Corangamite Soil Health Strategy – discussion paper

Evaluating the public benefit from the soil health actions.

Background:

The mission of the Corangamite Catchment Authority (CCMA) is "*to ensure the protection and restoration of land and water resources, the sustainable development of natural resource-based industries and the conservation of our natural and cultural heritage*". To achieve this mission, the CCMA in consultation with the Corangamite community, developed its Regional Catchment Strategy (RCS) for 2003 to 2008. The RCS provides the strategy for the investment required to achieve the Corangamite community's and CCMA's vision for their catchment.

In practical terms, the goals of the RCS are delivered through a number of sub-strategies and action plans, developed for specific catchment management issues. One of these, the Corangamite Soil Health Strategy (CSHS) is currently being developed. The governing principles for the development of the CSHS are the goals of the RCS, viz:

- A healthy environment
- Sustainable economic use of natural resources
- A smaller footprint
- A planned landscape
- Cohesive, innovative communities
- Partnership between community and government

The CSHS will provide the detail, in the form of actions and targets (where applicable), to deliver some of the Resource Condition Targets (RCT) in the RCS, particularly in relation to soil threat, stated as "*Maintain and enhance soil condition for sustainable and productive landuse by 2020*". However, the CSHS is not limited to the targets set in the RCS and specific soil health targets and actions are being developed through the investigation of issues, priorities, management practices, and benefits and costs of implementing the strategy.

During the development of the CSHS in 2003, a series of actions were formulated though one or more workshops which brought together agricultural industry experts. The actions relating to agriculture were supplemented by others related to forestry, municipal planning, education and extension, monitoring and evaluation, and research. The resulting action list (Appendix A, Table 1) was included in the first draft of CSHS which was presented to the CCMA Sustainable Agriculture and Land Management Implementation Committee (SALMIC) for ratification. The actions also provided the data for an economic analysis (benefit – cost) which will be used to justify the adoption of the CSHS. In this initial economic analysis, the private benefit-cost was evaluated, but not the public benefit-cost.

In their review of the actions and economic analysis of the CSHS, the SALMIC were critical of the focus on private benefit, since the RCS is clearly aimed at investing in actions which have a clear public benefit. It was the opinion of the members of SALMIC that the CSHS would fail to attract annual investment through the Regional Catchment Investment Plan (RCIP) unless the public benefits were clearly equal to or greater than the private benefits.

This discussion paper aims at guiding the economic analysis towards the public benefits of the soil health actions.

Public benefit of soil health

The importance of soil health to society has probably been recognised since the emergence of agriculture. The value of soils as media for crop production has long been acknowledged, and their role in animal grazing and fodder production is also recognized. Farmers depend on healthy soil for their livelihood, and therefore have a direct economic incentive to ensure that soil health is sustained. Similarly, it is generally recognised that soil health is important to sustain urban parks and gardens, and considerable funds have been invested in soil health to maintain the value of privately owned assets.

Public investment in soil health in the Corangamite region commenced with the establishment of the Sludge Abatement Board in the early twentieth century. The board was established to regulate and police a single industry (mining) so that the impact of erosion and deposition on the health of waterways was minimised. With the establishment of the Soil Conservation Authority (SCA) in the late 1930s, public monies were invested in a broader range of soil health issues for public benefit. The authority was established in response to the obvious need to control soil erosion, which was having a dramatic impact on public assets, particularly waterways. However, by the early 1980's the SCA's activities had broadened to include a diverse range of soil health activities including land capability mapping, soil salinity research and statutory planning advice. With the rationalisation of public services in later years, the activities of the SCA were integrated into other government departments.

Water quality is still widely regarded as the most important indicator of catchment health, and the obvious public benefit of improved soil health is clean water. However, ecological research increasingly identifies the interrelatedness of all components of the environment. The result is that the public benefits of investment in soil health are extensive, and bounded only by our limited perception. They include such diverse benefits as habitat for species, sequestering carbon, water storage and filtration, and reducing the risk of loss of life (in the case of landslides). The extensive value of soil health questions the distinction between of private and public benefits, since it is apparent that all actions to improve soil health have some public benefit (even if we can't recognise it yet!).

So why shouldn't the CCMA invest in private benefit? It can be argued that even if an action has no demonstrable public benefit in the short term, perhaps in the longer term the benefit to catchment health will be obvious. For example, if the CCMA encourages the responsible use of lime to prevent soil acidification, the short term public benefit is not readily apparent, but the long term benefit is the sustained agriculture in the region, which has measurable social and economic well being for the region. This logic encourages the investment of public funds to assist landholders in their "duty of care" towards their soils, so as to discourage soil mining and other degradation practices. However, to assist landholders in their duty of care towards their environment for long-term public benefit, can be regarded as a subsidy for a practice that they should be undertaking anyhow (especially as it provides them with a financial gain).

Using public funds for investment in land stewardship is increasingly common. The Canadian Government's Agricultural Environmental Stewardship Initiative (AESI)[1] is an example where the focus is on maintaining soil health. However, most programs have a strong focus on the immediate public benefit, rather than the longer-term (probably because of their limited funding cycles).

Another component to the discussion on soil health actions is the balance between public benefit and public detriment. As an example, the adoption of bed farming, if not properly designed and managed can have a greater negative than positive effect on catchment health.

