

Chapter 30

Environmental management and monitoring



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Chapter 30. Environmental management and monitoring

The proposed environmental management and monitoring for the project is based on the findings of the impact assessment process; itself informed by the extensive baseline data collection across several key environmental and social disciplines that have been undertaken across the project site. The key learnings from this process have been proposed as the environmental and social management and monitoring framework to ensure that the project would proceed consistent with the impacts assessed herein.

The key messages with regard to environmental management and monitoring are:

- the environmental management and monitoring framework is based on learnings from over five years of study within the project area to date
- the management and monitoring framework utilises the principles of adaptive management to ensure continual and timely review of monitoring data, with a continuous improvement or learning feedback loop implemented
- the environmental management and monitoring process will be subject to regular independent audit
- there is public access to key water data via the Santos on-line water portal.

This chapter outlines the environmental management framework that would be applied to the project. The proponent is committed to conducting activities associated with the project in an environmentally responsible manner; and would implement best practice environmental management in accordance with:

- Santos' corporate approach to environmental management
- the conditions of approval
- relevant statutory obligations
- landholder agreements
- the findings of this EIS.

Santos' corporate values, applicable policies and systems, and a high level overview of the individual management and monitoring plans proposed for the project, are discussed below.

30.1 Corporate governance

30.1.1 Framework

Santos' corporate environmental commitment is to 'a workplace where we all go home without illness or injury and manage the impact of our operations on the environment'.

These corporate values are the basis of Santos' commitment to operate, with a view to its long-term sustainability. Santos has developed a range of policies to support its vision and values, as outlined in Table 30-1, and Appendix T1.

Aspect	Description	
Environmental, health and safety policy	The environmental, health and safety policy seeks to find new ways to minimise environmental impact across the lifecycle of activities, and conduct business in a manner that prevents injury or illness to workers and the public.	
Community policy	The community policy aims to establish and maintain enduring and mutually-beneficial relationships with communities within which Santos operates ensuring its activities generate positive economic and social benefits for and in partnership with these communities.	
	To achieve this, it will, among other things:	
	• Comprehensively share information about activities that have a major effect on the communities of which it is a part.	
	 Identify the social effects of operations in these communities, seeking to manage these effects while delivering business outcomes 	
	 Report on community investment and consultation activities 	
Climate change policy	Climate change is a long-term issue, requiring urgent but informed action to stabilise atmospheric greenhouse gas concentrations. As a global stakeholder in the energy business, Santos recognises that one of our key social and environmental responsibilities is to pursue strategies that address the issue of climate change.	
Aboriginal engagement policy	The Aboriginal engagement policy promotes working with Aboriginal communities and creating beneficial relationships across all of its operations.	

Table 30-1 Overview of key Santos' corporate governance

30.1.2 Environment, health and safety management system

The Santos Environment, Health and Safety Management System (EHSMS) provides a framework for environmental and safety practices across Santos' operations. The framework has been developed to be consistent with AS 4801:2000 Occupational Health and Safety Management Systems and AS/NZS ISO 14001:2015 Environmental Management Systems. The implementation of the project management plans for the Narrabri Gas Project would be integrated into the EHSMS.

The EHSMS documents are accessible to all employees. Contractors engaged by Santos are required to undergo a pre-qualification process and have an environmental management system in place. The environmental management and monitoring plans summarised in this chapter build upon the corporate implementation, experience and understanding of previous and existing projects.

Should the project be approved, detailed management plans would be developed in accordance with the approval conditions to meet all Commonwealth and State regulatory requirements. Environmental management and monitoring plans would be developed for submission to NSW Department of Planning and Environment for approval.

30.2 Land access and stakeholder consultation

Landholder engagement and consultation is an important component of all stages of development. No gas well would be located on a property without a written Land Access Agreement in place in accordance with the principles of land access (as agreed in March 2014 with NSW Farmers, Cotton Australia, NSW Irrigators Council, and AGL). Dairy Connect and the Country Women's Association of NSW signed the land access agreement in September 2015.

