

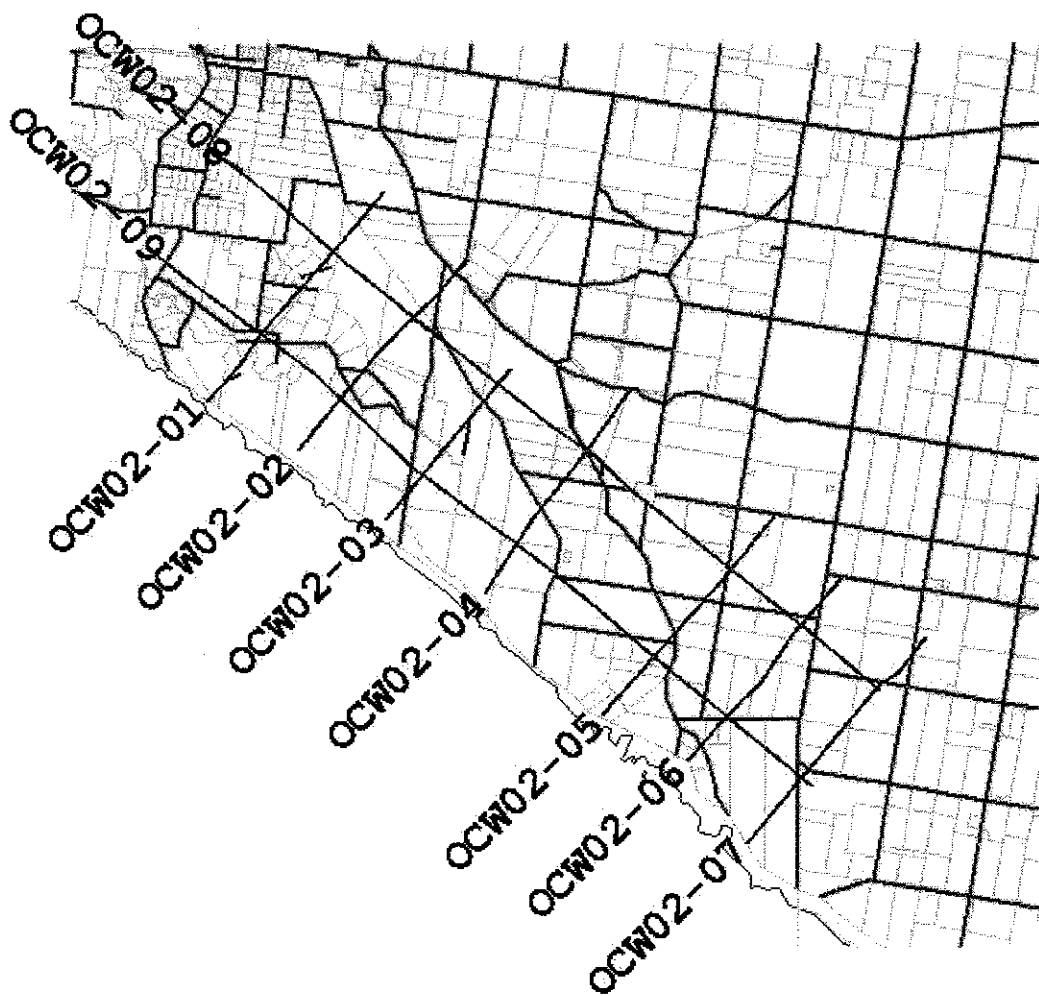
SURVEY OPERATIONS

END OF CONTRACT REPORT

CURDIE WEST 2D

SANTOS LIMITED

VICTORIA



FINAL SURVEY REPORT

For

SANTOS LIMITED

PEP 154

CURDIE WEST 2D SEISMIC SURVEY

LINES

OCW02-01

OCW02-02

OCW02-03

OCW02-04

OCW02-05

OCW02-06

OCW02-07

OCW02-08

OCW02-09

MARCH 2002

TABLE OF CONTENTS

1.	<u>INTRODUCTION</u>	2
2.	<u>LINE SUMMARY</u>	3
3.	<u>PERSONNEL AND EQUIPMENT</u>	4
3.1	<u>PERSONNEL</u>	4
3.2	<u>EQUIPMENT</u>	5
4.	<u>LINE PREPARATION</u>	6
5.	<u>SURVEYING METHODS</u>	7
5.1	<u>SURVEY DATUMS</u>	7
5.2	<u>SURVEY METHODS</u>	8
5.3	<u>SURVEY CONTROL</u>	8
5.4	<u>DATA PROCESSING AND QUALITY CONTROL</u>	9
5.5	<u>PERMANENT MARKERS</u>	9
5.6	<u>TRACE DIAGRAMS</u>	10
6.	<u>HEALTH, SAFETY AND ENVIRONMENT</u>	10
7.	<u>CONCLUSION</u>	11
8.	<u>APPENDIX A</u>	12
8.1	<u>LIST OF PERMANENT MARKERS</u>	12
9.	<u>APPENDIX B</u>	13
9.1	<u>INTERSECTION DIAGRAMS</u>	13