[1] http://www.agr.gc.ca/policy/environment/prog_01_e.phtml

Criteria for evaluating soil health actions

The criterion to evaluate each action in the Draft CSHS can be simply stated as follows:

Each action should be able to demonstrate a greater public benefit than public detriment over a short-term (5 –year) time frame.

The soil health actions can be assessed in a benefit – cost qualitative analysis, for example:

Action (in Draft CSHS, 2003): *Promote adoption of Bed Farming (raised beds or controlled traffic flat beds as appropriate) to reduce soil compaction and improve soil structure.*

In evaluating this action for the benefit-cost, the private benefits are clear, *viz:* greater economic return, more income to invest or spend, reduced waterlogging and improved soil structure on farm. The public benefits are less obvious and it can be argued that the public detriment may be greater if the design and construction of the raised beds was poor, *viz:* flash flooding, damage to road infrastructure, reduced environmental flows in waterways, increased runoff turbidity, and community disharmony.

From this elementary analysis of this soil health management action, it's clear that the public cost is far greater than the public benefit therefore the CCMA should not invest public funds in this action. Indeed, it should invest in making sure that raised beds are appropriately designed and constructed so that they have positive impacts on the natural environment, urban and rural infrastructure and community. The soil health action can then be reworded as:

Revised Action: *Promote the responsible adoption of bed farming (raised beds or controlled traffic flat beds as appropriate) to reduce soil compaction, improve soil structure, alleviate prolonged waterlogging, and minimise off-site effects. In particular, the potential for increased erosion, sediment export and nutrient export should be minimised.*

In rewriting the action, more emphasis is given to the public benefits, *viz:* reduced sediment and nutrient export to waterways and waterbodies, with resultant improvement of urban water quality (for example, Ballarat and Geelong) and ecological health of rivers and wetlands. Also included is the decreased risk of flash floods and consequent damage to public infrastructure (roads, bridges, culverts) and waterway health. Community harmony may be lessened, especially if the raised beds are constructed with regard to minimising runoff impacts on the neighbouring properties and community infrastructure.

To assist in the analysis of public benefit-cost, the CSHS 2003 actions have been redrafted and grouped into fewer industry-specific actions. They are presented in two tables. The first (Table 1) links the actions to their intended target group or sector and the issues that the action addresses. The second table (Table 2) outlines some of the public benefits that the action should achieve. Both tables are presented in the following pages.

