

# FINAL ACQUISITION REPORT

For the

## ELVER 3D MARINE SEISMIC SURVEY

Conducted by

## APACHE ENERGY LIMITED

In The Exploration Licence Area

## VIC/P59, GIPPSLAND BASIN VICTORIA

SURVEY START DATE 4<sup>th</sup> April 2007

SURVEY COMPLETION DATE 24<sup>th</sup> April 2007



Compiled by  
Bob Luff  
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## 1 INTRODUCTION

### 1.1 OBJECTIVES

Apache Energy Limited contracted WesternGeco (A) Pty Ltd to carry out a high quality 3D seismic survey of some 649.21 full fold square kilometres over the Elver 3D survey area. The location is in the VIC/P59 block, Gippsland Basin, Victoria, Australia.

The seismic survey vessel was the M/V Western Trident with Offshore Marine Services (OMS) providing the marine crew. WesternGeco (A) Pty Ltd supplied the seismic personnel, data processing and logistics.

Seismic operations were supervised by Bob Luff of Enquest.  
Navigation positioning operations were supervised by Stephen Burt of Enquest.  
Marine Mammal activity was monitored by Chris Lalas of Enquest.

### 1.2 SURVEY PARAMETRES

The following is a summary of the survey parameters:

Survey type	: 3D
Client	: Apache Energy Limited
Survey name	: Elver 3D MSS
SP interval	: 18.75m
Source	: 2 x 3147 in <sup>3</sup> . Bolt guns
Streamer Length	: 8 x 4000 metres
Groups	: 8 x 320
Positioning	
Primary	: Cnav (Inmarsat 109 East)
Secondary	: Veripos (Inmarsat IOR)
Tertiary	: Trinav GPS 2.6 (Inmarsat IOR)
Water depth	: 150m to 2700m
Number of sail lines	: 77
Survey surface area	: 649.21 km <sup>3</sup>
Contractor	: WesternGeco (A) Pty Ltd
Vessel	: M/V Western Trident
Client Representation	: Enquest Pty. Limited

