately 1,100 breeding cows on the island considering both private and public land. In addition to the limited areas of cattle grazing land as detailed above, cattle numbers on the island are also limited by restrictive biosecurity laws which limit importation of live ruminants and genetic material (semen and embryos). A genetic improvement program is in place to improve the genetic diversity of cattle on island, although this will take some time for the benefits to be realised and the genetic diversity of the cattle herd to be increased.

For the grazing of cattle on public land, grazing limits are set each year through the allocation of Pasturage Rights, administered via Stock Tags. For the purposes of this Strategy, one Stock Tag is treated as equivalent to one Cow/Calf Unit (one breeding cow with her calf up to six (6) months of age). If a calf remains depastured beyond six (6) months of age, it requires allocation of a Stock Tag in its own right. Eligible persons are allowed up to a maximum of six (6) Stock Tags. In 2023-24, 190 Stock Tags were issued for roadside grazing cattle. The historical variation in the number of Stock Tags issued over the past 15 years is detailed in *Table 2*.

**Table 2:** Number of Stock Tags issued under Norfolk Island Pasturage Rights since 2010 (1 Stock Tag = 1 breeding cow with calf up to six (6) months of age (equivalent to 1 Cow/Calf Unit)).

| Year        | Number of Stock Tags Issued |
|-------------|-----------------------------|
| 2010 - 2011 | 282                         |
| 2011 - 2012 | 282                         |
| 2012 - 2013 | 277                         |
| 2013 - 2014 | 277                         |
| 2014 - 2015 | 261                         |
| 2015 - 2016 | 240                         |
| 2016 - 2017 | 221                         |
| 2017 - 2018 | 195                         |
| 2018 - 2019 | 211                         |
| 2019 - 2020 | 209                         |
| 2020 - 2021 | 170                         |
| 2021 - 2022 | 190                         |
| 2022 - 2023 | 190                         |
| 2023 - 2024 | 190                         |

The cattle which graze on public land on Norfolk Island are generally segregated into five (5) distinct mobs or herds demarcated by Grazing Zone locations. The herds and approximate number of Stock Tags in each herd are detailed in *Table 3*.

**Table 3:** The five (5) main herds of cattle which graze public land and approximate number of Stock Tags per herd reported by NICA (1 Stock Tag = 1 breeding cow with calf up to 6 months of age (equivalent to 1 Cow/Calf Unit)).

| Grazing Zone | No. of Cattle | Effective Grazing Area (ha) |
|--------------|---------------|-----------------------------|
| Kingston     | 50            | 41.6                        |
| Headstone    | 30            | 17.2                        |
| Anson Bay    | 60            | 30.5                        |
| Cockpit      | 30            | 26.6                        |
| Ball Bay     | 20            | 12.0                        |
| <b>Total</b> | <b>190</b>    | <b>128</b>                  |

It must be noted that the total Stock Tags allocated in any year do not reflect the full-time grazing pressure being applied to public lands and roadsides. Throughout the year cattle are moved to private land to be mated, have health treatments undertaken, and to calve, for example. Seasonal conditions and the availability of feed also result in changes to public land grazing cattle populations.

At the time of this Strategy, NICA had implemented their own management intervention and reduced the number of cattle grazing public land during early 2024. The decision to reduce public land cattle numbers was due to seasonal conditions, declining pasture availability, and a desire to maintain ground cover and pasture health by NICA membership. Cattle numbers as reported by Dr Candice Nobbs, Norfolk Island Veterinary Surgery on behalf of the NICA membership are presented in *Table 4*. Current stock numbers grazing public land represent 75% of the Stock Tag allocation. This alteration highlights the intuitive management practices currently underway by NICA membership and that the number of Stock Tags allocated does not correlate with numbers always grazing public lands and roadsides.

Given the dynamic nature of management changes, accurate quantification of the exact grazing days by public land cattle at any given year cannot currently be achieved. The Consultants note that Stock Tag allocations are a maximum figure for a given year, not indicative of the actual stocking rate.

**Table 4:** *The five (5) main herds of cattle which graze public land and approximate number of stock grazing during the 2024/2025 season as reported by NICA (1 Stock Tag = 1 breeding cow with calf up to 6 months of age (equivalent to 1 Cow/Calf Unit)).*

| Grazing Zone | No. of Cattle | Effective Grazing Area (ha) |
|--------------|---------------|-----------------------------|
| Kingston     | 40            | 41.6                        |
| Headstone    | 18            | 17.2                        |
| Anson Bay    | 33            | 30.5                        |
| Cockpit      | 40            | 26.6                        |
| Ball Bay     | 18            | 12.0                        |
| <b>Total</b> | <b>149</b>    | <b>128</b>                  |

While Stock Tag allocations describe the administrative framework for public land grazing and provide an indicative distribution of cattle across Grazing Zones, effective grazing pressure is ultimately determined by how cattle are managed on the ground (including rotation practices, timing and duration of grazing, pasture availability and seasonal conditions). To support sustainable grazing outcomes and inform subsequent Carrying Capacity assessments, Section 6 Grazing Management summarises current grazing management practices on Norfolk Island and outlines grazing strategies that can be applied to improve pasture utilisation and recovery while reducing the risk of adverse environmental impact. Section 7 Pastures & Pasture Assessment then describes pasture condition and pasture assessment approaches that can be used to monitor biomass and forage quality, establish benchmarks over time, and support more objective grazing management decisions.

## 6. Grazing Management

### 6.1. Concept

Grazing management is a dynamic balance between pasture growth and quality, animal requirements and environmental protection. Optimised grazing management ensures animal performance is maximised whilst maintaining the primary feed resource and the environment in a sustainable cycle of production year-on-year. Maintaining pasture ground cover year-round reduces erosion, increases soil organic matter and microbial activity, increases water infiltration and thereby reduces water and nutrient runoff. Maintaining a residual ground cover therefore also promotes healthier plants that respond to rainfall events and will produce more dry matter over time. Optimum grazing management is mutually beneficial for environmental and cattle production outcomes.

### 6.2. Current Practice

Currently the grazing management strategy on Norfolk Island is a blend of continuous stocking and rotational grazing. Herds across the island have their core range of public land which they have access to (Grazing Zones and Current Grazing Areas listed in *Table 1*; Appendix B – Mapped Current Grazing Areas) and are then moved into certain areas at the discretion of the cattle owners based on visual assessment of pasture and cattle condition. The only supplementary feeding which occurs is when some limited amounts of pasture are harvested from the Norfolk Island Airport runway and KAVHA grounds and fed to selected cattle grazing public land with priority given to cattle in poorer condition. Harvesting of forage from the Airport is undertaken by Aaron Graham (NICA) on a voluntary basis and by KAVHA groundskeepers. However, quantifying the exact volume of feed harvested and then the resultant proportion of feed utilised is challenging due to variability of season, topography and frequency of harvest and distribution.

### 6.3. Grazing Strategies

There are many techniques utilised to graze livestock across landscapes and some examples of relevant grazing strategies, along with a brief description of each, are provided in *Table 5*. Continuous stocking is the most common, where animals have unrestricted access to a specific unit of land for an extended period. Alternatively, rotational grazing strategies are based on the principle of higher intensity grazing for a short period of time, after which animals are moved onto an ungrazed area and restricted from where they have grazed. Whilst there are several different grazing strategies to move animals through the landscape, they all aim to provide plants with sufficient rest to maintain adequate ground cover and maximise dry matter production whilst preventing degradation of the soil.

**Table 5: Grazing strategies and a brief description of each.**

| Grazing Strategy |   | Grazing Strategy Description  |
|------------------|---|---|
| 1                | <b>Continuous Grazing / Set Stocking</b>          | Cattle have unrestricted access to a single pasture for an extended period of time, which is often the entire grazing season.   |
| 2                | <b>Rotational Grazing</b>                         | Pastures are divided into smaller paddocks either permanently or temporarily (strip grazing) and livestock are rotated between them on a schedule to allow for rest and regrowth. |
| 3                | <b>Intensive Rotational Grazing (Mob Grazing)</b> | Livestock are moved frequently (multiple times per day) to new areas, resulting in high stocking density for short durations.   |
| 4                | <b>Deferred Grazing</b>                           | Certain pastures are rested for a portion of the growing season to allow plants to mature and set seed.   |
| 5                | <b>Rest-Rotation Grazing</b>                      | At least one pasture in a multi-paddock system is rested for an entire growing season while others are grazed.  |
| 6                | <b>Creep Grazing</b>                              | Calves are given access to high-quality pastures through gates or under electric wires that restrict the access of adult cattle.  |
| 7                | <b>Variable Stocking</b>                          | The number of animals grazing is adjusted throughout the season based on forage availability and pasture conditions.  |
| 8                | <b>Seasonal Grazing</b>                           | Grazing is limited to specific seasons, often aligning with forage growth cycles or avoiding wet periods.   |
| 9                | <b>Leader-Follower Grazing</b>                    | High-nutrient-demand animals graze a paddock first, followed by lower-nutrient-demand animals to utilise remaining forage.  |
| 10               | <b>Mixed-Species Grazing</b>                      | Different species of livestock graze the same pasture, often targeting different plant species.   |

The grazing strategies outlined above are intended to balance cattle productivity with pasture recovery and environmental protection. Their successful application depends on regularly assessing pasture quantity and quality so that grazing duration, rotation intensity and stocking adjustments can be made in a timely and evidence-based manner. Section 7 Pastures & Pasture Assessment describes the current pasture context on Norfolk Island and provides practical pasture assessment approaches to support ongoing monitoring, refinement of Carrying Capacity assumptions and adaptive grazing management.

## 7. Pastures & Pasture Assessment

### 7.1. Current Status

Current pastures on Norfolk Island consist of Kikuyu (*Cenchrus clandestinus*), Rhodes (*Chloris gayana*) and Paspalum (*Paspalum spp.*) grasses, with some clover (*Trifolium spp.*) depending on the area. These pasture species are not native to Norfolk Island but have become naturalised and self-propagating over time since their introduction, with little evidence of pasture renovation or improvement due to the cost and biosecurity constraints of importing seed and fertilisers onto the island. Some rehabilitation of roadside banks and verges is undertaken by transplanting the runners of Kikuyu to promote establishment. The dominant pasture species are Summer-active, producing maximum dry matter during the Spring - Summer seasons. Colder conditions during winter will slow grass growth and reduce feed quality.

Pasture availability is reduced by frequent Armyworm infestations on the island, typically during the time of peak pasture growth and quality. Some spraying control measures are implemented, although efficacy is reported to be variable.

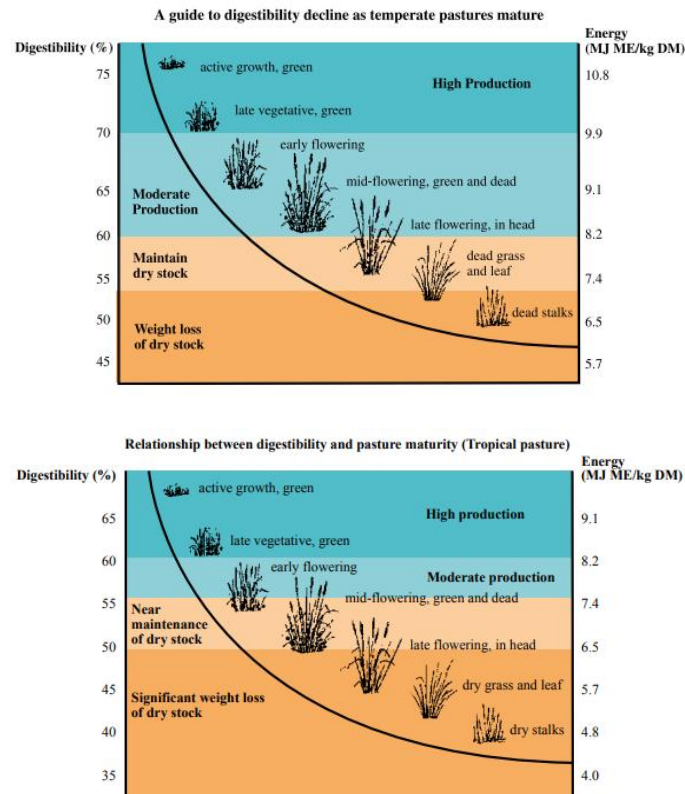
Visual assessment of pasture condition by the Consultants in August 2024 revealed pastures were starting to respond to increasing daytime temperatures, although growth rate was reduced due to the dry seasonal conditions with annual rainfall totalling 563 mm (56% of mean rainfall). No recent infestations of Armyworm had occurred. Low rainfall through late Spring 2024 and Summer 2025 resulted in low pasture growth and availability when the Consultants revisited the island for in February 2025. Cattle numbers had been reduced by NICA members to alleviate pressure from Current Grazing Areas as a result.

Several weed species that exist on Norfolk Island (including African Olive (*Olea europaea subsp. cuspidata*), Tobacco Bush (*Solanum mauritianum*), Hawaiian Holly (*Schinus terebinthifolius*), Cherry Guava (*Psidium cattleianum*), Lantana (*Lantana camara*) and Coral Berry (*Rivina humilis*)) compete with pastures for water and nutritional resources but may also be grazed by cattle at certain growth stages.

At the time of this Strategy, no pasture nutritional composition data was available to review to understand the nutritional constraints of the natural pastures on the island. Some blood testing of cattle had been previously undertaken as part of the Artificial Breeding program on island, identifying the presence of copper deficiency in breeding cows on the island.

### 7.2. Pasture Quality & Quantity

Pasture growth, and the resulting biomass and nutritional composition directly influence the availability and nutritional value of forage consumed by grazing cattle. Adequate pasture biomass ensures a consistent supply of feed, supporting optimal intake levels for maintenance, growth, reproduction, and lactation. High-quality pastures, characterised by nutrient-dense and digestible forage, provide essential energy, protein, and minerals that enhance animal performance and health. Conversely, pastures with low biomass or poor quality can lead to reduced weight gains, diminished reproductive efficiency, and increased reliance on costly supplemental feeds. Understanding the typical growth curve, total biomass potential and quality across the growing season is crucial to matching livestock requirements to feed availability (*Figure 1*).



**Figure 1:** Typical pasture growth curves showing variations in digestibility and energy for various pasture growth stages (NSW DPI, Prograze (2017)).

### 7.3. Pasture Assessment

Pasture assessment is a critical tool to optimise grazing management. Evaluation of key factors such as forage biomass, species composition, ground cover, and chemical composition (energy, protein, minerals) provides valuable data for adjusting stocking rates, rotation schedules, and supplemental feeding strategies to match forage availability with livestock needs. A well-executed pasture assessment ensures pastures are managed to maintain productivity, ecological balance, and long-term sustainability.

There are a variety of pasture measurement strategies and techniques which vary in inputs required and complexity, and the intensity of pasture assessment should reflect the intensity and value of the enterprise. Pasture measurement can include manual on-site techniques such as physical cuts, visual estimates or pasture rulers. Alternatively, more complex techniques can be employed to enhance accuracy, repeatability and efficiency of monitoring such as satellite imagery or electronic sensors (<https://www.farmote.com/>). An example of a pasture assessment protocol is provided in the appendices (Appendix F - Pasture Assessment Protocol Example). Consistency of measurement technique is the most important aspect when assessing pastures for long term feed budgeting and pasture management.

Basic pasture assessment focuses on the two metrics of pasture biomass (the amount of pasture available) (Table 6) and pasture quality (digestibility and energy content) (Table 7). Consideration should also be given to pasture growth stage and pasture species composition to help determine pasture nutritional value. This information can be used to calculate Carrying Capacity and the appropriate grazing and rest periods to maximise pasture utilisation and resulting recovery. An example of an appropriate pasture assessment protocol is provided in the Appendices (Appendix F - Pasture Assessment Protocol Example).

**Table 6:** Pasture height and corresponding indicative herbage mass to aid calculation of pasture biomass (NSW DPI, Prograze (2017)).

| Average Plant Height (cm) | Indicative Herbage Mass (kg green DM/ha) |
|---------------------------|--|
| 2                         | 700                                      |
| 4                         | 1200                                     |
| 6                         | 1600                                     |
| 8                         | 2000                                     |
| 10                        | 2400                                     |
| 12                        | 2800                                     |
| 14                        | 3200                                     |

**Table 7:** Corresponding pasture digestibility and energy content to aid calculation of pasture quality (NSW DPI, Prograze (2017)).

| Digestibility % | Energy Content (MJ ME/kg DM*) |
|-----------------|-------------------------------|
| 40              | 4.8                           |
| 50              | 6.5                           |
| 60              | 8.2                           |
| 70              | 9.9                           |
| 80              | 11.6                          |

\*Megajoules of metabolisable energy per kg dry matter

#### 7.4. Pasture Residual

Grazing management is a balance between maximising pasture growth, harvesting pasture at the optimum quality, and maintaining sufficient residual to allow plants the opportunity to recover quickly. Maintaining sufficient residual forage after grazing increases water infiltration rate, reduces compaction, reduces erosion, increases plant microbial communities, improves soil health and provides sufficient leaf area for plants to recover leading to increased dry matter production. Pasture growth rate is impacted by soil fertility, rainfall and overall plant health. Without physical measurement of pasture growth and performance specific to the location, we can only model projected pasture availability and quality. Grazing management is a dynamic process that needs measurement and monitoring to inform management decisions (see previous Section 6 Grazing Management).

Pastures should be managed so they do not exceed 3,000 kilograms of dry matter (DM)/ha (MLA (2024)). After this point, plants mature, indigestible fibre content will increase, and nutritional quality will decline. As such, a target entry dry matter yield of 2,500-3,000 kg DM/ha should be used for temperate and sub-tropical pasture species.

Pasture residuals when grazing cattle is essential for maintaining forage productivity, animal performance and pasture health. Residual height, the amount of plant material left after grazing, affects regrowth, soil health and forage quality. Maintaining an appropriate residual ensures rapid regrowth, reduces compaction, and reduce the risk of erosion. Residuals are maintained by allowing pastures time to rest and recover.

Different pasture species have different target residual heights post-grazing. Common targets for the species prevalent on Norfolk Island are:

- Perennial Ryegrass and Clover Pastures: 4-6 cm (1.5-2.5 inches);
- Kikuyu: keep a residual of 5-7 cm (2-3 inches);
- Lucerne (Alfalfa): leave a stubble height of 5-10 cm (2-4 inches);
- Rhodes Grass: maintain a post-grazing residual of 7-10 cm (3-4 inches); and
- Paspalum: aim for a residual of 5-7 cm (2-3 inches).