Farm Management Plans would be developed in consultation with landholders to document planned activities and their indicative timing for both the landholder and the proponent to enable co-existing activities to be managed effectively.

As discussed in Chapter 9, a Community and Stakeholder Management Plan would continue to support the approvals, detailed design, construction, operations, decommissioning and rehabilitation phases of the project. Community engagement and stakeholder management measures would also be incorporated into discipline-specific management plans.

A Stakeholder Strategy and Plan were developed in 2013 to guide the effective and timely delivery of consultation activities during the EIS process in accordance with the NSW Government's *Strategic Regional Land Use Policy Delivery Guidelines* (NSW Trade & Investment 2012). In March 2016, new guidelines were issued by the NSW Department of Industry (Division of Resources and Energy) titled *Exploration code of practice: community consultation* (NSW Department of Industry 2016). The requirements of this code are now incorporated into consultation and engagement planning and implementation. The proponent would continue to implement the plan throughout the project.

The Plan includes:

- identification of a broad group of stakeholders potentially impacted by the project footprint
- an overview of potential issues and risks / opportunities to manage during the project development and approval process
- engagement techniques for dissemination of, and access to, timely, accurate and credible information regarding the project
- an integrated approach designed to support the commitment to build and maintain effective relationships with stakeholders and communities based on open, transparent and factual communication.

The Plan was developed to integrate with existing engagement activities undertaken as part of the project development, while also interfacing with The proponent 's broader engagement and communication strategies.

30.3 Environmental management overview

The environmental management framework, also referred to as an environmental management strategy (EMS) for the project includes a number of discipline-specific sub-plans that would be implemented during each phase of the project, as shown in Figure 30-1. Environmental management would occur during:

 planning and design – environmental management would involve implementing the Field Development Protocol which includes a micro-siting procedure to locate field infrastructure

- construction and operation the environmental management strategy would include:
 - specific environmental management sub-plans that would be implemented at the appropriate time in the project schedule
 - environmental monitoring, compliance, reporting and auditing procedures. These are not shown on Figure 30-1 though remain a critical project component. Refer to Section 30.6.2 for additonal information.
- decommissioning and rehabilitation environmental management would involve rehabilitation management planning in line with the overarching Rehabilitation Strategy (refer to Appendix V) and Decommissioning Plan (refer to Appendix W).

The framework would be developed and implemented with reference to Santos' overall approach to environmental management (refer to Section 30.1.2) and in accordance with *AS/NZS ISO 14001:2015 Environmental Management Systems – Requirements with Guidance for Use.*

At a high level, the overarching environmental management strategy would generally include:

- Santos' environmental policy, objectives and performance targets for construction and operation, including corporate management policies, procedures and review processes to assess the implementation of environmental management practices and the environmental performance of the project against the objective and targets
- all compliance requirements, statutory obligations and guidelines for management, and the process for complying with these obligations, including:
 - conditions of approval for the development
 - mitigation measures and the statement of commitments specified within this EIS
 - licence and petroleum title conditions
 - relevant construction and operation management guidelines
- roles and responsibilities of all personnel and contractors to be employed on site
- specific procedures and responsibilities for:
 - training, competency and awareness
 - communications and reporting
 - control of documents and records
 - monitoring implementation and auditing compliance
 - incident management
 - management of subcontractors and suppliers
 - reviewing and updating the environmental management plans, including continuous improvement.
- sub-plans for key environmental disciplines
- procedures for complaints handling and ongoing communication with the community.



Figure 30-1 Environmental management strategy for the Narrabri Gas Project

Sub-plans within the environmental management strategy would generally be prepared according to the indicative structure shown in Table 30-2, with specific requirements by sub-plan included as required.

Generally, environmental monitoring requirements would be included in each sub-plan by technical discipline, with a few exceptions that command a stand-alone monitoring document. One example would be the Water Monitoring Plan (refer to Appendix G3).

