Net community benefits and Seismic Line Remediation – a case study

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SUMMARY

Petroleum Group of Primary Industries and Resources South Australia (PIRSA) conducted an audit of seismic lines within Petroleum Exploration Licenses (PELs) 5 & 6 in 1999, to assess their condition upon expiry of these licenses.

A significant number of seismic lines located in gibber plains and residual tablelands to the north of Innamincka were identified as being in poor condition, particularly in regard to active erosion.

Maps were produced from low-level aerial videography of more than 1200 kilometres of seismic lines that enabled detailed assessment of the amount of seismic lines in poor condition.

Physical rehabilitation of windrows or erosional gullies would be unlikely to make a significant improvement to the impacted lines. Rather than wasting money and effort by forcing Santos to undertake any physical remediation, PIRSA, Santos and NPWS agreed that funding of other environmental projects in the Innamincka Regional Reserve would provide a better net benefit to the local environment.

The Santos has set up a fund for a range of environmental projects within the Innamincka Regional Reserve. In return the Government agrees that no further rehabilitation of the lines will be required. As part of the process, PIRSA undertook a risk assessment to ensure that the level of any such risk is acceptable.

Key words: seismic lines, rehabilitation, goal attainment scaling, Innamincka Regional, Geographic Information Systems, GIS

INTRODUCTION

In 1999, South Australian Petroleum Exploration Licenses 5 & 6 in the Cooper Basin held by Santos Ltd lapsed after 45 years without right of renewal. It is a requirement of the *South Australian Petroleum Act 1940,* the relevant legislation at the time, that upon expiry of a licence, the licensee must deliver the land covered by the license, in good order and condition.

To ascertain whether lands impacted by seismic lines were left in good condition, the Petroleum Group of Primary Industries and Resources South Australia (PIRSA) undertook an aerial inspection of seismic lines that had been recorded over a period of approximately thirty years. A total of over 100 000 km of seismic lines had been recorded in that period.

This inspection sampled over 6000 kilometres of seismic lines in the 72,000 square kilometre license area. It focused on the impacts associated with seismic lines such as vegetation regrowth, erosion, visibility and third party usage (Moss & Low, 1996; Woodburn & Fatchen, 2000).

Whilst most of the seismic lines sampled were accepted as not requiring further address, two areas were identified that were not acceptable. An area northwest of the Cooper Basin in gibber plains had extensive windrow development that was conducive to remediation. The windrows in this area were respread across the seismic lines providing effective rehabilitation.

Seismic lines that traverse the gibber plains and tablelands of the Merninie Ranges, north of Innamincka, were identified as being in much poorer condition. Removal of the protective gibber mantle has resulted extensive areas of gully erosion along many segments of 1975 to 1984 seismic lines (Figures 1 & 2). During this period, seismic lines were deeply 'cut' by bulldozers to make a smooth access track for seismic vehicles. This practice stopped in 1985 when long-term erosional impacts of the practice were identified. The few seismic lines recorded prior to this period had much less impact as there was much less earthmoving and lines were located in more accessible terrains.

The following sections detail the methodology used in assessing the impacts of these seismic lines in the Merninie Ranges and the process of determining the best method of address.

Figure 1. Six metre deep erosion Gully

Figure 2. Erosion Gully on 1981 Seismic line

Over 1200 kilometres of the seismic lines recorded in during 1978-1984 were assessed in a GIS project over the area. This involved obtaining aerial geo-referenced video imagery, classifying the degree of severity of erosion and windrows and preparing a series of map to aid the planning of any remedial actions.

ASSESSMENT METHODOLOGY

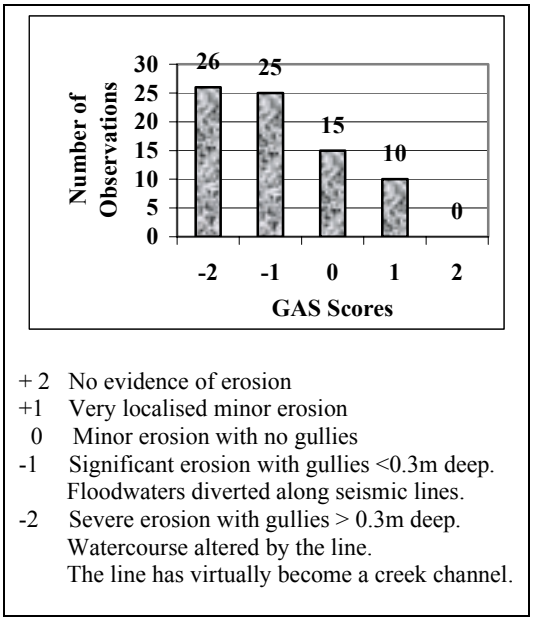
Aerial Inspection of Seismic Lines
The aerial audit undertaken by PIRSA was the first stage in assessing the condition of the seismic lines. This saw the introduction of airborne goal attainment scaling (GAS) to assess the various environmental impacts. GAS is an assessment tool that the Petroleum Group of PIRSA uses to measure environmental outcomes against objectives previously agreed to by stakeholders (Malavazos, 1996). Each outcome is allocated a score in a range of "-2" to "+2" (Fig 1) for defined criteria, as indicated for erosion in Figure 2.