Plants can also be managed based on leaf emergence rates (Evergraze (2024)), although in mixed species this is more challenging to apply to larger areas. As such, it is recommended that residual height be used to guide grazing management decisions on Norfolk Island.

It must be noted that target residuals, rest periods and grazing intensity will vary throughout the seasons, particularly with tropical, summer active species such as Kikuyu that require greater intensity of grazing during the summer, and rest during the winter (MLA (2007)).

Pasture management is often carried out intuitively by graziers, yet it is important to set some target thresholds to optimise grazing management. In the case of public land grazing on Norfolk Island, it is strongly recommended that target pasture residuals be adopted, and ongoing monitoring of pasture growth to set benchmark growth rates and yield will then inform a more precise grazing plan.

## 7.5. Pasture Improvement

Pasture production could be improved on the island using, improved pasture genetics and fertilisers, however, adoption of these practices is currently limited by freight costs of product onto the island and the lack of seeding and spreading equipment. Should these financial and logistical barriers be removed, then there are several options available for implementation.

Within the current pasture species on the island, there are now several newer varieties available that have been selectively bred for improved production and forage quality. For example, newer varieties of Rhodes grass (Samford type) are available with higher leaf:stem ratio, increased plant tillering, and improved feed quality when mature.

The addition of new pasture species that will improve total biomass, diet quality and extend season of growth are also an option for improving production levels in a restricted land mass. With a temperate, sub-tropical climate, there are many options available for Norfolk Island, including Ryegrass (Perennial and Annual), Fescue, Panic, Digit and Cocksfoot grasses, along with legume options such as Lucerne, Clover (Sub or White) Desmanthus and Stylo species. With the variability in terrain and soil type, there will be different species suited to different areas and therefore targeted planning would need to be formulated. It must also be noted that new species could not be introduced to the Norfolk Island National Park Forestry Zone, so would be limited to non-Forestry and private land areas.

Overall increases in forage production could also be achieved utilising forage crops on areas of land (public or private) where they can be grazed or harvested. Species such as Oats, Sorghum, Lablab or Maize provide the opportunity to grow significant dry matter yields and supplement cattle during times of lower feed availability. Grazing of these standing crops is the lowest cost option, although other options exist including “cut and carry” options such as fresh harvest or as storage as silage (bale or chopped pit) or hay.

Establishing new pastures or forage crops on Norfolk Island is logistically constrained by the cost of importation of seed, the steep topography of the areas to be sown, and the limited equipment available to sow areas that are accessible. Assuming that seed can be obtained cost-effectively, there are now options to sow pastures in challenging and small areas. Small ATV/UTV towed direct drill seeders such as the

GreenPRO GP1200 6-IN-1 Seeder (<https://greenpro.com.au>) are available that are portable, easy to use, and allow access into small areas. Alternatively, drone technology is now readily available (e.g. <https://www.xagastralia.com.au/aerial-seeding>) for seeding and fertilising of areas that are hard to access. With several commercial operators throughout Australia, the opportunity would exist to engage a contractor for a short period of time to seed grazing areas on the island.

The use of fertilisers on existing or new pastures offers the opportunity to increase the total biomass and at times quality of the feed available to cattle on the island. By identifying limiting or excessive nutrients through soil testing, the appropriate level of nitrogen, phosphorous, potassium, calcium or magnesium can be applied to meet those requirements (and avoid those areas where fertilisation is not required). Although these nutrients are commonly applied in a synthetic form (e.g. Urea, Single Superphosphate, Potash), there are alternative methods to deliver nutrients to pastures. Liquid fertilisers, composts and compost teas all provide an option to deliver nutrients to pastures in an organic form. Many of these natural options not only provide the chemical nutrients but also focus on soil conditioning and the promotion of microbial populations in the soil (either through addition of soil microbes or delivery of substrates to promote microbial growth). There are several commercially available products in this category, but the opportunity exists for production of some of these products (particularly composts and compost teas) to be produced on island. This may pose an opportunity to recycle waste material (plant material, animal waste and manure) from the island however, the specific requirements for production of these fertilisers is outside the scope of this Strategy.

Before use of fertilisers, the appropriate level of agronomic investigation needs to be conducted to determine the level of inputs, if any, required. When applying fertilisers, the potential for nutrient runoff needs to be considered (particularly in the context of the water quality concerns mentioned earlier in this Strategy), although with targeted application and appropriate grazing management to maintain ground cover and soil integrity, nutrient leaching can be managed.

As noted above, implementation of pasture improvement strategies on Norfolk Island are constrained by cost and logistics of importing equipment and inputs onto the island. Because of these restrictions, it is recommended that adequate monitoring of the current pasture base is implemented, and maximum utilisation of existing feed is exploited first before more expensive pasture improvement options are considered. Pasture managers need to understand the biomass of pasture available, the quality of pasture present, and to then correlate and implement an appropriate grazing period to maximise pasture utilisation throughout the year and across various grazing land area options and supplementary feed.

Pasture biomass and forage quality are the primary determinants of the feed available to grazing cattle, and therefore underpin the Carrying Capacity of public land grazing areas. The pasture assessment approaches outlined above provide a practical basis for improving the accuracy of key inputs used in Carrying Capacity calculations over time (including dry matter production, utilisation and energy content). The following Section 8 applies the available information and assumptions to estimate Current, Target and Optimised Carrying Capacity scenarios for public land grazing on Norfolk Island.

## 7.6. Key Recommendations

- Implement routine pasture assessments (monthly during the growing season) using a consistent protocol to build Norfolk Island baseline data on biomass and quality.
- Manage grazing to maintain protective residuals (use species-based residual height targets) and avoid pasture maturity/quality decline (target entry ~2,500-3,000 kg DM/ha where practical).
- Prioritise optimising utilisation of existing naturalised pastures first, recognising biosecurity, freight, and equipment constraints.

- If improvements are pursued, develop a targeted Pasture Improvement Plan (outside National Park Forestry Zone) that integrates weed risk, nutrient/runoff considerations, and feasibility of inputs/equipment.

## 8. Cattle Carrying Capacity

### 8.1. Concept

Carrying Capacity refers to the maximum number of cattle that a specific area of land can support sustainably. The Carrying Capacity aims to meet the cattle's nutritional requirements for their stage of production (pregnancy, lactation, growth) whilst maintaining a minimum residual pasture level to minimise the risk of adverse impacts to the environment (including soil, surface water, groundwater and vegetation).

Several land and animal specific factors need to be considered in the determination of appropriate long-term, sustainable Carrying Capacity for a given area. Land factors include the capability of the land and the soil to produce feed and to maintain pasture growth (fertility, water holding capacity, topography), the current amount and quality of pasture available, typical climatic conditions (particularly rainfall and temperature), the current pasture species seasonal growth patterns, and the presence of competitive weeds.

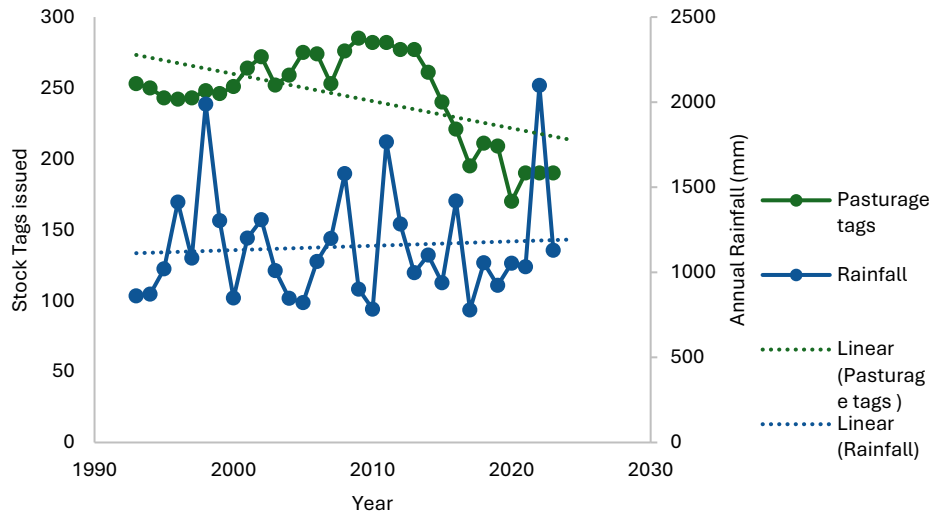
Animal factors that influence the Carrying Capacity include cattle breed, age, mature size, body condition, stage of production (pregnant lactating, growing) and the target market weight. Current levels of supplementary feed, if any, are also considered so far as practicable. Whilst key assumptions and generic figures can initially be used to approximate a Carrying Capacity for a given land area and group of cattle, further refinement can also be undertaken by recording the liveweight and condition score of the cattle over the course of a production season to validate their standard reference weight (live weight at Body Condition Score 3) and resulting energy requirements.

The Carrying Capacity of an area of land is determined by the amount of land available, its productive ability, the requirements of the stock class to be grazed, and the period over which grazing is to be conducted. Carrying Capacity is measured in a range of units, typically, Animal Equivalents (**AE**), Dry Sheep Equivalents (**DSE**), Livestock Stocking Units (**LSU**), all of which reflect the energy requirements to sustain a different class of stock. The number of animal units for the class of stock grazed are then calculated and the number of head/breeding units can be determined and reported as number of livestock units (cow/calf, weaner) per hectare per year. In the context of cattle grazing on public land and roadsides on Norfolk Island, Carrying Capacity calculations are expressed in Cow/Calf Units (consistent with Stock Tag allocations), representing the energy requirements of a mature cow over a year with a calf at foot up to six (6) months of age.

### 8.2. Historical Carrying Capacity

The GHD (2016) report utilised climate and pasture growth data for Kempsey NSW in lieu of regionally specific data and physical pasture assessment data to model the potential stocking rate for Norfolk Island. The GHD (2016) assessment recommended an average stocking rate of 211 Cow/Calf Units for the 183.5 ha of effective grazing land. Since the GHD (2016) report, the average Stock Tag allocation on public lands has been 202 Cow/Calf Units, with less than 200 since 2020 (*Table 2*). Rainfall data records and verbal communication with cattle owners reveals the below average rainfall for 2017-2022 resulted in the need to reduce stock numbers grazing public lands, a testament to the intuitive nature of historical cattle management on island (*Figure 2*).

This Strategy adopts a reduced area of grazed public land (a Current Effective Grazing Area of 128 ha) due to increased accuracy of mapping assessments based on data received from the Working Group and observations made by the Consultants on island, as well as a reduction in Current Effective Grazed Road Areas which was deemed to be 50% of the road reserves due to the presence of sealed land (see Section 4 Public Land Grazing Areas and *Table 1*).



**Figure 2:** A comparison between the number of Stock Tags issued each year and average annual rainfall.

### 8.3. Current Carrying Capacity

In the absence of physical pasture assessment data from Norfolk Island, pasture growth and quality data has been adapted from North Coast Hunter Valley NSW to simulate the potential production on the island (*Table 8*). Production for an average, 0.5 of average, and 1.5 of average year’s production has been used to model the potential variation in pasture productivity.

**Table 8:** Expected pasture growth for Norfolk Island based on north coast Hunter Valley NSW rainfall and similar pasture species (NSW DPI, Prograze (2017)).

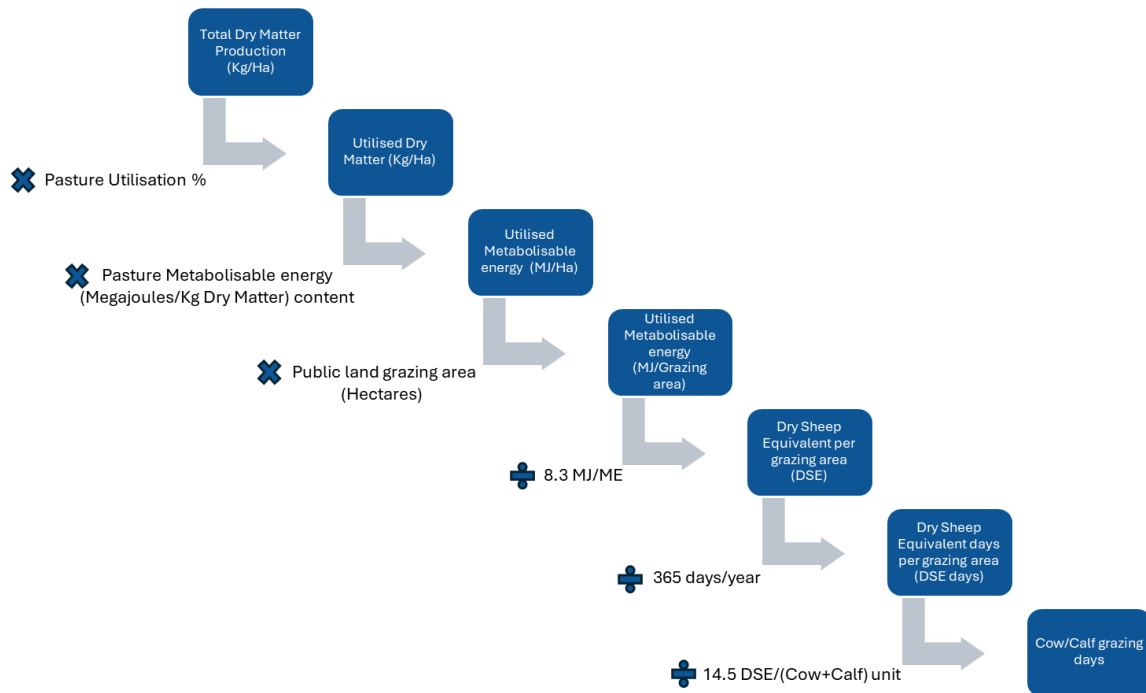
| Kg DM/ha <sup>1</sup> | TONNES DM/year |        |        |        |       | AV ME (MJ/kg DM) <sup>2</sup> |
|-----------------------|----------------|--------|--------|--------|-------|-------------------------------|
|                       | Summer         | Autumn | Winter | Spring | TOTAL |                               |
| <b>0.5</b>            | 2              | 2      | 0      | 1      | 5     | 9                             |
| <b>Average</b>        | 4              | 3      | 0      | 1      | 8     |                               |
| <b>1.5</b>            | 5              | 5      | 1      | 2      | 13    |                               |

<sup>1</sup>Kilograms of dry matter per hectare

<sup>2</sup> Average Metabolisable Energy (Megajoules per Kilogram Dry Matter)

The process used to calculate Carrying Capacity of public land grazing areas is depicted in *Figure 3* and a summary of the results of these calculations applied to the Current Grazing Areas are provided in *Table 9*. Firstly, the predicted total dry matter production needs to be adjusted based on the pasture utilisation to determine the harvested dry matter/ha (**DM/ha**). As no physical measures on pasture growth and utilisation exist, an assessment was made by the Consultants when visiting the island, and a high pasture utilisation rate of 75% was assumed for the initial calculations.

Total pasture dry matter production (per ha) was multiplied by the available grazing area for each section of public land (the Current Effective Grazing Areas). Total dry matter per hectare (kg/ha) was multiplied by Metabolisable energy content (Megajoules (MJ)) to calculate total available energy availability (MJ/ha). Total available energy was divided by 8.3 MJ to obtain the Dry Sheep Equivalents (DSE) per hectare. Total DSE/ha was then divided by the DSE rating of the Cow/Calf Unit (14.5 DSE) to obtain the total cow/calf grazing days. The Cow/Calf Unit (14.5 DSE) used to calculate Carrying Capacity is the equivalent of a single Stock Tag. Total cow grazing days indicates the number of grazing days per public land area, which is the potential number of Cow/Calf Units (Stock Tags) that can be grazed across the course of the year.



**Figure 3:** The process used to calculate Carrying Capacity.

**Table 9:** Current Effective Grazing Area and expected total dry matter (DM) production across each Grazing Zone on Norfolk Island.

| Grazing Zone | Current Effective Grazing       |  |
|--------------|---------------------------------|--|
|              | Area (ha)(reserves & roadsides) | Annual tonnes Dry Matter Total AVERAGE |
| Kingston     | 41.6                            | 312                                    |
| Headstone    | 17.2                            | 129                                    |
| Anson Bay    | 30.5                            | 229                                    |
| Cockpit      | 26.6                            | 199                                    |
| Ball Bay     | 12                              | 90                                     |
| <b>TOTAL</b> | <b>128</b>                      | <b>959</b>                             |

The full Current Carrying Capacity calculations are detailed in the Appendices (Appendix G - Carrying Capacity Calculations) using the assumed high pasture utilisation rate of 75%. A summary of the Current Carrying Capacity results of these calculations are set out in *Table 10*. The calculated Current Carrying Capacity can be compared to the allocated Stock Tags as detailed in *Table 3* and to the actual stock grazing during the 2024/2025 season as detailed in *Table 4*.

