Healthy Country

managing the land for healthy waterways

Benchmarking current management practices

Lockyer, Bremer and Albert-Logan catchments

July 2009

SEQ Catchments

HEALTHY WATERWAYS

Queensland Government

SEQTOA

Benchmarking current management practices

Lockyer, Bremer and Logan-Albert Catchments

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Queensland Primary Industries and Fisheries

FarmFLOW
growth through good practice

An initiative of the Healthy Country Project supported by SEQ Waterways, SEQ Catchments, Queensland Primary Industries and Fisheries and the South East Queensland Traditional Owners Alliance to improve water quality in SEQ's catchments and Moreton Bay.

On 26 March 2009, the Department of Primary Industries and Fisheries was amalgamated with other government departments to form the Department of Employment, Economic Development and Innovation.

This publication has been compiled by Julie O'Halloran, Ian McConnel and Marie Vitelli of the Integrated Regional Planning group, Primary Industries and Fisheries as part of the FarmFLOW project for sustainable land management. FarmFLOW is an initiative of the Healthy Country Project supported by Queensland Primary Industries and Fisheries to improve water quality in SEQ's catchments and Moreton Bay.

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Introduction

A key deliverable through the Healthy Country project is a 30% improvement in the adoption of best management practices (BMPs) specifically related to soil and water management. These practices have the potential to improve productivity and profitability and minimise the potential contribution of sediment and nutrients to downstream waterways. However, in order to assess the impact of this project on the adoption of best management practices, an understanding of current management practices is required.

This report includes a preliminary benchmark of producers within the target catchments to provide an understanding of the current agricultural management practices, particularly those related to soil and water (Appendix 1 and 2). This information is necessary to ensure project officers have a thorough understanding of the catchment and the production systems within the region. The report also provides feedback on what producers see as the key issues and major constraints to the sustainability of their businesses. Also contained in this report is information on the social networks of agricultural industries within the catchment (Appendix 3).

Initial results indicate that best management practices associated with soil, water and land management have been implemented to varying degrees by producers within these catchments. There are a variety of motivators and factors influencing landholder management decisions and in nearly all cases producers identified that they would be implementing a range of best management practices if not for various barriers to adoption, the key one being available funds to implement the changes.

This report was compiled as part of the '*Healthy Country: managing the land for healthy waterways*' program. Healthy Country is a partnership between the Queensland Government, South-East Queensland Catchments (SEQC) and the Healthy Waterways Partnership with collaboration with SEQ Traditional Owners Alliance (SEQTOA).

Best practice for erosion and sediment control

The SEQ Healthy Waterways Partnership has listed Best Management Practices (BMP's) relevant to sediment and nutrient management in the priority catchments (Table 1). This list is not inclusive of all management practices that could be implemented by landholders to contribute to minimising sediment and nutrient movement off farm.

Table 1. Effectiveness of sediment and nutrient BMPs.

BMP	Effectiveness
Cross banks	• 65-94% sediment trapped in sign areas
Buffer strips	• 90% sediment removed • 50% phosphorus removed
Road runoff management	• 37% medium to coarse sediment trapped/10m dispersive pathways • <5% fine particles trapped in filter strips adjacent to roads
Riparian buffers	• 48-98% sediment removed • 10-88% phosphorus removed • 56-91% nitrogen removed
Conservation tillage	• 71-98% suspended solids removed
Diversion banks and grassed waterways	• 70 ± 20% phosphorus removed • 95% solids removed • 50 ± 20% nitrogen removed
Contour banks	• 5-12% nutrient removed

Source: South East Queensland Healthy Waterways Partnership 2008

Extensive studies in the Queensland rangelands have demonstrated that best practice management for grazing lands has a positive impact on pasture composition and ground cover. However it may take many years to show the impact on these grazing practices on hillslope erosion and losses of sediment and nutrient at the catchment scale (Post ***et al***, 2006).

Improving or maintaining land condition involves three grazing land management strategies:

1. Conservative utilisation rates of native pasture (in most cases, <30%)
2. Seasonal spelling (especially wet season spelling) to assist recovery of patches of pasture in poor (C) condition. Land that is highly degraded (D Condition) is beyond natural recovery. Costly mechanical or chemical intervention is needed for the land to recover to A condition. Land in C condition will usually recover naturally when allowed to rest and requires minimal mechanical or chemical intervention to return to A condition intervention. Land that is in B condition is able to naturally recover quickly with adequate spelling and/or weed management. Land in B condition is able to return to A condition without mechanical or chemical intervention. Land in A condition displays a number of desirable plant species, very little erosion and is highly productive. The cost to rehabilitate land from D Condition to good (A) or fair (B) condition is approximately the market value of the land.
3. Retaining adequate dry season cover and biomass levels to protect the soil surface, slow run off and provide litter necessary for improved infiltration and nutrient cycling. In tussock grass pastures, the aim should be 70% ground cover and 1000kg/ha dry matter at the end of the dry season (Post ***et al***, 2006).

Additional best landscape management principles have also been developed for sub-coastal eastern Australia, especially the grassy woodland ecosystems. These include:

1. Maintaining riparian buffers and managing stock access to watercourses.
2. Retain viable stands of native vegetation on major land types.
3. Protect vegetation on potential recharge areas where salinity hazards exist.

A senior DPI&F extension officer in SEQ has prepared a draft of grazing land best management practices for South East Queensland (Appendix 4). These practices need to ratified by graziers and other key beef industry stakeholders for endorsement and feedback.

Grazing system: benchmarking current practices

Lockyer

The number of producers benchmarked to date (n=7) may not be representative of the total grazier population within the catchment. The intent is to continue benchmarking additional landholders each year and update this report. The main grazing land use is beef cattle and horses.

The majority of grazing landholders interviewed under the current Healthy Country FarmFLOW project have off-farm income and the average size of a semi-commercial grazing property is 385 ha (980 acres). Most are breeding herds in the Lockyer Catchment, with a few targeting the weaner and bullock markets. Many utilise native forest practice and farm forestry as a source of long-term funds.

Grazing management practices

Maintaining grass cover / pasture utilisation rates

Widely accepted and adopted cattle grazing best management practices by Lockyer Catchment graziers include maintaining grass cover and land condition. Very few graziers understand or refer to the term 'percentage (%) utilisation rates', however they manage their grazing regimes to retain pasture cover. Pasture utilisation ranges from conservative graziers utilising less than 20%, to heavy graziers that utilise more than 50% and have degraded pastures. Degraded pastures in the Lockyer Valley commonly have signs of erosion and a high percentage of non preferred grasses such as couch. The motivations and attitudes of graziers in this spectrum vary from "*runoff into dams is limited and the water is clear*" to "*prefers couch dominance because it gives quick green pick after rain*". Many horse owners continuously graze and have limited ground cover.

Pasture spelling / rotational grazing/ wet season spelling

The interviewed graziers all undertake rotational grazing. Spelling paddocks and riparian areas is becoming more widely implemented. Spelling is mainly achieved through subdivisional fencing or provision of sufficient off-stream waterpoints to adjust grazing pressure and move stock around.

Location of infrastructure, watering points and tracks

Use of watering points to control grazing pressure and rotate pastures is common practice in the Lockyer. Additional dams and stock waterpoints help to spread grazing pressure. The recent five year drought provided an opportunity for many graziers to desilt dams and increase their on farm water storage capacity.

Training needs

The Lockyer Catchment has had previously limited grazing extension services. Grazing extension packages such as Meat and Livestock Australia (MLA) Edge Grazing Land Management and DPI&F Stocktake have not been previously conducted in the Lockyer Catchment.

Training design for grazing landholders on rural lifestyle blocks needs to consider that these people are often well-educated, frequently use web sites, are more transient and primary sources of income may be 'off-farm'. Due to off-farm work commitments of many of the rural lifestyle landholders training times may need to be considered.

Bremer

To date eighteen (18) landholders in the Bremer Catchment have been engaged to gain an understanding of grazing practices. The intention is to continue liaising with grazing landholders throughout the project period to update this benchmarking.

Grazing management practices

Commercial and semi-commercial producers often manage stock access to their frontage country by a variety of methods. Rotational grazing and wet season spelling is adopted by landholders with sub-divisional fencing. The most common method is the provision of additional waterpoints (dams, tanks and troughs) throughout the paddock.

Methods of improving grazing eveness include patch burning and sowing legumes such as Wynn cassia into the higher well-drained forested country. Cattle are naturally attracted to the protein-rich legumes when in full pod. Also the warmer eastern slopes attract cattle to graze the slopes of the forested country during the cooler winter months. Other graziers spell their paddocks between selling their consignment of fattened bullocks or weaners and restocking for the next cycle. Continuous grazing is the common practice on peri urban properties.

Erosion management (gullies, hillslope, etc)

The Walloon scrub and Marburg sodic soils are particularly prone to erosion, including tunnel erosion. There is approximately 1000 hectares of gully affected sodic soils in the Bremer and Warrill sub-catchments (Thompson, 2008) These areas of erosion are often associated with the gum topped box and sodic soils at the base of slopes. Contour banks have been and are still commonly used throughout the catchment to slowdown runoff and reduce erosion (Steentsma, 2008).