1.0 INTRODUCTION

WesternGeco was contracted by Santos Limited to undertake the Curdie West 2D survey. The prospect is situated between towns of Allansford and Nullawarre in Victoria's Otway Basin. This area is part of Exploration Permit PEP 154 belonging to Santos Limited (hereafter referred to as Santos).

The ranging of line commenced on the 7th February. Surveying line fieldwork commenced on 12th March 2002 and was completed on 15th March 2002. A total of 56.66 kilometres was surveyed and ranged. The survey control was established on 9th March.

Ranging consisted of one crew based out of the Boggy Creek Hotel at Curdievale. Ranging and surveying proceeded more rapidly than the Cobden 2D because the terrain was better, the dairying less intense and the fencing crews overtook the surveying.

The survey work was accomplished using Real Time Kinematic GPS (RTK) methods and conventional levelling methods. A GPS backpacking crew was used to survey through areas of remnant native vegetation at road crossings and to survey any offsets.

2.0 LINE SUMMARY

The survey of Curdie West 2D consisted of 9 lines totalling 56.66 kilometres. The station interval for the survey was 20.0m. The lines were positioned with the "crooked line" processing technique for processing being a criterion. Thus the lines wandered along the general route chosen.

The individual line details are listed below.

Line	Start	End	Stn Int.	Total
OCW02-01	200	426	20	4.52
OCW02-02	200	410	20	4.2
OCW02-03	200	360	20	3.2
OCW02-04	200	405	20	4.1
OCW02-05	200	420	20	4.4
OCW02-06	200	396	20	3.92
OCW02-07	220	426	20	4.52
OCW02-08	224	915	20	13.82
OCW02-09	205	904	20	13.98
			Total	56.66

3.0 PERSONNEL AND EQUIPMENT

3.1 PERSONNEL

The WesternGeco survey crew consisted of twelve people. The following is a list of personnel utilized during the survey:

Name	Duties
Charlie Johnson	Senior Surveyor
Scot Townsend	Ranging
Dave Black	Ranging
Jens Tolsdorf	Survey
Jay Argent	Survey
Denis O'Sullivan	Survey
Haydn Kreicbergs	Survey
Ian Seeto	Survey
Gerard Mackenzie	GPS Operator
Matt Skinner	GPS Operator
Dan Kool	GPS Operator
Tim Browne	GPS Operator
Trent Davies	Utility
Andrew Gleeson	Utility

3.2 EQUIPMENT

The following equipment was used during the survey:

Ranging	2 Toyota Landcruiser Ute
	2 Trimble NT300 GPS receivers
	2 VHF Crew radio
	2 UHF radio (Survey communications)
	1 Toshiba Notebook computer
Survey/Chaining	3 Toyota Landcruiser utes
	1 Toyota Landcruiser Wagon
	4 Trimble 4000 SSI GPS receiver
	2 Trimble 4700 GPS receivers
	2 TSC1 Survey controllers
	3 TDC1 Survey controllers
	5 Beech Base station radio/modem
	6 Beech Portable radio/modems
	1 Lecea Total Station
	2 VHF Crew radios
	5 UHF radios
	1 Desktop computer
	2 Dell Laptop Computer
	1 Canon S4500 printer
	Trimble Processing software
	GPSeismic Processing software
	Survey consumables

4.0 LINE PREPARATION

One ranging crew was deployed throughout the prospect. The ranging crew had a Toyota landcruiser fitted with Trimble NT300 GPS/display unit and a handheld Garmin GPS unit. The ranger used a combination of design coordinates and topographic maps to scout and bend lines to avoid obstacles and fit the lines to the surrounding terrain.

The lines were ranged and bent in a manner sensitive to landholder requirements and environmental considerations.