**Table 10: Average Current Carrying Capacity (Cow/Calf Units) (using the assumed high pasture utilisation rate of 75%) for Current Effective Grazing Areas.**

| Grazing Zones and Areas  | Current Effective Grazing Area (ha) | Cow/Calf Units Average |
|--|-------------------------------------|------------------------|
| <b>KINGSTON</b>  |                                     |                        |
| Kingston Common Reserve  | 13.8                                | 21                     |
| Commonwealth FH (b/w Country Rd and Middlegate Rd)                 | 0.8                                 | 1                      |
| Crown (Pound Paddock)  | 1.5                                 | 2                      |
| Crown (hill between Rooty Hill Rd and Quality Row)                 | 8.8                                 | 14                     |
| Crown (Middlegate Rd near Guide & Community Hall)                  | 0.8                                 | 1                      |
| Crown (Middlegate Rd near Banyan Park)                             | 1.0                                 | 2                      |
| Public Land (opposite Central School)                              | 2.1                                 | 3                      |
| Public Land (Portion 44a)  | 1.9                                 | 3                      |
| Kingston Road Reserves   | 10.8                                | 17                     |
| <b>TOTAL</b>   | <b>41.6</b>                         | <b>64</b>              |
| <b>HEADSTONE</b>   |                                     |                        |
| Portion 183 (New Farm Rd (Airport))                                | 1.9                                 | 3                      |
| Headstone Reserve (part)   | 3.9                                 | 6                      |
| Airport Douglas Dr   | 3.0                                 | 5                      |
| Stock Reserve Lot 2 Section 28                                     | 0.6                                 | 1                      |
| Headstone Reserve (northwest)                                      | 0.1                                 | 0                      |
| Headstone Road Reserves  | 7.8                                 | 12                     |
| <b>TOTAL</b>   | <b>17.2</b>                         | <b>26</b>              |
| <b>ANSON BAY</b>   |                                     |                        |
| Public Land (Kingfisher Paddock)                                   | 10.6                                | 16                     |
| Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)      | 0.3                                 | 0                      |
| Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)     | 0.3                                 | 0                      |
| Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                  | 2.2                                 | 3                      |
| Selwyn Reserve (Anson Bay Rd)                                      | 0.2                                 | 0                      |
| National Park Forestry Zone  | 1.5                                 | 2                      |
| Anson Bay Private Land   | 6.0                                 | 9                      |
| Anson Bay Road Reserves  | 9.5                                 | 15                     |
| <b>TOTAL</b>   | <b>30.5</b>                         | <b>47</b>              |
| <b>COCKPIT</b>   |                                     |                        |
| Cascade Reserve Lot 28 Sec 10 (south)                              | 5.7                                 | 9                      |
| Cascade Reserve Lot 28 Sec 10 (north)                              | 6.0                                 | 9                      |
| Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)     | 0.8                                 | 1                      |
| Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)     | 3.7                                 | 6                      |
| Cockpit Road Reserves  | 10.4                                | 16                     |
| <b>TOTAL</b>   | <b>26.6</b>                         | <b>41</b>              |
| <b>BALL BAY</b>  |                                     |                        |
| Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)      | 0.6                                 | 1                      |
| Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                    | 3.8                                 | 6                      |
| Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic) | 0.1                                 | 0                      |
| Two Chimneys Reserve (part) (second picnic area)                   | 0.2                                 | 0                      |
| Ball Bay Private Land  | 0.5                                 | 1                      |
| Ball Bay Road Reserves   | 6.9                                 | 11                     |
| <b>TOTAL</b>   | <b>12.0</b>                         | <b>18</b>              |
| <b>GRAND TOTAL</b>   | <b>128</b>                          | <b>196</b>             |

As detailed in *Table 10*, total expected Current Carrying Capacity based on current pasture production and assumed 75% pasture utilisation was calculated and averaged 196 Cow/Calf Units for the Current Effective Grazing Areas.

Overall potential Stock Tag allocation was below the average Current Carrying Capacity for the Current Effective Grazing Areas, averaging 97%. However, given a higher than target pasture utilisation of 75%, these results indicate a need to alter beef cattle grazing management on areas of public land with the aim of better aligning the numbers of cattle grazing with pasture availability and capacity. This will then have the benefits of increasing pasture production and pasture utilisation on these areas of public land whilst simultaneously minimising the risk of adverse impacts to pasture composition, soils, vegetation and subsequently environmental features on and adjoining these areas.

## 8.4. Target Carrying Capacity

Pasture utilisation rate is one of the biggest determinants of long-term productivity and sustainability in a pasture-based beef breeding enterprise. Utilisation of pasture is a continual balance between maximising pasture harvested whilst maintaining sufficient pasture leaf area and ground cover to allow plant recovery after grazing and minimise the risk of soil degradation and erosion. Typically, sustainable cattle breeding enterprises utilise 40-55% of the total dry matter grown (MLA (2024)). This compares to the high pasture utilisation rate of 75% adopted for initial calculations as detailed in the previous Section (8.3 Current Carrying Capacity). To adopt a more conservative and realistic pasture utilisation rate, the MLA (2024) upper range utilisation rate of 55% can be applied to the Current Effective Grazing Areas.

Using this target pasture utilisation rate of 55%, the Target Carrying Capacity was calculated against each of the Current Effective Grazing Areas (detailed in *Table 1*). The Target Carrying Capacity calculations are detailed in the Appendices (Appendix G - Carrying Capacity Calculations) and a summary is set out in *Table 11*.

**Table 11: Average Target Carrying Capacity (Cow/Calf Units) (using a target pasture utilisation rate of 55%) across the Current Effective Grazing Areas.**

| Grazing Zones and Areas  | Current Effective Grazing Area (ha) | Cow/Calf Units Average |
|--|-------------------------------------|------------------------|
| <b>KINGSTON</b>  |                                     |                        |
| Kingston Common Reserve  | 13.8                                | 16                     |
| Commonwealth FH (b/w Country Rd and Middlegate Rd)                 | 0.8                                 | 1                      |
| Crown (Pound Paddock)  | 1.5                                 | 2                      |
| Crown (hill between Rooty Hill Rd and Quality Row)                 | 8.8                                 | 10                     |
| Crown (Middlegate Rd near Guide & Community Hall)                  | 0.8                                 | 1                      |
| Crown (Middlegate Rd near Banyan Park)                             | 1.0                                 | 1                      |
| Public Land (opposite Central School)                              | 2.1                                 | 2                      |
| Public Land (Portion 44a)  | 1.9                                 | 2                      |
| Kingston Road Reserves   | 10.8                                | 12                     |
| <b>TOTAL</b>   | <b>41.6</b>                         | <b>47</b>              |
| <b>HEADSTONE</b>   |                                     |                        |
| Portion 183 (New Farm Rd (Airport))                                | 1.9                                 | 2                      |
| Headstone Reserve (part)   | 3.9                                 | 4                      |
| Airport Douglas Dr   | 3.0                                 | 3                      |
| Stock Reserve Lot 2 Section 28                                     | 0.6                                 | 1                      |
| Headstone Reserve (northwest)                                      | 0.1                                 | 0                      |
| Headstone Road Reserves  | 7.8                                 | 9                      |
| <b>TOTAL</b>   | <b>17.2</b>                         | <b>19</b>              |
| <b>ANSON BAY</b>   |                                     |                        |
| Public Land (Kingfisher Paddock)                                   | 10.6                                | 12                     |
| Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)      | 0.3                                 | 0                      |
| Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)     | 0.3                                 | 0                      |
| Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                  | 2.2                                 | 2                      |
| Selwyn Reserve (Anson Bay Rd)                                      | 0.2                                 | 0                      |
| National Park Forestry Zone  | 1.5                                 | 2                      |
| Anson Bay Private Land   | 6.0                                 | 7                      |
| Anson Bay Road Reserves  | 9.5                                 | 11                     |
| <b>TOTAL</b>   | <b>30.5</b>                         | <b>34</b>              |
| <b>COCKPIT</b>   |                                     |                        |
| Cascade Reserve Lot 28 Sec 10 (south)                              | 5.7                                 | 6                      |
| Cascade Reserve Lot 28 Sec 10 (north)                              | 6.0                                 | 7                      |
| Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)     | 0.8                                 | 1                      |
| Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)     | 3.7                                 | 4                      |
| Cockpit Road Reserves  | 10.4                                | 12                     |
| <b>TOTAL</b>   | <b>26.6</b>                         | <b>30</b>              |
| <b>BALL BAY</b>  |                                     |                        |
| Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)      | 0.6                                 | 1                      |
| Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                    | 3.8                                 | 4                      |
| Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic) | 0.1                                 | 0                      |
| Two Chimneys Reserve (part) (second picnic area)                   | 0.2                                 | 0                      |
| Ball Bay Private Land  | 0.5                                 | 1                      |
| Ball Bay Road Reserves   | 6.9                                 | 8                      |
| <b>TOTAL</b>   | <b>12.0</b>                         | <b>13</b>              |
| <b>GRAND TOTAL</b>   | <b>128</b>                          | <b>144</b>             |

As detailed in *Table 11*, total expected Target Carrying Capacity (based on the Current Effective Grazing Area, current pasture production and target pasture utilisation of 55%) averaged 144 Cow/Calf Units, indicating that overall potential Stock Tag allocation is 132% of the Target Carrying Capacity. Although NICA has proactively reduced stock numbers to 149 Cow/Calf units due to poor seasonal conditions (*Table 4*), the Target Carrying Capacity is based on a sustainable average pasture utilisation rate of 55%, whereas available data and on-ground observations indicate that current grazing is occurring at a significantly higher pasture utilisation rate of approximately 75%. These results highlight some discrepancy between current public land cattle grazing management and a Target Carrying Capacity scenario.

It is worth reiterating that the designated grazing area (Current Effective Grazing Area) is smaller than that used in previous assessments of public land carrying capacity undertaken by other consultants (for example, GHD (2016)). Variation in Carrying Capacity exists across regions on island and over seasons, such that under some conditions, Carrying Capacity is at or under potential. However, under recent historical and current conditions, this could indicate why adverse environmental impacts are occurring on and adjacent to public land grazing areas on Norfolk Island. This conclusion indicates a need for management changes to beef cattle grazing on public land and presents the challenges of a combination of:

- ground-truthing and increasing accuracy of the calculations detailed herein;
- increasing public land areas available for cattle grazing;
- increasing pasture production on grazed public land areas;
- improving grazing management strategies; and/or
- decreasing beef cattle stocking rates on public land.

Methods which can assist these management changes, particularly aimed at increasing beef cattle production, improving cattle management efficiency, improving pasture composition and production and minimising the risk of adverse environmental impact are provided in this Strategy (Section 6 Grazing Management; Section 7 Pastures & Pasture Assessment; Appendix F - Pasture Assessment Protocol Example; Appendix H - Herd Cultural Practices; Appendix I - Weeds). More specific methods aimed at appropriately managing beef cattle Carrying Capacity on areas of public land on Norfolk Island are expanded on in the next Section 9 Changes to Public Land Grazing.

## 8.5. Key Recommendations

- Adopt the Target Carrying Capacity (based on approximately 55% pasture utilisation) as the primary sustainable stocking benchmark for public land grazing, rather than relying on the Current Carrying Capacity.
- Progressively align stocking levels and grazing management within each Grazing Zone with the calculated Target Carrying Capacity of approximately 144 Cow/Calf Units.
- Review and recalculate Target Carrying Capacity annually as pasture monitoring and livestock performance data become available, and following significant seasonal events.
- Apply Carrying Capacity at a Grazing Zone and site-specific scale, recognising seasonal variability and infrastructure constraints.
- Use the Carrying Capacity findings to inform the package of recommended changes to public land grazing outlined in Section 9 Changes to Public Land Grazing, including adjustments to grazing rotations, seasonal restrictions, access to additional areas and restrictions in environmentally sensitive areas.

## 9. Changes to Public Land Grazing

### 9.1. Recommended Changes to Public Land Grazing

To strike an acceptable balance between public land grazing cattle productivity and minimising adverse environmental impacts (in particular adverse impacts to surface water quality), it is recommended that a combination of strategies, which are expanded on within this Section, are implemented including the:

- 9.1.1. implementation of improved grazing rotations across all areas;
- 9.1.2. implementation of seasonally restricted grazing for some areas;
- 9.1.3. implementation of pasture management to increase production on some areas;
- 9.1.4. optimisation of watering point access for grazing areas;
- 9.1.5. commencement of grazing on some areas not currently grazed, including sections of:
  - A. public land; and
  - B. the Forestry Zone;
- 9.1.6. cessation of grazing in some environmentally sensitive areas; and
- 9.1.7. reduction of cattle numbers grazing some areas.

These recommendations should not be implemented in isolation but should be implemented holistically to optimise cattle management on Norfolk Island. The degree and magnitude of implementation of one recommendation is likely to influence the scale and intensity of other recommendations. Therefore, a combination of these recommendations should be implemented across each Grazing Zone with the implementation of each recommendation tailored to suit each specific area within a particular Grazing Zone.

Some grazing management improvements can be implemented on all grazed public land and roadsides. The current cattle grazing management should continue with integration of the recommendations detailed herein to improve management. Grazing management should continue to respond to variations in soil moisture, pasture composition, weeds and in pasture quality and quantity. Some grazed public land areas are likely to continue with similar cattle numbers at similar stocking rates grazing for similar periods with minor modifications to grazing management based on this Strategy's recommendations, whilst other areas will need to undergo significant grazing management changes. As many of the recommendations detailed herein as possible should be implemented to each grazed public land area.

#### 9.1.1. Improved Grazing Rotations

Many of the Current Grazing Areas are suitable for continued cattle grazing however, all grazed areas would benefit from refined grazing management (refer to earlier Section 6.3 on Grazing Strategies). It is recommended that more structured, evidence-based, grazing management practice is implemented to improve the current continuous stocking and rotational grazing, by enhancing and intensifying rotational grazing and/or by adopting some of the more complex strategies outlined in *Table 5*. However, the adopted grazing management strategies will need to be tailored to suit each public land area and each Grazing Zone. In addition, grazing management must be flexible to appropriately respond with adjustments in stocking rates, grazing timing, the grazing period and pasture rest periods to variations in soil moisture, pasture volume and pasture quality present. Reference should be made to the earlier Section 7 on Pastures & Pasture Assessment and in particular the sections on Pasture Residual and Pasture Improvement as the quality and quantity of pasture available will directly impact management decisions relating to grazing management.

The need to implement pre- and post-grazing targets for public land grazing areas mandates the need for accurate and repeatable pasture measurement. One of the most important aspects of grazing management is the ability to objectively and accurately assess pasture quantity and quality. It is critical that grazing and public land area managers become proficient in an appropriately detailed and consistent methodology for pasture assessment. This should include the recording of pasture quantity and condition along with cattle numbers and grazing times for each area to benchmark production and to help refine the Carrying Capacity calculations and targets detailed in this Strategy.

Improvements to grazing rotations are not onerous and can readily be implemented by cattle grazing managers. The development of dynamic grazing rotation strategies for each Grazing Zone and for each location is beyond the scope of this Strategy however, it is envisaged that with the provision of pertinent information and tools to aid the enhancement of grazing management within this Strategy, local cattle managers can progressively enhance grazing rotations.

### 9.1.2. Seasonally Restricted Grazing

Some Current Grazing Areas show signs of pasture degradation from high stocking rates and overgrazing and should periodically have grazing restricted. These areas can continue to be grazed but with reduced grazing periods, potentially in conjunction with lower stocking rates. Grazing of these areas should not occur when soil conditions are excessively moist or when pasture residual is minimal or under conditions which present a heightened risk of adverse environmental impact. Managing these areas with seasonally restricted grazing still enables cattle production to occur, land maintenance costs to be reduced, and cultural aesthetics to be maintained whilst minimising the risk of adverse environmental impacts. Some public grazing areas are already managed with periodic grazing restrictions such as Town Creek Swamp 2 in the Kingston Grazing Zone. Other areas need to be managed in the same way including the Quarantine Reserve in the Cockpit Grazing Zone and other areas of KAVHA in the Kingston Grazing Zone.

### 9.1.3. Pasture Improvement

As detailed earlier (Section 7 on Pastures & Pasture Assessment), pasture production could be improved on island however, improving the varied pastures across the various public land areas is a complex task further complicated by importation restrictions and is therefore beyond the scope of this Strategy. In any event, it is envisaged that with the provision of pertinent information and tools in this Strategy, pastures can be cost effectively improved across many of the grazed public land areas. Rapid and efficient investigation of pasture improvement options should be instigated aiming to improve pasture production as quickly and efficiently as possible (refer to Section 7 on Pastures & Pasture Assessment). As detailed earlier, one of the most important aspects of improving pastures is the ability to objectively and accurately assess pasture quantity and quality. It is recommended that grazing and public land area managers (where relevant) become proficient in an appropriately detailed and consistent methodology for pasture assessment. An example of an appropriate pasture assessment protocol is provided in the Appendices (Appendix F - Pasture Assessment Protocol Example). For completeness, pasture improvement is not considered suitable for the Forestry Zone.

### 9.1.4. Optimise Watering Points

Cattle drinking water on Norfolk Island is sourced from natural waterways, with most accessing creeks and streams directly. In some Current Grazing Areas (for example, Kingston Common Reserve Lot 10 Sec 4, Cockpit, Kingfisher Paddock) water is pumped to a trough for cattle to access. Pumping water from

waterways to troughs removes the immediate pressure on the waterway itself, reducing the direct impact of cattle walking near waterways, eroding banks and defecating on/in waterways. Utilising troughs also allows for strategic placement of watering points, which promotes more balanced grazing across the landscape.

Grazing pressure around a waterpoint is known as a Piosphere, which is generally the size of one day's travel for cattle in the given conditions (Andrew (1988)). Typically, 80% of cattle grazing behaviour will generally occur within 2km of a water point (MLA (2024)), but will also be influenced by terrain, available cover, and the presence of preferred feed sources. Large sections of the grazed lands on Norfolk Island do not have a central water source and rely on cattle travelling to and from those areas. Whilst restriction of water access can be a useful tool to control animals use of certain areas, excessive travel to reach water can lead to excessive energy use and inefficient production, as well as increase the grazing pressure and trampling of pastures nearer to the water source. Water access can still be controlled and used to move animals across the landscape using fencing and taps on troughs to restrict access. To encourage more even use of the available grazing area, installation of additional water points should be implemented alongside the exclusion of waterway access and installation of trough watering points. As a priority, it is recommended that the water features in the Stock Reserve in the Headstone Grazing Zone are fenced to prevent cattle access (Appendix J – Mapped Optimised Grazing Areas). Note that the fencing of water features and watering points (as discussed in this section) is recommended in addition to, the fencing of environmentally sensitive areas under recommendation 9.1.6 Cease Grazing in Environmentally Sensitive Areas.

The development of a Stock Water Plan is beyond the scope of this Strategy however, it is noted that where areas adjoining water features are excluded from cattle grazing, new trough infrastructure could be installed to facilitate provision of stock drinking water. Infrastructure design could aim to utilise efficient and more cost-effective methods of delivering drinking water to the cattle, such as gravity feed or solar pumping mechanisms. Where troughs are utilised, it is paramount that they be kept clean and flushed regularly to ensure water is clean and there is minimal algal growth in the trough. In addition, regular maintenance of infrastructure and vigilance to prevent stock from running out of drinking water will be critical.

### 9.1.5. New Grazing Areas

#### A. Public Land

Members of NICA and/or the Working Group aided the Consultants in nominating areas of public land which are not currently grazed, but which have the potential to be grazed (Potential Grazing Areas) (Appendix D – Mapped Potential Grazing Areas). We understand that some of these areas may require statutory or regulatory changes in land use conditions and/or Plans of Management to facilitate grazing. The Consultants are not acquainted with the permissions and legalities required to instigate grazing on these areas and it is recommended that external advice is sought from an appropriately qualified and experienced third-party to clarify the processes required to instigate grazing in each location if required.