"*In the last 5-10 years, landholders have put a lot of money into correcting the mistakes of the last generation. Landholders cannot afford to keep injecting funds like this*" (Thompson, 2008).

Poorly vegetated streambanks in the upper and mid catchments are prone to slumping and severe erosion. Bamboo and giant reed have been planted along the banks of some stretches of the mid Warrill, with limited success in managing erosion. One surveyed landholder has invested over $70 000 in stream bank works to minimise the loss of his alluvial cropping land valued at $10 000/ac.

Revegetation

The Ipswich City Council, Bremer Catchment Association and other project partners have invested in substantial gully erosion work and revegetation of the swamp tea tree (***M. irbyana***) communities in the Purga Nature Reserve. Some of the adjoining areas to the reserve are grazed and the landholders are also involved in the swamp tea tree revegetation projects. SEQ Catchments along with interested landholders, have conducted strategic riverbank revegetation projects across the Bremer Catchment.

Native forest practice

Native forest practice is common in the region due to the predominance of freehold land and the value of hardwood timber. Native forest practice is a sustainable, long term source of diversified income. Some landholders have planted spotted gum (***Corymbia citriodora***) and tallowwood (***Eucalyptus. microcorys***) in their cleared country as a long term native forest plantation. Many producers including Ternouth (2008) have also had success with plantations of grey gum (***E. longistrata***).

Training needs

These are some of the training needs that have emerged from discussions with landholders in the Bremer catchment.

- Understanding the interaction of fire, grazing and pasture composition / biodiversity.
- Use of GPS and computer mapping for property management, including managing giant rats tail grass.
- Pasture identification booklet relevant to SE Qld OR a book such as 'Productive plants of the Scenic Rim for extensive areas' (information on native forest trees and pasture species).
- Paddock walks by Damien O'Sullivan (DPIF) for pasture and legume identification.
- The use of NIRS (near infra red spectroscopy) as a management tool.
- Opportunities for graziers with climate change and for carbon trading.

Edge Grazing Land Management training courses were conducted in the region in 2007/08 through Boonah Landcare. While these training packages received good feedback, two dairy farmers and three graziers who have previously completed a range of training packages such as Edge Grazing Land Management, have indicated they are '***workshopped out***' and are very time poor.

Their current training needs relate to very specific areas of information. Interviewed dairy farmers did not know of any other dairy farmers that had time to commit to the QDO Dairying Better-N-Better program.

The Upper Bremer landholders and adjoining National Park have recently developed a unified Fire Management Plan for minimising the risk of wild fires and coordinating strategic responses to fires. This management tool will help continue selective burning of the southern speargrass dominant pastures and conduct controlled burns of the National Park. A large proportion of commercial graziers use fire to manage speargrass dominant pastures, control weeds and woody regrowth. Intensity and frequency of fires varies according to purpose and land type. Appendix 5 summarises the main fire strategies used in the upper Bremer Catchment (Thompson, 2007). Pasture composition can be managed through fire frequency and seasonality.

Photo: Grazing of riparian areas

Source: Marie Vitelli

Photo: Grazing in Bremer catchment.

Source: Marie Vitelli

Logan-Albert

Various beef cattle graziers and dairy farmers have focused on improving soil health on their properties. Producers have sourced organic matter such as composted chicken manure and used 'Naturmin' rock dust and incorporated this organic matter into their soils. Others have trialled the use of soil biological amendments.

Genetics also has a role in improved grazing management. There are a number of beef cattle studs in the Logan Albert Catchment. Local studs such as Rathburn Farms, Knapps Creek use feed conversion and growth criteria for selecting breeding stock.

The Beaudesert region hosts an extensive equine industry with many large horse complexes.

Grazing management practices

Rotational grazing and spelling frontage country

Many dairy farmers and other producers control grazing in their riparian zone to manage weeds, reduce fuel loads for fire management and keep the area 'open and accessible'. Dairy farmers prefer a mix of pasture and grasses along the riparian zone and generally consider the width of the tree line should extend to a width equal to the stream width or to the top of the first bank (Chataway ***et al***, 2006).

Rotational grazing allows all grasses to recover. Alternatively, areas can be continuously grazed, as long as the stocking rate is less than the carrying capacity. Many graziers are aware of the benefits of rotational grazing and have implemented some rotational / pasture rest systems.

Erosion management (gullies, hillslope, etc)

A field study of erosion sites in 2007 found that 63% of 38 sites had less than 30% ground cover (Thompson, 2007). The most common land uses with low ground cover were dairy day paddocks and horse paddocks. The sandy and low fertile Marburg sandstones in the Knapps – Cannon Creek catchments never had more than 40% ground cover, independent of land use (Thompson, 2007). Post ***et al*** (2006) found that the rate of infiltration and soil loss are severely affected when mean ground cover drops below the 40% threshold.

Sodic duplex soils, often associated with the Marburg sandstones and Walloon Forests are particularly prone to gully and tunnel erosion. In 2007, 75% of sites across the Walloon Forest landscapes were moderately eroded (Thompson, 2007)

Thompson's (2007) field study also revealed more than 50% of areas affected by sheet (hillslope) erosion at 53% of inspected sites and 42% of sites had active land slips. A factor contributing to this erosion potential was the previous four years of below average rainfall.

Areas with limited erosion included the basalt and Scrub Walloons of the upper Logan, Palen Creek, Running Creek areas and sections of the Heifer Creek sandstone (Thompson, 2007).

Native forest practice

Some freehold properties with remnant vegetation are using native forest practice.

Training needs

The Scenic Rim Regional Council is committed to expanding the 'Horse Management on Small Properties' workshops and include information on specific topics. Sub actions include developing a relevant workshop series in stream bank and gully erosion control, track building, fire management and pasture improvement for rural properties.

Thompson (2007) identified the need for fact sheets on pasture quality and pasture improvement for landholders grazing cattle and horses. Priority soils requiring this local information are the Walloon soils, basalt soils and the Heifer Creek and Marburg sandstones.

Cropping system: benchmarking current practices

A benchmarking framework was developed to be used in informal discussions with producers to assess the current level of adoption of best management practices in cropping systems (See Appendix 2). The framework was limited to those farm management practices that may impact on sediment and nutrient movement. The benchmarking process was carried out one on one in informal (semi-structured interviews) discussions. The information reported here represents an initial sample of producers from within the Lockyer and Bremer Catchments and this information will be built on in the future.

Photo: Bare field waiting for planting.

Source: Julie O'Halloran

Photo: Harvest traffic damage.

Source: Steve Harper

Table 2. Benchmarking results of current on farm best management practices of horticultural operations in the Lockyer and Bremer Catchments.

	Lockyer Catchment	Bremer Catchment
General information	In the Lockyer Catchment six producers had been surveyed at the time of writing this report. The benchmarking process has been limited by the timeframe since commencement of the project and also timing of work activities within the production system. During the benchmarking timeframe producers were very time poor due to production commitments with planting and harvest. Within the farm enterprises that were discussed farm sizes ranged from 120-900 acres. The majority were around 200 acres. Farm enterprises surveyed so far have all been family farm operations. A wide range of crops are grown by participants including: ▪ baby beets ▪ processed and fresh beetroot ▪ lettuce ▪ sweet corn ▪ broccoli ▪ mungbeans ▪ sorghum ▪ barley ▪ wheat ▪ lucerne ▪ maize ▪ cauliflower ▪ potatoes ▪ celery ▪ green beans ▪ shallots ▪ onions ▪ silverbeet ▪ pumpkins ▪ watermelon ▪ capsicum ▪ carrots ▪ soybeans The grazing component of participants operations, if they had any, was more rural lifestyle rather than commercial production.	In the Bremer catchment only a few producers had been surveyed at the time of completing this report. Within the farm enterprises that were discussed farm sizes ranged from 150 to 1000 acres. A wide range of crops are grown by participants including: ▪ potatoes ▪ green beans ▪ beetroot ▪ lucerne ▪ sweet corn ▪ carrots ▪ mungbeans ▪ onions ▪ pumpkins ▪ adzuki beans ▪ soybeans ▪ lettuce ▪ wheat ▪ sorghum ▪ millet
Rotations	Results indicated that 50% of those surveyed to date have made changes to their rotation due to limited water. This encompassed a change in crop type (e.g. changing from more intensive vegetable crops to grain crops) and/or reducing the number of crops per year. In terms of cropping intensity, 50% of those surveyed produce 1.5 crops per year and 50% 3 crops per year. The benchmarking revealed that $/ML return and the ML/ha used have been the key deciding factors in crop choice.	On average participants generally have a cropping intensity of 1.5 crops per year. Some areas are double cropped while others areas tend to be 3 crops over two years. Some areas are under a long term rotation with lucerne. Cropping rotation varies depending on the crops produced in the farming system.
Cover crops	Approximately 66% of producers surveyed to date try to regularly incorporate cover crops or opportunity crop to ensure that fields are not bare fallowed. Cover crops or opportunity crops tend to be forage/hay or grain crops such as barley, wheat, sorghum. Opportunity crop choice is dependent on the season and markets. Producers are increasingly looking at legume crops to include in their rotation for nitrogen benefits. Legume options of respondents include cowpeas, mungbeans, soybeans. Responses from participants indicate that cover crops are incorporated into the rotation for various reasons including improving organic matter content, reducing soil/sediment loss, improved nutrition, soil structure and yield. *"bale once then let grow back and chop into the ground to get some organic matter back into ground"*	One participant regularly incorporates cover crops/green manure crops such as lab lab or lupins for adding organic matter to the soil. Opportunity cropping is also common to maximise returns. Opportunity crops tend to be grain crops. Cropping rotation is market price dependent and participants have made the decision to plough crops in when market prices are not sufficient to make it financially worthwhile to harvest. *"use green manure crops ... to build up organic matter"*

Photo: Lab-lab grown as green manure crop.