Line preparation and permitting was contracted to Exploration Field Services and was supervised by Ray Willox. Three fencing crews and one slasher were used during the survey. Each of the fencing crews consisted of two persons. A fire tender attended the slasher. The ranging crew discovered properties that had been overlooked by the permitting crew and lines had to be bent or cut short to accommodate this oversight.

Ray Willox supervised the line preparation and liaised with the survey and recording crews. He also handled the permitting, keeping the landholders informed of the progress of the survey and when the line preparation and survey crews would be entering onto their land.

5.0 SURVEYING METHODS

5.1 SURVEY DATUMS

GPS field survey data was collected in World Geodetic System 1984 (WGS84) datum. It was then down loaded into GPSeismic software (by Dynamic Survey Solutions) for conversion to the Australian datum. WGS84 coordinates were converted to the Geocentric Datum of Australia 1994 (GDA94) and output in Map Grid of Australia Zone 54 coordinates. Ellipsoidal heights were converted to the Australian Height Datum (AHD) using the OSU91A geoid separation model.

The following parameters define the World Geodetic System 1984 datum:

Datum	World Geodetic System 1984 (WGS84)
Ellipsoid	WGS84
Semi-Major Axis	6 378 137.0
Inverse Flattening	298.257223563
Unit of Measure	International Metre

The following parameters define the Geocentric Datum of Australia 1994:

Datum	Geocentric Datum of Australia 1994 (GDA94)
Ellipsoid	Geodetic Reference System 1980 (GRS80)
Semi-Major Axis	6 378 137.0
Inverse Flattening	298.257222101
Unit of Measure	International Metre

For all intents and purposes GDA94 is the same as WGS84, so no transformations were applied.

The following parameters define the Map Grid of Australia 1994 - Zone 54:

Projection:	Universal Transverse Mercator
Latitude of origin:	0°
Central Meridian (CM):	141° E
Scale Factor at CM:	0.9996
False Easting:	500 000
False Northing:	10 000 000
Unit of Measure:	International Metre

5.2 SURVEY METHODS

The 'real time' kinematic (RTK), and the kinematic GPS surveying method was used during the surveying of the prospect.

The 'real time' kinematic (RTK) method uses a radio and modem connected to a GPS receiver on a known base point. The base radio broadcasts raw GPS data measured at the base and the base position directly to a radio and modem connected to a roving GPS receiver. Thus the roving receiver can calculate it's own position to within a few centimetres, eliminating time-consuming post-processing. Position data in WGS 84 format was collected in Trimble TSC1 and TDC1 data collectors and downloaded into GPSeismic software where datum transformations and geoid separations were applied. The data was then edited and QC checked.

The **static** method involves setting up a receiver to log data on a known point then logging data on unknown points with a roving receiver for periods upwards of 15 minutes depending on the length of the baseline and satellite geometry. This enables the change in geometry of the satellite positions to be measured and by post-processing the data an accurate position can be determined. RTK base stations were surveyed using the static method for positioning.

Conventional trigonometric levelling was used to survey between GPS points across roads where it was difficult to get vehicular access..

The static method was used for establishing control and surveying new base positions. The survey crew used the RTK method for line chaining / surveying.

5.3 SURVEY CONTROL

One control point was established for the survey. The datum for the Curdie West 2D survey was trig station Heytesbury. The Geocentric Datum of Australia 1994 coordinates and AHD height for this site is:

Station	East	North	Elevation	Remarks
Heytesbury	685622.304	5738646.525	171.4	PSM

Ties to old Permanent Markers are listed below:

Station	Line	Delta E.	Delta N.	Delta Ht.
PM120	HA90-02	2.166	-0.715	2.518
PM195+17	HA90-04	2.318	-0.717	2.598

Old Permanent Markers Coordinates:

Station	Tie line	Easting	Northing	Elev.
PM102+23	OB83CT72 PR	643 343.77	5 746 194.76	38.16
PM102+8	OB83 C70 PR	642 001.94	5 747 341.15	28.35
PM120	HA90-02	649 268.45	5 740 194.24	34.61
PM195+17	HA90-04	649 018.37	5 737 872.98	30.23
PM235+9	CH98-05	644 573.98	5 744 980.11	38.87
PM79	OB83C-80P	647 800.49	5 741 160.34	30.17
PM83C-84	OB83C-84	650 506.10	5 739 358.86	38.40
PM87+10	PM84-82 PR	649 172.02	5 740 476.52	33.06
PM90+30	OB83C-72 PR	643 088.27	5 745 867.89	36.72
PM95+23	OB83C 82 PR	649 356.13	5 740 702.24	37.23

5.4 DATA PROCESSING AND QUALITY CONTROL

Survey data collected in the field was processed in different ways depending on which survey method was used.

