Please note: the substantive content of the 2026 NRI Roadmap Survey begins at Question 20 (with prior questions dealing with administrative and other information).

As such all submissions that are published include the responses submitted from Question 20 onwards only.

Q20.

Part 2: Research themes

2.1 NRI comprises the assets, facilities and associated expertise to support leading-edge research and innovation in Australia and is accessible to publicly and privately funded users across Australia and internationally. We are seeking your input on possible directions for future national-level investment - i.e., where the requirements are of such scale and importance that national-level collaboration and coordination are essential.

The 2021 Roadmap used a challenge framework to support NRI planning and investment. With this in mind, consider likely future research trends in the next 5 - 10 years, and with respect to one or more of the 8 challenge areas identified in the 2021 Roadmap as listed below:

- describe emerging research directions and the associated critical research infrastructure requirements that are either not currently available at all, or not at sufficient scale and
- describe current national infrastructure requirements that you anticipate will no longer fit the definition of NRI in 5-10 years.

Do not limit your commentary to NCRIS funded capabilities.

Q21.

Resources Technology and Critical Minerals Processing

Q22.

Food and Beverage

Emerging research trends in the next 5–10 years will increasingly focus on enhancing agricultural productivity and sustainability in the face of climate variability, soil degradation, and water constraints. Soil health and soil-plant interactions are central to these challenges, particularly the ability to understand and optimise root traits that drive crop resilience, nutrient use efficiency, and soil carbon sequestration. The Australian Plant Phenomics Network (APPN) is positioned to play a critical role in addressing these needs. Expansion of APPN's phenotyping capabilities to include advanced, large-scale root phenotyping, particularly across a representative range of Australia's key cropping soil types, will significantly enhance Australia's ability to systematically study root architecture, water use efficiency, and nutrient uptake. Focusing on six of the most agronomically important soil types—covering approximately 80% of Australia's productive cropping regions—will ensure that research outcomes are nationally relevant and deliver practical benefits to growers and policymakers. This integrated capability would provide the infrastructure to support breeding programs, precision agriculture, and sustainable input management, addressing national-level agricultural priorities. The resulting datasets would offer long-term, nationally integrated insights to support collaboration across research, industry, and policy sectors. Infrastructure That May No Longer Fit NRI Definition: Small-scale, regionally focused phenotyping facilities and fragmented root phenotyping efforts may no longer meet the national-scale coordination required. Investment should prioritise integrated platforms capable of addressing emerging agricultural sustainability challenges across multiple soil types and climatic conditions.

Q23.

Medical Products

Q24.

Defence

Q25.

Recycling and Clean Energy

Q26.

Space

Q27.

Environment and Climate

Addressing environmental sustainability and climate resilience over the next decade requires a deeper understanding of soil's role in carbon sequestration, water regulation, and biodiversity. Root phenotyping is essential to understanding how crop root systems influence soil carbon storage, nutrient cycling, and plant responses to environmental stressors. Enhanced root phenotyping capabilities within the Australian Plant Phenomics Network (APPN) would directly support these research priorities. By integrating advanced below-ground phenotyping with APPN's existing sensor and mobile phenotyping infrastructure, researchers would gain the ability to conduct long-term, multi-site studies on plant-soil interactions under varying environmental conditions. This would enable research on soil carbon dynamics, greenhouse gas emissions, and climate-smart cropping systems. Expanded root phenotyping infrastructure would provide real-time data on root traits, water use, and nutrient cycling, supporting the development of nature-based solutions and regenerative agricultural practices. This integrated capability aligns with the 2021 NRI Roadmap's emphasis on phenotyping and environmental monitoring.

Q28.

Frontier Technologies and Modern Manufacturing

Q29.

2.2 The 2024 statement of National Science and Research Priorities (NSRPs) includes outcomes linked to each priority to assist in identifying critical research needed in the next 5 to 10 years.
Consider the priority statements and, with respect to one or more of the 5 priority areas as listed below:

- describe emerging research directions and the associated critical research infrastructure requirements that are either not currently available at all, or
- not at sufficient scale and describe current national infrastructure requirements that you anticipate will no longer fit the definition of NRI in 5-10 years.

Do not limit your commentary to NCRIS funded capabilities, and where relevant, refer to the underpinning outcomes and research identified in the NSRPs document.

Q30.