Table 30-2 Indicative sub-plan structure and content

Element	Description of content
Existing environmental values and potential impacts	A description of the environmental values likely to be affected by the project during the construction and operational phases.
Management objective(s)	The overarching objective to be achieved for the environmental value likely to be affected by the project.
Performance criteria	Measurable outcomes or indicators prescribed to gauge whether the management objectives are being met.
Management and mitigation measures	The strategies, tasks or methods proposed to achieve the performance criteria. This section provides the measures relevant to design, construction and operation.
Monitoring requirements and corrective actions	The proposed monitoring activities to measure the performance criteria against relevant thresholds or trigger values and the corrective actions to be implemented where certain performance criteria are not met.

30.4 Field Development Protocol

The location and siting of well pads and other field infrastructure would be undertaken in accordance with a Field Development Protocol, which has been developed using the output of the environmental impact assessment process (refer to Figure 30-2).

Regular auditing and compliance monitoring would be used to ensure agreed environmental performance measures, documented in the Field Development Protocol, are adhered to. Implementation would be undertaken in accordance with the Plan of Operations and relevant management plans.

If development consent and approval under NSW and Commonwealth legislation is granted, the Field Development Protocol presented in this EIS would be revised to capture conditions of approval related to the siting of field infrastructure.



Figure 30-2 Process flow chart for implementing the Field Development Protocol

30.5 Sub-plans

The construction and operational impacts and respective management and mitigation measures identified in this EIS would be summarised in a specific management sub-plan for each key environmental discipline, with additional detail about the actual implementation of each management and mitigation measure also included as required. Decommissioning Plans based on the Decommissioning Report (refer to Appendix W) would increase in detail over the life of the specific infrastructure to be decommissioned.

A high level description of the indicative content of each sub-plan is summarised below.

30.5.1 Erosion and sediment control

The purpose of the Erosion and Sediment Control Plan is to minimise sedimentation to surface watercourses as a result of construction activities. The Interpretative Soils report (refer to Appendix I1) identified pockets of dispersive soil in the project area that would require appropriate management during construction.

The Erosion and Sediment Control Plan would be constructed consistent with the requirements of relevant guidelines, including:

- Managing Urban Stormwater: Soils and Construction Vol 1 (Landcom 2004)
- Managing Urban Stormwater: Soils and Construction Vol 2A Installation of Services (DECC 2008)
- Managing Urban Stormwater: Soils and Construction Vol 2C Unsealed Roads (DECC 2008a).

The Plan would generally include a site description, identify erosion and sediment hazards, identify management and mitigation for the proposed activity by construction area, discuss staging of works, and articulate reinstatement works for each construction area. The Plan would be used throughout construction, operation, decommissioning and rehabilitation of the project.

30.5.2 Soil

The Soil Management Plan would work in conjunction with the Erosion and Sediment Control Plan, and would be implemented during construction, operation, decommissioning and rehabilitation of the project.

Lower quality land that has lower agricultural capability due to erodibility, poor structure and / or low fertility for example may be more susceptible to impacts from engineering works, and therefore represent a greater hazard, requiring more mitigation.

The Soil Management Plan would include guidance on soil stripping, handling, stockpiling, spreading and rehabilitation for the key soil types within which construction works would be undertaken. It would also include soil amendment details if required to ameliorate soils to mitigate erosivity and dispersivity potential in sodic soils within the project area.

30.5.3 Air quality

An Air Quality Management Plan would be implemented during construction and operation of the project. The Plan would include an air quality monitoring program and a suite of measures that could be implemented to prevent or minimise air emissions, where necessary.

Standard construction dust control measures that would be reflected in the Air Quality Management Plan include watering or application of commercial dust suppressants on disturbed soil surfaces, covering erodible material prior to transport and vehicle speed controls.

30.5.4 Noise and vibration

The Noise Management Plan would be developed for the construction, operation and decommissioning and rehabilitation stages of the project, detailing the methods used to minimise construction noise such that noise constraints are met. The Plan would be reviewed and updated as necessary as additional information on construction becomes available. It would include relevant standards and guidelines, including the *Interim Construction Noise Guideline* (DECC 2009) and the *NSW Industrial Noise Policy* (NSW EPA 2000).