Static points were processed using Trimble Geomatics Office software. This produced data in WGS84 format. This data then had the geoid separation applied using the OSU91A model. The data was then set to GPSeismic for editing and QC checks.

For 'real time' kinematic (RTK) data, as the field data was collected in WGS84 format, it was downloaded into GPSeismic software where datum transformations and geoid separations were applied to obtain Map Grid of Australia 1994 (MGA94) Zone 54 coordinates and AHD heights. The data was then exported to a text file for use by the IMS (Information Management System) department.

The enhanced QC capabilities of GPSeismic allow for many checks, some of which are listed below:

- The GPS base coordinate and elevation is checked against the correct data.
- Compute delta x, y and z for Check shots to other stations.
- Check for duplicate stations and gaps.
- Checks on GPS status at time of recording.
- Check the measured distance between stations
- Check elevations at intersection between lines

5.5 PERMANENT MARKERS

The surveyors placed 3 Permanent Markers at appropriate points along each seismic line including, intersections of new lines and at intervals along the line. Where possible the PM was placed close to fences to avoid disturbance by livestock or

agricultural activities. These markers consist of a steel fencing post with steel dumpy at the base and an aluminium tag, with the line name, station number and any comments inscribed upon it.

A listing of Permanent Marker information is included as Appendix A of this report.

5.6 TRACE DIAGRAMS

The chaining crew prepared line trace sketches showing details of Permanent Markers, line intersections, crew access, hazards and any other features of importance to the recording crew. Copies of these were passed on to the recording crew. A prospect map was marked up with roads, tracks, pipelines, fences, gates and other relevant information by the Senior Surveyor and passed onto the recording crew.

6.0 HEALTH, SAFETY AND ENVIRONMENT

The Curdie West 2D was situated in the farming community between the township of Nullaware and the city of Warrnambool. The terrain was low rolling hills adjacent to the southern coast of Victoria. Land use was predominately intense dairying with small grazing paddocks with some areas of irrigation and fodder crops.

Line preparation was carried out in accordance with the environmental code of practice, as set out by Santos.

As a result of a high emphasis being placed on safety by WesternGeco, there were no lost time incidents during the prospect. WesternGeco safety policies were adhered to and regular safety meetings were held to discuss relevant safety and environmental matters. Daily "toolbox" meetings were held to discuss current issues concerning the prospect and operations.

All WesternGeco vehicles were fitted with fire extinguishers, Driveright monitors and first aid kits. In addition, some WesternGeco personnel hold Senior First Aid certificates. The Driveright vehicle monitoring devices assist in controlling vehicle speeds and driver behaviour.

All WesternGeco personnel carried out their duties in an environmentally aware manner. All rubbish generated in the field was returned to camp for proper disposal.

7.0 CONCLUSION

The line preparation of the Curdie West 2D was conducted in an efficient and environmentally sensitive manner. All client and company environmental constraints and guidelines were comprehensively adhered to for the full duration of the survey.

No problems were encountered during the survey except for the permitting. Permitting maps and forms provided by the permitting officer were of a lower standard than the Cobden 2D and in most cases hard to read. A section of lines OCW02-07 and OCW02-08 had to be re-ranged and moved due to the property not being permitted. The northern section on the line OCW02-06 was dropped because it was not permitted. A section on the line OCW02-03 had to be offset for the vibrators (at short notice) due to landowners request to avoid his organic farming microbes. This was not identified at time of permitting. Numerous irrigation areas had a general comment to check with the landowner as to location of pipelines. This was thought to be more a permitting exercise as the survey crew hadn't the time due to the lack of lead.

The more open terrain allowed for a trouble free survey and reasonably speedy survey, however the small lead-time did not allow any leeway for mistakes, which fortunately did not occur.

All safety guidelines were complied with, and as a result no accidents or lost time injuries occurred.

APPENDIX A

LIST OF PERMANENT MARKERS

Permanent Markers established during the Curdie West 2D survey.

PM Id	Line	Easting	Northing	Elev.
PM120	HA90-02	649268.45	5740194.24	34.61
PM195+17	HA90-04	649018.37	5737872.98	30.23
PM235+9	CH98-05	644573.98	5744980.11	38.87

APPENDIX B

INTERSECTION DIAGRAMS