Source: Julie O'Halloran

Photo: Sorghum cover crop.

Source: Julie O'Halloran

	Lockyer Catchment	Bremer Catchment
Nutrition	Nutrition management decisions are based on a range of factors including soil tests, crop/field history, yield, crop removal, soil capability, known soil limitations and deficiencies.	
Soil tests	17% of participants do not soil test. The decision to do soil tests tends to be based on individual crops (e.g. those that don't generally soil test may do so for high input/return crops). 33% of participants soil test irregularly or to assist in identifying a problem. 50% soil test regularly e.g. each year across representative fields. Only 33% of participants consider soil tests in making fertiliser rate decisions.	All participants regularly undertake soil tests. Fertiliser rates are based on numerous factors including soil tests, replacement rates and a little extra, the crop, experience, soil type. One participant had reduced his fertiliser use through the implementation of minimum tillage. Soil testing may be based around a specific crop ie at a specific part in the rotation.
Plant tissue testing	50% of those surveyed to date do plant tissue tests to assist in monitoring/checking their fertiliser program. This is not the same 50% that soil test. So some growers that don't soil test will plant tissue test and vice versa.	The use of tissue testing varied between participants with some using in some crops, others have used in the past while for others it is something that they may consider in the future. Those who have used tissue tests had issues in terms of the turnaround time and implementing any necessary action.
Fertiliser use	50% of growers surveyed to date have been involved in trialling composts as soil ameliorants or additives to fertiliser programs. 50% of participants have reduced their fertiliser application recently (e.g. in the last 1-2 years). Reductions in fertilisers have been estimated to be between 40-120kg/acre. Often this is also associated with water savings or some other change to the farming system such as minimising tillage. All of those surveyed to date are applying fertiliser up front as well as in crop by side dressing and fertigation. The primary nutrients applied by all growers in the survey include N, P, K and micro-nutrients and trace elements. All growers recognised the importance of micro-nutrients and trace elements in their production. The exact nutrients applied are dependent on the crop being grown.	The primary nutrients applied by all growers in the survey include N, P, K and micro-nutrients and trace elements. All growers recognised the importance of micro-nutrients and trace elements in their production. The exact nutrients applied are dependent on the crop being grown. *"biggest change to come [in nutrition] is the cost of fertiliser"* *"once it [fertiliser] becomes as expensive as it is you sort of look and say maybe I can get away with 1 bag instead of 2 bags"*

Photo: Fertigation equipment.

Source: Julie O'Halloran

	Lockyer Catchment	Bremer Catchment
Soil structure	Soil structure has been identified as an issue by 66% of surveyed producers. Soil structure concerns are mainly associated with compaction. Results indicated that 50% of participants had made some changes to their tillage practices to try to reduce their tillage impacts on soil structure.	
Tillage practices	66% have reduced the number of tillage operations in some aspect of their farming system. 33% have implemented reduced tillage practices in their horticultural production system. 33% are trying to implement controlled traffic farming in some form. 33% have implemented GPS. Other motivations for this change include minimising energy costs as well as other perceived benefits such as machinery wear and tear, healthier plants from reduced insect and disease impacts from good soil structure. Loss of productive soil through erosion was also seen as an issue by 50% participants. *"if I could get the soil back to better than original.. that is my goal"* *"GPS reduced our cultivation by, probably at least 50%"*	One participant has implemented controlled traffic farming in his grain cropping system. This has been to minimise erosion and compaction and improve soil structure. Controlled traffic farming and minimum tillage is more difficult in horticultural production systems due to intensity of cropping, trash, disease, seed bed preparation etc. One participant incorporates green manure cropping into his system to add organic matter to improve the soil. They have also trialled composts which also assist in improving soil structure. *"stage where these products probably weren't as widely used because of the rates you have to use.. price of fertiliser the way it is now.. fertiliser costs are past the cost of compost products"*
Erosion and sediment control	All growers surveyed have dams to capture on farm runoff. This is to maximise water availability but these dams would also act as a sediment trap for any sediment moving off fields or other areas of the farm. Other practices being implemented by those surveyed to minimise soil movement include: ▪ Reducing tillage practices ▪ Cover crops and opportunity cropping ▪ Keeping drains grassed ▪ Construction of sediment ponds to capture sediment before it moves off farm ▪ Field design to increase infiltration and reduce runoff. ▪ Irrigation practice to minimise leaching and runoff ▪ Deeper rooted crops on country with greater slopes. ▪ Crop choice matched to field – e.g. doesn't grow crops that require more intensive tillage practices on country with greater slopes.	The majority of participants have dams to capture runoff on farm. This is to maximise water availability but these dams would also act as a sediment trap for any sediment moving off fields or other areas of the farm. Participants doubted that there was much opportunity to lose a lot of sediment due to the cropping intensity which means that there is either a crop in the ground or a lot of trash. However, it was recognised that at some stages in the system there is potential for soil losses due to erosion ie storm events during field preparation but this would be dependent on crop, particularly carrots and onions. One participant has implemented controlled traffic farming and minimum tillage in his grain cropping system. There was interest in controlled traffic farming and minimum tillage by some of the horticultural growers, however, the system does not necessarily lend itself easily to these farming practices. Other limitation to implementing these systems is the equipment available and contract farming. Smaller growers who contract farm for larger growers often use their equipment and therefore are subject to a planting program to ensure continuous supply and growers are forced into planting when too wet. *"I came here with bloody good ideas on how we were going to minimum till, zero till but it just hasn't worked how I hoped it would have"* *"great potential but its the sort of thing that if it was that easy then it would be done"*

Photo: Series of sediment ponds on vegetable farm.

Source: Julie O'Halloran

Photo: Erosion evident in horticultural field.

Source: Julie O'Halloran

	Lockyer Catchment	Bremer Catchment
Irrigation	The growers surveyed to date had a range of irrigation systems, often within the one farming enterprise. 66% of participants use solid set irrigation 50% of participants use linear boom irrigators 16% of participants use lateral move and centre pivot irrigators 50% of participants use trickle irrigation Of those surveyed, 66% participants have been involved in the Growcom 'Water for Profit' Program (WfP). This involvement has included monitoring of system efficiencies and distribution uniformities, optimising scheduling for Water Use Efficiency and monitoring on-farm storage efficiencies in terms of seepage and evaporation. All those who participated in Growcom WfP believe that they have improved water savings from this involvement. Of those surveyed, 50% participants had made changes in their irrigation scheduling as a result of this involvement with Growcom. These changes generally involved reducing the frequency and/or duration of irrigation. Irrigation scheduling is carried out by participants according to crop stage, appearance, weather, tensiometer and C-probe information. Of those surveyed 33% use C-probes. Another 33% have used them in the past but no longer do for various reasons. Calculations of water use by participants rely on meters on sprinkler systems and t-tape delivery capacity. Most participants do not have a measure of their WUE.	A range of irrigation systems are used by participants including linear move irrigators, lateral booms, solid set irrigation and hand shift pipes. The majority of participants have looked into alternative irrigation systems for efficiency gains but had been unable to make any changes primarily due to the cost of these systems. None of the growers surveyed so far use trickle irrigation. Water scheduling is assisted by the use of C-probes and tensiometers. In some cases participants ceased use of irrigation scheduling equipment during the drought as limited water meant that their irrigation schedule was already stretched. One participant has found the C-probe to be invaluable in gaining confidence in water use after reducing water volumes per irrigation and stretching irrigations by a couple of days based on the data provided by the C-probe. *"confidence with which to schedule waters [using the probe]…I don't know how I would have done that [matched irrigation to plant needs] before"* The majority of participants so far have been involved in the Growcom 'Water for Profit' program involving on farm assessments of irrigation systems, scheduling and or water storages. Participants in this program have a better understanding of where losses from their system are occurring.
Salinity/ Sodicity	Water quality tests have been carried out and participants are aware where they have water quality issues. Of those surveyed 50% of participants have water of suitable quality. Management practices are put in place where saline water is an issue. Where water quality is poor, participants shandy the poorer quality water with better quality water captured from on farm runoff. Alternatively they will try not to use the poorer quality water at all and rely on captured farm runoff for irrigation. One grower has converted one of his irrigated farms back to dryland cropping to avoid using poor quality irrigation water. All participants were aware of the quality of their water and potential impact on productivity and land degradation. Soil tests when done, generally include a measure of salinity.	Water quality tests have been carried out and participants are aware where they have water quality issues.