The Noise Management Plan would include details of the construction methods, details of specific licence or consent conditions, and options for feasible and reasonable mitigation methods to meet noise criteria.

The Noise Management Plan would also include details of the noise monitoring program for the project including monitoring in accordance with the relevant requirements of the *NSW Industrial Noise Policy* (NSW EPA 2000). It would contain a notification procedure for surrounding sensitive receivers that have the potential to be impacted by noise, which would include details of the nature of the work that would be undertaken including timing, likely noise or vibration levels and site contact details to lodge a complaint. Finally, it would contain a consultation procedure to deal with complaints arising from noise issues.

If vibration-generating activities were to be undertaken in the vicinity of occupied sensitive receivers or buildings, a Vibration Management Plan would be developed and implemented containing measures such as:

- preparation of property condition reports
- investigation of alternative work methods
- provision of advice to potentially impacted receivers.

30.5.5 Cultural heritage

The Cultural Heritage Management Plan has been developed for all project stages and is included as Appendix N2. The Plan provides the framework for avoiding or minimising impacts from the project on cultural heritage and to promote the responsible management of cultural heritage values in connection with undertaking the project. No disturbance activities would be undertaken in the project area that are not consistent with the process set out in the Plan, including pre-clearance surveys undertaken with the Aboriginal community.

The Cultural Heritage Management Plan describes how the impact of activities required for the project on cultural heritage would be managed. Project activities would be designed such that, to the greatest extent possible, there would be no impact on cultural heritage. Where impact cannot be avoided, the project activity would be designed to minimise impact on Aboriginal objects, places or values, and other management measures as appropriate would be implemented to minimise or mitigate harm.

A cultural heritage working group would be established to help implement the Plan. The working group would appoint a cultural heritage coordinator. The proponent would appoint a third party to undertake a review of this Plan within five years of the Plan's approval.

30.5.6 Biodiversity

Mitigation and management measures proposed to minimise the impacts on terrestrial flora and fauna in the project area (including threatened and migratory species, populations and ecological communities) would be incorporated into a Biodiversity Management Plan.

The Biodiversity Management Plan would be in use for all project stages and would include a Significant Species Management Plan and management measures to minimise impacts on terrestrial flora and fauna. The Biodiversity Management Plan would also include the pre-clearing and clearing procedure to minimise potential impacts or risk to fauna during vegetation removal (refer to Appendix J1). The purpose of the procedure is to identify fauna and flora occurrence in the subject site, encourage fauna to relocate outside of the subject site prior to habitat clearing, and move fauna during clearing.

Other appropriate construction and operational controls would be included in the Biodiversity Management Plan to ensure that mitigation measures are successfully implemented.

A monitoring program would also be developed consistent with approval conditions that would specify a methodology to scientifically monitor the direct and indirect impacts of the project. The methodology would include steps to ensure the proposed mitigation measures are adequately addressing impacts. Additional measures would be implemented as required to ensure impacts are avoided and / or mitigated as feasible throughout the life of the project.

The monitoring program would include quantitative key performance targets to ensure that progress is being compared to measurable benchmark conditions.

Monitoring would also occur at offset properties, as required, to ensure that the management of the offset properties is adequate for the aims of the associated Biodiversity Offset Management Plan. The monitoring required would depend on the management tasks required but may include rehabilitation monitoring or revegetation monitoring. Previous monitoring programs (such as by Forestry Corporation of NSW) would be reviewed to align efforts where possible with existing data sources.

30.5.7 Pest, Plant and Animal Control

The proponent would develop a nil-tenure feral animal control strategy which will be approximately equivalent to one third of the total offset liability of the project. The feral animal control strategy will initially focus on the study area (including a 5 to 10 kilometre buffer) and will be implemented over a 20-year period. The strategy will focus efforts heavily in the first couple of years followed by maintenance control for the remaining period.