Any Potential Grazing Areas nominated for public cattle grazing will need to be examined and approved by the Working Group, NICA, the appropriate land area owner/manager, and appropriately qualified and experienced environmental consultants. These areas must only be approved after confirmation of suitability for grazing to form part of long-term sustainable management. Some of these areas are likely to require area specific management to ensure both optimum cattle production and protection of the environment. As with all public land grazing areas, cattle grazing on these locations should also be subject to the recommendations outlined in this Section 9.

The nominated Potential Grazing Areas adopted in this Strategy as part of an optimised grazing scenario are identified in Section 11 Optimised Carrying Capacity, *Table 12* and *Table 13* and mapped as Additional Grazing Areas in the appendices (Appendix J – Mapped Optimised Grazing Areas).

## B. Forestry Zone

A limited area of the Norfolk Island Forestry Zone is grazed by cattle under license agreement between the NINP and NICA (Section 4 Public Land Grazing Areas; *Table 1*; Appendix B – Mapped Current Grazing Areas). Additional areas of the Forestry Zone have been identified by the Working Group as Potential Grazing Areas, which have been adopted as Additional Grazing Areas as part of an optimised grazing scenario in this Strategy (Section 11 Optimised Carrying Capacity; *Table 12* and *Table 13*; Appendix J – Mapped Optimised Grazing Areas). These areas would not be grazed concurrently but would be rotated with only one area grazed at a time. The Forestry Zone is within, and therefore managed according to, the Norfolk Island Management Plan 2020, under the EPBC Act. Any change to existing grazing would require a new or revised license agreement between the Director of National Parks (NINP) and NICA.

### 9.1.6. Cease Grazing in Environmentally Sensitive Areas

As noted in earlier sections and as expanded on in Section 10 Management of Sensitive Environmental Features and Section 11 Optimised Carrying Capacity, some Current Grazing Areas are suffering from, or are susceptible to, excessive environmental degradation, and can contribute to poor surface water quality. Some areas show signs of pasture degradation and adverse environmental impact resulting from high stocking rates and overgrazing, often in conjunction with soil conditions unsuitable for grazing, low pasture growth, weed infestations or conditions which present a heightened risk of adverse environmental impact. Some of these areas should be excluded from cattle grazing. In some instances, entire areas should be excluded from grazing whilst in other cases, partial areas should be fenced to exclude cattle. The Current Grazing Areas which should be adjusted to exclude environmentally sensitive areas from cattle grazing have been identified and indicatively mapped as Reduced Grazing Areas in the Appendices to this Strategy (Appendix J – Mapped Optimised Grazing Areas) and explained further in Section 10 Management of Sensitive Environmental Features.

### 9.1.7. Reduce Cattle Numbers

A decrease in beef cattle stocking rates can improve pasture recovery and help minimise the risk of adverse environmental impact. The Strategy indicates that optimised grazing management and access to the Optimised Grazing Areas may reduce the need for reductions. However, Stock Tag allocations may still exceed calculated Carrying Capacity benchmarks under some scenarios (Section 11 Optimised Carrying Capacity). NICA has already imposed reductions in response to poor seasonal conditions.

It may be possible to reduce stock numbers grazing public land while increasing the proportion of stock managed on private land. However, consideration of private land carrying capacity and any redistribution of grazing pressure falls outside the scope of this Strategy.

In some locations, increasing the effective public land area available for grazing through the adoption of suitable Additional Grazing Areas may help reduce pressure on existing grazed areas and partially offset the need for stock reductions. Notwithstanding this, and based on the assumptions and indicative calculations presented in this Strategy, reductions in the number of cattle grazing some public land areas

may still be required under certain conditions to better align grazing pressure with sustainable Carrying Capacity benchmarks.

As detailed in subsequent sections, implementation of the recommended grazing management, pasture monitoring and environmental protection measures may improve sustainable Carrying Capacity on public land over time and reduce adverse environmental impacts in environmentally sensitive areas. Comprehensive implementation of these measures is also expected to reduce the likelihood, extent and frequency of future stock reductions required to maintain sustainable grazing outcomes.

## 9.2. Key Recommendations

- Implement improved grazing rotations across all areas as a priority management action, noting these can generally be achieved without major capital works.
- Fence and exclude cattle from environmentally sensitive areas as the highest priority capital works.
- Progressively open Additional Grazing Areas to help offset Reduced Grazing Areas and support cattle productivity.
- Develop and implement a Stock Water Plan to reduce direct creek access and associated water quality impacts.
- Obtain formal endorsement from NICA and NIRC (and relevant land managers/agencies, as required) prior to implementing any changes to Stock Tag allocations.

## 10. Management of Sensitive Environmental Features

### 10.1. Sensitive Features

A range of sensitive environmental features on or adjoining Current Grazing Areas were identified as part of Strategy compilation, some from past studies (CSIRO (2024) Norfolk Island Water Quality Assessment; CSIRO (2023) Acid Sulphate Soil Management in the KAVHA), some from stakeholders and some from observations made on island. Sensitive environmental features typically encompass riparian zones, erosion-prone areas and wetlands. To ensure the long-term sustainability of cattle grazing on Norfolk Island while mitigating any environmental impact, it is crucial to protect and enhance the environment and to safeguard it from further degradation. Protection of these features will help preserve water quality, reduce erosion and promote biodiversity. Key sensitive areas on Norfolk Island have been identified as particularly vulnerable to the negative impacts of cattle grazing. These areas include:

- **Riparian Zones:** Vulnerable waterways such as Watermill Creek and Town Creek are particularly vulnerable to nutrient runoff from cattle manure, which has been shown to degrade water quality and contribute to algal blooms in nearby marine environments like Emily and Slaughter Bays (*Image 1*).
- **Erosion-Prone Areas:** Steep slopes, particularly along the coastlines and hillsides, are susceptible to soil erosion, particularly where vegetation is limited. Grazing in these areas increases the risk of sedimentation, which further degrades nearby water bodies (*Image 3*).
- **Native Vegetation:** In some cases, there may be valuable native vegetation, ranging from individual trees to diverse areas of natural species, which is at risk of adverse impacts from cattle. Removing cattle access to these areas will help protect important native vegetation.
- **Wetlands:** Wetlands on island play a crucial role in maintaining biodiversity, in water regulation and in water quality enhancement by helping to remove sediments and nutrients from surface and groundwater. Unrestricted cattle access has led to soil compaction and vegetation loss, diminishing their ecological function (*Image 2*).
- **Acid Sulfate Soils:** Naturally occurring acid sulfate soils are found in wetlands and lower landscape positions across Norfolk Island (CSIRO Acid Sulfate Soils Dataset (2024)). When left undisturbed and saturated, there is little risk of adverse impacts from these soils however, when dried or disturbed, highly acidic material, and in particular sulfuric acid, can be released resulting in adverse impacts to the environment and infrastructure. Excessive acidic conditions at several locations across the island have been linked to declining groundwater levels coupled with soil disturbance through excavation or cattle grazing (resulting in pugging). The recommended management strategy for acid sulfate soils is to avoid disturbance and to maintain waterlogged or saturated conditions (*Image 2*). The predominant area of CSIRO-mapped acid sulfate soils relevant to public land grazing is located within KAVHA in the Kingston Grazing Zone and is depicted in Appendix E – Mapped KAVHA Acid Sulfate Soils.



**Image 1:** Riparian zone along Watermill Creek showing limited riparian vegetation, fenced to exclude cattle access. This creek is a key pathway for nutrient and sediment runoff to downstream receiving environments.



**Image 2:** At Kingston Common Reserve, excessive pugging around Watermill Creek and on mapped acid sulfate soils.



*Image 3: At Cascade Reserve, highly eroded hillside with terracettes.*

## 10.2. Cattle Exclusion

As mentioned above in Section 9 (Cease Grazing in Environmentally Sensitive Areas), it is imperative that cattle are excluded from sensitive environmental features in the Current Grazing Areas either through cessation of grazing in the areas where these features occur, or through the establishment of physical barriers to prevent cattle access to these features. For completeness, it is noted that virtual fencing has been investigated for Norfolk Island prior to the inception of this Strategy but was anecdotally deemed undesirable by private cattle owners due to the lack of clarity around the management of grazing and the ownership of virtual fencing control. It is recommended that physical fencing is used in key locations to:

- provide a minimum buffer zone of 10 m from each bank (that is, 10 m either side of the waterway) (preferably up to 30 m where feasible) along vulnerable waterways creating a zone to help filter runoff, capturing sediment and reducing nutrient mobilisation (*Image 1*);
- restrict cattle access to steep areas where grazing exacerbates erosion which will in turn increase vegetation to protect the soil and will enhance soil structure and stability, which will in turn reduce sediment mobilisation, runoff and ingress into water features;
- preclude cattle from in and around wetland areas and sensitive natural watering points to stop cattle induced erosion, soil compaction and damage to native vegetation to help maintain wetland biodiversity and health;
- restrict cattle access from areas used by local fauna, such as nesting seabirds; and
- prevent cattle from accessing areas of acid sulfate soils to help minimise disturbance to these areas and to help maintain saturated conditions which will in turn reduce the risk of adverse impacts from highly acidic material.

Some of the key locations deemed to be the most environmentally sensitive and recommended to be removed from cattle grazing in consideration of the above, are:

- part of Kingston Common Reserve to ensure a minimum buffer from Watermill Creek and the preclusion of cattle from acid sulfate soils as mapped by CSIRO Acid Sulfate Soils Dataset (2024) and depicted in Appendix E – Mapped KAVHA Acid Sulfate Soils;
- part of Cascade Reserve and Quarantine Reserve to prevent cattle access from the steep, eroded areas within the reserve, and those areas utilised by nesting seabirds; and
- part of Stock Reserve to restrict cattle access to Mission Pool, to protect the wetland area, riparian zone and short-finned eel population located within the water source.

Whilst it is outside the scope of this Strategy to establish a Fencing Plan, these approximate areas are mapped as Reduced Grazing Areas in Appendix J – Mapped Optimised Grazing Areas and listed in red font in Section 11 Optimised Carrying Capacity (*Table 12* and *Table 13*). It is recommended that site specific environmental management plans are compiled for the above areas to ensure adequate rehabilitation and ongoing monitoring and management of weeds and pests however, some general rehabilitation measures are set out below.

### 10.3. Rehabilitation

The exclusion of cattle provides an initial step in protecting environmentally sensitive areas however, this cannot be done in isolation. Cattle grazing can facilitate vegetation management in an area (for example, weed control) and once cattle are excluded from an area, there is a risk that weeds and/or vermin will colonise. It is therefore imperative that once cattle are excluded, active management of these areas is implemented to control weeds and to revegetate protected areas to support natural vegetation recovery and to enhance biodiversity. As mentioned above, whilst it is outside the scope of this Strategy to set out detailed weed, pest and rehabilitation measures, revegetation recommendations include (noting that these will be dependent on accessibility and hardiness, as well as site specific requirements):

- **Riparian Restoration:** Native vegetation such as Swamp Lily (*Crinum pedunculatum*), Swamp Hibiscus (*Hibiscus diversifolius*), Common Spike Rush (*Eleocharis acuta*), Drain Flax (*Typha orientalis*), Club Rush (*Schoenoplectus tabernaemontani*), Bull Rush (*Juncus continuus*), Beech (*Myrsine ralstoniae*) (vulnerable), Norfolk Island Cabbage Tree (*Cordyline oblecta* (vulnerable)), Coprosma (*Coprosma baueri*) (endangered), Ironwood (*Nestegis apetala*), White Oak (*Lagunaria patersonia*) and Ferns (various species, such as *Blechnum nudum*), should be planted along the banks of waterways to create natural filters for runoff and to stabilise soil. Where native species are unavailable or difficult to source, alternative non-native species that are commonly used in riparian restoration may be considered on a case-by-case basis, subject to environmental approval. These may include Lomandra and Norfolk Island Flax (*Phormium spp.*, native to New Zealand). However, preference should always be given to locally native species to maintain ecological integrity (Native Sedge (*Carex appressa*) and Shrubby Daisy (*Olearia solandri*)). These plantings will also provide habitat for local fauna, contributing to increased biodiversity. In cases where stock need to cross a waterway, a fenced crossing with trafficable material and embankments stabilisation can be employed (*Image 4*).



*Image 4: Stabilised, fenced culvert crossing with hardened approaches and protected banks to concentrate stock access and minimise erosion and direct waterway disturbance. Source: Stock & Waterways (2019). Photo: Stuart Naylor.*

- Erosion Control (Earthworks):** In some areas of existing erosion where significant soil has been displaced, or is at risk of displacement, engineering based remediation and stabilisation strategies could be employed to stabilise these eroded areas where funding and materials are available. These are likely to be site-specific and could include forms of soil protection, stabilisation, gully head controls, constructed embankments, retaining walls, piling, gabion wall etc. These could be implemented in conjunction with excess surface water control and/or revegetation. Publications detailing a range of different erosion control and soil stabilisation options are readily available (NSW Roads & Maritime Services (2015); (NSW Local Land Services (2018)). The adopted configuration of remediation will depend on a range of factors including desired extent of remediation, local contractor knowledge, funding, regulatory authority preferences and compatibility with soils, landscapes and other compatible remediation options. In isolated cases, where excessive stock traffic adversely impacts vegetation and soil structure (for example, around watering points), and where stock traffic can be controlled, it may be beneficial to install synthetic soil protection strips to encourage dedicated zones for stock to traverse thereby protecting surrounding land (*Image 5*). Similarly, synthetic soil protection may provide an option to minimise the risk of soil erosion in stock preferential camps or stock yards.



**Image 5:** A range of versatile options are available to control soil erosion in high stock traffic areas.

- Erosion Control (Exposed Soil):** Because exposed soil is susceptible to stock, water and wind induced erosion, any exposed soil surfaces or soil disturbance should be protected and/or stabilised with geotextile matting, mulch and/or vegetation.
- Erosion Control (Revegetation):** In erosion-prone areas, deep-rooted and hardy native species such as Norfolk Island Pine (*Araucaria heterophylla*), Norfolk Island Cabbage Tree (*Cordyline obtecta*), White Oak (*Lagunaria patersonia*), Melky Tree (*Excoecaria agallocha*), Whitewood (*Celtis paniculata*), Ironwood (*Nestegis apetala*), Bloodwood (*Baloghia inophylla*), Tree Ferns (*Cyathea brownii*), Pulau (*Hibiscus tiliaceus*), Beech (*Myrsine ralstoniae*), Maple (*Elaeodendron curtispiculum*), Meryta (*Meryta latifolia*), and Norfolk Island Palm (*Rhopalostylis baueri*), should be introduced to anchor the soil and prevent further erosion. Species selection, placement and planting density should be matched to site conditions (including exposure, soil depth, moisture and light availability) to avoid excessive competition and canopy closure that can suppress understory establishment. In addition, ground covers and smaller understory plants which tolerate the partial shade conditions beneath these species such as native ferns (*Blechnum nudum*) and wetland herbs, should also be established. This will help stabilise slopes and reduce sedimentation into the waterways. Revegetation should include vegetation types and species which rapidly establish and have longevity to facilitate continued and progressively enhanced protection of exposed soil. Prior to establishment of vegetation, the site must be prepared to maximise the chances of vegetation lodgement and establishment and may require sourcing and applying mulch or topsoil.
- Wetland Rehabilitation:** Native wetland plants should be reintroduced to enhance the ecological function of these areas if possible. This will improve water retention and filtration, while also creating habitat for native wildlife.

These revegetation strategies would need to be coupled with ongoing monitoring to assess rehabilitation success, along with management measures adapted as necessary, particularly to ensure adequate weed and plant control. These measures will be important to promote natural recovery while ensuring cattle

grazing can continue sustainably on other parts of the island. Extensive guidance is available online on stock exclusion and the protection and rehabilitation of waterways, including topics such as fencing, revegetation, weed and pest animal control, and flood management. Agriculture Victoria's Livestock Management on Riparian Land and the NSW Stock and Waterways guide are useful resources (see Section 14 References).

#### 10.4. Key Recommendations

- Establish minimum 10-metre riparian buffers from the top of bank on each side of waterways (preferably up to 30 metres where feasible) and fence to prevent cattle access.
- Exclude cattle from Cascade Reserve / Cascade Creek corridor, steep erosion-prone areas, and areas with KAVHA identified acid sulfate soils.
- Implement active rehabilitation (native revegetation and erosion control) immediately following cattle exclusion to stabilise soils and reduce sediment/runoff.
- Prioritise fencing of KAVHA acid sulfate soil areas and Watermill Creek riparian zones as the highest priority exclusion works.

## 11. Optimised Carrying Capacity

By implementing the recommendations outlined in Section 9 Changes to Public Land Grazing to the extent practicable, sustainable Carrying Capacity on public land and roadsides may be improved over time. The Optimised Carrying Capacity used in this assessment is based on the following amendments to the Current Grazing Areas, which are listed in the Optimised Grazing Areas in *Table 12*:

- a reduction in the Current Grazing Areas in locations containing sensitive environmental features (in Kingston Common Reserve, Stock Reserve, and Quarantine Reserve) as identified in Section 10 Management of Sensitive Environmental Features and mapped as Reduced Grazing Areas in Appendix J – Mapped Optimised Grazing Areas; and
- the addition of grazing locations to increase total effective grazing area of public lands which are mapped as Additional Grazing Areas in Appendix J – Mapped Optimised Grazing Areas.

The Additional Grazing Areas have been adopted from the Potential Grazing Areas nominated by the broader Working Group through consultation with NIRC, NINP and NICA. As noted in Section 9 Changes to Public Land Grazing, these adopted areas may require changes to governing plans and agreements before grazing access is permitted however, exploration of these requirements is beyond the scope of this Strategy.

Further, additional Carrying Capacity could be achieved if the overall pasture dry matter production is increased through implementation of strategies outlined in Section 9 Changes to Public Land Grazing. Whilst the exact increase is difficult to quantify and will vary depending on implementation intensity within different public grazing areas, Carrying Capacity increases of approximately 10 to 15% are achievable.