Photo: Lateral move and solid set irrigation.

Source: Julie O'Halloran

Photo: Solid set irrigation.

Source: Julie O'Halloran

Issue analysis

Grazing

Lockyer

Grazing land condition issues include, erosion, soil condition, pasture renovation, weeds, managing timber regrowth, conserving forested areas in Helidon Hills, managing and adapting to climate change.

Bremer

Issues include weeds, managing giant rats tail grass, improving pasture condition, soil condition, hard wearing grasses for horse paddocks, erosion, fire management for pasture composition and managing regrowth.

Logan-Albert

A report on previous landholder interviews across the Logan catchment indicated issues associated with riparian zones included the farmer's rights within the stream bed and banks and weed management (Chataway ***et al***, 2006). The weeds of most concern were cats claw creeper (*Macfadyena ungis-catii*) and chinese celtis (*Celtis sinensis*). Lack of rights include concerns over activities such as vegetation removal, the threat of compulsory fencing and complete exclusion of cattle from the riparian zone. These concerns can be summed up from a quote from the Logan Catchment, '*Once they would have paid you to keep the watercourse free. Now they are likely to charge you if you remove anything from it*' (Chataway ***et al***, 2006).

Wildfires at the wrong time of year can be an issue. Although annual cool fires are used extensively to control rank spear grass, pasture condition can be jeopardised by the inappropriate intensity and timing of wildfires.

For horseowners, issues are managing laminitis in horses caused by the ingestion of pastures too high in carbohydrates. Horseowners prefer hard-wearing 2P grasses rather than some of the productive 3P grasses (eg. panic grasses). Grasses such as setaria and pangola grass which are high in oxalates can cause bighead in horses. Preferred pastures include native pastures, Rhodes grass, creeping blue grass and digit grass.

Giant rats tail grass (GRT) infestations throughout the catchment pose a major problem. The productivity of many areas is threatened. As a landholder from the extensively eroded Knapps Creek catchment said, 'Erosion is not the main issue here, giant rats tail grass is the biggest threat.' Effective GRT management across sodic soils is an issue since these areas should not be deep ripped.

Cropping

Major issues impacting on the sustainability of businesses and the areas for greatest potential gain in their production system were also discussed as part of the benchmarking of current management practices undertaken with horticultural and cropping producers in the Lockyer and Bremer Catchments.

The information obtained from surveyed producers regarding key issues that have been identified to be impacting on the sustainability of their businesses can be separated into two levels; those impacting on the sustainability of their individual production system and those impacting on the industry as a whole and agriculture in general.

Production sustainability

- Water availability was identified as the key issue impacting on the sustainability of their production system by 77% of participants (Lockyer and Bremer).
- Soil management issues were raised by all participants as a key issue and encompassed a range of different factors including soil health, structure, nutrition, minimising tillage and bio and organic potential. A key aim of 66% of participants is to leave the soil in a better condition than when they started farming it.
- Land use intensity and the waste of resources used to produce crop that is not destined for sale due to lack of markets was also an issue.
- Markets, prices, turnover and market access (buyer for product) were also key issues identified by participants.
- Carbon trading and how that will be implemented in terms of farming practices and what that will mean for producers has also been identified as an issue for the sustainability of their enterprises. There is not enough information on carbon value per tonne and what it will be worth.
- The availability of funds to make changes on farm necessary for improved sustainability was also seen as a key issue impacting on the ability of growers to remain sustainable and implement best management practices.
- Multi-use of water by the community will be key for continued horticultural production in dry times.

Agricultural sustainability

Feedback from surveyed growers also identified issues that are impacting on the sustainability of agriculture in terms of natural resource management. The issues communicated include:

- Natural resource management is increasingly becoming the responsibility of the farmer, however, in many cases the producers do not have the necessary skills or funds to invest in

natural resource management on behalf of the wider community.
- Consultation processes with industry are often seen as token gestures. Policy is often developed without realistic or practical advice regarding what is achievable on farm.

Potential gains in the production system

Areas identified by surveyed producers with the greatest potential for gains in the production system include:

- Net profit – the need to minimise inputs as production is ultimately about net profit rather than the highest yield.
- More efficient use of water – reducing losses from the system.
- Labour – labour costs are a high cost of production and reducing labour costs would help achieve reduced inputs and therefore increase net profit.
- Getting the crop mix or rotation right
- Improving yields

"can't pass on the costs" [of making improvements to management]

"water is the big one.. anything to do with water both quantity and quality but mainly quantity as you just can't grow anything without it.. not the kind of crops that you grow anyway"

"compaction is a really massive problem…you've got to see a carrot paddock after its been harvested, its just the most appalling thing you've ever seen.. running semi trailers in paddock with 30 tonne every 3 rows.. it doesn't matter whether its dry or wet"

Barriers and motivators for change

Grazing systems

Lockyer

Diverse income, lack of financial resources, lack of rural equipment and limited rural land knowledge can reduce the likelihood that peri-urban landholders and small farms can implement conservative land management and water quality practices (South East Queensland Healthy Waterways Partnership 2008).

Peri-urban landholders without equipment and rural knowledge may need to contract employment and equipment for tasks such as building fences, pasture ripping, planting trees, etc. It is not known if the 'barter day' model would be effective amongst certain neighbourhoods of peri-urban landholders and adjoining grazing landholders.

Landholders that are mainly motivated by social and financial goals tend to look more for external motivators such as incentives to implement conservation practices (Greiner ***et al***, 2008).

Bremer

Activities requiring additional labour can be an issue. It is very difficult to source good labour in the area (Thompson, 2008; Purcell, 2008). Contract musterers can generally be sourced and often there are substantial waiting lists. Many of the smaller properties, especially the peri-urban blocks do not have necessary equipment to improve land condition. Most do not have tractors, tynes, fencing equipment, etc (Ternouth, 2008). Profit is not a driver or motivator for land management by peri-urban landowners (MacLeod and Kearney, 2007).

Logan-Albert

Lack of available funds and time are the two main barriers to implementing better management. Unfavourable season conditions, including drought are also constraints or barriers.

The SEQ Healthy Waterways Strategy 2007-2012 (SEQ Healthy Waterways Partnership 2007) has identified that community capacity has been restricted in this catchment due to no NRM investment in the area prior to 1997. Access to and availability of skilled, experienced NRM professionals has been limited and there has been a lack of government funding support for the Logan Albert River Catchment Association. Lack of qualified extension personnel was also identified as a barrier by Chataway ***et al*** (2006).

A lack of extension services and no central point for information and assistance has impeded the build up of skills and activities in the catchment. Like other northern Queensland catchments, landholders require information emanating from credible scientific research for decision making.

In the lower parts of the floodplains, the recurring cost of fencing repair and rehabilitation costs after flooding are a deterrent for infrastructure and other on-ground works in the riparian zone (Chataway ***et al***, 2006).

Cropping systems

Feedback from horticultural and cropping producers in the Lockyer and Bremer Catchments regarding the factors that they perceived were barriers to the adoption of new practices or technologies include:

- Lack of funding to make necessary changes (e.g. changing machinery or irrigation system). Many changeovers in technology/machinery are very expensive and hard to do without subsidisation or initiatives to assist producers. Many growers are under pressure to make changes or want to make improvements to management but cannot afford to.
- Prioritisation of needs to spend available funds on
- Attitude to risk – the mind set of the individual grower.
- Risk/cost of trying something new. Implementing new practices or technologies can take time and resources to fit into system. Tighter and tighter margins mean that growers are increasingly unable to wear the potential costs of lost production while finetuning a new practice or technology to their production system.
- Fear of the unknown.
- Scarcity of water – has made growers even less likely to change practices as they really have to make what they have work to remain viable. Limited water availability has reduced their willingness to risk not gaining the full benefits of the water they have.
- Need local results to demonstrate benefits.
- Cultural change of growers and farm labour - can be hesitant to change their ways of doing something.

"…now that water is so scarce its probably even harder for people to change their ways

because fearful, that only have enough to water 20 acres rather than 60 acres,

so really need to make this work"

Social analysis

The population of the Lockyer catchment was estimated to be 33,300 in the Year 2000 (Abal et al, 2002) and increasing. An understanding of the social and industry networks available to producers in the region will be able to assist in carrying out the Healthy Country Program. Social networks analysis will identify potential sources of engagement with landholders as well as pathways for delivery (Appendix 4).