Transitioning to a net zero future

Australia's commitment as stated in the National Science and Research Priorities (NSRPs) to transition to a net zero economy by 2050 will require transformative research into soil carbon sequestration, greenhouse gas emissions reduction, and sustainable land management. Emerging research directions are focusing on leveraging the soil-plant interface and biological mechanisms for carbon storage and emission mitigation. However, there is currently no nationally coordinated infrastructure capable of systematically studying these processes across Australia's diverse soil landscapes under real-world and controlled conditions. Critical Infrastructure Requirements: There is a need for integrated, large-scale research infrastructure that enables: • Precise measurement of soil carbon flux and sequestration potential across key Australian soil types. • Monitoring of greenhouse gas emissions (CO_2, CH_4, N_2O) from cropping systems and sustainable land management practices. • Controlled environment phenotyping to simulate elevated CO_2, temperature extremes, and drought scenarios. • Advanced below-ground phenotyping technologies to study root traits that promote carbon storage and water-use efficiency. • Long-term datasets integrated into a national platform, supporting carbon accounting frameworks and policy development. This need aligns with Australia's established investment in national biological collections and research datasets, as referenced in the Research Infrastructure Review. Expanding research infrastructure to include functional datasets on soil-plant interactions and phenotyping capabilities would provide critical information necessary to underpin carbon markets and climate mitigation strategies.

Q31.

Supporting healthy and thriving communities

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

Strengthening Aboriginal and Torres Strait Islander leadership, participation, and knowledge integration is essential to Australia's future research landscape. The National Science and Research Priorities (NSRPs) highlight the importance of supporting Indigenous research leadership, protecting and applying Indigenous ecological knowledge, and integrating Indigenous knowledge systems across Australia's science and research sectors. Research infrastructure should actively support Indigenous-led research and foster long-term partnerships that recognise, protect, and elevate Indigenous knowledge systems. Expanding soil and plant research capabilities—particularly through advanced phenotyping platforms and soil health monitoring—offers significant opportunities for collaboration with Aboriginal and Torres Strait Islander communities. This collaboration can focus on: • Co-developing sustainable land management strategies that draw on traditional knowledge systems and scientific research to enhance soil health, biodiversity, and climate resilience. • Preserving and applying Indigenous ecological knowledge in the management of Australia's diverse soil types and cropping systems. • Creating culturally safe and meaningful partnerships that respect Indigenous sovereignty, intellectual property rights, and cultural protocols. Additionally, advanced soil and plant research infrastructure can support the co-development and growth of the native foods industry in Australia. By integrating Indigenous knowledge of native plants and ecosystems with cutting-edge phenotyping technologies, researchers and Indigenous communities can: • Enhance understanding of native species' agronomic traits and environmental tolerances. • Support sustainable cultivation practices for native food species, contributing to food security, cultural preservation, and economic opportunities for Indigenous communities. • Develop long-term datasets that strengthen the resilience and scalability of the native foods industry while maintaining respect for traditional ownership and cultural significance. Investing in nationally coordinated infrastructure that elevates Aboriginal and Torres Strait Islander knowledge systems will ensure Australia's research community is inclusive, ethically engaged, and better positioned to deliver environmental, cultural, and economic benefits for all Australians.

Q33.

Protecting and restoring Australia's environment

Future research will increasingly focus on soil as a key component of environmental health, biodiversity conservation, and land restoration. Soil degradation, erosion, and declining soil biodiversity threaten the sustainability of Australia's ecosystems and agricultural landscapes. Critical Infrastructure Requirements: The National Plant & Soil Research Centre will provide the necessary infrastructure to: • Investigate soil health indicators across diverse agro-ecological zones, supporting land restoration programs. • Study soil-plant-microbiome interactions to promote soil biodiversity and ecosystem function. • Evaluate the impact of various land management practices on soil erosion, nutrient cycling, and hydrology using large-scale lysimeters. • Develop strategies for integrating sustainable agriculture with environmental conservation. • Engage with land managers, Indigenous communities, and policymakers through public education facilities and outreach programs. This aligns with Australia's existing research collections, such as the Australian National Herbarium and Virtual Herbarium referenced in the Research Infrastructure Review. Adding new functional data on soil biodiversity and plant-soil interactions will support national efforts to protect and restore Australia's degraded soils and landscapes.

Q34.