Using the Optimised Effective Grazing Areas (a combination of Current Effective Grazing Areas, Reduced Grazing Areas and effective Additional Grazing Areas), the Optimised Carrying Capacity for public grazing areas on Norfolk Island was calculated. The Carrying Capacity calculations detailed earlier (and in the appendices (Appendix G - Carrying Capacity Calculations)) were applied to each of the Optimised Effective Grazing Areas of land yielding another set of Cow/Calf Units which can again be compared to the allocated Stock Tags detailed in *Table 3*. A summary of the results of these calculations of average Optimised Carrying Capacity are set out in *Table 13* and the complete calculations are provided in the Appendices (Appendix G - Carrying Capacity Calculations).

The Optimised Effective Grazing Area totals 137 ha (91.6 ha of public land and 45.4 ha of Current Effective Grazed Road Areas), which is a net increase of 9 ha from the Current Effective Grazing Areas (*Table 1* and *Table 12*).

**Table 12: Current Effective Grazing Areas against Optimised Effective Grazing Areas, including *Additional Grazing Areas* and *Reduced Grazing Areas*.**

| GRAZING ZONES          | CURRENT GRAZING AREAS  | CURRENT EFFECTIVE GRAZING AREA(ha)                  | OPTIMISED GRAZING AREAS   | OPTIMISED EFFECTIVE GRAZING AREA (ha) |
|------------------------|--|---|---|---------------------------------------|
| KINGSTON               | Kingston Common Reserve  | 13.8  | <b>Kingston Common Reserve</b>  | <b>8.2</b>                            |
|                        | Commonwealth FH (b/w Country Rd and Middlegate Rd)                 | 0.8   | Commonwealth FH (b/w Country Rd and Middlegate Rd)                    | 0.8                                   |
|                        | Crown (Pound Paddock)  | 1.5   | Crown (Pound Paddock)   | 1.5                                   |
|                        | Crown (hill between Rooty Hill Rd and Quality Row)                 | 8.8   | Crown (hill between Rooty Hill Rd and Quality Row)                    | 8.8                                   |
|                        | Crown (Middlegate Rd near Guide & Community Hall)                  | 0.8   | Crown (Middlegate Rd near Guide & Community Hall)                     | 0.8                                   |
|                        | Crown (Middlegate Rd near Banyan Park)                             | 1.0   | Crown (Middlegate Rd near Banyan Park)                                | 1.0                                   |
|                        | Public Land (opposite Central School)                              | 2.1   | Public Land (opposite Central School)                                 | 2.1                                   |
|                        | Public Land (Portion 44a)  | 1.9   | Public Land (Portion 44a)   | 1.9                                   |
|                        | Kingston Road Reserves   | 10.8  | Kingston Road Reserves  | 10.8                                  |
|                        |  |   | <b>Midleridge reserve (NIRC recommended)</b>                          | <b>0.2</b>                            |
|                        |  | <b>Guide and Community Hall (NICA recommended)</b>  | <b>0.7</b>  |                                       |
| <b>SUBTOTAL:</b>       |  | <b>41.6</b>   |   | <b>36.8</b>                           |
| HEADSTONE              | Portion 183 (New Farm Rd (Airport))                                | 1.9   | Portion 183 (New Farm Rd (Airport))                                   | 1.9                                   |
|                        | Headstone Reserve (part)   | 3.9   | Headstone Reserve (part)  | 3.9                                   |
|                        | Airport Douglas Dr   | 3.0   | Airport Douglas Dr  | 3.0                                   |
|                        | Stock Reserve Lot 2 Section 28                                     | 0.6   | <b>Stock Reserve Lot 2 Section 28</b>                                 | <b>0.2</b>                            |
|                        | Headstone Reserve (northwest)                                      | 0.1   | Headstone Reserve (northwest)   | 0.1                                   |
|                        | Headstone Road Reserves  | 7.8   | Headstone Road Reserves   | 7.8                                   |
|                        |  |   | <b>Headstone Reserve Northwest (NIRC recommended)</b>                 | <b>0.6</b>                            |
|                        |  |   | <b>Headstone Reserve Central West (NICA recommended)</b>              | <b>0.4</b>                            |
|                        |  | <b>Airport West of airstrip (DITR recommended)</b>  | <b>4.3</b>  |                                       |
|                        |  | <b>Airport adjacent terminal (DITR recommended)</b> | <b>0.9</b>  |                                       |
|                        |  | <b>Point Ross reserve (NIRC recommended)</b>        | <b>1.1</b>  |                                       |
| <b>SUBTOTAL:</b>       |  | <b>17.2</b>   |   | <b>24.1</b>                           |
| ANSON BAY              | Public Land (Kingfisher Paddock)                                   | 10.6  | Public Land (Kingfisher Paddock)                                      | 10.6                                  |
|                        | Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)      | 0.3   | Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)         | 0.3                                   |
|                        | Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)     | 0.3   | Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)        | 0.3                                   |
|                        | Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                  | 2.2   | Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                     | 2.2                                   |
|                        | Selwyn Reserve (Anson Bay Rd)                                      | 0.2   | Selwyn Reserve (Anson Bay Rd)   | 0.2                                   |
|                        | National Park Forestry zone  | 1.5   | National Park Forestry Zone   | 1.5                                   |
|                        | Anson Bay Private Land   | 6.0   | Anson Bay Private Land  | 6.0                                   |
|                        | Anson Bay Road Reserves  | 9.5   | Anson Bay Road Reserves   | 9.5                                   |
|                        |  | <b>Forestry Reserve North (NINP recommended)</b>    | <b>1.4</b>  |                                       |
|                        |  | <b>Forestry Reserve South (NINP recommended)</b>    | <b>0.5</b>  |                                       |
|                        |  | <b>Forestry Reserve Central (NICA recommended)</b>  | <b>0.5</b>  |                                       |
| <b>SUBTOTAL:</b>       |  | <b>30.5</b>   |   | <b>32.9</b>                           |
| COCKPIT                | Cascade Reserve Lot 28 Sec 10 (south)                              | 5.7   | Cascade Reserve Lot 28 Sec 10 (south)                                 | 5.7                                   |
|                        | Cascade Reserve Lot 28 Sec 10 (north)                              | 6.0   | Cascade Reserve Lot 28 Sec 10 (north)                                 | 6.0                                   |
|                        | Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)     | 0.8   | Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)        | 0.8                                   |
|                        | Cockpit Road Reserves  | 10.4  | Cockpit Road Reserves   | 10.4                                  |
|                        | Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)     | 3.7   | <b>Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)</b> | <b>3.2</b>                            |
| <b>SUBTOTAL:</b>       |  | <b>26.6</b>   |   | <b>26.0</b>                           |
| BALL BAY               | Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)      | 0.6   | Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)         | 0.6                                   |
|                        | Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                    | 3.8   | Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                       | 3.8                                   |
|                        | Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic) | 0.1   | Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic)    | 0.1                                   |
|                        | Two Chimneys Reserve (part) (second picnic area)                   | 0.2   | Two Chimneys Reserve (part) (second picnic area)                      | 0.2                                   |
|                        | Ball Bay Private Land  | 0.5   | Ball Bay Private Land   | 0.5                                   |
|                        | Ball Bay Road Reserves   | 6.9   | Ball Bay Road Reserves  | 6.9                                   |
|                        |  |   | <b>South of Stockyard Rd</b>  | <b>0.5</b>                            |
|                        |  | <b>Two Chimney reserve South (NIRC recommended)</b> | <b>4.3</b>  |                                       |
| <b>SUBTOTAL:</b>       |  | <b>12.0</b>   |   | <b>16.8</b>                           |
| <b>LAND SUBTOTAL:</b>  |  | <b>82.4</b>   |   | <b>91.2</b>                           |
| <b>ROADS SUBTOTAL:</b> |  | <b>45.4</b>   |   | <b>45.4</b>                           |
| <b>TOTAL (ha)</b>      |  | <b>128</b>  |   | <b>137</b>                            |

**Table 13: Average Optimised Carrying Capacity (Cow/Calf Units) (using Optimised Effective Grazing Areas and target utilisation (55%)).**

| Grazing Zones and Areas   | Optimised Effective Grazing Area (ha) | Cow/Calf Units Average |
|---|---------------------------------------|------------------------|
| <b>KINGSTON</b>   |                                       |                        |
| <b>Kingston Common Reserve</b>  | <b>8.2</b>                            | <b>9.2</b>             |
| Commonwealth FH (b/w Country Rd and Middlegate Rd)                    | 0.8                                   | 0.9                    |
| Crown (Pound Paddock)   | 1.5                                   | 1.7                    |
| Crown (hill between Rooty Hill Rd and Quality Row)                    | 8.8                                   | 10.0                   |
| Crown (Middlegate Rd near Guide & Community Hall)                     | 0.8                                   | 0.9                    |
| Crown (Middlegate Rd near Banyan Park)                                | 1.0                                   | 1.1                    |
| Public Land (opposite Central School)                                 | 2.1                                   | 2.4                    |
| Public Land (Portion 44a)   | 1.9                                   | 2.1                    |
| <b>Middleridge reserve (NIRC recommended)</b>                         | <b>0.2</b>                            | <b>0.2</b>             |
| <b>Guide and Community Hall (NICA recommended)</b>                    | <b>0.7</b>                            | <b>0.8</b>             |
| Kingston Road Reserves  | 10.8                                  | 12.2                   |
| <b>TOTAL</b>  | <b>36.8</b>                           | <b>42</b>              |
| <b>HEADSTONE</b>  |                                       |                        |
| Portion 183 (New Farm Rd (Airport))                                   | 1.9                                   | 2.1                    |
| Headstone Reserve (part)  | 3.9                                   | 4.4                    |
| Airport Douglas Dr  | 3.0                                   | 3.3                    |
| <b>Stock Reserve Lot 2 Section 28</b>                                 | <b>0.2</b>                            | <b>0.3</b>             |
| Headstone Reserve (northwest)   | 0.1                                   | 0.1                    |
| <b>Headstone Reserve Northwest (NIRC recommended)</b>                 | <b>0.6</b>                            | <b>0.7</b>             |
| <b>Headstone Reserve Central West (NICA recommended)</b>              | <b>0.4</b>                            | <b>0.4</b>             |
| <b>Airport West of airstrip (DITR recommended)</b>                    | <b>4.3</b>                            | <b>4.8</b>             |
| <b>Airport adjacent terminal (DITR recommended)</b>                   | <b>0.9</b>                            | <b>1.0</b>             |
| <b>Point Ross reserve (NIRC recommended)</b>                          | <b>1.1</b>                            | <b>1.2</b>             |
| Headstone Road Reserves   | 7.8                                   | 8.8                    |
| <b>TOTAL</b>  | <b>24.1</b>                           | <b>27</b>              |
| <b>ANSON BAY</b>  |                                       |                        |
| Public Land (Kingfisher Paddock)                                      | 10.6                                  | 12.0                   |
| Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)         | 0.3                                   | 0.3                    |
| Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)        | 0.3                                   | 0.3                    |
| Selwyn Reserve Lot 6 Sec 31 (part) (Puppys Point)                     | 2.2                                   | 2.4                    |
| Selwyn Reserve (Anson Bay Rd)   | 0.2                                   | 0.2                    |
| National Park Forestry Zone   | 1.5                                   | 1.7                    |
| Anson Bay Private Land  | 6.0                                   | 6.7                    |
| <b>Forestry Reserve North (NINP recommended)</b>                      | <b>1.4</b>                            | <b>1.5</b>             |
| <b>Forestry Reserve South (NINP recommended)</b>                      | <b>0.5</b>                            | <b>0.6</b>             |
| <b>Forestry Reserve Central (NICA recommended)</b>                    | <b>0.5</b>                            | <b>0.6</b>             |
| Anson Bay Road Reserves   | 9.5                                   | 10.7                   |
| <b>TOTAL</b>  | <b>32.9</b>                           | <b>37</b>              |
| <b>COCKPIT</b>  |                                       |                        |
| Cascade Reserve Lot 28 Sec 10 (south)                                 | 5.7                                   | 6.4                    |
| Cascade Reserve Lot 28 Sec 10 (north)                                 | 6.0                                   | 6.7                    |
| Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)        | 0.8                                   | 1.0                    |
| <b>Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)</b> | <b>3.2</b>                            | <b>3.6</b>             |
| Cockpit Road Reserves   | 10.4                                  | 11.7                   |
| <b>TOTAL</b>  | <b>26.0</b>                           | <b>29</b>              |
| <b>BALL BAY</b>   |                                       |                        |
| Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)         | 0.6                                   | 0.6                    |
| Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                       | 3.8                                   | 4.2                    |
| Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic)    | 0.1                                   | 0.1                    |
| Two Chimneys Reserve (part) (second picnic area)                      | 0.2                                   | 0.2                    |
| Ball Bay Private Land   | 0.5                                   | 0.5                    |
| <b>South of Stockyard Rd</b>  | <b>0.5</b>                            | <b>0.6</b>             |
| <b>Two Chimney reserve South (NIRC recommended)</b>                   | <b>4.3</b>                            | <b>4.9</b>             |
| Ball Bay Road Reserves  | 6.9                                   | 7.8                    |
| <b>TOTAL</b>  | <b>16.8</b>                           | <b>19</b>              |
| <b>GRAND TOTAL</b>  | <b>137</b>                            | <b>154</b>             |

The total expected Optimised Carrying Capacity, based on the Optimised Effective Grazing Areas and a target pasture utilisation rate of 55%, averaged approximately 154 Cow/Calf Units for the island (Table 13). This provides an indicative benchmark for a more sustainable public land grazing scenario under the Optimised Grazing Area configuration.

Comparing Stock Tags issued and current stock numbers against both Target and Optimised Carrying Capacity benchmarks helps distinguish the administrative allocation framework from on-ground grazing pressure under current and proposed area configurations.

When compared with current settings, the average Stock Tag allocation (190 Cow/Calf Units) remains above both the Target Carrying Capacity benchmark (144 Cow/Calf Units, based on the Current Effective Grazing Areas at 55% utilisation) and the Optimised Carrying Capacity benchmark (154 Cow/Calf Units, based on the Optimised Effective Grazing Areas at 55% utilisation). However, at the time of reporting, cattle owners had reduced actual stock numbers grazing public land to approximately 149 Cow/Calf Units, which equates to approximately 103.5% of the Target Carrying Capacity and 97% of the Optimised Carrying Capacity (*Table 4, Table 11 and Table 13*).

As outlined earlier, improved pasture and grazing management (including more consistent pasture assessment and record keeping) may improve pasture productivity and, over time, refine and potentially increase Carrying Capacity estimates. These conclusions should be considered in the context of limited Norfolk Island-specific pasture production data, the assumptions used in the calculations, and inherent variation across grazing areas and seasons.

## 12. Carrying Capacity Summary

Current grazing management of public lands on Norfolk Island is primarily guided by visual assessment of cattle and pastures, together with the practical knowledge of land managers developed over generations. In the absence of long-term pasture production records, Carrying Capacity of public lands has been assessed using satellite mapping, limited on-ground observations and pasture growth data from comparable climates. To protect environmentally sensitive areas while maintaining cattle productivity on-island, an optimised grazing scenario (Optimised Grazing Areas) has been identified that incorporates reductions (Reduced Grazing Areas) and additions (Additional Grazing Areas) in area, together with a target pasture utilisation rate of 55% to support pasture persistence and recovery.

The key findings of the Carrying Capacity assessments are:

- current stock numbers grazing public land are below the issued Stock Tags due to seasonal conditions and management decisions by NICA to reduce cattle numbers (Section 8.3 Current Carrying Capacity);
- under average conditions and a target pasture utilisation rate of 55%, the Current Effective Grazing Area (128 ha) is estimated to support approximately 144 Cow/Calf Units annually (Section 8.4 Target Carrying Capacity);
- under the optimised scenario, where environmentally sensitive areas are protected, suitable additional areas are accessed and a target utilisation rate of 55% is adopted, the Optimised Effective Grazing Areas (137 ha) are estimated to support approximately 154 Cow/Calf Units annually (Section 11 Optimised Carrying Capacity);
- improved grazing management and pasture monitoring (and, where feasible, practical pasture improvement measures) may improve pasture utilisation and productivity over time and refine Carrying Capacity outcomes (Section 9 Changes to Public Land Grazing); and
- refinements in data collection on pasture parameters (dry matter yield, forage quality), animal factors (weight, condition, growth rate) and grazing records (including time spent grazing specific areas and the proportion of the year cattle graze public lands) will improve the reliability of Carrying Capacity assessments and may lead to changes in estimated Carrying Capacity.

As detailed earlier in this Strategy, the designated Current Effective Grazing Area is smaller than that used in previous assessments. The above assessments are based on estimates of cattle weight and pasture growth potential, and conclusions are therefore subject to amendment as Carrying Capacity inputs are refined and management adjustments are made based on ongoing pasture assessment and grazing management data. These conclusions are also based on averages across herds (Grazing Zones) and grazing areas, and refinement of Carrying Capacity and implementation of recommendations will need to be appropriately tailored to specific public grazing areas.

Cattle grazing and public land area managers should seek to progress toward the Optimised Carrying Capacity scenario through implementation of the recommendations outlined in Section 9 Changes to Public Land Grazing. The Strategy indicates that improving pasture dry matter production and applying sound, sustainable grazing management can support more sustainable Carrying Capacity outcomes over time. In addition, enabling access to suitable additional grazing areas may help reduce pressure on existing grazed areas and lessen the likelihood or extent of reductions in stocking rates or Stock Tag allocations required to align grazing pressure with sustainable Carrying Capacity benchmarks.

### 13. Implementation & Monitoring

Input from, and consideration by, all relevant stakeholders will be required to determine the most appropriate, efficient, practical and realistically attainable approach to implementing this Strategy. An overarching body, such as the Working Group, should oversee Strategy implementation, coordinate stakeholder input, and monitor progress against agreed actions and timeframes. The Working Group should establish a formal approval process for implementing Strategy recommendations, including clear decision-making protocols, documentation requirements and stakeholder consultation procedures. Additionally, responsibilities for ongoing fencing maintenance should be assigned, including regular inspection schedules, repair protocols and funding arrangements, to support the long-term effectiveness of exclusion fencing.

It is envisaged that Strategy implementation will involve initial information dissemination, confirmation of implementation priorities and timing, allocation of responsibilities, and the provision of equipment and training to facilitate monitoring and assessment. As a priority, the required processes should be implemented to facilitate the assessment, approvals and practical requirements needed to enable grazing in the Additional Grazing Areas identified for cattle grazing. Additional areas not currently considered for cattle grazing may also be identified over time and could be considered through future Strategy review and updates. Conversely, additional locations within Current Grazing Areas may also be identified as presenting an increased risk of adverse environmental impact and may require restriction or removal from public land cattle grazing.