Table 1. REVISED ACTION PROGRAM

New No	Action	Target group														Target Issue													
		Strategy Support	Monitoring and Evaluation	Education and Extension	Research and Development	Broadacre grazing	Cropping	Dairy	Productive forestry	Local Government	Lifestyle Properties	Urban	Industry and mining	Public land management		Water erosion	Wind erosion	Coastal dune movement	Mass wasting	Structure decline	Waterlogging	Salinity	Acid sulphate	Acidification	Nutrient excess	Contamination	Nutrient deficiency	Organic carbon decline	Biota decline
A	**The strategy – sustaining a "living document"**																												
A1	Maintain the CSHS Technical Group to evaluate the impact of implementing regional soil health strategy and provide direction and advice on investment in soil health actions in time for the annual funding cycle.	✓														✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A2	Using objective methods, evaluate the trends shown in the soil health monitoring and the progress towards meeting the RCTs on an annual basis with an aim of revising the CSHS within five years of its implementation (2011?).	✓	✓													✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B	**Monitoring and evaluating soil health in the Corangamite region**																												
B1	Establish and monitor a network of soil health reference sites in the major soil groups that can be used to collect benchmark data, provide monitoring sites, and establish RCTs. These sites may also be useful for education and extension, and should include the existing long-term sites monitored by PIRVic.		✓		✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B2	Monitor trends in best management practice for soil health across all industries (primary industries and municipal) and their adoption in known high risk areas. The monitoring should reflect the MATs and progress towards achieving the RCTs.		✓		✓																			✓	✓		✓		
C	**Soil health investigation, research and development**																												
C1	Research the possibility of using individual soil health parameters, or a combination of parameters, for setting RCTs across the range of soil/landform units in the CCMA, which is independent of land use.				✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
C2	Develop an objective process to prioritise soil health investment based on the protection of regional assets and public benefit. The process should include objective methods to map priority areas using a risk-based approach.				✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
C3	Research the potential to use resource condition indicators measured in other sub-strategies to the Regional Catchment Strategy as surrogate indicators for aspects of soil health.		✓		✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
C4	Develop soil health assessment tools, which are specific to the soils of particular farming systems, for use by agricultural industry groups. Soil performance indicators may be derived from this research to develop resource condition targets for both soil health and general catchment health.		✓	✓	✓	✓	✓	✓			✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
C5	Map the potential for Acid Sulphate Soils and assess the risk of their impact on regional assets. Municipal overlay				✓					✓				✓		✓							✓						
C6	Map the extent of soil degradation by all forms of erosion, mass-wasting, soil structure decline, waterlogging and salinity, at an appropriate scale for each issue within each soil/landform unit. Some issues (eg. Salinity) can be linked to other CCMA strategies.				✓											✓	✓	✓	✓										
C7	Investigate the potential impacts on soil health (both on-farm and off-farm) by changing from traditional grazing to cropping practices.		✓		✓	✓	✓				✓					✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓
C8	In partnership with current research programs into no-till practices, investigate alternative practices for stubble management to encourage stubble retention.				✓		✓									✓	✓			✓				✓			✓	✓	✓
D	**Soil health education program**																												
D1	Develop, promote and distribute soil health educational materials including brochures, web-based information, media releases and journal/magazine articles. This should include appropriate materials targeted to specific groups such as schools, universities, Landcare networks, primary producers, urban communities and recreational groups.	✓		✓	✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D2	Develop, promote and deliver technical short-courses and workshops across all industries (including municipalities) to inform participants of and encourage participants in best practice management of specific soil health issues (these should be accredited when appropriate). Examples include best practice soil health management of earthworks and road construction, design and installation of raised beds, remediation of gully and tunnel erosion, and disposal of animal effluent.			✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D3	Educate the program managers within the CCMA, DPI, DSE and water authorities about the national standards for landslide risk management and encourage them to adopt the standards for all on-ground works, actions and developments, both to protect regional assets and minimise their organisation's exposure to litigation. The uniform regional guidelines for erosion risk management should be included in the education program once they have been developed.			✓						✓				✓		✓	✓	✓	✓										
E	**Extending soil health to primary industries**																												
E1	Undertake a review of the current agricultural extension programs to include the RCTs, MATs and general principles of the Corangamite SHS where appropriate. Focus should be on encouraging the uptake of soil health actions to improve the public benefits associated with the strategy.			✓		✓	✓	✓			✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E2	Promote and implement best management practices to reduce nutrient and sediment export to waterways in all agricultural industries (grazing, cropping, dairying, intensive animal production, horticulture, viticulture, aquaculture, etc., etc.). In particular, encourage the use of optimum fertiliser and lime rates to match the production demand and avoid export of excess, long-term detrimental changes to soil health, and contamination of soils.			✓		✓		✓			✓					✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
E3	Encourage the appropriate application of lime and fertiliser in production systems to sustain or improve soil fertility and reduce long-term nutrient decline in the soil.			✓			✓																	✓	✓	✓	✓		✓
E4	Promote the fencing of different land classes to allow appropriate grazing and encourage graze and spell (rotation) based on understanding of plant and soil needs to sustain long-term soil health.			✓		✓					✓					✓	✓			✓	✓	✓			✓		✓	✓	✓
E5	Increase the establishment of perennial pastures, with a preference for direct drilling.			✓		✓					✓					✓	✓			✓	✓	✓		✓	✓			✓	✓
E6	Promote the responsible adoption of bed farming (raised beds or controlled traffic flat beds as appropriate) to reduce soil compaction, improve soil structure, alleviate prolonged waterlogging, and minimise off-site effects. In particular, the potential for increased erosion, sediment export and nutrient export should be minimised.			✓			✓													✓	✓	✓							
E7	Promote the adoption of minimal tillage and no-till practices to improve soil and catchment health.			✓			✓									✓	✓			✓				✓			✓	✓	✓
E8	Reduce adverse soil health impact of dairy farming on wet or waterlogged soils through improved management practices to reduce environmental impacts.			✓				✓								✓			✓	✓	✓	✓			✓			✓	✓
E9	Promote farm forestry plantations in areas that benefit soil and catchment health, and support the delivery of specialist technical advice in Farm Forestry to increase the implementation of best practices in site establishment and harvesting operations to sustain soil health and minimise off-site impacts.			✓												✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓
E10	Encourage the implementation of the Codes of Forest Practices for Timber Production from private plantations and farm forestry through all Shire Planning Schemes, and on public land. The intent is to sustain soil health and reduce the off-site impacts of forest management and timber harvesting.			✓					✓							✓	✓		✓	✓	✓	✓			✓	✓		✓	✓
E11	Promote the appropriate management of mining and quarrying sites to ensure that soil health is maintained, soil/nutrient loss and contamination threats are reduced.			✓									✓			✓	✓		✓			✓	✓			✓	✓		✓
F	**Extending soil health to urban and peri-urban populations, and secondary and tertiary industries**																												
F1	In partnership with municipalities, government agencies and community organisations, promote the appropriate design and management of urban parks and gardens (municipal, domestic and horticultural) to reduce urban wastes, nutrient export and contamination of waterways.			✓						✓		✓								✓					✓		✓	✓	✓
F2	In partnership with municipalities, government agencies and community organisations, promote the correct management and disposal of urban, peri-urban and industrial wastes to reduce the contamination of soils and waterways.			✓						✓		✓													✓	✓			
F3	In partnership with the EPA, identify contaminated soil sites so that they can be registered and correctly managed to minimise their impact on catchment assets.				✓					✓		✓	✓	✓												✓			
G	**Soil health incentives**																												
G1	Develop and implement a soil health 'Incentives Plan', based on the adoption of soil health assessment using existing environmental management systems and guidelines, and/or the development of neighbourhood group landscape plans in conjunction with other strategies.			✓		✓	✓	✓			✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
G2	Provide incentives to implement the national standards for landslide risk management and uniform regional standards for erosion risk management in the Erosion Management Overlays (EMO) of the regional municipal planning schemes (i.e. co-invest with municipalities).			✓						✓						✓	✓	✓	✓										
G3	Provide incentives to rehabilitate and stabilise active gully and tunnel erosion sites to reduce their impact on regional assets, particularly waterways (i.e. co-investment with landholders).			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓										
G4	Strategically establish trees to act as windbreaks to control wind erosion in high-risk areas. This should be adopted in conjunction with other sub-strategies to the RCS (eg. Salinity, Native Vegetation) or programs (eg. Greenhouse) to maximize multiple benefits.			✓		✓	✓	✓			✓		✓	✓			✓												