Grazing systems

In the peri-urban and grazing sector, Lockyer Valley Landcare Group, West Moreton Landcare Group, ABC (Atkinson/Buaraba Creek Catchment) Landcare Group and Helidon Hills-Murphys Creek Landcare Group are active networks.

The horse owners have extensive equine networks through Tania MacDonald, Janice Holstein, Withcott Produce, Jane Myers Equiculture, Mark Freemantle, Cam MacDonald –Withcott Equestrian Centre and Zone 3 Pony Clubs. The website lists contact details for the Gatton, Harrisville, hattonvale, Laidley, Lowood/Fernvale, Withcott and Wivenhoe Pony Clubs (see http://www.pcaq.asn.au/Secretary's%20Listing.htm). In addition to pony clubs, there are other horse sport enthusiasts in the area such as polocrosse, campdrafting etc.

Active networks in the Bremer catchment include the Bremer Catchment Association, Boonah Landcare, Mihi Creek Catchment Care Group. The West Moreton Landcare Group covers a section of the Bremer and Lockyer catchments. There is limited neighbourhood interaction between many of the peri-urban landholders. This poses a challenge to activities such as pest management, riparian health and landscape connectivity which are best managed across sub-catchments rather than cadastral property boundaries. Engagement with peri-urban landholders requires traditional and innovative communication approaches (MacLeod and Kearney, 2007).

Rural groups in the Logan-Albert catchment include Beaudesert Landcare, Canungra Progress Association (CUDDA), Rural Fire Brigades, Beaudesert AgForce Branch.

Cropping systems

Industry and social networks for horticulture and cropping within the region are currently very limited.

The Lockyer Valley Alliance (LVA) has previously been very active but the membership of this group has diminished significantly over recent times. The executive of the LVA are currently trying to rejuvenate this industry group. At the 2008 Annual General Meeting the LVA made the commitment to provide direction and feedback to the DPI&F component of the Healthy Country Program. There is potential for the DPI&F component of the Healthy Country Program to assist in rejuvenating the LVA where possible.

The Lockyer Valley Water Users Forum is currently the most active horticultural industry network within the Lockyer Catchment. This group is currently focused on negotiating and working with State and Federal Governments to develop co-management of water resources in the Lockyer Valley between government and irrigators. This group is also involved in a project discussing the potential use and distribution of recycled water for irrigation with State and federal Governments. There is potential to utilise the networks of this group where appropriate.

There is also potential to use the network of beetroot growers within the region. The Lockyer Valley produces the majority of processing beetroot for Golden Circle. Golden Circle has in the past held meetings with their growers.

Other informal groups that could potentially be utilised include contract growers for the larger horticultural companies such as Mulgowie Farming Company in the Lockyer and Kalfresh in the Bremer. This network has not been utilised in the past as a group. The potential to use these informal networks of growers and the willingness of the larger horticultural companies has to be investigated further.

The Lockyer and Bremer Healthy Country Local Steering Committees are also other groups that have industry representation and will be providing feedback and direction to officers within the Healthy Country Program.

This is not a comprehensive list of networks or industry groups within the regions.

"to be sustainable you need decent turnover, decent profits that's the first thing.... the second thing is minimising as much as possible any sort of environmental impact without hurting number one"

"to slowly improve everything to get everything as efficient as can be with the smallest amount of environmental harm possible"

Sources of information

Grazing systems

Amongst commercial and some semi-commercial graziers, the biannual 'Beeftalk' DPI&F beef industry newsletter is well read and many graziers keep back copies for future reference. SEQ Catchments has an email distribution list for rural landholders and other stakeholders in the Lockyer Catchment.

It is not clearly understood where rural-lifestylers / peri-urban residents with grazing animals source their information about grazing land management. The Land Management Best Practices Implementation Plan for the Lockyer Catchment (SEQ Healthy Waterways Partnership 2008), Biosecurity Qld and Meat Livestock Australia have all noted the challenge in communicating with the peri-urban sector, especially relating to knowledge and skills in animal health and welfare, land and pest management.

A 'Living in Lockyer' booklet aimed at providing information to new rural landholders is currently being revised by SEQ Catchments and the Lockyer Valley Landcare Group before being reprinted and circulated to new landholders through the Lockyer Valley Regional Council.

Cropping systems

There is a range of written and online information sources available to horticultural and cropping producers. These include Growcom factsheets, DPI&F publications, Horticulture Australia publications, other agricultural state government publications, the 'Good Fruit and Vegetables' Magazine, the Graingrower Magazine, Conservation Farmers publications.

Contacts that can also be good sources of information for producers include DPI&F staff, Growcom staff, SEQ Catchments staff, agronomy consultants, chemical resellers, chemical, fertiliser and seed company representatives.

Feedback from horticultural and cropping producers in the Lockyer and Bremer catchments identified that they source information from the following:

- Growcom literature
- new product literature
- local and regional papers
- internet
- industry magazines
- DPI&F
- agribusiness salespeople
- experience
- other growers
- NRW

Photo: Industry publications available to horticulture producers.

Source: Julie O'Halloran

- SEQC does not have grower networks and there is concern regarding how information/works may potentially be used against them in the future
- Growcom was identified as a source of information by some but was also not a preference for other growers

The majority of those surveyed prefer to receive information by mail and email.

"Growers today are much more knowledgeable than in the past – Agronomists have done a lot of capacity building when extension officers were cut back. Many growers know where to source information themselves today".

General media

Table 3. Contact details of local newspapers in the Catchments.

Lockyer Catchment	Contact
Gatton Star (published on Wednesday, 80 cents)	45 North St, Gatton, QLD Ph 5462 2266 Fax 5462 2491 Email: editor@gattonstar.com.au Editor: Adam Byatt
Withcott Times (monthly – available online) Relevant to Withcott / Murphys Creek/ Helidon Hills area	www.withcotttimes.com.au Ph 0417 303 582 Fax 4637 4023 Email: withcotttimes@bigpond.com Editor: Janice Holstein
Fassifern Guardian (published on Wednesday, 90 cents)	7 Church St, Boonah QLD Ph 5463 1888 Fax 5463 1039 Email: bnc@gil.com.au
QT – Queensland Times (published daily, $1.00) 'QT Country' supplement in Thursday's edition.	260 Brisbane St, (PO Box 260), West Ipswich QLD 4305 Ph 3817 1704 Fax 3817 1736 Email: qt@qt.com.au Editor: Natalie Gauld
Beaudesert Times (published Wed, 60 cents) 'On the Land' feature Scenic Rim Regional Council also has a regular column titled 'Council Comment'	PO Box 99, Beaudesert, QLD 4285 Fax: 5541 3213 / 5541 1388 Email: edit@beaudeserttimes.com.au Editor: Doug Brammall

The Queensland Country Life rural newspaper is also another source of information for agricultural producers.

Other

The Lockyer Valley Regional Council has a useful website with relevant information and an events calendar (website: http://www.lockyervalley.qld.gov.au/HOME/tabid/36/Default.aspx). The Council Environment Officer is a useful and informed local contact for DPI&F and SEQ Catchments project staff.

For the rural sector of the Bremer catchment, the Scenic Rim Regional Council has a useful website with relevant information and an events calendar (website: http://www.boonah.qld.gov.au/newsEvents/calendar2008.shtml). Deputy Mayor and Councillor David Cockburn is very helpful and involved in one of the local steering committees for the Healthy Country project. The Ipswich City Council administers the city of Ipswich with approximately 150 000 people and 43% of South East Queensland's industrial estate (Website: http://www.ipswich.qld.gov.au/index.php).

A recent survey from the Australian Bureau of Statistics shows an average of 44% of homes across Boonah Shire have internet access, with the majority being dial-up.

For the rural sector of the Logan-Albert catchment, the Scenic Rim Regional Council has a useful website with relevant information and an events calendar (website: http://www.scenicrim.qld.gov.au/newsEvents/annualEvents.shtml).

References

Abal, E.G., Moore, K.B., Gibbes B.R. and Dennison, W.C. (eds) 2002 State of South East Queensland Waterways Report 2001. Moreton Bay Waterways and Catchment Partnership.

Chataway, R., Miller, J. and Orr,W. (2006). 'Establishing a way forward for the management of riparian zones on Queensland dairy farms'. In the Australasia Pacific Extension Network (APEN) Proceedings of the Natural Resource Management Extension Symposium, eds TWG Graham, J James, G Leach and A Moore, Toowoomba, Queensland, Australia, January 2006. ***Internet***: http://www.regional.org.au/au/apen/2005/4/2805_chatawayr.htm

Greiner,R., Miller, O and Patterson, L. (2008). The role of grazier motivations and risk attitudes in the adoption of grazing best management practices. In Proceedings of the 52nd Annual Conference of the Australian Agricultural and Resource Economics Society, Canberra. 5-8 Feb., 2008.

