

Climate-adapted actions for land and water management

Examples to help environmental managers
implement the 6As of Adaptation

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About this document

This document is a practical supplement to the 6As of Adaptation for environmental management described on the [AdaptNSW](#) website.

Climate-adapted environmental management actions will vary based on the location and values of the land and waters. However, there are some common actions that can be useful across different locations, ecosystems, and property types. Below you'll find some examples of climate-adapted actions – use these as a starting point to investigate what actions might be best for your adaptation goals.

Reducing other pressures

Actions that reduce non-climate pressures on land and water often enhance your climate-adapted management efforts. Where possible, try to implement or align with other programs that reduce the impacts of intensive land use, vegetation clearing, and pollution.

Preparing and restoring habitats and sites for future conditions

Climate-adapted restoration actions can benefit all land and water management efforts. These actions focus on 'fast-tracking' the adaptation of land and water environments, by introducing habitat-building species (such as trees) that are adapted to future climate conditions. These actions apply to natural, managed and modified environments, including conservation areas, farms, coastal zones, waterways and urban green spaces. Useful tools to help you implement these actions include Which Plant Where and Restore and Renew.

Example actions

- Using plant stock from a mixture of species and provenances to account for future climate uncertainty, and aiming for quality over quantity to support ongoing natural regeneration (that is, prioritising diversity and complexity of ecosystems over number of individuals within a species)
- Kelp banking to restore kelp forests with suitable genetic and climate-adapted traits
- Coral seeding to support reef restoration using spawn from climate-adapted coral species
- Protecting and enhancing blue carbon ecosystems such as seagrass meadows, mangroves and saltmarshes
- Restoring oyster reefs to protect estuary ecosystems from inundation and erosion risks
- Replanting estuarine and upstream vegetation with climate-adapted species, to stabilise banks and trap sediments
- Restoring habitats to create refuges for important species affected by climate change
- Identifying sites and habitats that will become suitable for native species in future (marine, freshwater and terrestrial)
- Working with local First Nations groups to improve ecosystem health, biodiversity and cultural outcomes through cultural burning (especially for soil health)
- Using waterpoints away from streams and dams to protect riparian vegetation from livestock, preserving its function in maintaining water quality and reducing evaporation
- Using cover crops, compost or organic fertilisers to help agricultural soils retain moisture and nutrients in drier periods
- Practicing regenerative water and pasture management, such as using leaky weirs to slow, spread and sink water, and planting perennial pastures
- Re-incorporating native groundlayer species, such as grasses and wildflowers, into urban public spaces to help with cooling and provide habitat refuges
- Planting pioneer species for immediate canopy to provide shade and cooling for smaller plant and animal species
- Planting threatened plant species in future climate niches to increase their range (similarly with planting food and habitat plant species in future climate niches of threatened animal species, such as planting climate-adapted koala habitat and food trees)
- Saving seed from climate-adapted stock for further planting

Assisted migration and breeding programs

In some cases, it won't be feasible to maintain or restore an area exactly as it was. This means you'll need to look for actions beyond a particular site or property to help ensure the survival of socially, culturally, ecologically and economically important species. Where restoration fast-tracks the adaptation of an ecosystem, assisted migration fast-tracks the spread of species to suitable areas.

Example actions

- Identifying future habitats and climate refuges to conserve for the long-term survival of species
- Translocating marine species that are highly susceptible to marine heatwave impacts
- Translocating culturally and ecologically important plants to a nursery or area likely to be a good climate match in the future (terrestrial and riparian/aquatic plants)
- Identifying and securing suitable areas for habitat migration, such as surrounding low-lying land for estuarine vegetation to migrate as conditions change
- Establishing captive populations of species where wild habitat is in decline, to support the return of species to the wild when/where conditions are favourable, and ensure the future of the species (for example, breeding alpine fish species in climate-controlled facilities)
- Investing in farmland in areas that will be suitable in a future climate, for example, moving certain wine grape varieties to cooler climates
- Moving eggs and nests of shorebirds and turtles to avoid coastal inundation risks

Managing the shifting ranges of pests, weeds and diseases

Like native species, the distribution and spread of invasive species is also changing alongside our climate. Lands and waters may face new or increased threats from pests, weeds and diseases.

Example actions

- Increasing monitoring in areas where climate conditions are becoming more favourable for invasive species, such as monitoring for the Crown-of-thorns starfish in ocean waters off northern NSW
- Changing the timing and effort of weeding, pest and disease control activities (especially in conservation, restoration and agriculture practices)
- Changing the focus of pest control in response to climate impacts and overlapping pressures, for example, increasing predator control during times when native animals are already under pressure (such as from drought), and increasing weeding activities during periods of high rainfall

Infrastructure, physical interventions, and nature-based solutions

Physical interventions may be needed when the values of land and water cannot be protected in other ways. This section focuses on physical, engineered and nature-based interventions implemented on the ground, recognising these actions are often enabled by planning and policy decisions. These actions can have consequences if not managed carefully (this is known as maladaptation). Using nature-based solutions reduces the risk of maladaptation and often has cobenefits with other values and climate change mitigation efforts.