Initially, to support implementation, appropriately qualified and experienced personnel should develop an Implementation Plan identifying and making decisions on:

- **Prioritisation:** Identification of priority areas for immediate intervention, including fencing, alternative water sources and pasture measurement.
- **Resource Allocation:** Discussion of responsibilities, budgets, funding opportunities, equipment and other resources required for Strategy implementation.
- **Limitations and Contingencies:** Consideration of potential obstacles and strategies to address them, including limited resources and community participation.

- **Metrics and Indicators:** Description of metrics for tracking water quality outcomes, soil health, pasture condition, weed management and cattle productivity.
- **Monitoring Schedule:** Outline of a schedule for monitoring activities, including regular water quality testing and pasture assessments.
- **Evaluation:** Framework for evaluating Strategy effectiveness over time and adjusting actions as required.

To complement implementation of this Strategy, appropriately qualified and experienced personnel should be engaged to develop plans for key components of the Strategy, which should be approved by the Working Group. A Public Land Grazing Strategy Plan (including plans, direction, configuration, responsibilities, permissions, costs, personnel, timing and implementation methodology) should be developed for each of the following:

- **Fencing:** Identify transects, materials (configuration, availability, costing etc.) and personnel required to fence out environmentally sensitive areas as a priority, and maintain fences to ensure functionality.
- **Stock Water:** Develop a plan to identify and install appropriate stock watering infrastructure, including upgrading existing infrastructure (Section Optimise Watering Points).
- **Erosion Control:** Identify and prioritise key erosion locations based on magnitude and risk, and develop site-specific erosion control measures.
- **Acid Sulfate Soils:** Continue working with CSIRO to consolidate acid sulfate soil management plans.
- **Pasture Assessment:** Develop a practical, repeatable methodology for pasture assessment, including training and tools (see below).
- **Grazing Rotations:** Develop island- and Grazing Zone-specific grazing rotation plans that consider pasture quality, Optimised Carrying Capacity and stock numbers, and specify objective approaches to grazing timing and periods, supported by agreed governance arrangements.
- **Pasture Improvement:** Develop Grazing Zone-specific pasture improvement plans aimed at optimising pasture composition, pasture production, pasture recovery post-grazing and herd health.
- **Pasturage Rights:** Identify any required adjustments to Stock Tag allocations and determine an equitable and practical approach to implementing these adjustments.
- **Weeds:** Develop weed management plans for priority sites including existing and newly fenced areas, grazed pastures, roadsides, water features and priority weed species (Appendix I - Weeds).
- **Herd Health:** Continue development of herd health strategies to support beef production (Appendix H - Herd Cultural Practices).

To support optimisation of public land grazing, it will be important to monitor grazing and pasture metrics, including:

- Benchmark animal size and performance to inform Carrying Capacity calculations:
  - Collect weight and body condition score data on cows over one production cycle.

- Collect liveweight gain data on calves over one season.
- Benchmark pasture growth rates, total biomass and nutritional composition:
  - Undertake pasture monitoring (monthly minimum) manually by a designated employee or remotely using sensor technology.
  - Prepare feed budgets informed by stocking rate and animal requirements (standard reference weights).
- Establish monitoring triggers and decision points for cattle movements:
  - Establish pre- and post-grazing thresholds for public land grazing areas.
  - Confirm who monitors (e.g. NICA, NIRC or other) and who makes decisions on cattle movement based on current feed budgets.

Some Strategy recommendations should be implemented as soon as practicable, such as fencing to exclude cattle from specific areas and the provision of alternative water sources. Improved grazing rotation management and basic pasture improvement measures could also be progressed in parallel. However, development of the above-mentioned Public Land Grazing Strategy Plans will take time and should be commenced as a priority.

After 12 months of comprehensive monitoring, the Carrying Capacity calculations should be reviewed and updated based on monitoring results, to inform refined Strategy direction and targets. The Strategy should be treated as a living document and reviewed annually to reflect monitoring outcomes and implementation progress. As the above-mentioned Public Land Grazing Strategy Plans are developed, the Strategy should be updated to refer to these.

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## 15. Glossary & Acronyms

| Term                                   | Definition  |
|--|---|
| <b>ABS</b>                             | Australian Bureau of Statistics   |
| <b>Additional Grazing Areas</b>        | Public land areas proposed to be opened to cattle grazing, adopted from the Potential Grazing Areas and subject to relevant assessments and necessary approvals.  |
| <b>Carrying Capacity</b>               | The number of livestock that a defined grazing area can support over a given period without causing unacceptable degradation of pasture condition, soil stability, or environmental values. Carrying Capacity is influenced by pasture production, pasture utilisation, seasonal conditions, grazing management and land characteristics. In this Strategy, Carrying Capacity is expressed as the number of Cow/Calf Units that can be supported by the grazing area under specified assumptions. |
| <b>Cow/Calf Unit</b>                   | A standard livestock unit used in this Strategy to represent one breeding cow together with her dependent calf up to six (6) months of age. The cow and calf are treated as a single grazing unit for the purpose of estimating pasture demand and calculating Carrying Capacity.   |
| <b>CSIRO</b>                           | Commonwealth Scientific and Industrial Research Organisation.   |
| <b>Current Carrying Capacity</b>       | The estimated number of cattle (expressed as Cow/Calf Units) that the Current Effective Grazing Areas could support under the present grazing configuration and assumed pasture production. In this Strategy, Current Carrying Capacity is calculated using a higher average pasture utilisation assumption of approximately 75%, which reflects conditions where pasture utilisation may be maximised but may not allow optimal pasture recovery or long-term sustainability.                    |
| <b>Current Effective Grazing Areas</b> | The portion of Current Grazing Areas that is practically usable and productive for cattle grazing, excluding sealed roads, waterways, steep or eroded terrain, and dense vegetation. It represents the land area used in the Current Carrying Capacity and Target Carrying Capacity calculations.   |
| <b>Current Grazing Areas</b>           | Refers to mapped land areas where roadside cattle are currently known or reported to graze (public and some private land). This includes entire reserves, road reserves, and other designated zones, regardless of how much of that land is actually usable or productive for grazing. This term includes areas that may be unsuitable due to erosion, tree cover, sealed surfaces, or other constraints.   |
| <b>DCCEEW</b>                          | Department of Climate Change, Energy, the Environment and Water.  |
| <b>DITRDCA</b>                         | Department of Infrastructure, Transport, Regional Development, Communications and the Arts.   |
| <b>DM</b>                              | Dry Matter.   |
| <b>DSE</b>                             | Dry Sheep Equivalents.  |
| <b>Grazing Zone</b>                    | One of five broad areas on Norfolk Island formed by the typical locations that each of the five distinct herds of cattle typically graze, comprising: Kingston, Headstone, Anson Bay, Cockpit, Ball Bay.  |
| <b>KAVHA</b>                           | Kingston and Arthur's Vale Heritage Area.   |
| <b>MLA</b>                             | Meat & Livestock Australia  |
| <b>NICA</b>                            | Norfolk Island Cattle Association.  |
| <b>NINP</b>                            | Norfolk Island National Park.   |

|  |   |
|--|---|
| <b>NIRC</b>                              | Norfolk Island Regional Council.  |
| <b>Optimised Carrying Capacity</b>       | The estimated number of cattle (expressed as Cow/Calf Units) that could be sustainably supported under the Strategy’s Optimised Effective Grazing Area scenario. In this Strategy, Optimised Carrying Capacity is calculated using a conservative average pasture utilisation rate of 55% and is indicative, as it depends on implementation, seasonal variability, and ongoing refinement of inputs through monitoring.  |
| <b>Optimised Effective Grazing Areas</b> | The estimated effective grazing area (ha) used in the Strategy’s optimised scenario to calculate Optimised Carrying Capacity. It represents the portion of the Optimised Grazing Areas considered practically available for grazing after accounting for areas of reduced or no effective grazing (for example sealed surfaces, dense vegetation, waterways, steep terrain or heavily eroded areas). Optimised Effective Grazing Areas are indicative and are expected to be refined as area verification and monitoring data become available.                                     |
| <b>Optimised Grazing Areas</b>           | The areas of land considered in the Strategy’s optimised grazing scenario, comprising the Current Grazing Areas adjusted to remove locations recommended for restriction or exclusion due to environmental sensitivity (Reduced Grazing Areas) and to include suitable areas proposed for grazing (Additional Grazing Areas). This includes entire reserves, road reserves, and other designated zones, regardless of how much of that land is actually usable or productive for grazing. Optimised Grazing Areas are indicative and subject to relevant assessments and approvals. |
| <b>Pasturage Rights</b>                  | A right administered under the Norfolk Island pasturage system that permits eligible cattle to be depastured on applicable land in accordance with Council policy and relevant legislation. Pasturage Rights are administered operationally through Stock Tags.   |
| <b>Potential Grazing Areas</b>           | Public land not currently grazed but identified as potentially suitable for cattle grazing.   |
| <b>RDA</b>                               | Regional Development Australia.   |
| <b>Reduced Grazing Areas</b>             | Areas identified as environmentally sensitive and recommended for restriction or exclusion from public land cattle grazing.   |
| <b>Stock Tags</b>                        | The administrative unit used to manage Pasturage Rights for cattle grazing on public land. In this Strategy, one Stock Tag is treated as equivalent to one Cow/Calf Unit (one breeding cow with calf up to six months of age) for the purposes of describing stocking levels and Carrying Capacity comparisons.   |
| <b>Target Carrying Capacity</b>          | The estimated number of cattle (expressed as Cow/Calf Units) that the Current Effective Grazing Areas can sustainably support over time. In this Strategy, Target Carrying Capacity is calculated using a conservative average pasture utilisation rate of approximately 55%, allowing adequate pasture recovery and reducing environmental risk. Target Carrying Capacity provides a benchmark for aligning stocking levels with sustainable grazing management.   |
| <b>Working Group</b>                     | The Norfolk Island Grazing Project Working Group comprised representatives from NIRC, NICA, DITRDCA, Norfolk Island National Park and other relevant stakeholders engaged through the project.  |

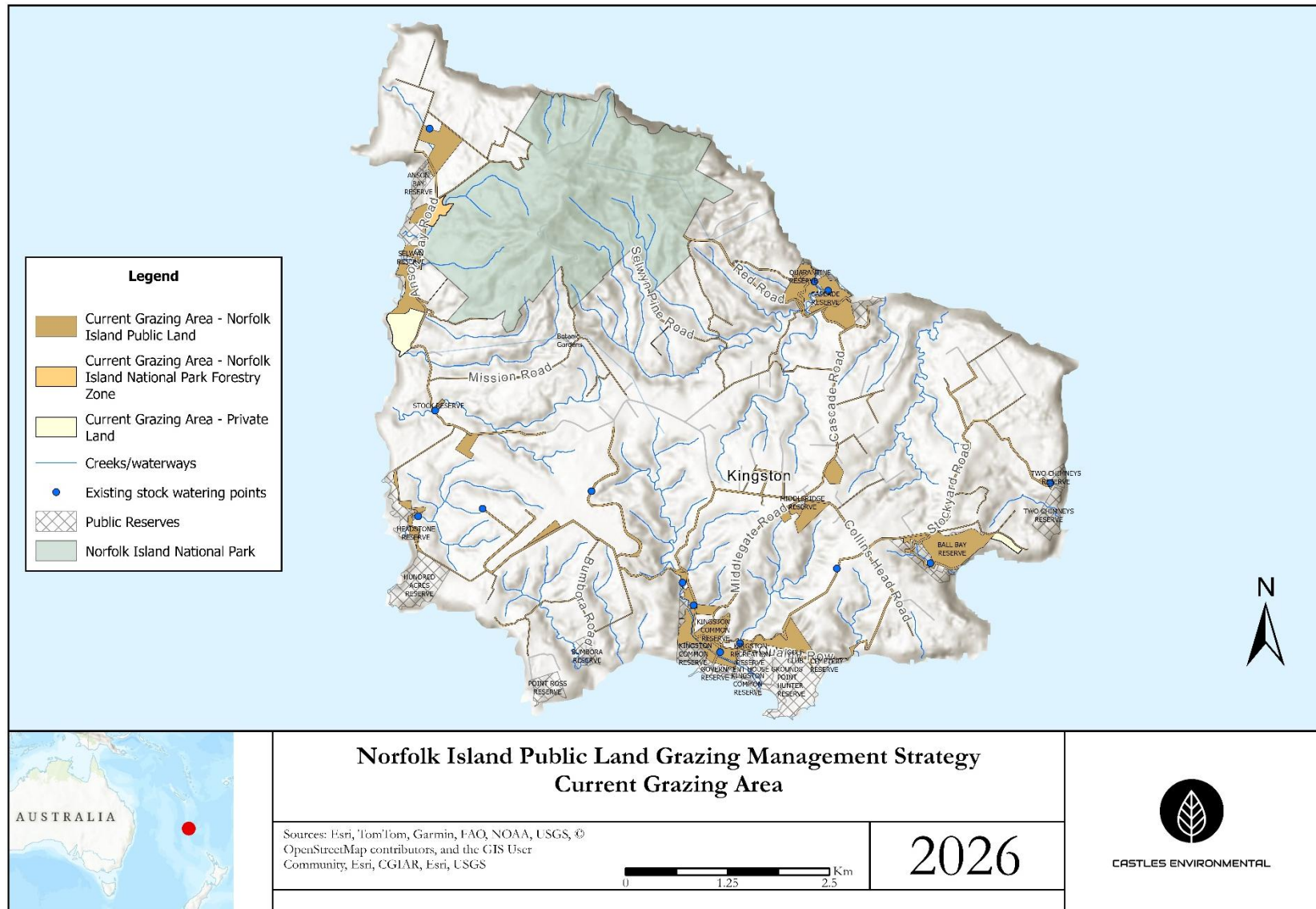
## 16. Appendices

### Appendix A - Main Strategy Consultation Phases

| Date              | Location        | Attendance  |
|-------------------|-----------------|---|
| 20 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Tara Patel, NIRC</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 21 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Zoe Knapp, NINP Manager</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>   |
| 21 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Aaron Graham, NICA</li> <li>2. PJ Wilson, NICA</li> <li>3. Brad Collins, DITRDCA</li> <li>4. Briony Dance, Cadeema</li> <li>5. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 21 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Simon Bigg, NICA</li> <li>2. Brad Collins, DITRDCA</li> <li>3. Briony Dance, Cadeema</li> <li>4. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 22 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Joanne Vanderzalm, CSIRO</li> <li>2. Lisa Golding, CSIRO</li> <li>3. Brad Collins, DITRDCA</li> <li>4. Brad Robinson, DITRDCA</li> <li>5. Briony Dance, Cadeema</li> <li>6. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol> |
| 22 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Aaron Graham, NICA</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 22 August 2024    | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Candice Nobbs, Norfolk Island Veterinary Surgery</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 4 September 2024  | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Mike Johnston, Site Manager KAVHA Projects and Works, DITRDCA</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>   |
| 6 September 2024  | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Allan McConnel, Special Projects Officer, NIRC</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 10 September 2024 | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Dr Anthony Rice, Granite Belt Integrated Pest Management</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 17 September 2024 | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Bonnie Learmonth, DITRDCA</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>   |
| 19 September 2024 | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Zoe Knapp, NINP Manager</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>   |
| 25 September 2024 | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Madeleine Lawler, RDA</li> <li>2. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>   |
| 18 November 2024  | Microsoft Teams | <ol style="list-style-type: none"> <li>1. Working Group</li> </ol>  |
| 25 February 2025  | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Tara Patel, NIRC</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 25 February 2025  | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Briony Dance, Cadeema</li> <li>2. Michael Wilkes, Michael Wilkes Livestock Co.</li> <li>3. Charles Brister, DITRDCA</li> <li>4. Catherine Jewell, DITRDCA</li> <li>5. Tom Sapienza, DITRDCA</li> </ol>                              |
| 25 February 2025  | Norfolk Island  | <ol style="list-style-type: none"> <li>1. Zoe Knapp, NINP Manager</li> </ol>  |

|                  |                |   |
|------------------|----------------|---|
|                  |                | <ol style="list-style-type: none"> <li>2. Joel Christian, NINP</li> <li>3. Briony Dance, Cadeema</li> <li>4. Michael Wilkes, Michael Wilkes Livestock Co.</li> </ol>  |
| 25 February 2025 | Norfolk Island | <ol style="list-style-type: none"> <li>1. Tara Patel, NIRC</li> <li>2. Briony Dance, Cadeema</li> <li>3. Michael Wilkes, Michael Wilkes Livestock Co.</li> <li>4. Norfolk Island Cattle Association (<b>NICA</b>).</li> </ol> |
| 26 February 2025 | Norfolk Island | <ol style="list-style-type: none"> <li>1. Briony Dance, Cadeema</li> <li>2. Michael Wilkes, Michael Wilkes Livestock Co.</li> <li>3. Aaron Graham, NICA</li> <li>4. PJ Wilson, NICA</li> </ol>                                |
| 26 February 2025 | Norfolk Island | <ol style="list-style-type: none"> <li>1. Briony Dance, Cadeema</li> <li>2. Michael Wilkes, Michael Wilkes Livestock Co.</li> <li>3. Aaron Graham, NICA</li> </ol>  |