Table 2. EXAMPLE PUBLIC BENEFITS OF THE ACTIONS

	Action	Public benefit
A	**The strategy – sustaining a "living document"**	
A1	Maintain the CSHS Technical Group to evaluate the impact of implementing regional soil health strategy and provide direction and advice on investment in soil health actions in time for the annual funding cycle.	Capacity building of Corangamite community, CCMA staff & DPI staff. Strategic planning and management to maximise the benefits of the economic investment and minimise wastage.
A2	Using objective methods, evaluate the trends shown in the soil health monitoring and the progress towards meeting the RCTs on an annual basis with an aim of revising the CSHS within five years of its implementation (2011?).	Strategic planning and management of economic resources to maximise all public benefit returns. Improving the Corangamite region knowledge base and minimise duplication.
B	**Monitoring and evaluating soil health in the Corangamite region**	
B1	Establish and monitor a network of soil health reference sites in the major soil groups that can be used to collect benchmark data, provide monitoring sites, and establish RCTs. These sites may also be useful for education and extension, and should include the existing long-term sites monitored by PIRVic.	Improved knowledge base for all soil issues. Public education and capacity building. Developing the RCTs for the protection of all public assets.
B2	Monitor trends in best management practice for soil health across all industries (primary industries and municipal) and their adoption in known high risk areas. The monitoring should reflect the MATs and progress towards achieving the RCTs.	Improved knowledge base for all soil issues. Strategic planning and management to maximise the benefits of the economic investment and minimise wastage.
C	**Soil health investigation, research and development**	
C1	Research the possibility of using individual soil health parameters, or a combination of parameters, for setting RCTs across the range of soil/landform units in the CCMA, which is independent of land use.	Improved knowledge base for all soil issues. Strategic planning and management to maximise the benefits of the economic investment and minimise wastage. Developing the RCTs for the protection of all public assets.
C2	Develop an objective process to prioritise soil health investment based on the protection of regional assets and public benefit. The process should include objective methods to map priority areas using a risk-based approach.	Strategic planning and management to maximise the benefits of the economic investment and minimise wastage. Improving the Corangamite region knowledge base and minimise duplication.
C3	Research the potential to use resource condition indicators measured in other sub-strategies to the Regional Catchment Strategy as surrogate indicators for aspects of soil health.	Builds linkages across sub-strategies, efficiencies gained in monitoring costs and efforts by avoiding duplication of measurement.
C4	Develop soil health assessment tools, which are specific to the soils of particular farming systems, for use by agricultural industry groups. Soil performance indicators may be derived from this research to develop resource condition targets for both soil health and general catchment health.	Capacity building of Corangamite community, CCMA staff & DPI staff. Improved knowledge base for all soil issues. Early intervention to prevent soil health issues impacting on public assets (examples: nutrient excess contaminating waterways and groundwater, erosion causing turbid water and silting waterways, nutrient decline impacting on regional productivity and communities).
C5	Map the potential for Acid Sulphate Soils and assess the risk of their impact on regional assets. Municipal overlay	Strategic planning and management prevents damage to public assets through acid runoff (examples: damage to infrastructure such as roads, bridges and public buildings; killing aquatic plants and animals in waterways and water bodies; destruction of cultural heritage sites such as aboriginal middens).
C6	Map the extent of soil degradation by all forms of erosion, mass-wasting, soil structure decline, waterlogging and salinity, at an appropriate scale for each issue within each soil/landform unit. Some issues (eg. Salinity) can be linked to other CCMA strategies.	Strategic planning and management prevents damage to public assets through 1) erosion (examples: damage to infrastructure such as roads and bridges; contamination of water supplies; destruction of agricultural land productivity and consequent impact on a regional community), 2) landslides (examples: loss of life and damage to public infrastructure; closure of waterways by landslide dams), 3) soil structure decline (examples compaction creating more water runoff and reducing groundwater recharge; drainage of sodic soils creating erosion and sediment export), 4) waterlogging (examples: prolonged waterlogging of soils increasing groundwater recharge and salinity) and 5) salinity (refer to SAP for examples).
C7	Investigate the potential impacts on soil health (both on-farm and off-farm) by changing from traditional grazing to cropping practices.	Improved knowledge base for all soil issues. Early intervention to prevent soil health issues impacting on public assets (examples: sediment and nutrient export to waterways; long-term soil decline through acidity and nutrient loss impacting on the productivity and sustainability of regional communities).
C8	In partnership with current research programs into no-till practices, investigate alternative practices for stubble management to encourage stubble retention.	Capacity building of Corangamite agricultural industry, CCMA staff & DPI staff. Improved knowledge base for soil issues. Acting on the research outcome will reduce erosion (and sediment and nutrient export to waterways).
D	**Soil health education program**	
D1	Develop, promote and distribute soil health educational materials including brochures, web-based information, media releases and journal/magazine articles. This should include appropriate materials targeted to specific groups such as schools, universities, Landcare networks, primary producers, urban communities and recreational groups.	Public education and capacity building of Corangamite community, CCMA staff & DPI staff. Improved knowledge base for all soil issues.
D2	Develop, promote and deliver technical short-courses and workshops across all industries (including municipalities) to inform participants of and encourage participants in best practice management of specific soil health issues (these should be accredited when appropriate). Examples include best practice soil health management of earthworks and road construction, design and installation of raised beds, remediation of gully and tunnel erosion, and disposal of animal effluent.	Public education and capacity building of Corangamite community, CCMA staff & DPI staff. Improved knowledge base for all soil issues. Strategic planning, early intervention and improved management to prevent soil health issues impacting on public assets (examples: damage to infrastructure such as roads and bridges; contamination of water supplies; impact on biodiversity of wetlands).
D3	Educate the program managers within the CCMA, DPI, DSE and water authorities about the national standards for landslide risk management and encourage them to adopt the standards for all on-ground works, actions and developments, both to protect regional assets and minimise their organisation's exposure to litigation. The uniform regional guidelines for erosion risk management should be included in the education program once they have been developed.	Capacity building of Corangamite CMA staff, DSE staff, DPI staff and other public land managers. Improved knowledge base for erosion and landslide management. Early intervention to prevent erosion and mass-wasting impacting on public assets (examples: river sedimentation and/or blockage; erosion of coastlines, loss of life and damage to public infrastructure, costly litigation for public authorities).
E	**Extending soil health to primary industries**	