Building a secure and resilient nation

Australia's food security, economic stability, and environmental resilience depend on the sustainable management of its soil and water resources. The 2024 National Science and Research Priorities (NSRPs) emphasise the need to build sovereign economic, societal, and food security resilience. Research must focus on developing technologies to manage water and produce food under Australia's changing climate, as well as predicting, detecting, and responding to biosecurity threats and natural disasters. Increasing climate variability, extreme weather events, and supply chain pressures necessitate advanced research infrastructure that can support the development of climate-resilient, resource-efficient agricultural systems. Critical Infrastructure Requirements: National-level infrastructure is needed to: • Provide a platform to assess crop performance, soil water use, and nutrient efficiency across diverse soil types and climatic conditions. • Support the development of resilient cropping systems through below-ground phenotyping and root system analysis, enabling improved drought and salinity tolerance. • Enable data-driven decision-making and predictive modelling, enhancing Australia's capacity to anticipate and respond to agricultural and environmental shocks. • Facilitate collaboration between researchers, industry, and government to develop adaptive management strategies that ensure food production stability. • Contribute to national biosecurity through research on soil-borne pests, diseases, and microbiome dynamics. • Deliver public engagement and training programs to build agricultural knowledge and capacity across the community. In line with the Research Infrastructure Review's recognition of the importance of national biological collections and integrated data platforms, expanding capabilities to systematically capture and analyse soil and plant interaction data will significantly enhance Australia's capacity to manage land use, biosecurity risks, and food security.

Q35.

2.3 The case for a new NRI capability, or enhancements to existing capabilities, typically emerges through advocacy from research communities clustering around rigorously identified needs and goals. Such a concept could respond to a requirement for novel or expanded capacity within a domain, or across domains, and must be such that it could only be made available with national-level investment.
If you have identified such a requirement, briefly describe the need, the proposed infrastructure capability, the medium-term goals, impacted research communities, and the timeframe over which you advocate its establishment. Your response can include links to relevant existing reports.

New Capability Proposal: National Soil and Plant Research Centre Australia's agricultural productivity, environmental sustainability, and climate resilience are underpinned by the health and function of its diverse soils. Yet, there is no nationally coordinated research infrastructure dedicated to systematically studying soil-plant interactions across Australia's varied agro-ecological zones. Current infrastructure, including the CSU Rhizolysimeter, provides an important foundation but is limited in scale—restricted to two soil types from the Wagga region. This presents a significant gap in addressing national research, industry, and policy priorities. To address this, we propose the establishment of a National Soil and Plant Research Centre at Charles Sturt University (CSU), developed in collaboration with the Australian Plant Phenomics Network (APPN). Located in a key regional hub, this centre will position Australia at the forefront of soil and plant science by delivering nationally relevant datasets, innovative research capabilities, and wide-reaching benefits across agricultural, environmental, and policy sectors, while also strengthening research and development opportunities in regional Australia. Proposed Infrastructure Capability 1. Expansion of Rhizolysimeter Infrastructure - Expansion from two to six agronomically significant soil types, representing 80% of Australia's productive cropping soils. - Focus on crop root physiology at the cropping scale, bridging controlled environment and field-based research. - The proposed centre will focus on crop root physiology at the cropping scale, rather than individual plants, effectively bridging the gap between controlled environment research and field-based studies. 2. Controlled Environment Phenotyping Facility - Glasshouses over lysimeter bays for controlled temperature, humidity, light, and CO_2. - Simulation of climate scenarios and plant responses. - Integration with above- and below-ground phenotyping platforms. 3. Advanced Monitoring and Sensor Integration -Deployment of leading-edge root imaging sensors (e.g., minirhizotrons and advanced optical systems) to non-invasively monitor root architecture and dynamics in situ. -Integration of new lysimetry technologies including advanced soil moisture and nutrient sensors for real-time monitoring. Establishment of a comprehensive root phenotyping and soil hydrology network linking above- and below-ground sensor systems. -Integration with APPN's phenotyping and data platforms, with the APPN central data team leading efforts to ensure national interoperability. 4. Public Engagement, Education, and Outreach Facilities -Interactive spaces to showcase soil and plant research to students, industry stakeholders, policymakers, and the wider community. -Supports STEM education, agricultural extension, and public awareness of sustainable soil management. Medium-Term Goals (2028–2038) - Enable research into plant-soil interactions across key soil types. - Provide integrated datasets to inform soil carbon sequestration, nutrient management, and climate-smart agriculture. - Drive innovation in crop breeding and sustainable land management. - Support predictive modelling of soil-plant-water dynamics. - Reduce cost and complexity of multi-region trials, increasing corporate R&D investment. - Strengthen Australia's global leadership through international collaborations. - Foster long-term collaboration across research, industry, government, and Indigenous communities. Impacted Research Communities - Agricultural Scientists, Soil Scientists, Plant Breeders - Climate, Environmental, and Data Scientists - Industry Stakeholders, Policymakers, Indigenous Land Managers - Educators, Students, Community Stakeholders Timeframe for Establishment - Infrastructure planning, stakeholder consultation, and lysimeter expansion. Expansion from CSU's existing facility expedites establishment. - Construction of glasshouses and installation of monitoring technologies. - Development of public engagement facilities. - Integration of datasets and establishment of research programs and collaborations. - Establishment timeframe: 2028 to 2038. Strategic Justification Crop-scale lysimetry bridges the gap between single-plant controlled environment research and field-scale research, providing a platform to study root physiology and soil-plant interactions under real-world conditions. No existing facility systematically studies plant-soil interactions across six of Australia's most productive soil types. Integrating advanced phenotyping, leading-edge sensors, and a national soil hydrology network, the centre aligns with: - Australia's net-zero transition. - National food security by improving drought and nutrient resilience. - Restoration of soil health, biodiversity, and landscape resilience. - Collaboration with Indigenous communities on land management and native foods. - Public education and workforce development to build agricultural and environmental capacity. This nationally coordinated infrastructure cannot be realised through fragmented or institution-level investments. It requires strategic, long-term commitment at the national level to deliver benefits across Australia's research, industry, policy, and community sectors.