MacLeod, N.D and Kearney, F.C. (2007). Ag-SIP project AG14, Adoption of sustainable landscape design practices on small holdings. Final Report. CSIRO Sustainable Ecosystems, St Lucia, Queensland. ***Internet***: http://www.csiro.au/files/files/pjoy.pdf

Post, D.A., Bartley, R., Corfield, J., Nelson, B., Kinsey-Henderson, A., Hawdon, A., Gordon, I., Abbott, B., Berthelsen, S., Hodgen, M., Keen, R., Kemei, J., Vleeshouwer, J., MacLeod, N., and Webb, M. (2006). 'Sustainable grazing for a healthy Burdekin Catchment'. CSIRO Land and Water Science Report 62/06. ***Internet***:http//www.clw.csiro.au/publications/science/2006/sr62-06.pdf

Purcell, M. (2008). ***Personal communication.*** Landholder

South East Queensland Healthy Waterways Partnership (2008). Land Management Best Practices Implementation Plan Lockyer Creek Catchment ***Internet: http://www.healthy waterways.org/***

South East Queensland Healthy Waterways Partnership (2007). South East Queensland Healthy Waterways Strategy 2007-2012. ***Internet:*** http://www.healthywaterways.org/strategy_pdfs.html

Steentsma, W. (2008). ***Personal communication.***

Ternouth, J. (2008). ***Personal communication.*** Landholder

Thompson, B. (2008). ***Personal communication.*** Landholder

Thompson, B. (2007). Collation of fire strategies used in the Rosevale Tarome area in the upper Bremer Catchment. Working Document.

Appendix 1: Issues analysis and benchmarking best management practices (grazing lands)

Lockyer, Bremer and Albert –Logan Catchments

General information

Property size, type of enterprise [grazing - cattle, breeding/fattening/other - horses, sheep, other]

Issue analysis

What are the top 3 issues that you are concerned about impacting on the sustainability of your business / grazing land?

Why are they important?

Are you doing anything to address them? What factors constrain your actions (eg. time, labour, financial resources, knowledge, uncertainty)? Do you have sufficient resources to address them? What would you like to do? What would you need?

Do you know of any catchment scale issues that may impact on the sustainability of your business?

Eg. Water quality, vegetation management, variable climate, erosion/sediment loss

Have you been involved in any property management planning or farming systems management programs?

Do you use a property map for planning (eg infrastructure) and management decisions?

Information sources

What are the most important sources of information for property management decisions? Please list which newspaper, radio station, etc?

Newspapers	Industry newsletters	Landcare or NRM Group
Radio station	Other landowners	Field days
Websites	Government agencies	Other

Property Management Practices (PMP)

Which of these have been implemented on your property?

Spelling paddocks regularly (rotational, wet season, etc)	Fencing to exclude stock from vulnerable / important natural waterholes
Adjust stock numbers to pasture condition	Pest management
Regular pasture condition and stock monitoring	Manage tree grass balance (eg. with fire, herbicides, competitive pasture, other)
Manage grazing on frontage country to minimise erosion (eg fencing, controlled grazing)	Native Forest Practice
Pasture management (eg. sown pasture, ripping)	Maintain vegetation/wildlife corridors
Other	

Pasture condition

What are the most productive pastures on your property?

Can you estimate your average ground cover at the end of the dry season? (<30%, 30-50%, 50-70%, >70%)

What proportion of the property has been sown to improved pastures?

What proportion of your property has non-productive pastures such as wire grass, blady grass, and giant rats tail grass?

Erosion and sediment control

What is your overall soil condition [stable, compaction and crusting, scalds]?

Do you have areas affected by erosion or where there is a risk of sediment loss?

What management options do you use to minimise compaction, erosion or sediment loss?

Riparian (frontage country) management

Do you have frontage country or riparian areas such as lakes, swamps, rivers, large creeks?

What proportion of watercourses on your property are open to cattle all year round?

What proportion of riparian areas are fenced to control stock grazing pressure?

How would you rate the health of your riparian areas?

Pasture / native trees and shrubs / weeds / water quality [good, fair, poor]

Productive or lifestyle property

What % of your income is from property activities (eg grazing livestock) and what % is off-property income?

Training and knowledge needs

What land management topics would you like more information about?

Are there any land management training programs you are interested in?

What is your postcode?

Thank you for your valued time in completing these survey questions.

Appendix 2: Benchmarking best management practices (cropping land)

Cropping production systems

Purpose of this meeting

- Benchmark the current land management practices
- Identify opportunities in the farming system – with a focus on water and nitrogen as critical inputs and outputs of the production system
- Identify potential opportunities for trial/demonstration/monitoring site collaborators

Background to project

Healthy Country project through Healthy Waterways. The project is focused on working with growers to identify opportunities to make gains in the production system while minimising downstream impacts. The project will involve on farm trials and demonstrations in the areas of soil and water best management practices. This is also an opportunity to highlight to the wider community the land management practices growers are putting in place.

General information ▪ Crops grown ▪ Farm size ▪ area cultivated ▪ grazing	
Issue analysis ▪ What are the top 3 issues that you are concerned about impacting on the sustainability of your business? ▪ Sustainability in terms of this project: best management practices that have production gains but also minimise impacts downstream. ▪ Why are they important? ▪ Are you doing anything to address them? Do you have sufficient resources to address them? What would you like to do? What would you need? ▪ Do you know of any catchment scale issues that may impact on the sustainability of your business? This may not be catchment but sub catchment or just broader than the farm scale. Eg floodplain/overland flow management, water reform, salinity sodicity, erosion/sediment loss ▪ Where/in what areas do you see the greatest potential for gains in your production system? What do you need to unlock these gains? ▪ Have you been involved in any property management planning or farming systems management programs? Why or why not?	
Rotations ▪ What is your standard cropping cycle/rotation? What are your reasons for growing those crops? Eg sorghum could be to utilise N reserves. ▪ Do you incorporate cover crops,, break crops, legume rotation into your production cycle? ▪ Do you consider N added to the soil from the legume rotation when making nutrition management decisions?	
Cover crops ▪ What do you see as the benefits of cover crops? Why include them? ▪ What does the process of including them involve ie when do you plant etc? How often? ▪ What are the factors that determine your ability to incorporate cover crops in your system? ▪ What would you need to consider incorporating them? Why wouldn't you incorporate them into your production system?	
Nutrition ▪ What do you consider when making your nutrition management decisions? ▪ Prompts: soil testing, tissue testing, yield removal/crop uptake, field/rotation history ▪ Do you soil test/tissue test? How often? Which part of cropping cycle? ▪ If using soil and tissue testing do you use it to make fertiliser management decisions? ▪ What nutrients do you apply? ▪ What methods/timing of nutrient application do you use? ▪ Do you keep records of your nutrition program? ▪ Do you monitor any other aspects of soil health? ▪ Do you know if you are losing any nutrients by leaching through the profile? If they don't know, is this something that they are concerned about?	

Erosion and sediment control ▪ Do you have any areas on farm that are affected by erosion or where there is a risk of sediment loss? ▪ Need an understanding of farm topography as well as water movement. ▪ Where would you go to get advice on managing erosion related issues? ▪ Do you have any management options in place to minimise erosion or sediment loss? ▪ Prompts: field design to account for slopes and susceptible soils, filter strips/sediment traps / maintained grassed headlands, storm water management plan/ overland flow/ runoff management and treatment in treatment wetlands, CTF and min till	
Irrigation ▪ What type/s of irrigation system do you have on your farm? ▪ Where people have made a change in their system – why did they make the change? ▪ If have not made a change, why not? ▪ How do you determine irrigation requirements of your crops? Ie schedule ▪ Eg crop stage, soil moisture, weather ▪ Do you monitor water use and/or do any calculations of water use efficiency?? Simplest measure for vege growers will be on a ML/ha basis per crop. Obviously this will depend on the crop. ▪ Have you done any monitoring of your system efficiency? ▪ Have you put in place any management practices to improve water use efficiency? ▪ Do you know whether or not you are losing any water through the profile into groundwater? ▪ Do you keep any records on irrigation? ▪ Has irrigation water been assessed to determine any contribution to land degradation issues? ▪ Do your irrigation practices account for salinity/sodicity risks? Eg shandying, leaching fraction	
Soil Structure ▪ Do you have any issues with soil structure? Eg compaction, sodicity ▪ What strategies/actions do you have in place to improve or maintain soil structure?	
Salinity/Sodicity ▪ Are water or soil tests used to determine salinity/sodicity risks? ▪ Do you have any management strategies in place to manage salinity/sodicity risks?	

Appendix 3: Social survey and social network analysis

Project: Healthy Waterways Non-urban Rural Diffuse Project

Sub-project: DPI&F FarmFLow: '*growth through good practice'*

Survey locations: Locker / Bremer (Marie Vitelli / Julie O'Halloran)

Logan / Albert (Marie Vitelli / Julie O'Halloran)

Pumicestone (Zane Nicholls)

Middle Mary (Gympie PMSI – Adam Logan)

Target survey audience

Grazing:

- beef (commercial and rural lifestyle)
- boutique sheep (alpacas, Llamas etc)
- dairy
- horse (commercial and rural lifestyle).