## Appendix B – Mapped Current Grazing Areas



Appendix C - Photos of Grazing Areas



Kingston



Headstone



Anson Bay

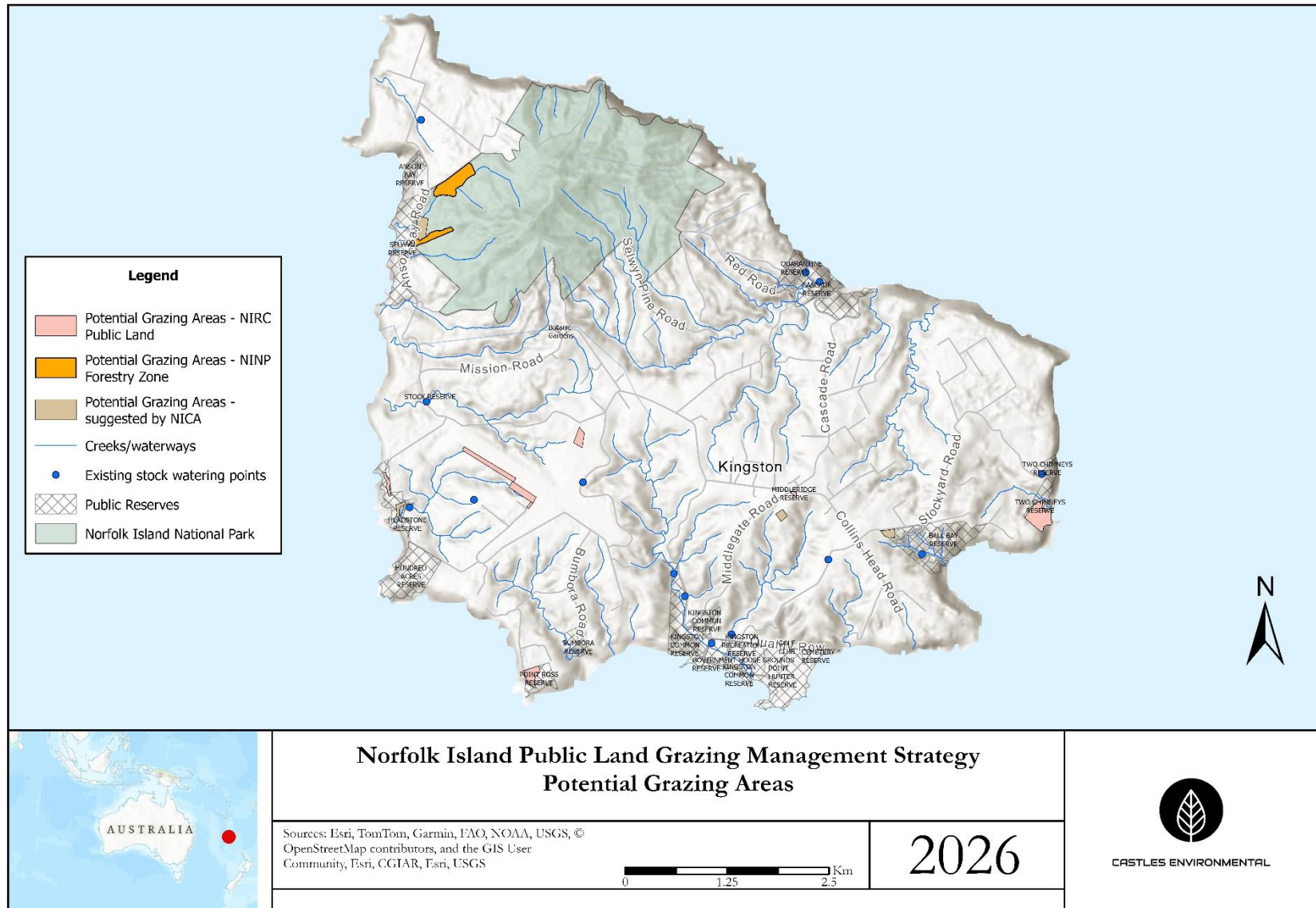


Cockpit

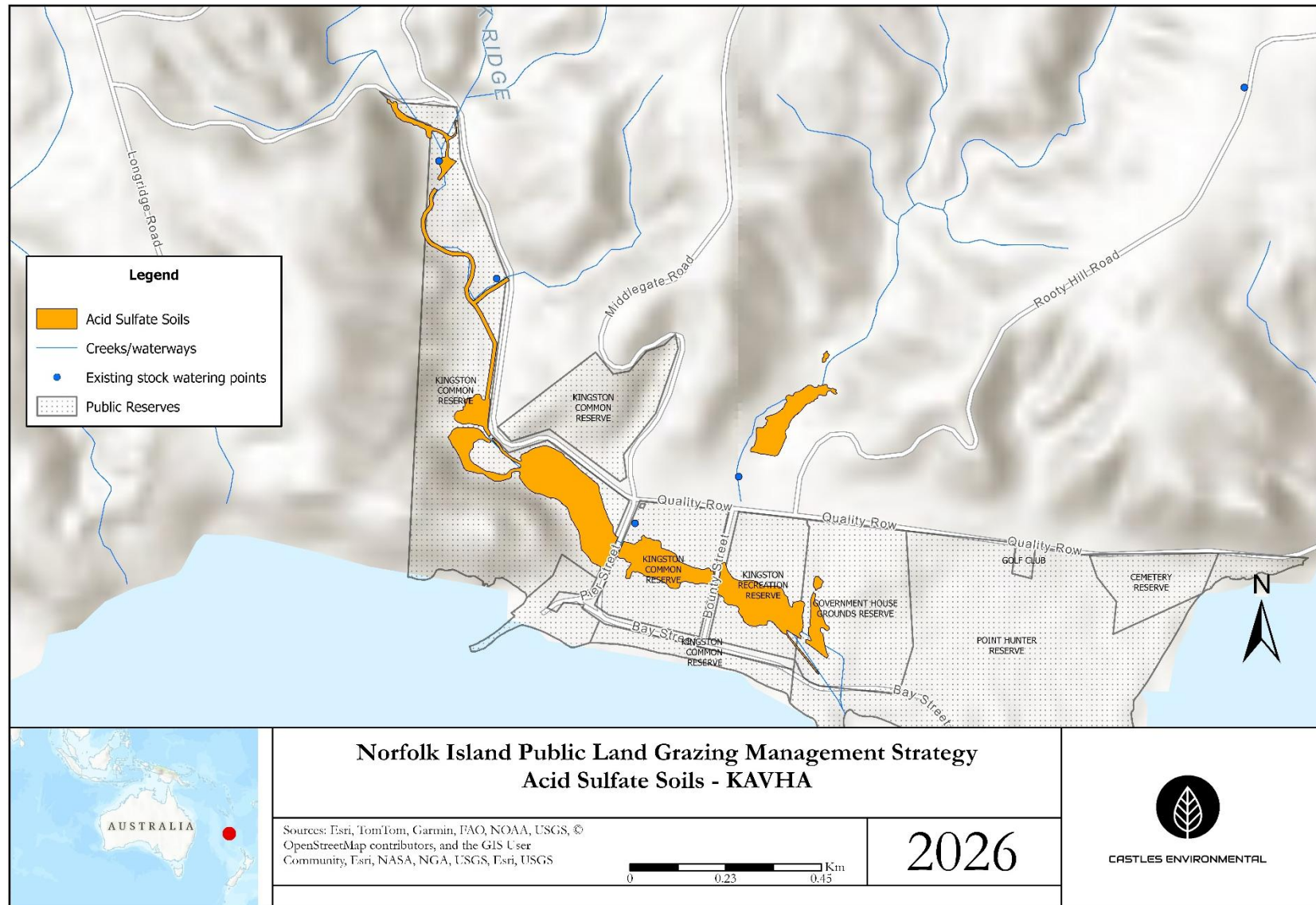


**Ball Bay**

## Appendix D – Mapped Potential Grazing Areas



### Appendix E – Mapped KAVHA Acid Sulfate Soils



## Appendix F - Pasture Assessment Protocol Example

There are several examples of pasture assessment protocols available for reference. One of the most comprehensive is the Prograze 9<sup>th</sup> Edition Manual (NSW Department of Primary Industries). Segment 1 and Appendices 1 and 2 of that Manual contain a comprehensive overview of a suitable pasture assessment protocol. Copies of Appendices 1 and 2 are extracted below for reference.

### APPENDIX 1

#### MEASURING HERBAGE MASS – THE MEDIAN QUADRAT TECHNIQUE

The following is a step-by-step description of the median quadrat technique.

##### Equipment required

- 1.5 m × 0.5 m median quadrat. It is important that the dimensions are followed accurately (see Figure A1).
- Battery or hand operated shears.
- Plastic bags.
- Four marker pegs.
- Force draft or microwave oven.
- Scales capable of weighing to a gram.
- Forceps or tweezers.
- Pen and paper.

##### Method

- Step 1.* Choose the area of pasture to be assessed. This can be about 30 m × 30 m and its boundary identified with pegs, one in each corner. If this technique is used to predict the herbage mass of paddocks, selection of an area that adequately represents the paddock will be critical for an accurate assessment. Before selecting the representative area it is essential to evaluate all parts of the paddock to obtain an appreciation of the extent of the paddocks variation. The area selected should represent average yield (herbage mass) and composition (green, dead, legume and weed) of the whole paddock.
- Step 2.* Following selection, walk a set number of paces (5–10) from the edge of the area and place the quadrat at your toe. Herbage which has been bent over by the quadrat should be straightened.
- Step 3.* Eliminate the two highest and two lowest yielding subquadrats by eye. Cut all herbage within the remaining subquadrat to ground level and store in a plastic bag. Remove stones, dirt and faeces from the sample.

*Step 4.* Starting from the cut area, change direction and repeat Steps 2 and 3 at least 4–9 times. As the variation in the assessment area increases, increase the number of cuts (up to 10). Upon reaching the boundary of the selected area, turn 90°, turning back into the area, and continue pacing.

*Step 5.* Record the weight of herbage in each bag to the nearest gram. The attached sheet can be used to record weights, then calculate the average weight of the cut quadrats. Ensure the bag weight is not included.

*Step 6.* Bulk the herbage from all bags.

*Step 7.* Thoroughly mix the herbage so it appears uniform throughout. Split the herbage into four equal amounts. Discard two diagonally opposite portions. Recombine the remaining two portions.

*Step 8.* Repeat Step 7 until a sample equal to that which could be heaped onto a large dinner plate (approximately 150 grams) remains.

*Step 9.* To calculate the pasture dry matter percentage, record the weight of the sample. Place the sample in a force draft oven for at least 24 hours below 70°C; that is, until the weight of the sample is constant. Alternatively, use a microwave oven. If a microwave oven is used:

- a. Place the sample on a microwave dish in the oven, along with a cup of water. Refill the cup if the water level gets too low.
- b. Set the microwave to maximum power and dry for 5 minutes.
- c. Weigh the sample, turn it over and loosen it (the sample tends to compact while drying).
- d. Repeat steps (b) and (c) until the weight remains constant between successive weighings.

Then, to calculate the dry matter percentage (DM%), use the following formula:

$$DM\% = \frac{\text{weight of sample dry (g)} \times 100}{\text{weight of sample wet (g)}}$$

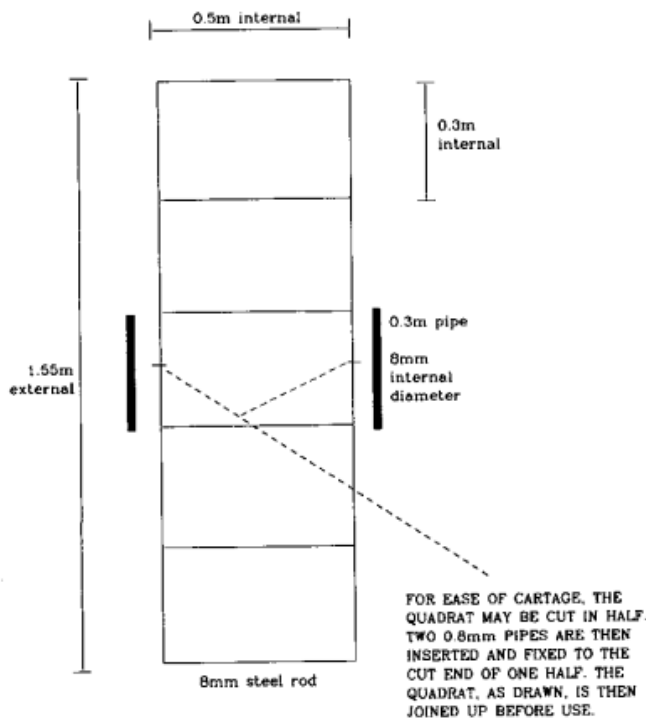
**Step 10.** Multiply the average weight of herbage calculated in Step 5 by the DM percentage. Multiply this figure (in grams) by 67. To ensure this figure remains appropriate, dimensions for the median quadrat must be followed accurately. This will give kilograms of dry matter per hectare (kg DM/ha). This is your estimate of the herbage mass for the area being assessed.

**Step 11.** To obtain an estimate of pasture composition (percentage legume, percentage green and percentage dead) use the oven-dried sample. If the sample is significantly larger than an open handful it can be reduced using the technique described in Step 7. Sort the sample

into fractions of interest, usually, green legume, dead legume, other dead and other green. Tweezers or forceps are useful for the sorting process.

**Step 12.** By weighing each fraction the percentage and yield (kg DM/ha) of each component is calculated. The attached data sheet should be useful for recording the weight and proportion of each component. Pasture samples dried in an oven can be forwarded for laboratory analysis to obtain predictions of pasture quality, e.g. digestibility, energy and protein levels. Samples dried by microwave are unsuitable for laboratory analysis.

Figure A1. Median quadrat.



**Herbage mass calculation sheet**

| A. (Steps 1 to 5) |                           |                |          |
|-------------------|---------------------------|----------------|----------|
| Paddock name:     | Quadrat number            | Wet weight (g) |          |
| Date:             | 1                         |                |          |
| Observer:         | 2                         |                |          |
| Notes:            | 3                         |                |          |
|                   | 4                         |                |          |
|                   | 5                         |                |          |
|                   | 6                         |                |          |
|                   | 7                         |                |          |
|                   | 8                         |                |          |
|                   | 9                         |                |          |
|                   | 10                        |                |          |
|                   | <b>Total</b>              |                |          |
|                   | <b>Average wet weight</b> |                | <b>g</b> |

| B. (Steps 6 to 9)    |  |  |  |  |  |  |  |            |  |
|----------------------|--|--|--|--|--|--|--|------------|--|
| Weight of container  |  |  |  |  |  |  |  |            |  |
| Weight of wet sample |  |  |  |  |  |  |  |            |  |
| Total                |  |  |  |  |  |  |  |            |  |
|                      |  |  |  |  |  |  |  | Container  |  |
|                      |  |  |  |  |  |  |  | Dry weight |  |

|   |
|---|
| $\text{Dry matter \%} = \frac{\text{Weight of dry sample (g)} \times 100}{\text{Weight of wet sample (g)}} = \text{\%}$ |
|---|

|  |
|--|
| <b>C. (Step 10)</b><br>$\text{Herbage mass} = \frac{\text{Average wet weight (g)} \times \text{dry matter \%} \times 67}{100} = \text{kg DM/ha}$ |
|--|

| D. (Steps 11 & 12)  |                |                       |                         |
|---------------------|----------------|-----------------------|-------------------------|
| Component           | Dry weight (g) | Percentage of total % | Herbage mass (kg DM/ha) |
| Green – legume      |                |                       |                         |
| Green – grass       |                |                       |                         |
| Green – other       |                |                       |                         |
| Dead – legume       |                |                       |                         |
| Dead – other        |                |                       |                         |
| <b>Total</b>        |                |                       |                         |
| <b>Total legume</b> |                |                       |                         |
| <b>Total green</b>  |                |                       |                         |
| <b>Total dead</b>   |                |                       |                         |

## APPENDIX 2

### COLLECTING YOUR SAMPLES

The laboratory can only determine the quality of the sample as it is received. It is therefore very important how you collect, sub-sample and dispatch your sample to the laboratory.

- **Collect your bulk samples.** Collect your bulk sample early in the week so that it can be received and processed by the laboratory before the weekend. Ensure that the bulk sample represents the feed you are testing, (see below) and free from contamination from soil and leaves etc. For baled hay and silage it is recommended that a sample corer be used to collect your sample. If a corer is not available a 'grab' from deep within the bale or pit is recommended.
- **Thoroughly mix the bulk sample and sub-sample.** Use the mixing, coning and dividing technique shown below to obtain the quantity of sample indicated on the provided sampling bag.
- **Complete the sample submission form enclosed.** This information tells the laboratory who owns the sample and what tests are required.
- **Package and dispatch.** Package the sample and submission form into the prepaid envelop provided and send to laboratory.
  - » Samples with high moisture content (fresh pasture, fresh mown pasture and silage) must be frozen before sending to the laboratory. Once frozen, the sample will remain stable during delivery. The sample should be well wrapped in wet newspaper to minimise defrosting. Sample should be sent to the laboratory by overnight courier.
  - » Samples must not be allowed to heat during storage and transport prior to testing, as they will deteriorate. Never leave samples in vehicles, particularly on a hot day.

### HOW TO COLLECT YOUR SAMPLE

#### Pasture – fresh and fresh mown

Sampling at random by taking between 15–20 'grab' samples across a paddock.



Grab to grazing height or the full depth of the swath or windrow.

Combine all 'grabs' in a bucket and mix well.

#### Baled hay

*Small square bales:* 10–20 bales selected at random. One core from each bale, through the 'butt' and at right angles to the surface.

Combine cores in a bucket and mix well.

*Large round or square bales:* 5–10 bales selected at random. One core from each side of the bale probing at right angles to the surface and at different heights.

Combine cores in a bucket and mix well.

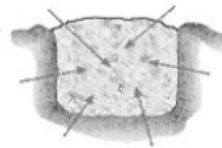
#### Cubes, pellets, meals and grain

10–15 'grab' samples from the bulk supply or individual bags.

Combine all 'grabs' in a bucket and mix well.

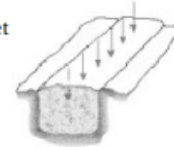
#### Silage

*Bunker or pit silage:* 0–15 sites across a freshly cut silage face or 7–10 random sites along the length of the pit. Avoid sampling from only the top 50 cm of the pit.



Combine cores in a bucket and mix well

*Baled silage:* 10–15 bales selected at random. Two cores from the middle of the curved or one core from each side of a bale probing at right angles to the surface and at different heights.



Combine cores in a bucket and mix well.