E1	Undertake a review of the current agricultural extension programs to include the RCTs, MATs and general principles of the Corangamite SHS where appropriate. Focus should be on encouraging the uptake of soil health actions to improve the public benefits associated with the strategy.	Education and capacity building of Corangamite agricultural community, CCMA staff & DPI staff. Improved knowledge base for all soil issues. Strategic planning, early intervention and improved management to prevent soil health issues impacting on public assets (examples: erosion impacts on rural roads, waterways and aboriginal heritage sites; sediment and nutrient impacts on water quality for urban supplies; soil degradation leading to infestations of pest plants and animals on public lands; contaminated soils impacting on urban water quality and ecological health of wetlands, carbon sequestration).
E2	Promote and implement best management practices to reduce nutrient and sediment export to waterways in all agricultural industries (grazing, cropping, dairying, intensive animal production, horticulture, viticulture, aquaculture, etc., etc.). In particular, encourage the use of optimum fertiliser and lime rates to match the production demand and avoid export of excess, long-term detrimental changes to soil health, and contamination of soils.	Reduced sediment and nutrient export to waterways and waterbodies, with resultant improvement of urban water quality (for example, Ballarat and Geelong) and ecological health of rivers and wetlands. Long-term sustainability of soil health on agricultural land (especially by maintaining appropriate nutrient and acidity levels) and the consequent sustainability of agricultural production and rural communities in the Corangamite region.
E3	Encourage the appropriate application of lime and fertiliser in production systems to sustain or improve soil fertility and reduce long-term nutrient decline in the soil.	Long-term sustainability of soil health on agricultural land (especially by maintaining appropriate nutrient and acidity levels) and the consequent sustainability of agricultural production and rural communities in the Corangamite region.
E4	Promote the fencing of different land classes to allow appropriate grazing and encourage graze and spell (rotation) based on understanding of plant and soil needs to sustain long-term soil health.	Reduced erosion leads to less sediment and nutrient export to waterways and water bodies.
E5	Increase the establishment of perennial pastures, with a preference for direct drilling.	Reduced wind erosion and water erosion resulting in reduced sedimentation of waterways.
E6	Promote the responsible adoption of bed farming (raised beds or controlled traffic flat beds as appropriate) to reduce soil compaction, improve soil structure, alleviate prolonged waterlogging, and minimise off-site effects. In particular, the potential for increased erosion, sediment export and nutrient export should be minimised.	Reduced sediment and nutrient export to waterways and waterbodies, with resultant improvement of water quality and ecological health of rivers and wetlands. Decreased risk of flash floods and consequent damage to public infrastructure (roads, bridges, culverts) and waterway health.
E7	Promote the adoption of minimal tillage and no-till practices to improve soil and catchment health.	Reduce sediment load to waterways and waterbodies; carbon sequestration.
E8	Reduce adverse soil health impact of dairy farming on wet or waterlogged soils through improved management practices to reduce environmental impacts.	Reduced sediment and nutrient export to waterways and waterbodies, with resultant improvement of ecological health of rivers and wetlands.
E9	Promote farm forestry plantations in areas that benefit soil and catchment health, and support the delivery of specialist technical advice in Farm Forestry to increase the implementation of best practices in site establishment and harvesting operations to sustain soil health and minimise off-site impacts.	Reduce wind erosion, water erosion, and small-scale landslides with consequence of less sediment export to waterways and damage to infrastructure (roads, culverts, etc.), less weed infestations; reduce groundwater recharge and mitigate salinity in target areas; reduce waterlogging and therefore nutrient export; long-term sustainability of rural communities. Education and capacity building of forestry and agricultural community, CCMA staff and DPI staff. Sequestering carbon.
E10	Encourage the implementation of the Codes of Forest Practices for Timber Production from private plantations and farm forestry through all Shire Planning Schemes, and on public land. The intent is to sustain soil health and reduce the off-site impacts of forest management and timber harvesting.	Reduce sediment load to waterways.
E11	Promote the appropriate management of mining and quarrying sites to ensure that soil health is maintained, soil/nutrient loss and contamination threats are reduced.	Reduce the impact of sediment load and nutrients to waterways and water bodies. Prevent contamination of groundwater resources. Strategic planning and management prevents damage to public assets (especially where public land is mined or quarried) by soil and water contamination (eg. heavy metals), erosion, infestations of pest plants and pest animals.
F	**Extending soil health to urban and peri-urban populations, and secondary and tertiary industries**	
F1	In partnership with municipalities, government agencies and community organisations, promote the appropriate design and management of urban parks and gardens (municipal, domestic and horticultural) to reduce urban wastes, nutrient export and contamination of waterways.	Community education and capacity building. Avoid contamination of public assets, especially waterways and water bodies, groundwater resources, and public land.
F2	In partnership with municipalities, government agencies and community organisations, promote the correct management and disposal of urban, peri-urban and industrial wastes to reduce the contamination of soils and waterways.	Community education and capacity building. Avoid contamination of public assets, especially waterways and water bodies, groundwater resources, and public land.
F3	In partnership with the EPA, identify contaminated soil sites so that they can be registered and correctly managed to minimise their impact on catchment assets.	Avoid contamination of public assets, especially waterways and water bodies, groundwater resources, and public land.
G	**Soil health incentives**	
G1	Develop and implement a soil health 'Incentives Plan', based on the adoption of soil health assessment using existing environmental management systems and guidelines, and/or the development of neighbourhood group landscape plans in conjunction with other strategies.	Community education and capacity building. Strategic planning and management to maximise the benefits of the economic investment and minimise wastage. Improving the Corangamite region knowledge base for all soil issues. Minimise duplication of effort and investment, gain by co-investment of private and public funds to protect community assets. Early intervention to prevent soil health issues impacting on public assets (refer to action C7 for examples).
G2	Provide incentives to implement the national standards for landslide risk management and uniform regional standards for erosion risk management in the Erosion Management Overlays (EMO) of the regional municipal planning schemes (i.e. co-invest with municipalities).	Protection of community assets (roads, bridges, culverts, water supply dams and reservoirs, waterways, wetlands, etc.); minimise loss of life; limit CCMA and local government exposure to costly litigation; protect long-term sustainability of regional communities; capacity building for local government staff.
G3	Provide incentives to rehabilitate and stabilise active gully and tunnel erosion sites to reduce their impact on regional assets, particularly waterways (i.e. co-investment with landholders).	Reduce sediment load to waterways and waterbodies; restoration of riparian ecologies; reduce incidence of pest plant and pest animal infestations and consequent impact on public assets; capacity building of Corangamite community; long-term sustainability of agricultural lands and rural communities.
G4	Strategically establish trees to act as windbreaks to control wind erosion in high-risk areas. This should be adopted in conjunction with other sub-strategies to the RCS (eg. Salinity, Native Vegetation) or programs (eg. Greenhouse) to maximize multiple benefits.	Intervention to prevent wind erosion impacting on public assets (examples: sedimentation of waterways and waterbodies; damage to public infrastructure). Sequester carbon.