Horticulture operations:

- beetroot
- lettuce
- sweet-corn
- potatoes
- beans
- brassicas
- carrots
- forage cropping
- production nurseries. (n.b. social survey of Pumicestone commodities such as strawberry, turf, pineapples, chicken meat, nursery has already been undertaken).

Social survey methodology

1. Pre-survey information gathering
2. Survey delivery: One-on-One discussion with producer / manager (typically coupled with farm walk to commence benchmarking of farm practices).
3. Follow-up discussion as determined by extension officer / producer.
4. Recording and reporting of information

Survey areas of interest

Some idea of:

age

work experience

education

Social network analysis:

a. Which business-related formal groups do you belong to (if any)?

What is your level of involvement in these? 1. minimal, 2. regular involvement, 3. leadership role

b. Who, or which organisations, do you talk to most about business-related issues? (*This may depend on the type of issue – list issues as they emerge and ascribe a value to each*).

c. Are you involved in any social / community / groups. If so, which ones?

d. How would you rate your level of involvement with these groups?

1. very involved, 2. reasonably involved, 3. not much involved *(if not already mentioned producers can be asked or shown a number of relevant groups / organisations and attitude towards group / organisation scored on Lickert type scale*.)

e. What are some barriers / motivators to adoption of farm practices?

f. Is the commodity produced your main source of income for the farm?

g. Who is the decision maker in the business – owner / manager? Which others are involved in the decision making process? What factors can impact on who is involved in the decision making process? Eg size of decision, level of risk

Do you know of any other growers in the area who are trying something a bit different in terms of management on their farm???

Information sources

a. Where or who do you source information from on farm practices/ technology?
(*extension officer may prompt from list if necessary*).

Other growers, agronomists, sales reps, Growcom, QDPI

Other what are they?

b. Where or who do you source information on NRM related issues? (*extension officer may prompt from list if necessary*).

NRW, SEQC, Catchment associations, Landcare

c. How do you prefer to obtain information on farm management? (e.g. *field days, workshops, one-on-one, farm trials, DPI&F, agribusiness, internet, industry or government publications, sharing experience/knowledge with other farmers, email etc).*

What is the best timing for extension activities such as workshops, field days, meetings etc? (timing/duration *time of year, time of week and time of day)*

d. What are some barriers to obtaining farm management information? (*e.g. time, lack of network knowledge, literacy issues, trustworthiness, information overload).*

Appendix 4: FIRST DRAFT Best management grazing land practices for south east Queensland

These practices to be ratified by peer review by graziers and beef industry stakeholders.

BEST MANAGEMENT PRACTICES	Short term savings/ productivity gains or Break Even	Upfront costs Medium to Long term profitability gains	Upfront costs, broad catchment/ public savings only.
Grazing Land Types ▪ Knowledge of each of the GLT's and its ability to produce useful forage ▪ GLTs have been identified and mapped on PMP ▪ The capability of each GLT to produce DM/ha is quantified ▪ Recognition of safe pasture utilisation rates for each GLT ▪ Skills in assessing pasture dry matter yields/ha using ◆ photo standards sheets ◆ quadrat pasture cuts ▪ Skills to assess land as in A, B, C or D conditions ▪ Fencing to better manage individual Grazing Land Types			
Grazing Management (managing stock for profit and/or lifestyle, managing grazing land for sustainable production) ▪ Knowledge of the ABCD Framework for assessing grazing land condition ▪ Monitoring grazing land condition and recording changes ◆ pasture condition ◆ surface soil condition ◆ woodland condition ▪ Land maintained in A or B condition by use of practices such as ◆ wet season spelling to improve grazing land condition ▪ Forward planning for the dry season through use of forage budgeting ▪ Grazing system promotes evenness of grazing ◆ rotational grazing ◆ conservative stocking rates ◆ distribution of water points ◆ sub-division fencing ◆ fencing to land type ▪ Fire management of native pastures to improve utilisation and composition of desirable species			
Grazing Land Condition ▪ Management strategies are in place to maintain land in A or B condition ▪ Management strategies are in place to improve land in C or D condition			
Pasture Condition ▪ Knowledge of Productive, Palatable and Perennial (3P) pasture species ▪ Skills to identify pasture plants ▪ Monitoring for Pasture Condition ◆ coverage of 3P pasture species ◆ DM produced from 3P spp ◆ significant weeds ◆ grass/legume balance ▪ Management strategies are in place to maintain optimum (A or B) pasture condition ▪ Management strategies are in place to improve pasture condition ▪ Management strategies are in place to retain end of dry season standing pasture of 1000 kg DM/ha or better (dependent on individual GLTs) ▪ Strategic burning of native pastures to improve pasture composition e.g. promote 3P native grasses ▪ Over-sowing of low-key legume species to improve pasture composition			

Surface Soil Condition
▪ Monitoring of surface soil condition
  ◆ signs of plant pedestalling
  ◆ signs of gully erosion
  ◆ signs of surface scalding
  ◆ signs of compaction
  ◆ signs of salinity or sodicity
▪ Ground cover is maintained at greater than 40% and higher on vulnerable land types
▪ Management strategies are in place to minimise soil loss
▪ Best practice construction and location of laneways, tracks, fences, watering points and other infrastructure
▪ Management strategies are in place to improve water infiltration and reduce run-off e.g. the use of spaced interval keyline / contour ripping practices
▪ Strategic short-term fencing of gully erosion and scalded areas to assist the rehabilitation process
▪ Strategic tree-planting or regeneration to address rising water-tables and salinity outbreaks			

Soil Health
▪ Knowledge of how soil health impacts on grazing land condition and forage production
▪ Soil health factors are monitored eg
  ◆ top soil depth
  ◆ fertility
  ◆ soil texture
  ◆ organic matter
  ◆ soil structure
  ◆ earthworms
  ◆ smell
  ◆ infiltration
  ◆ drainage
  ◆ plant Available Water Capacity
  ◆ pH (optimum range is 6.0 – 7.0)
  ◆ EC (above 1000 ms/cm may restrict plant growth)
▪ Laboratory soil analysis to determine nutrient deficiencies or toxicities
▪ Management strategies are in place to promote good soil health and prevent decline			

Woodland Condition
▪ Knowledge of woodland function
  ◆ to grow pasture and timber
  ◆ to cycle nutrients
  ◆ to regulate groundwater/control salinity
  ◆ to contribute to biodiversity
▪ Monitoring woodland condition
  ◆ tree health
  ◆ shade for stock
  ◆ wildlife corridors
  ◆ habitat values
  ◆ regrowth thickening
  ◆ woody weeds
  ◆ tree basal area
▪ Compliance with legislation (where applicable):
  ◆ Veg Mgt Act (REs),
  ◆ SEQ Koala Plan,
  ◆ EPBC Act
  ◆ local government by-laws
▪ Management strategies are in place to maintain and improve woodland condition e.g. facilitate natural regeneration
▪ Strategic use of fire in grazed woodlands to manage thickening of timber regrowth
▪ Establish shelter belts for wildlife habitat and stock shade where required			

Riparian Zone Condition
▪ Knowledge of functions and benefits of riparian zones
  ◆ filter strip for sediments and nutrients
  ◆ protecting water qualityDenitrification filter strip
  ◆ carbon sequestration
  ◆ wildlife corridor
  ◆ habitat (terrestrial and in-stream)
▪ Monitoring riparian zone condition (ABCD assessment framework)
  ◆ adequate shading of water
  ◆ vegetation structure – 3 layers, groundcover, shrubs and trees
  ◆ bank stability
  ◆ weeds - aquatic and riparian
  ◆ water quality
▪ Management strategies are in place to optimise their ability to function, e.g.
  ◆ selective fencing
  ◆ off-stream water points
  ◆ controlled grazing
  ◆ enrichment plantings or natural regeneration
  ◆ weed control (incl. bio-control agents)
Wetland Condition
▪ Knowledge of functions and benefits of wetlands
  ◆ filter strip for sediments and nutrients
  ◆ protecting water quality
  ◆ denitrification
  ◆ carbon sequestration
  ◆ habitat (terrestrial and in-stream)
▪ Monitoring wetland condition (Rapid2 ABCD assessment framework)
  ◆ terrestrial vegetation (shade and structure)
  ◆ connectivity to riparian zones
  ◆ bank stability/surrounding conditions (pugging)
  ◆ aquatic plants (native spp. and weed spp)
  ◆ riparian plant (native spp. and weed spp)
  ◆ water quality
▪ Management strategies are in place to optimise their ability to function e.g.
  ◆ selective fencing
  ◆ off-stream water points
  ◆ controlled grazing
  ◆ natural regeneration
  ◆ weed control (incl. bio-control agents)
▪ Management strategies are in place to improve on-farm and downstream water quality
On-farm and Downstream WQ Targets
▪ Knowledge of practices that impact on-farm and downstream water quality
▪ Monitoring water quality (ambient and event)
  ◆ dissolved Oxygen
  ◆ turbidity
  ◆ EC
  ◆ pH
  ◆ N and P
  ◆ temperature
▪ Management strategies to address downstream water quality are in place to comply with EPA's water quality objectives (WQOs).
▪ Management strategies are in place to improve on-farm and downstream water quality			

Property Management Planning System ▪ An effective property management system has been developed, documented and implemented ♦ record keeping ♦ maps incl layers (RE, GLT, Infrastructure) ♦ hygiene (eg weed prevention) ♦ flexibility to allow adaptive management ♦ safe Long Term Carrying Capacities ♦ links BMPs to GLTs and enterprise profitability			
Adaptation to Climate Change ▪ Managers have an understanding of climate processes and the effects on their enterprise ▪ Management practices are in place for adaptation including ♦ revising long term carrying capacity ♦ stock water security ♦ fodder conservation ♦ increased resilience by use of 3P pasture plants ♦ drought risk management strategies ▪ Things to consider ♦ use of SOI/other long term weather forecasting for forecasting ♦ potential of Carbon sequestration ♦ reducing Green House Gas emissions ♦ changing rainfall patterns			

Appendix 5: Fire strategies used in the Rosevale Tarome area in the upper Bremer Catchment

Collated by Bill Thompson October 2007

based on the series of meeting and discussions held in the area over 2004 to 2007.