## Appendix G - Carrying Capacity Calculations

### Current Carrying Capacity – 75% Utilisation – Current Effective Grazing Areas

| Location   | Effective grazing area | Kg DM ANNUAL TOTAL |               |               | ME ANNUAL TOTAL |                |                | DSE ANNUAL TOTAL |               |               | DSE/ha       |              |              | Annual DSE/ha |            |            | DSE days   |            |             | Cow/Calf units |            |            |  |
|--|------------------------|--------------------|---------------|---------------|-----------------|----------------|----------------|------------------|---------------|---------------|--------------|--------------|--------------|---------------|------------|------------|------------|------------|-------------|----------------|------------|------------|--|
|  |                        | 0.5                | AVERAGE       | 1.5           | 0.5             | AVERAGE        | 1.5            | 0.5              | AVERAGE       | 1.5           | 0.5          | AVERAGE      | 1.5          | 0.5           | AVERAGE    | 1.5        | 0.5        | AVERAGE    | 1.5         | 0.5            | AVERAGE    | 1.5        |  |
| <b>KINGSTON</b>  |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             |                |            |            |  |
| Kingston Common Reserve  | 13.8                   | 51272.5            | 10345.0       | 134491.5      | 465547.5        | 931095.0       | 1210423.5      | 56990.1          | 112180.1      | 145834.2      | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 153.7      | 307.3      | 399.5       | 10.6           | 21.2       | 27.6       |  |
| Commonwealth FH (b/w Country Rd and Middlegate Rd)                 | 0.8                    | 3150.0             | 6300.0        | 8190.0        | 28350.0         | 56700.0        | 73710.0        | 3415.7           | 6831.3        | 8980.7        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 9.4        | 18.7       | 24.3        | 0.6            | 1.3        | 1.7        |  |
| Crown (Pound Paddock)  | 1.5                    | 5520.0             | 11040.0       | 14352.0       | 49680.0         | 99360.0        | 129168.0       | 5985.5           | 11971.1       | 15562.4       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 16.4       | 32.8       | 42.6        | 1.1            | 2.3        | 2.9        |  |
| Crown (hill between Rooty Hill Rd and Quality Row)                 | 8.8                    | 33142.5            | 66285.0       | 86170.5       | 298282.5        | 596565.0       | 775534.5       | 35937.7          | 71875.3       | 93437.9       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 98.5       | 196.9      | 256.0       | 6.8            | 13.6       | 17.7       |  |
| Crown (Middlegate Rd near Guide & Community Hall)                  | 0.8                    | 2913.8             | 5827.5        | 7675.8        | 26223.8         | 52447.5        | 68181.8        | 3159.5           | 6319.0        | 8214.7        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 8.7        | 17.3       | 22.5        | 0.6            | 1.2        | 1.6        |  |
| Crown (Middlegate Rd near Banyan Park)                             | 1.0                    | 3813.8             | 7627.5        | 9915.8        | 34323.8         | 68647.5        | 89241.8        | 4135.4           | 8270.8        | 10752.0       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 11.3       | 22.7       | 29.5        | 0.8            | 1.6        | 2.0        |  |
| Public Land (opposite Central School)                              | 2.1                    | 8040.0             | 16080.0       | 20904.0       | 72360.0         | 144720.0       | 188136.0       | 8718.1           | 17436.1       | 22667.0       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 23.9       | 47.8       | 62.1        | 1.6            | 3.3        | 4.3        |  |
| Public Land (Portion 44a)  | 1.9                    | 6975.0             | 13950.0       | 18135.0       | 62775.0         | 125550.0       | 163215.0       | 7563.3           | 15126.5       | 19664.5       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 20.7       | 41.4       | 53.9        | 1.4            | 2.9        | 3.7        |  |
| Kingston Road Reserves   | 10.8                   | 40546.9            | 81093.8       | 105421.9      | 364921.9        | 729843.8       | 948796.9       | 43966.5          | 87933.0       | 114312.9      | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 120.5      | 240.9      | 313.2       | 8.3            | 16.6       | 21.6       |  |
|  | <b>42</b>              | <b>155829</b>      | <b>311659</b> | <b>405156</b> | <b>1402464</b>  | <b>2804929</b> | <b>3646407</b> | <b>168972</b>    | <b>337943</b> | <b>439326</b> | <b>36596</b> | <b>73193</b> | <b>95151</b> | <b>100</b>    | <b>201</b> | <b>261</b> | <b>463</b> | <b>926</b> | <b>1204</b> | <b>32</b>      | <b>64</b>  | <b>83</b>  |  |
| <b>HEADSTONE</b>   |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             |                |            |            |  |
| Portion 183 (New Farm Rd (Airport))                                | 1.9                    | 7053.8             | 14107.5       | 18339.8       | 63483.8         | 126967.5       | 165057.8       | 7648.6           | 15297.3       | 19886.5       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 21.0       | 41.9       | 54.5        | 1.4            | 2.9        | 3.8        |  |
| Headstone Reserve (part)   | 3.9                    | 14662.5            | 29325.0       | 38122.5       | 131962.5        | 263925.0       | 343102.5       | 15899.1          | 31798.2       | 41337.7       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 43.6       | 87.1       | 113.3       | 3.0            | 6.0        | 7.8        |  |
| Airport Douglas Dr   | 3.0                    | 11070.0            | 22140.0       | 28782.0       | 99630.0         | 199260.0       | 259038.0       | 12003.6          | 24007.2       | 31209.4       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 32.9       | 65.8       | 85.5        | 2.3            | 4.5        | 5.9        |  |
| Stock Reserve Lot 2 Section 28                                     | 0.6                    | 2193.8             | 4387.5        | 5793.8        | 19743.8         | 39487.5        | 51333.8        | 2378.8           | 4757.5        | 6184.8        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 6.5        | 13.0       | 16.9        | 0.4            | 0.9        | 1.2        |  |
| Headstone Reserve (northwest)                                      | 0.1                    | 375.0              | 750.0         | 975.0         | 3375.0          | 6750.0         | 8775.0         | 406.6            | 813.3         | 1057.2        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 1.1        | 2.2        | 2.9         | 0.1            | 0.2        | 0.2        |  |
| Headstone Road Reserves  | 7.8                    | 29193.8            | 58387.5       | 75903.8       | 262743.8        | 525487.5       | 683133.8       | 31655.9          | 63311.7       | 82305.3       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 86.7       | 173.5      | 225.5       | 6.0            | 12.0       | 15.6       |  |
|  | <b>17</b>              | <b>64549</b>       | <b>129098</b> | <b>167827</b> | <b>580939</b>   | <b>1161878</b> | <b>1510441</b> | <b>69993</b>     | <b>139985</b> | <b>181981</b> | <b>24398</b> | <b>48795</b> | <b>63434</b> | <b>67</b>     | <b>134</b> | <b>174</b> | <b>192</b> | <b>384</b> | <b>499</b>  | <b>13</b>      | <b>26</b>  | <b>34</b>  |  |
| <b>ANSON BAY</b>   |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             |                |            |            |  |
| Public Land (Kingfisher Paddock)                                   | 10.62                  | 39825.0            | 79650.0       | 103545.0      | 358425.0        | 716850.0       | 931905.0       | 43183.7          | 86367.5       | 112277.7      | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 118.3      | 236.6      | 307.6       | 8.2            | 16.3       | 21.2       |  |
| Anson Bay Reserve Lot 19 Section 33/Portion 18 Area 33 (part)      | 0.3                    | 990.0              | 1980.0        | 2574.0        | 8910.0          | 17820.0        | 23166.0        | 1073.5           | 2147.0        | 2791.1        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 2.9        | 5.9        | 7.6         | 0.2            | 0.4        | 0.5        |  |
| Selwyn Reserve Lot 6 Sec 31 (part) (southwest Bullocks Hut Rd)     | 0.3                    | 1102.5             | 2205.0        | 2866.5        | 9922.5          | 19845.0        | 25798.5        | 1195.5           | 2391.0        | 3108.3        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 3.3        | 6.6        | 8.5         | 0.2            | 0.5        | 0.6        |  |
| Selwyn Reserve Lot 6 Sec 31 (part) (Puppies Point)                 | 2.2                    | 8066.3             | 16132.5       | 20972.3       | 72596.3         | 145192.5       | 188750.3       | 8746.5           | 17493.1       | 22741.0       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 24.0       | 47.9       | 62.3        | 1.7            | 3.3        | 4.3        |  |
| Selwyn Reserve (Anson Bay Rd)                                      | 0.2                    | 813.8              | 1627.5        | 2115.8        | 7323.8          | 14647.5        | 19041.8        | 882.4            | 1764.8        | 2294.2        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 2.4        | 4.8        | 6.3         | 0.2            | 0.3        | 0.4        |  |
| National Park Forestry Zone  | 1.5                    | 5535.0             | 11070.0       | 14391.0       | 49815.0         | 99630.0        | 129519.0       | 6001.8           | 12003.6       | 15604.7       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 16.4       | 32.9       | 42.8        | 1.1            | 2.3        | 2.9        |  |
| Anson Bay Private Land   | 6.0                    | 22312.5            | 44625.0       | 58012.5       | 200812.5        | 401625.0       | 522112.5       | 24194.3          | 48388.6       | 62905.1       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 66.3       | 132.6      | 172.3       | 4.6            | 9.1        | 11.9       |  |
| Anson Bay Road Reserves  | 9.515                  | 35681.3            | 71362.5       | 92771.3       | 321131.3        | 642262.5       | 834941.3       | 38690.5          | 77381.0       | 100595.3      | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 106.0      | 212.0      | 275.5       | 7.3            | 14.6       | 19.0       |  |
|  | <b>30</b>              | <b>114326</b>      | <b>228653</b> | <b>297248</b> | <b>1028936</b>  | <b>2057873</b> | <b>2675234</b> | <b>123968</b>    | <b>247936</b> | <b>322317</b> | <b>32530</b> | <b>65060</b> | <b>84578</b> | <b>89</b>     | <b>178</b> | <b>232</b> | <b>340</b> | <b>679</b> | <b>883</b>  | <b>23</b>      | <b>47</b>  | <b>61</b>  |  |
| <b>COCKPIT</b>   |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             |                |            |            |  |
| Cascade Reserve Lot 28 Sec 10 (south)                              | 5.898                  | 21330.0            | 42660.0       | 55458.0       | 191970.0        | 383940.0       | 499122.0       | 23138.9          | 46277.8       | 60135.2       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 63.4       | 126.7      | 164.8       | 4.4            | 8.7        | 11.4       |  |
| Cascade Reserve Lot 28 Sec 10 (north)                              | 5.952                  | 22320.0            | 44640.0       | 58032.0       | 209680.0        | 419360.0       | 522288.0       | 24202.4          | 48404.8       | 62906.3       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 66.3       | 132.6      | 172.4       | 4.6            | 9.1        | 11.9       |  |
| Quarantine Reserve Lot 27 Sec 10 (southwest Prince Phillip Dr)     | 0.844                  | 3165.0             | 6330.0        | 8229.0        | 28485.0         | 56970.0        | 74061.0        | 3431.9           | 6863.9        | 8923.0        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 9.4        | 18.8       | 24.4        | 0.6            | 1.3        | 1.7        |  |
| Quarantine Reserve Lot 27 Sec 10 (northeast Prince Phillip Dr)     | 3.717                  | 13938.8            | 27877.5       | 36504.8       | 125448.8        | 250897.5       | 326166.8       | 15114.3          | 30228.6       | 39297.2       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 41.4       | 82.8       | 107.7       | 2.9            | 5.7        | 7.4        |  |
| Cockpit Road Reserves  | 10.38                  | 38925.0            | 77850.0       | 101205.0      | 350325.0        | 700650.0       | 910845.0       | 42207.8          | 84415.7       | 109740.4      | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 29.0       | 115.6      | 231.3      | 300.7       | 8.0            | 16.0       | 20.7       |  |
|  | <b>27</b>              | <b>99679</b>       | <b>199358</b> | <b>259165</b> | <b>897109</b>   | <b>1794218</b> | <b>2332483</b> | <b>108085</b>    | <b>216171</b> | <b>281022</b> | <b>20331</b> | <b>40663</b> | <b>52861</b> | <b>56</b>     | <b>111</b> | <b>145</b> | <b>296</b> | <b>592</b> | <b>770</b>  | <b>20</b>      | <b>41</b>  | <b>53</b>  |  |
| <b>BALL BAY</b>  |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             |                |            |            |  |
| Ball Bay Reserve Lot 140 Sec 2 & Portion 48e (west Marshs Rd)      | 0.6                    | 2100.0             | 4200.0        | 4200.0        | 18900.0         | 37800.0        | 37800.0        | 2277.1           | 4554.2        | 4554.2        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 6.2        | 12.5       | 12.5        | 0.4            | 0.9        | 0.9        |  |
| Ball Bay Reserve Lot 140 Sec 2 (east Marshs Rd)                    | 3.76                   | 14100.0            | 28200.0       | 28200.0       | 126900.0        | 253800.0       | 253800.0       | 15289.2          | 30578.3       | 30578.3       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 41.9       | 83.8       | 83.8        | 2.9            | 5.8        | 5.8        |  |
| Two Chimneys Reserve Lot 72 Sec 1 Portion 11b (Steele's Pt Picnic) | 0.05                   | 187.5              | 375.0         | 375.0         | 1687.5          | 3375.0         | 3375.0         | 203.3            | 406.6         | 406.6         | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 0.6        | 1.1        | 1.1         | 0.0            | 0.1        | 0.1        |  |
| Two Chimneys Reserve (part) (second picnic area)                   | 0.18                   | 675.0              | 1350.0        | 1350.0        | 6075.0          | 12150.0        | 12150.0        | 731.9            | 1463.9        | 1463.9        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 2.0        | 4.0        | 4.0         | 0.1            | 0.3        | 0.3        |  |
| Ball Bay Private Land  | 0.488                  | 1830.0             | 3660.0        | 3660.0        | 16470.0         | 32940.0        | 32940.0        | 1984.3           | 3968.7        | 3968.7        | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 5.4        | 10.9       | 10.9        | 0.4            | 0.7        | 0.7        |  |
| Ball Bay Road Reserves   | 6.92                   | 29590.0            | 59180.0       | 59180.0       | 233500.0        | 467100.0       | 467100.0       | 28138.6          | 56277.1       | 56277.1       | 4066.3       | 8132.5       | 10572.3      | 11.1          | 22.3       | 22.3       | 77.1       | 154.2      | 154.2       | 5.3            | 10.6       | 10.6       |  |
|  | <b>12</b>              | <b>44843</b>       | <b>89685</b>  | <b>89685</b>  | <b>403583</b>   | <b>807165</b>  | <b>807165</b>  | <b>48624</b>     | <b>97249</b>  | <b>97249</b>  | <b>24398</b> | <b>48795</b> | <b>48795</b> | <b>67</b>     | <b>134</b> | <b>134</b> | <b>133</b> | <b>266</b> | <b>266</b>  | <b>9</b>       | <b>18</b>  | <b>18</b>  |  |
| <b>TOTAL head (ANNUAL)</b>   |                        |                    |               |               |                 |                |                |                  |               |               |              |              |              |               |            |            |            |            |             | <b>98</b>      | <b>196</b> | <b>250</b> |  |





## Appendix H - Herd Cultural Practices

### Cattle Breeding & Herd Health

Matching the overall feed intake and energy requirements of cattle to pasture supply is the first step in achieving a healthy, productive herd. Optimising stocking rates, pasture rest periods, and assessing strategies to increase pasture productivity (new varieties, fertiliser) will all play a role in boosting overall productivity.

In addition, understanding the quality and composition of pastures is an important process to identify if there are any rate-limiting deficiencies or nutritional problems that may interfere with cattle performance.

Trace mineral nutrition is essential for maintaining the health, productivity, and reproductive performance of cattle grazing pastures. Trace minerals such as Copper, Zinc, Selenium, Cobalt, and Manganese play vital roles in numerous physiological processes, including immune function, enzyme activation, energy metabolism, and tissue repair. Pasture-based diets often lack consistent levels of these critical nutrients due to variations in soil composition, plant species, and environmental conditions. A deficiency in trace minerals can lead to weakened immune responses, poor growth rates, reduced fertility, and increased susceptibility to disease, directly impacting herd performance and profitability.

Blood sampling work conducted as part of the “Norfolk Island Beef Cattle Assessment and Improvement Plan” identified the presence of a Copper deficiency in the cows selected for Artificial Insemination and Embryo Transfer Programs. This was addressed with the use of an injectable Copper supplement. In addition to blood testing, the mineral status of pasture diets can be achieved through wet-chemistry analysis of pasture samples. Mineral content, along with energy, protein and fibre can then be assessed, intake calculated, and any deficiencies determined. Addressing the mineral nutrition of cattle on Norfolk Island would ensure cattle receive the proper balance of nutrients needed to optimise their health and grazing efficiency, potentially leading to greater reproductive rate, calf growth rate and cow body condition maintenance, thereby increasing the production of beef on the island from the same number of breeding cows.

Depending on the limiting nutritional factors identified, there are several ways to address shortages, including injectable supplements, rumen boluses, water additives, and loose lick mineral supplement. The specifics of any supplementation strategy is entirely dependent on the limiting nutritional factor identified.

There is no reported presence of Johnes disease of Bovine Viral Diarrhoea Virus (**BVDV**, commonly known as Pesti virus) on Norfolk Island. As such, there are no notable reproductive or growth performance affecting diseases that may hamper productivity of beef production on the island.

Parasite control on Norfolk Island is reportedly part of regular management practice, with cows and calves drenched throughout the year on an as need basis.

The “Norfolk Island Beef Cattle Assessment and Improvement Plan” is a Regional Development Australia (RDA) funded initiative that is supporting an Embryo Transfer and Artificial Insemination program for Island cattle to import diverse genetics and reduce the impact of inbreeding on the island. It is expected that the importation of these new genetics will support an increase in performance through hybrid vigour and accessing elite performance genetics from across the world. High performance genetics require optimised feed and management, and thus the optimisation of grazing management on the island is of importance to the success and growth of the cattle industry on Norfolk Island.

## Appendix I - Weeds

Major weed species (Hawaiian Holly, Wild Olive, Cherry Guava and Tobacco Bush) on Norfolk Island will remain a challenge to the maintenance of natural biodiversity and landscapes. Grazing of livestock remains an important component of an integrated weed management strategy and should continue to be considered as a cost-effective tool on Norfolk Island. In public grazing areas, weeds can continue to be managed through high intensity grazing of cattle for a short period of time. In areas restricted from grazing, and where weeds become too mature to be consumed by cattle, alternative strategies (manual harvest, herbicide, fire) will have to be continued to be used, at significant cost.

In many countries, small ruminants (Sheep and Goats) are incorporated into weed management strategies to control woody weeds, as these animals can access areas cattle cannot and have a greater affinity for the consumption of the woody components of these species (Field and Popay 1996). Although ruminant importations to Norfolk Island are currently restricted, there may be scope to utilise the existing sheep and goat herds on the island to implement an integrated approach to woody weed control. Alternatively, there is justification in expansion of the sheep and goat flocks on Norfolk Island to increase woody weed control whilst providing another food and income resource to residents, reducing labour costs associated with herbicide application and manual harvesting.

## Appendix J – Mapped Optimised Grazing Areas