Towards a more realistic benefit-cost analysis for the CSHS

The initial 2003 economic analysis[2] was based on the premise that the benefit of CSHS is the difference between the impacts on soil degradation with and without the CSHS. However, a major shortcoming in that analysis is acknowledged as follows:

It is vital to remember that a number of potential benefits could not be quantified. These relate to off-site benefits, such as, all the benefits associated with improved water quality, and all the imperfectly known off-site benefits associated with reduced soil acidity. Where these other benefits have been quantified, the attractiveness of the CSHS would be superior to that presented here.

The CCMA's Mission recognises the need to sustain the health of all soils (and not just agricultural soils) for public benefit. Since the term "public" refers to both the social and environmental communities of the Corangamite region, benefits and detriments should be evaluated in economic, social and environmental terms. In keeping with other RCS sub-strategies, the CSHS requires an Investment Plan which will[3]:

- Complete an evaluation of the costs and benefits to key stakeholders arising from the implementation of the CSHS;
- Conduct a sensitivity analysis to determine the stability of the results to changes in the data and key assumptions used;
- Determine, as far as time constraints permit, equitable and transparent cost sharing arrangements for plan activities;
- Set priorities for investment for the next 30 years; and
- Identify key deficiencies in the data available for analysis during future investigations.

It is critical to the success of the CSHS that both the private benefits and the public benefits be evaluated and used to set the investment priorities.