Q36.

Part 3: Industry perspectives

This section is seeking input specifically from industry-based respondents. Other respondents can skip this section.

Recommendation 6 of the 2021 Roadmap related to improvements in industry engagement with NRI. To complement work on this topic that has occurred since then, we are seeking additional advice on NRI requirements as perceived by current or potential industry-based users.

Q37.

3.1 Have you (or your organisation) interreacted with or used Australia's NRI?

- ○ Yes
- ◉ No

Q38.

3.2 If so, please briefly outline the NRI capabilities you (or your organisation) have interacted with or used. Do not limit your response to NCRIS capabilities.

This question was not displayed to the respondent.

Q39.

3.3 Please indicate your (one or more) primary reasons for interacting with NRI:

This question was not displayed to the respondent.

Q40.

3.4 If you answered no, please indicate your (one or more) primary reasons:

- [ ] I did not know about it
- [ ] Other facilities suit my needs better
- [ ] I would like to, but cannot get access due to geographical location
- [ ] I would like to, but believed that access was only available to academic researchers
- [ ] I am not aware of any capability that meets my needs
- [ ] Other (please specify) _____

Q41.

Part 4: Other comments

4.1 Please elaborate on any of your above responses or add any other comments relevant to the development of the 2026 Roadmap. Your response can include reference or links to existing reports that you recommend be considered during the 2026 Roadmap development process.

Charles Sturt University (CSU) is proud to be a new node of the Australian Plant Phenomics Network (APPN), contributing to a nationally integrated research platform that underpins Australia's capacity to address critical challenges in agriculture. The 2026 National Research Infrastructure (NRI) Roadmap represents a vital opportunity to build upon the strategic investments outlined in the 2021 Roadmap, and to secure the long-term sustainability of newly established APPN nodes. As one of six recently funded nodes (expanding APPN from 3 to 9 nodes in 2023), CSU has been actively engaged in the initial phases of infrastructure commissioning, establishing joint operating protocols with other nodes, and integrating capabilities into a cohesive national framework. However, it is essential to recognise that plant phenotyping and soil-plant research require long-term, stable investment to deliver meaningful outcomes. Crop research and breeding programs, as well as soil health research, are inherently multi-year endeavours, often spanning 5 to 10 years. Ensuring continuity of operational funding and provision for equipment renewal is critical to maintaining momentum and maximising return on investment. Specifically, sustained funding will: • Enable CSU and other APPN nodes to attract and retain the highly skilled technical and scientific staff essential for delivering research outputs. • Provide the certainty required to foster strong partnerships with industry, commercial partners, and government agencies. There is significant interest in utilising the newly developed capabilities offered by APPN nodes, but sustained engagement relies on confidence in long-term operational stability. The expansion of the Rhizolysimeter to create a nationally coordinated soil and plant research centre that integrates advanced above- and below-ground phenotyping will address a clear gap in Australia's NRI landscape. Regionally located infrastructure, such as CSU's facilities, ensures equitable access to cutting-edge research, supports regional workforce development, and facilitates engagement with industry, community, and educational stakeholders. We recommend that the 2026 NRI Roadmap prioritise: • Continued operational support and equipment renewal for APPN nodes to ensure delivery of long-term research outcomes. • Strategic alignment with the priorities identified in the 2021 Roadmap, particularly in sustainable agriculture, soil health, and phenotyping technologies. • Consideration of findings from the National Research Infrastructure Review regarding long-term planning, workforce capability, and coordination across the national infrastructure network. A commitment to sustained funding and integration of APPN capabilities will ensure that Australia remains at the forefront of plant and soil research, delivering benefits across the agricultural, environmental, and policy sectors.

Q49.

4.2 Optional Document Attachment.

Note: Our strong preference is that answers are provided against the relevant questions in the survey. However, this file upload option is available for submissions in file format, where needed. Please ensure the document includes your name or organisation.