These strategies represent the best intention of all land holders. This collation is not a set of best practice guidelines – rather it represents the most practical and effective strategies for the area. These pragmatic approaches involve both fire breaks/lines and fire strategies.

There are 40 kms of key primary fire breaks/lines installed in the area which separates freehold grazing and forestry areas from National Parks. Less than 4 kms is installed on national parks and this partly reflects the rugged nature of the park land. There are another 35 km of secondary fire breaks that help contain fire within freehold areas. All of these breaks benefit the wider community. There are over 3 times these lengths of breaks on private land that help land holders manage fire within their own properties

Fire strategies are used to achieve conservation, production and asset protection outcomes. The strategies listed in this collation reflect these needs.

Within the parks area, a strategy for conservation will override a strategy based on production outcomes. It is not practical (nor does it make economic or financial sense) that conservation based outcomes override strategies in all areas. Conversely production strategies cannot override conservation in all areas.

It is also not practical for a strategy in one area to be applied in a way which would prevent neighbours applying a different strategy. Invested in fire breaks is one way to allow relatively independent use of fire and thereby reduce cross border conflicts. Neighbours working together to implement burnoff is another key mechanism.

Within the production area, there are a variety of views on fire frequency and intensity and this is reflected in this collation. There are also a variety of views on appropriate frequencies and intensities for conservation areas. Generally speaking, land holders operate a variety of production based strategies depending on fuel loads, pasture composition and weediness – in other words fire is used as a flexible tool to achieve a variety of production outcomes. Landholder investment in infrastructure such as secondary fire breaks and subdivisional fencing to adjust fire and grazing pressure reflects this pragmatic reality.

Within conservation areas, there can be a need to use fire as a flexible tool to achieve a very wide range of conservation outcomes.

It is intended that this collation will be reviewed at the third field workshop on fire and biodiversity.

	Fire Regimes for Tarome Rosevale Land use zones and Fire Vegetation Groupings				
Fire Management Zones	Fire Vegetation Groupings	Season	Interfire Frequency	Environmental conditions for burning	Some suggestions
Wildfire Mitigation	Mitigation zones fall within containment areas including a variety of vegetation communities and therefore contain areas not intended to be burnt as mitigation. These include riparian/ fringing forest, rainforest, and wet sclerophyll forest. Included vegetation communities not intended for mitigation burning will be much less volatile and unlikely to burn.	February to April and May to August	Dependent on recommended fuel loads, environmental conditions and fire vegetation groups interfire frequency guidelines.	February to April DI <75, Temp <28°C, Relative Humidity >40%, wind strength, 15km/hr, fuel loads between 5-10 t/ha and within 6 days of 20mls of rain. May to August DI <85, Temp <28°, Relative humidity >30%, wind <15km/hr, 5-10t/ha within 10 days of 15mls of rain	• Conduct a test burn. Monitor up to 5 mins to determine flame height and rate of spread. If flame height or rate of spread exceeds the level proposed, the fire should be extinguished and the burn rescheduled. If the fire does not carry, it will not achieve the objectives of the burn, it should be extinguished and the burn rescheduled. • Aim for flame height <1m and a rate of spread of 90m/hr. (Unpublished: Guidelines for fire management in mitigation zones Kington 2007)

	Fire Regimes for Tarome Rosevale Land use zones and Fire Vegetation Groupings				
Sustainable production (Forestry)	Dry Sclerophyll, Moist Sclerophyll and Wet Sclerophyll forests including non remnant dry sclerophyll forests on main range foothills/ hill slopes and volcanic (trachytes) hill slopes	May-September	low intensity burn 3-7yrs	Fuel moisture greater than 10% with DI 20-70. Burn in winds less than 20km/hr preferably SE. Relative Humidity 40-70% with temperatures <25°C	• High intensity fires lead to poor timber quality. Fire intensity is dependent on environmental conditions prevailing including rainfall (mm). • Factors to consider include lighting pattern (when lighting up-slope use spot fires, down-slope strip lines). Caution when burning steep slopes, attempt to burn down-slope or across slopes to manage rate of spread. • Erosion is an issue on steep slopes. In the absence of complete fire exclusion breaks managing these areas to maximize forest outcomes is difficult. (Debuse & Lewis 2007) Strategic spelling from grazing maybe required after fires to allow sufficient ground cover to be established before erosive rains if Spring burns are used. Fire frequencies may need to be higher (or well maintained fire breaks in place along boundaries of these areas to reduce wild fire risks to grazing areas from Autumn Winter burns. High intensity fires maybe unavoidable in steeper lands of the Scenic Rim if fires initiated at base of slopes.
	Fire Regimes for Tarome Rosevale Land use zones and Fire Vegetation Groupings				
Sustainable production (Grazing)	Largely cleared Grazing Lands on basaltic soils. Including ironbarks and bloodwoods on non cracking clays, ironbarks and blue gums on clays and non remnant tall open forests.	Spring after rainfall	Burn after spring rainfall. Most common range is 2-5yrs range for whole of paddock burning. Annual mosaic burns may achieve similar overall frequency In cases of high fuel loads or woody weed regrowth, more frequent burning may be required. Frequency also varies depending on drought factors	Burn after 40-70mm Recent rainfall with soil moisture greater than 10%. Burn into wind 1015km/hr preferably from SE. Temperatures 2728°C.	• Weed control - flame height sufficient for leaf scorch. • Regrowth issues, 2-3 cycles of 2 year burnings followed by extended frequencies (i.e. 4 yrs recommended). • Regrowth problems due to long rotation (i.e. wild fire), use fire in a more planned way – need physical breaks to NP for this to work. Ideally a 2-4 yr frequency until regrowth is under control and pasture biodiversity improves. • Use pasture indicator species and biodiversity as tools for assessing effect and need for fire. * Note these areas are all high fertility areas (Debuse & Lewis 2007) (Pers comm. Thompson, Tran, Lewis, Debuse, Gilroy 2007)
	Grazing Lands on the Walloon coal measures including cleared scrub soils, iron barks and bloodwoods on non cracking clays and mixed open forest on duplexes and loams. Walloon Forest type areas include about 40% as mildly sodic soils.	Spring after rainfall	Variable frequencies are recommended dependent on soil types and drought factors. Frequencies of to be 2 to 4 years.	Burn after 40-70mm Recent rainfall with soil moisture greater than 10%. Burn into wind 1015km/hr preferably from SE. Temperatures 27-28°C	• Care with sodic soils to maintain vegetation cover to mitigate against erosion (note that these soils are highly dispersive). • Due to lower fertility these soils produce less dry matter and hence lower fuel loads. • Trickle burning and accidental mosaic burning is a common artefact with regrowth an increasing problem. • Lower quality soils require closer integration of fire and grazing management. (Debuse & Lewis 2007) (Pers comm. Thompson, Tran, Lewis, Debuse, Gilroy 2007)

References for fire strategies:

Debuse & Lewis 2007, 'Using fire in spotted gum - ironbark forests for production and biodiversity outcomes. Guidelines for landholders.' DPI&F and AgForests, March 2007

Environmental Protection Agency 2005. 'Regional Ecosystem Description Database REDD.' Version 5 updated December 2005.

Tran, C. 2002, 'Fire Operations Manual'. South East Queensland Fire and Biodiversity Consortium, SEQ 2002 Tran, C & Wild, C. 2000. 'A review of Correct Knowledge and literature to assist in determining Ecological Sustainable Fire Regimes for the South East Queensland Region.' Griffith University and the SEQ Fire and Biodiversity Consortium.

Watson, P. 2001. 'The role and use of fire for biodiversity conservation in South East Queensland. Fire management guidelines derived from ecological research.' South East Queensland Fire and Biodiversity Consortium, SEQ 2001