Consultation with NSW Forestry Corporation, the NSW National Parks and Wildlife Service and private landholders will be held during the preparation of the strategy to identify ways to integrate the feral animal control strategy with other strategies across the Pilliga region.

The nil-tenure feral animal control strategy will address feral animal control at a landscape scale. Given the connectivity of habitat in the study area and Pilliga, it is considered most beneficial to approach feral animal control at this scale.

The strategy will be designed to target feral fauna identified as high risk to the survival of native flora and fauna in the Pilliga. Control measures used will be specific for the target fauna species, with a range of control techniques to be applied. The poisoning of non-target species will be addressed through the design of the control techniques. The strategy will include monitoring to detect changes to targeted feral fauna abundance from control measures applied at the landscape scale. Monitoring will also aim to detect poisoning of non-target species to ensure the program is not having adverse effects on native wildlife.

Weeds would also be managed under the Plan. The Plan would include an inventory of weeds, list the diseases present, and identify management measures to be implemented in the design, construction and post construction phases to control weeds. The Plan would include measures to monitor and control weed populations that establish in disturbed areas, with particular attention to eradication of noxious weeds. Weed invasions would be monitored and controlled by a person experienced in weed management.

30.5.8 Historic heritage

The Historic Heritage Management Plan would include measures to guide the management and protection of identified heritage items within the project area. Such management documents are commonly used as heritage management tools, and their effectiveness and reliability is supported by the Heritage Council of NSW.

As a minimum, the Plan would include a list and GIS layer showing the location of identified heritage items, and a significance assessment and Statement of Significance for each site.

The Plan would also include induction protocols for staff to ensure they understand their obligations under the *Heritage Act* 1977, an unexpected finds procedure in the event that further sites are identified during micro-siting, a separate procedure for the discovery of skeletal remains, and criteria for the conservation of sites identified during the life of the project, including measures to prevent cumulative impacts.

30.5.9 Traffic

A Traffic Management Plan would be prepared that would include management outcomes from consultation with Narrabri Shire Council, Roads and Maritime, NSW Police Services and schools that may have school bus routes in and around the roads accessing the project. Outcomes of other consultation activities and the environmental impact assessment would also be included in the Plan. This may include speed restrictions, the installation of specific warning signs, the provision of advance notice of road / lane closures, and advice on alternative routes.

The Plan would also provide details on appropriate traffic control and warning signs for areas identified where potential safety risk issues exist. It would help to manage the impacts of the transportation of construction materials to site, including options for the use of the NSW Police Service and / or pilots, and opportunities to maximise vehicle loads in order to minimise vehicle movements.

The Plan would also include parking arrangements, pedestrian and vehicular access arrangements, traffic management for out of hours' construction work, and a compliance monitoring and consultation procedure to deal with complaints arising from the project. The Plan would also include ways to minimise impacts on traffic management on the Newell Highway at peak hours.

30.5.10 Waste

A Waste Management Plan would be developed to manage the generation, handling, placement and transport of waste during the construction, operation, decommissioning and rehabilitation phases of the project. The Waste Management Plan would include details on salt management generated from the treatment of produced water, which would be transported and disposed of to an off-site licensed landfill in accordance with regulatory requirements.

The Waste Management Plan would outline procedures for recording where different types of waste would be generated, specify waste and recycling collection systems and infrastructure, specify how waste would be transported and stored on site, and how waste would be transported off site including options for recycling and disposal. It would also include:

- training requirements to improve efficiency in the minimisation of waste streams
- reuse and recycling options
- detail on regular inspections and monitoring to ensure that adequate maintenance and operation of on-site waste management receptacles was undertaken.

Continuous improvement targets would be set to ensure an ongoing commitment to waste reduction in line with the NSW Waste Hierarchy.

30.5.11 Bushfire

A Bushfire Management Plan would be prepared in conjunction with landholders and the NSW Rural Fire Service, with components under the proponents control implemented for the project to mitigate this risk.