	Outcomes Achieved	**Acceptability**
+2	Much more than expected	Excellent
+1	More than expected	Good
0	Expected	Satisfactory
-1	Less than expected	Unsatisfactory
-2	Much less than expected	Very unsatisfactory

Figure 1 Definition of expected outcomes

The results of the aerial audit demonstrated that there were a significant number of sites of seismic line initiated erosion. The histogram (Figure 2) shows the marked negative skew with sixty seven percent of the observations in the "-1" and "-2" ranges. All these unsatisfactory scores came from seismic lines recorded during 1975 to 1985.

Video Imagery Interpretation
The second stage was to obtain much more accurate quantification of the extent of the eroding seismic lines. A specialist aerial contractor was employed to obtain geo-referenced video imagery of 1200 kilometres of 1975 to 1985 seismic lines in the Merninie Ranges area.



+ 2 No evidence of erosion
+1 Very localised minor erosion
0 Minor erosion with no gullies
-1 Significant erosion with gullies <0.3m deep. Floodwaters diverted along seismic lines.
-2 Severe erosion with gullies > 0.3m deep. Watercourse altered by the line. The line has virtually become a creek channel.

Figure 2 GAS Scores of Erosion along Seismic Lines in Innamincka Regional Reserve

The interpretation of the low-level, aerial video imagery resulted in seismic line initiated erosion being divided into three categories:

- Serious: deep, extensive, not confined to the width of the seismic line, water courses have been diverted;
- Moderate: extends beyond limits of the line in small areas, gullying has occurred but it is shallow and confined to the line; and
- Slight: discontinuous, no gullying and confined to the line.

These categories were determined by what could be identified from the imagery. Samples of images for each classification were selected and checked by on-ground field validation. The resolution of the video imagery at a scale was such that cattle pads twenty-five centimetres wide were classified as areas of slight erosion.

Other impacts were also assessed during this process, including windrows and landscape visibility. A rehabilitation program had previously been undertaken to respread windrows in the area by Santos. This provided effective remediation for most of the lines. However, in the steep slopes of the tablelands significant windrows existed where grading was not possible.

The lengths of seismic lines in these classifications were 75 kilometres of serious erosion, 164 kilometres of moderate erosion and 228 kilometres of slight erosion respectively. The remainder of the 1200 km had negligible erosion.

As a result of the field inspection, it was decided that the 'Slight' class would not require any rehabilitation work and thus was removed from any further consideration.

REHABILITATION CONSIDERATIONS

After analysing the maps and obtaining specialist advise (Twidale and Bourne 2001) Santos, PIRSA and National Parks and Wildlife Services (NPWS) agreed that any physical rehabilitation of windrows or erosional gullies would be

unlikely to make a significant improvement to the impacted lines. The effort and cost of any physical remediation program would therefore largely be wasted (Sociological and Environmental Assessments 1999). It was also likely that physical remediation would result in much greater areas being impacted during the course of using graders, trucks and bulldozers.

Rather than wasting money and effort by forcing Santos to undertake any physical remediation, PIRSA, Santos and NPWS agreed that other options would provide a better net benefit to the local environment.

If there was to be some other environmental offset, then a measure of the amount or value of that offset was needed. Whilst a range of environmental valuation methodologies exist (e.g. contingency valuation), the only practical one in this case was to determine a dollar value from hypothetical calculation of the cost of physically filling the erosional gullies.

Field measurements were made at a number of sites at four different parts of the area, in order to arrive at an average figure of volume of material eroded per length of line. Measurements of depth of gully and surface extent of erosion were used to provide an average figure for 'serious' and for 'moderate' categories. The dollar value estimates were derived from estimation of the plant and labour costs of hypothetically infilling and stabilising erosion gullies, using the average gully cross-sectional areas and the aerial measured lengths of impacts.

PIRSA, Santos and NPWS independently estimated the cost of rehabilitation. In arriving at the costing, PIRSA used the Caterpillar Performance Book as a primary source of reference. Calculations included such variables as skill level of plant operator, type of fill material and environmental factors such as heat and dust.

PIRSA estimated costs ranged from $250,000 to $800,000. Santos and NPWS independently derived similar figures using slightly different assumptions and plant cost bases.

As a consequence, Santos has agreed to fund projects that will be of direct benefit to the Innamincka Regional Reserve. A number of indicative projects have been proposed including:

- A biological survey of the reserve;
- Feral animal and plant control;
- The protection of the old Coongie Homestead Site;
- Tourist amenity infrastructure; and
- Installing hydrological gauging station on NW and main branch of the Coopers Creek.

Other projects may be considered in the 5 year timeframe suggested. A management group would be formed to assess the merits of projects and ensure the funding and undertaking of the projects to appropriate standards.

A key outcome of the process was the release of Santos from the prospect of any future directions to carry out rehabilitation works on the erosion gullies. PIRSA carried out a risk assessment and found that the level of risk inherent with hazards associated with the seismic lines ranged from negligible to acceptable.

CONCLUSIONS

Aerial GAS proved to be an effective tool in the identification of areas of seismic line initiated erosion. The low level geo-referenced video imagery was invaluable in detailed assessment and mapping of these erosion sites.

The area is in naturally eroding terrain rarely visited by tourists. The community benefit of funding projects in the Innamincka Regional Reserve area far outweighed costly physical rehabilitation that would be unlikely to achieve substantive long-term benefits (Fig 5).

Figure 5 Seismic line cutting across an Escarpment

ACKNOWLEDGEMENTS

The authors wish to thank Dragan Ivic for the production of the Seismic Line Erosion Assessment Maps and Ben Kaethner for his painstaking perusal of the many metres of video film to identify and classify the erosion and windrow sites.

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