Example actions

For land and freshwater management

- Installing water quality enhancement devices
- Using infrastructure to deliver water to climate-stressed wetlands that may no longer be receiving a natural flooding cycle (infrastructure also reduces evaporation during water delivery)
- Installing erosion-control measures until riparian vegetation has established, to protect from erosion caused by more frequent and intense rainfall events
- Using [leaky weirs](#) to slow the flow of water in streams and gullies to reduce erosion and allow sediments to settle
- Using on-ground solutions such as planting shelter belts, and installing shade structures and additional watering points to reduce livestock exposure to extreme heat
- Installing anchors, barriers or storage structures to physically secure farm equipment during intense rainfall and flooding, to prevent losses and damage, and protect downstream areas
- Installing water-efficiency infrastructure, such as automated monitoring and control systems for dams and ponds, and closed-loop systems to recycle water for livestock washing and cooling
- Using passive irrigation of street trees, such as those described in the [Street Tree Planting Design Manual](#)
- Adapting hard urban spaces into greener spaces to reduce urban heat, such as installing plant walls and roofs, and garden beds similar to the approach taken in the [Parramatta floating garden trial](#)
- Building supplementary habitat and climate refuges, such as artificial ponds for frogs within wider natural habitats, particularly in areas with declining habitat
- Restoring habitats by installing small dams to retain water in landscapes, removing tidal barriers, and planting dense riparian vegetation to provide shade
- Using seed enhancement technologies such as seed priming and coating to increase germination rates
- Increasing erosion-control measures to protect recovering land from intense rainfall events

For marine and coastal management

- Introducing artificial reefs to create habitat refuges and protect coastal areas from tidal erosion
- Creating [living shorelines](#) to manage erosion and inundation risk
- Raising the height of existing fish traps, or establishing new ones, to ensure the continuation of cultural practices as sea levels rise

- Restoring coastal dunes using climate-adapted plant species, to protect coastal habitats, infrastructure and community spaces from erosion and inundation risks (instead of using hard infrastructure)
- Decoupling artificially connected waterways in intertidal systems to prevent saltwater intrusion and mangrove incursion
- Raising drain inverts or shortening by infilling to slow the flow of water and reduce salt water intrusion to protect water quality
- Introducing or upgrading seawalls and revetments to protect coastal areas from inundation, and using living seawalls to add habitat refuges for species at risk of climate change impacts
- Implementing beach scraping and sand nourishment to counter erosion
- Placing veneers of sediment over tidal wetlands to raise ground level to help vegetation adapt to rising sea levels
- Installing plants with established root systems and structures such as rock fillets to protect foreshores from erosion
- Installing erosion-control measures to protect First Nations cultural heritage, including fish traps, middens and burial sites, that may be at risk due to flooding and sea level rises
- Taking a 'managed retreat' approach to relocate infrastructure in high-risk coastal areas

Adaptive planning and decision-making (government and industry)

Sometimes, the best action will be to change the way you use, plan, and make decisions about the land and waters that you manage. This section focuses on strategic, policy, business and governance decisions that shape how and where climate adaptation actions are implemented over time.

Example actions

- Transitioning to livestock breeds that are more heat-tolerant, such as tropical cattle breeds
- Using livestock containment lots as a planned management response during drought or extreme conditions, to allow soils and pastures time to recover from grazing pressure
- Transitioning to climate-adapted crops to reflect changing climate conditions
- Planning for system redundancy, such as ensuring backup power supplies for pumps and aerators or alternative effluent flow paths, to maintain operations during extreme weather events
- Changing zoning and land use in low-lying coastal areas to manage the increased risk of coastal inundation caused by sea-level rise
- Implementing setbacks, rolling easements and development controls that consider increased risks caused by sea-level rise and floods
- Raising awareness of sea-level rise impacts in the community, for example by promoting citizen science programs such as [CoastSnap](#)
- Maintaining and increasing marine and coastal protected areas to provide refuges for marine species affected by warming ocean temperatures
- Revising and updating environmental guidelines and management principles to ensure they account for future climate conditions
- Making industry and business planning decisions to transition to aquaculture species better suited to warmer water temperatures to ensure continued productivity of estuarine aquaculture industries
- Making decisions about the timing, allocation and delivery of environmental water to maintain river connectivity under drier future climate conditions
- Making strategic decisions to adopt regenerative farming approaches that improve soil resilience under hotter and drier climate conditions
- Diversifying crop types to build agricultural resilience
- Developing forward-looking drought-preparedness plans that guide early and coordinated responses to drying climate conditions
- Incorporating cultural worldviews, practices and participation into urban design processes
- Connecting urban green spaces through different local government areas to improve biodiversity and visitor comfort, such as in the [Greening the Great West Walk](#) project
- Formally integrating traditional ecological knowledge into threatened species and conservations programs, to ensure cultural values are included in conservation assessments
- Using a variety of restoration methods and staggering activities over time (this often involves longer timeframes and higher costs)