This document would include:

- a description of the bushfire risks to which staff, contractors and visitors may be exposed, and the process used to communicate these risks to these persons
- formal preparedness procedures for staff and contractors to maintain awareness of and respond to escalating forecast fire danger

- formal pre-rehearsed procedures for staff and contractors to respond to respond to a formal bushfire warning being issued by emergency services, including identification of escape routes and refuge areas
- identification of specific asset protection zones and strategic fire advantage zones around assets where vegetation management is required
- identification of appropriate construction standards for buildings and refuge areas. This may include measures to retrofit existing structures (such as fitting of ember screens and improved glazing) to improve the potential for structures to survive bushfire impacts
- preparation of an annual works mitigation schedule to identify works required to be implemented to
 prepare asset protection and strategic fire advantage zones around assets, maintenance to the
 assets themselves to improve their resilience to bushfires, and maintenance requirements for
 emergency access and egress routes.

30.5.12 Produced water

Produced water would be managed under a Produced Water Management Plan. Produced water management, which is described in Chapter 7, includes options for the beneficial reuse of treated and amended water for irrigation, stock watering, dust suppression, firefighting, construction and / or drilling.

The Produced Water Management Plan would address the full suite of beneficial reuse options for the produced water following its treatment and amendment; including:

- A water balance that would detail the quantities of water being stored, treated and beneficially reused by option and over time (refer to Chapter 7).
- An Irrigation Management Plan which would detail management methods on how to maintain soil structure, stability and productive capacity; minimise erosion, and implement effective surface water and stormwater runoff controls where these are required. The Irrigation Plan would also include a program of regular and appropriate monitoring. The irrigation schedule would be adjusted as needed, to address trends identified through the monitoring program (refer to Chapters 12 and 14, and Appendix G2).
- Dust suppression protocols that would detail mitigations such as the quantity of water applied would be restricted to that required to control dust and would only be applied in dry conditions, minimising the potential for waterlogging or ponding. (refer to Chapters 12 and 14).
- A Managed Release Protocol that would outline the rules around release to Bohena Creek when flow is equal to, or exceeds, 100 megalitres per day as recorded at the Newell Highway gauging station. The Plan would set out the procedures for undertaking releases and the monitoring and recording requirements. Monitoring requirements for the managed release are included in the Water Monitoring Plan (refer to Appendix G3 for additional information). The Managed Release Protocol would also link to the project's EPL, including toxicity based release criteria, to ensure compliance management. The managed release licence condition would be consistent with the Environment Protection Authority Licensing Fact Sheet: Using Environment Protection Licensing to Control Water Pollution (NSW EPA 2013). Refer to Chapters 12 and 13, and Appendix G1.
- Links to drilling protocols as to how the treated water would be beneficially reused in the drilling program (refer to Chapter 6).

30.5.13 Decommissioning

The Decommissioning Management Plan would be established for the decommissioning of gas wells that would be decommissioned in accordance with the NSW *Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS 2012). The Decommissioning Management Plan would also detail the decommissioning of major infrastructure at Leewood, Bibblewindi, Westport, the Leewood to Bibblewindi underground infrastructure corridor, and the Leewood to Wilga Park underground infrastructure corridor. It would also detail field infrastructure such as access tracks, telecommunications towers, water balance tanks, and gas and water gathering lines. Decommissioning Plans based on the Decommissioning Report (refer to Appendix W) would increase in detail over the life of the specific infrastructure to be decommissioned.

It would include:

- the purpose, objectives and targets of the Plan
- regulatory obligations, including requirements from project licenses and consent conditions
- roles and responsibilities for the implementation of the Plan
- decommissioning methodologies and associated environmental constraints
- mitigation measures to manage the environmental risks associated with decommissioning activities
- a compliance and auditing program to verify the implementation of the Plan.

The Plan would detail the decommissioning strategy presented in Appendix W and would complement individual Rehabilitation Management Plans for discrete project domains. The Plan would be submitted within five years of commencement, and would be further updated over the life of the project.

