From the ground up

Healthy soils are the foundation upon which all terrestrial life is built. They decompose organic matter, regulate water levels, nourish plants and can harbour tens of thousands of species of microorganisms per gram. Conversely, unhealthy soils make ecosystems more vulnerable to drought, invasive species and desertification. Monitoring soil health can give land managers forewarning of any issues or changes in ecosystems, such as those associated with a changing climate. But regular, long-term soil monitoring is a rare practice. It's difficult, time-consuming and expensive to monitor soil properties across large landscapes.

For the past two years, Bush Heritage has been working with tech company Freaklabs and Monash University, on an exciting PhD project, to compare off-the-shelf sensors against lab methodologies and develop a remote soil monitoring system that will allow land managers to monitor soil health in real-time and at a low cost. The system, dubbed 'BaseLiner Soil', will measure soil moisture, CO2, pH, salinity and temperature. Depending on available communications infrastructure, the data are then remotely uploaded to a database, using 3G, 4G, NB-IoT or satellite, making it immediately available, to check the soil's condition. The technology is currently being trialled at Bush Heritage's Nardoo Hills Reserve, Dja Dja Wurrung Country in north-central Victoria, and will be refined, making it ready for other reserves over the coming year.

"Monitoring the soil health characteristics of many locations in real-time will allow us to monitor for early warning signs of stressed ecosystems during extreme weather events," says Justin McCann, Bush Heritage Conservation Data Analyst.

Photo Soil monitors could help trigger early management responses to changes in landscape health. *By* Matthew Taylor

Tracking ecosystem change

In 2022, a partnership emerged between Bush Heritage and University of New South Wales' Centre for Ecosystem Science, funded by the Ian Potter Foundation, to use a functional approach for tracking change within ecosystems and identifying trigger points for management action.

This work builds on the International Union for Conservation of Nature's global classification system for Earth's ecosystems, which defines common functions and processes for each type of ecosystem. This functional approach allows us to better understand the drivers and how they impact ecosystems. These drivers determine our biodiversity. As Australia is set to continue experiencing future shifts in temperature, precipitation and ground water – this approach allows the identification of causes of thriving or decline and to define best management strategies. Understanding early changes means we can use them as warning signs and guides to restoration. Wherever possible, this allows us to act preemptively to protect our ecosystems and their biodiversity.

"We are increasing our attention to these less tangible indicators, in part, to understand the impacts of change on the species and communities within the ecosystem type – if species are going to change, move or decline, then we come back to: what do we need to do?" says Dr Rebecca Spindler, Bush Heritage's Executive Manager for Science & Conservation.

With the partnership in place, preparations and planning are now being made so the program can begin at Bush Heritage's Naree Station Reserve, Budjiti Country, New South Wales, and the Fitz-Stirling reserves, Koreng Noongar Country, Western Australia. If successful, the approach will be applied across all Bush Heritage reserves in the years to come.

Photo A Coolibah swamp provides key waterbird breeding habitat at Naree Station Reserve, Budjiti Country, NSW. *By* Leonie Corrick