Peter Dahlhaus

21/2/2005

[2] "Economic analysis of the Corangamite Soil Health Strategy" URS & RMCG, 10th December 2003.
[3] These dot points are essentially the same as those stated in the Corangamite Salinity Action Plan

Appendix A Actions in the draft CSHS (2003)

7.4 ACTION PROGRAM

1. Support Action Program					
No.	**Action**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil Issues**
1.1	Develop, promote and distribute soil health educational materials including brochures, web-based information, media releases and journal/magazine articles.	2004 onwards	CS	CCMA, DPI, DSE, municipalities, educational institutions, community groups, industry-based groups.	All issues
1.2	Continue support for the Corangamite soil health technical group to continue development and review of the Soil Health Strategy.	2004 onwards		CCMA, DPI, research organisations, technical consultants	All issues
1.3	Establish and monitor a network of soil health reference sites in the major soil groups that can be used for benchmarking, monitoring, education and extension. These sites should include the existing long-term sites monitored by PIRVic.	2004 onwards	SAP	CCMA, Research organisations, DPI, DSE, municipalities, landholders	All issues
1.4	Develop a process to monitor and evaluate the impact of implementing the Corangamite Soil Health strategy on an annual basis, so that the strategy can be revised as appropriate.	2004 onwards		CCMA	All issues
1.5	Monitor trends in best management practice for soil health across all industries (agricultural and municipal) and their adoption in high risk areas, including soil testing conducted and quantity of soil additives purchased.	2004 onwards		DPI, DSE, CCMA, fertiliser industries, soil testing laboratories, research organisations	All issues
1.6	Research the possibility of setting a range of values for individual soil health parameters for the range of soil/landform units, which is independent of land use.	2004-2007	RCS SAP	Research organisations	Acidity, nutrients, organic carbon, biota
1.7	Regularly review and upgrade the Draft CSHS for the next 5 years and make appropriate changes.	2004-2009		CCMA, DPI, technical Consultants	All issues
1.8	Review and further develop a framework for prioritisation on an asset-based approach.	2004-2006	SAP	CCMA, DPI, technical Consultants	All issues
1.9	Further develop and review risk maps to help priorities where investment will be best spent.	2004-2005		CCMA, DPI, technical Consultants	All issues
1.10	Explore soil related issues for urban areas within the Catchment and develop appropriated actions.	2004-2005	SAP	CCMA, DPI, local government, technical consultants	All urban soil issues

2. Education and extension						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
2.1	Develop, deliver and promote a soil health resource kit for use in schools.	**M**	2010 onwards	CS	Education institutions, CCMA, DPI, research organisations, technical consultants	All issues
2.2	Develop, promote and deliver technical short-courses and workshops across all industries (including municipalities) to inform participants of and encourage participants in best practice management of specific soil health issues (these should be accredited when appropriate).	**VH**	2004 onwards	SAP	Education institutions, training organisations and consultants, DPI, research organisations, technical consultants	All issues
2.3	Develop and implement a soil health 'Incentives Plan', based on the adoption of soil health assessment using Environmental Best Management Practice (EBMP) guidelines, and/or the development of neighbourhood group landscape plans in conjunction with other strategies.	**VH**	2004 onwards		CCMA, DPI, Landcare networks, municipalities, industry-based groups, community groups, DSE.	All issues
2.4	Review current agricultural extension programs and include upgraded soil health management recommendations and strategies where appropriate.	**VH**	2004		DPI, dairy industry groups	All issues
3. Research, investigation and filling knowledge-gaps						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
3.1	Map the potential for Acid Sulphate Soils and assess the risk of their impact on regional assets.	**VH**	2005-2008	WHS	CCMA, municipalities, DSE, DPI, research organisations, coastal committees, Landcare networks	Acid sulphate soils, erosion, soil structure
3.2	At a scale of 1:10,000 or larger, identify and map waterlogged areas which are environmental assets as opposed to those which are part of productive systems.	**H**	2006 – 2008	BAP NVP SAP	CCMA, DSE, DPI, agricultural industry groups, Landcare networks, municipalities	Waterlogging, nutrients, soil structure, erosion
3.3	Map the extent of soil degradation by all forms of erosion, mass-wasting, soil structure decline, waterlogging and salinity, at an appropriate scale for each issue within each soil/landform unit. Some issues (eg. Salinity) can be linked to other CCMA strategies.	**VH**	2004 – 2010	WHS SAP	CCMA, research organisations, Landcare networks, community groups, municipalities, DSE.	Landslides erosion, waterlogging, soil structure, salinity

3.4	Develop procedures for risk assessment and management for all forms of erosion and landslides, based on national standards and which is applicable to municipal planning schemes, infrastructure asset managers and government agencies.	**VH**	2004 – 2007	WHS	CCMA, municipalities, DSE, asset managers, research organisations, technical consultants	Landslides, water, wind and coastal erosion
3.5	Develop soil health assessment tools, which are specific to the soils of particular farming systems, for use by agricultural industry groups. Soil performance indicators may be derived from this research to develop resource condition targets.	**VH**	2006 – 2010	RCS	Industry-based groups, technical consultants, research organisations, CCMA, DPI	All issues
3.6	Research the potential to use resource condition indicators measured in other sub-strategies to the Regional Catchment Strategy as surrogate indicators for aspects of soil health.	**H**	2004 – 2010	RCS WHS NMP SAP	CCMA, research organisations	All issues
3.7	Investigate the potential impacts on soil health that may be caused by changing from traditional grazing to cropping practices.	**VH**	2004-2010	WHS BAP NVP	CCMA, DPI, Industry groups.	All Agriculture issues
4. Broadacre grazing						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
4.1	Encourage graze and spell (rotation) based on understanding of plant and soil needs.	**H**	2004-onward	SAP	DPI, technical consultants, Industry Groups, community.	Erosion, acidity, soil structure, waterlogging, nutrients, organic carbon, biota
4.2	Promote appropriate rate/type of nutrients/lime to match grazing demand.	**M**	2005-onward	NMP	DPI, Fertilizer Companies, technical consultants, community	Acidity, soil structure, nutrients
4.3	Promote the fencing of different land classes to allow appropriate grazing.	**H**	2004-onward	SAP	DPI, contractors, community	All agriculture related issues
4.4	Strategically establish trees to act as windbreaks to control wind erosion.	**M**	2004-onward	NVP BAP	CCMA, DPI Greening Australia, seed companies, nurseries, Landcare, community	Wind erosion, biota
4.5	Increase the establishment of perennial pastures, with a preference for direct drilling.	**H**	2004-onward		DPI, seed companies, contractors, technical consultants.	All agriculture related issues