30.5.14 Rehabilitation Strategy and Plans

A rehabilitation strategy applicable to all project phases has been prepared for the project (refer to Appendix V). It aims to ensure land disturbed by the project is rehabilitated to a standard that is representative of surrounding vegetation communities (including pasture) and is compatible with surrounding land use objectives.

The rehabilitation strategy is designed to ensure an overarching and consistent approach to rehabilitation management, with specific rehabilitation requirements to populate other Plans as required (such as Farm Management Plans, and Sediment and Erosion Control Plans).

The rehabilitation strategy provides a clear set of objectives and completion criteria for rehabilitation of project infrastructure including production wells, gas and water gathering lines and associated infrastructure and ancillary sites.

A Rehabilitation Plan containing detailed rehabilitation schedules and monitoring would be prepared and would be consistent with relevant approval conditions.

30.6 Monitoring

30.6.1 Overview

The environmental management strategy for the project will be implemented using ongoing environmental monitoring for specific sub-disciplines. This ongoing monitoring program would be used to guide the management of environmental impacts through early identification of environmental issues to allow for feedback into the environmental management process. This process is known as adaptive management.

The concept of adaptive management is a structured, iterative approach to decision making with the capacity to gradually reduce uncertainty over time through monitoring and adapting to environmental, economic and social changes. It allows the operator the opportunity for ongoing fine-tuning and continuous improvements to the overall management and monitoring strategy, using actual environmental data. An example would be adjusting dust suppression volumes and / or frequency commensurate with construction dust monitoring data to ensure optimal mitigation is achieved.

The individual monitoring plans that will drive the adaptive management process will include:

- surface and groundwater (refer to Appendix G3) (the content of this is detailed further below)
- biodiversity (refer to Appendices J1 and J2)
- rehabilitation (refer to Appendix W)
- air quality (refer to Appendix L)
- noise and vibration (refer to Appendix M).

By its very nature, adaptive management employs an inherent capacity to incrementally improve confidence through the re-integration of environmental monitoring data into the forward planning process, thereby reducing risk. Therefore, in circumstances where potential impacts cannot be entirely avoided, the adaptive management approach allows for an evaluation of the preferred mitigation controls employed, such that they are progressively improved and refined, or alternative solutions adopted.

The feedback loop would report back to the Field Development Protocol for periodic fine-tuning to ensure that leading practice environmental management is maintained for the project.

The process of adaptive management is shown in Figure 30-3. Specifically, the monitoring programs would aim to:

- detect environmental change and, specifically, identify those changes resulting from the project
- determine actual versus predicted change
- contribute to the assessment of the effectiveness of environmental management procedures
- provide data for the assessment of adherence to the environmental management plans, approval and licence conditions.

Monitoring programs would be reviewed regularly and modified as appropriate to ensure they are appropriate for their stated purpose. Reviews would consider the frequency and duration of monitoring and evaluate the ongoing need for individual programs. Records of all monitoring activities would be retained to facilitate auditing (refer to Section 30.7).



Figure 30-3 The process of adaptive management

30.6.2 Surface and groundwater monitoring

The proponent has been undertaking baseline surface water and groundwater monitoring for the project for over four years. The summary data, which includes water quality, groundwater depth and pressure, and surface water flows, inform a baseline data set for impact assessment in this EIS. Data are provided in the Water Baseline Report (refer to Appendix G4). The report was prepared to:

- provide a description of the existing surface water environment against which to assess potential impacts
- provide baseline surface and groundwater data
- support the project's Water Monitoring Plan (refer to Appendix G3).

The Water Monitoring Plan describes how monitoring of water resources within the project area would be undertaken, including surface and groundwater (refer Figure 30-4). The Plan addresses monitoring for potential surface and groundwater impacts, associated with extraction of water from the coal seams during the duration of the project.