5. Cropping						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
5.1	Promote adoption of Bed Farming (raised beds or controlled traffic flat beds as appropriate) to reduce soil compaction and improve soil structure.	**M**	2004-onward		DPI, Southern Farming Systems (SFS)	Waterlogging, compaction
5.2	Encourage appropriate lime and fertiliser application regimes to improve soil fertility and production, and reduce nutrient loss from paddocks.	**M**	2004-onward	NMP	DPI, Fertilizer companies, SFS	Acidity, structure, nutrients
5.3	Investigate alternative practices for stubble management to encourage stubble retention.	**M**	2005-2010		Research organisations, DPI, GRDC, SFS	Structure, organic carbon
5.4	Promote the adoption of minimal tillage and no-till practices.	**M**	2004-onward		Technical consultants, contractors, DPI, GRDC, SFS	Structure, organic carbon
5.5	Support research into no-till practices.	**M**	2005-2010		Technical consultants, contractors, DPI, GRDC, SFS	Structure, organic carbon
6. Dairy						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
6.1	Encourage optimum chemical composition of dairy soils, including optimum fertiliser rates to avoid excess nutrients and liming acidic soils.	**H**	Ongoing	NMP	DPI, dairy industry groups, agricultural consultants	Nutrients, acidity, biota
6.2	Reduce adverse soil health impact of dairy farming on wet or waterlogged soils through improved management practices to reduce environmental impacts.	**H**	Ongoing	NMP SAP	DPI, dairy industry groups, agricultural consultants	Waterlogging, soil structure, erosion, biota
6.3	Promote and implement best management practices to reduce nutrient and sediment export to waterways.	**H**	Ongoing	WHS NMP	DPI, dairy industry groups, agricultural consultants	Nutrients, erosion, biota
7. Productive & Farm forestry						
No.	**Action**	**Priority**	**Time**	**Strategy Links**	**Implementation stakeholders**	**Soil issues**
7.1	Support the implementation of the Codes of Forest Practices for Timber Production for private plantations and farm forestry through all Shire Planning Schemes and on public land.	**VH**	2004-onward	NVP	Local Government, DPI, contractors, plantation companies, community	Erosion, waterlogging, nutrient, organic carbon, biota
7.2	Increase awareness and skills on road design, maintenance and construction to reduce sediments and nutrients entering waterways.	**VH**	2004-onward	NMP	Local Government, DPI, contractors, plantation companies	Erosion, nutrients

7.3	Promote farm forestry plantations in areas that benefit soil and catchment health.	**M**	2004 – onward	SAP NVP	DPI, contractors, Landcare Groups, community	Erosion, landslides, organic carbon, salinity, biota
7.4	Support the delivery of specialist technical advice in Farm Forestry to increase the implementation of best practices in site establishment and harvesting operations.	**M**	2004-onwards		CCMA, DPI, local government, plantation companies, contractors, community.	Erosion, waterlogging, nutrients, organic carbon, biota
8. Local government / government agencies						
No.	**Action**	**Priority**	**Time**	**Strategy Links**		**Soil issues**
8.1	Encourage the implementation of uniform national standards for landslide risk management and erosion risk management in the Erosion Management Overlays (EMO) of the municipal planning schemes throughout the CCMA region.	**VH**	2005 – onward		CCMA, DSE, municipalities, technical consultants, DPI	Landslides, water erosion, wind erosion, coastal erosion
8.2	Actively encourage the CCMA, DPI, DSE and the regional infrastructure asset managers to adopt uniform national standards and procedures for the management of landslide risk and erosion risk in all their on-ground works, actions and developments, both to protect regional assets and minimise their exposure to litigation.	**VH**	2005-onward		CCMA, DPI, DSE, asset managers, municipalities, technical consultants	Landslides, water erosion, wind erosion, coastal erosion

Look up reference list for Priority Issues & Strategy Link columns.

Priority Issues		**Strategy Links**			
M	Medium	RCS	Regional Catchment Strategy	RAP	Rabbit Action Plan
H	High	WHS	Waterway Health Strategy	WAP	Weed Action Plan
VH	Very High	SAP	Salinity Action Plan	NVP	Native Vegetation Plan
		NMP	Nutrient Management Pan	LS	Landcare Strategy
		BAP	Biodiversity Action Plan	CS	Communication Strategy