Surface water monitoring locations have been sited in locations where the project may have a specific impact, or located within the wider area to monitor local to regional scale changes. The monitoring sites would be utilised to provide reference data and then to identify project impacts through monitoring of targeted monitoring sites, predominantly in Bohena Creek. The surface water component of the Water Monitoring Plan would include the collection of data to monitor the Bohena Creek managed release. The approach to groundwater monitoring is to both focus on beneficial use aquifers, which refer to the shallower hydrostratigraphic units where water is abstracted for stock, domestic and irrigation purposes, in addition to the deeper aquifers to assess for depressurisation impacts. Tiered assessment criteria would be developed for those units on the basis of 'no change' from baseline water pressure and water quality values. Further to this, site and facility specific monitoring may be required in targeted locations where the project may impact groundwater level or quality.

The groundwater component of the Water Monitoring Plan would include the collection of data to monitor:

- Bohena Creek managed release
- depressurisation impacts.

Collection and monitoring of groundwater pressure data would allow for a comparison of data against compliance limits where they have been established (e.g. in relation to a specific activity), and against other regional groundwater monitoring network data. Importantly, it allows for monitoring against the known timing and location of coal seam gas depressurisation activities to help determine project from non-project causes of groundwater pressure changes—if detected.

For transparency, Santos uploads key project water quality monitoring data onto a publically available portal located at: http://www.santoswaterportal.com.au/



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30.7 Auditing and compliance

30.7.1 Annual reporting

Environmental monitoring results provide quantified data that would be used in internal annual compliance checks, in addition to being provided to third parties for independent audits against approval conditions. The data would also be used to improve construction and operational management.

Ongoing regulatory arrangements would be established which would provide government with specific locations and indicative timing of well development activities in advance of them physically occurring. A Plan of Operations showing detailed locations for the proposed field infrastructure would be prepared on a regular basis and submitted to the NSW Department of Planning and Environment.

A Plan of Operations would be prepared for each project phase and would be submitted at least 28 days prior to the start of works. Updates would also be made to other regulatory licences that are required, such as the Petroleum Operations Plan and the EPL, to reflect the activities to be undertaken. Environmental monitoring data would be used to demonstrate to all key stakeholders that construction, operation, decommissioning and rehabilitation were proceeding consistent with predicted environmental impacts.

The proponent would be required to prepare and submit annual reports on compliance against its EPL and resource tenure. In addition, annual compliance checks would be undertaken to monitor performance against the Field Development Protocol, and an independent audit is proposed to be undertaken every three years, with a report on the audit findings to be provided to the NSW Department of Planning and Environment and Commonwealth Government Department of Environment and Energy.

On each anniversary of the commencement of the project, the proponent would review implementation to ensure activities were consistent with:

- the Protocol, management plans and procedures, and Plan of Operations
- conditions of the Commonwealth and State government approvals.

The proponent would identify non-compliance(s), analyse the causes of the non-compliance(s), and describe new measures to be implemented to ensure compliance in the future.

30.7.2 Third-party audit

Within three years of commencement of the project, and every three years thereafter, the proponent would facilitate a third-party environmental audit to ensure compliance with the following:

- implementation consistent with the Protocol and Plan of Operations
- conditions of the Commonwealth and State government approvals and relevant licences and plans
- management plans
- the annual compliance review obligations for the period.

The third-party auditor would be suitably qualified to conduct the audit. The audit report would be provided to the NSW Department of Planning and Environment and the Commonwealth Department of the Environment and Energy identifying non-compliance(s).

Further, and as noted above, Santos currently places key water monitoring data on its online water portal (www.santoswaterportal.com.au). Monitoring reporting would be aligned to the requirements set out within the EPL through the operational phase of the project.

Where monitoring and / or audits indicate that performance does not conform to environmental management requirements, or further improvement in performance standards is necessary, corrective action would be required. Investigation and corrective action procedures would be established to:

- determine the cause of non-conformance
- identify and implement corrective action
- initiate preventative actions
- apply controls to ensure that preventative actions are effective
- record changes in written procedure resulting from the corrective action.

Corrective actions would include management responsibilities for addressing, tracking and close-out of incident investigations, audits, inspections and monitoring programs.

In addition, emergency response procedures would be established including after-hours response, arrangements for containing environmental damage and attendance on site in the event of an emergency.