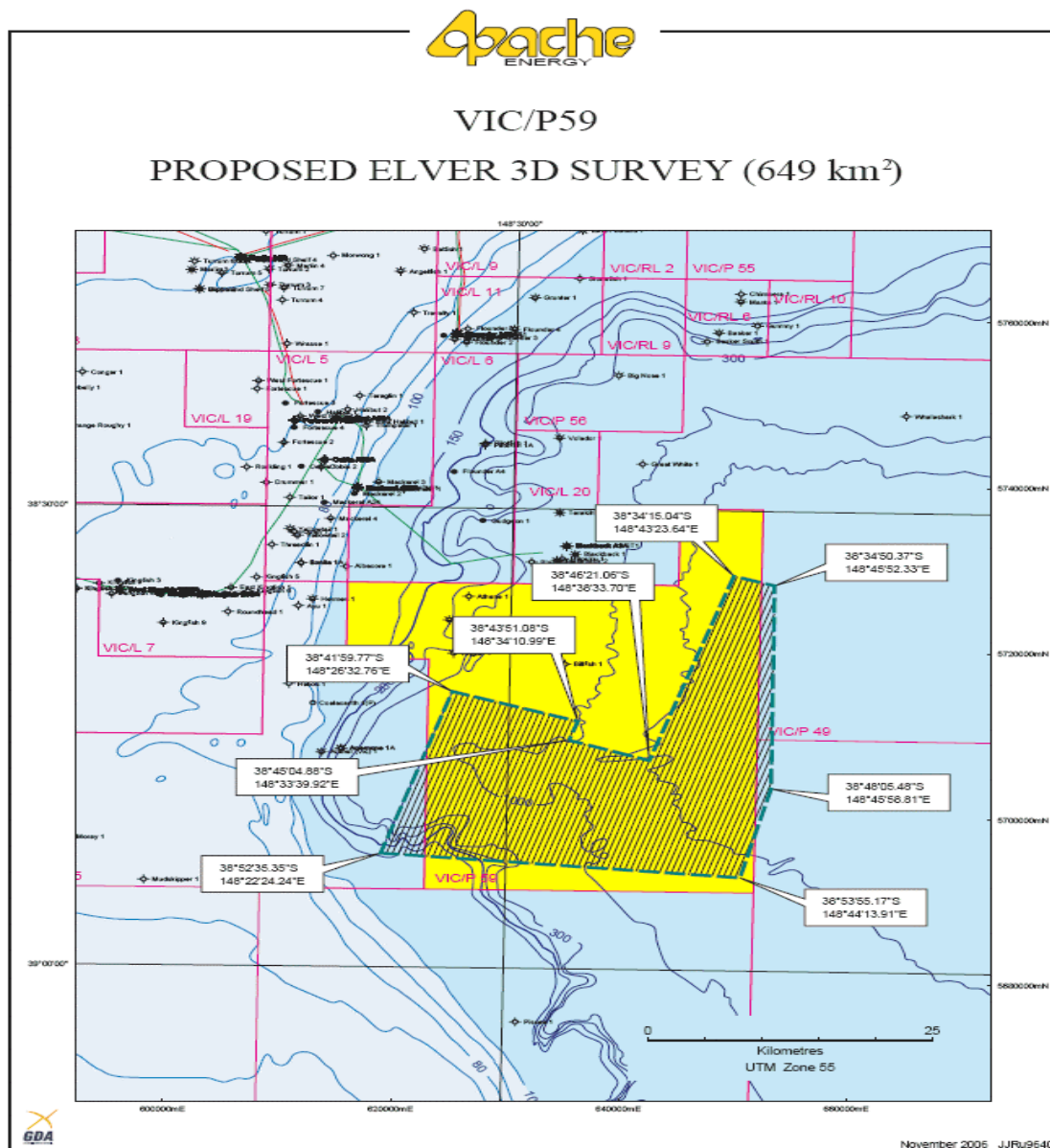
### 1.3 ACQUISITION PARAMETERS

Recording System	: Triacq V / MSX 2.1
Number of Channels	: 8 x 320
Record Length	: 6000ms
Sample Interval	: 2ms
Low Cut Filter	: 2Hz @ 12db/octave
High Cut Filter	: 206Hz @ 264dB/Oct
Tape Format	: SEG-D 8036, Rev 2
Digital Filter	: Zero phase
Energy Source Type	: Bolt 1900IIx and 1500II
Total Capacity	: 2 x 3147 cubic inches
Number of Arrays	: 2
Number of sub-arrays	: 3
Array Length	: 15.0m
Sub Array Separation	: 8.0m
Total Number of Guns	: 24
Capacity of each Sub-Array	: 1049 in <sup>3</sup>
Typical Output	: 82.7 bar/metres pk-pk
Primary / bubble ratio	: 18.1
Pressure	: 2000psi
Depth	: 7.0 metres
Shot Interval	: 18.75 metres
Number Of Groups	: 8 x 320
Group Length	: 17.75 metres
Group Interval	: 12.5 metres
Group Sensitivity	: 20.0v/ bar
Hydrophones per Group	: 16 in parallel connection (8 per 6.25m base group)
Streamer depth	: 8 metres +/- 1.0m
Typical Noise	: 6.0 to 12.0 microbars
Offset (In-line)	: 236.0m
Nav Ref.-Cent. Source	: 361.9m
Primary Navigation	: Cnav
Secondary Navigation	: Veripos
Integrated Navigation System	: TRINAV 3.01
Coverage Binning System	: TRINAV 3.01
Echo Sounder	: Simrad EA500, 18/200 kHz

## 1.4 LOCATION MAP

COVERAGE POLYGON (GEOGRAPHIC):

38 52 35.177 S 148 22 21.483 E  
 38 53 54.679 S 148 44 05.632 E  
 38 49 00.615 S 148 45 59.264 E  
 38 34 50.369 S 148 45 52.329 E  
 38 34 15.039 S 148 43 23.641 E  
 38 46 23.095 S 148 38 41.566 E  
 38 45 04.675 S 148 33 39.131 E  
 38 43 50.411 S 148 34 08.219 E  
 38 41 59.142 S 148 26 30.190 E



**1.5 LINE CO-ORDINATES**

<b>Line ID</b>	<b>SP</b>	<b>Easting</b>	<b>Northing</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Length</b>
GAP07B1008	1001	619246.2	5695982.1	38 52 36.962 S	148 22 28.924 E	
(1001-1016)	2095	625550.1	5715501.9	38 42 00.740 S	148 26 37.687 E	20512.5
GAP07B1024	1006	619655.6	5695948.4	38 52 37.855 S	148 22 45.933 E	
(1017-1032)	2095	625930.8	5715379	38 42 04.532 S	148 26 53.521 E	20418.7
GAP07B1040	1011	620065.1	5695914.7	38 52 38.747 S	148 23 02.943 E	
(1033-1048)	2094	626305.7	5715238.2	38 42 08.905 S	148 27 09.129 E	20306.2
GAP07B1056	1015	620468.8	5695863.1	38 52 40.220 S	148 23 19.725 E	
(1049-1064)	2094	626686.3	5715115.3	38 42 12.696 S	148 27 24.964 E	20231.3
GAP07B1072	1020	620878.2	5695829.4	38 52 41.112 S	148 23 36.735 E	
(1065-1080)	2094	627066.9	5714992.3	38 42 16.486 S	148 27 40.799 E	20137.5
GAP07B1088	1025	621287.7	5695795.7	38 52 42.002 S	148 23 53.745 E	
(1081-1096)	2094	627447.6	5714869.4	38 42 20.276 S	148 27 56.635 E	20043.7
GAP07B1104	1030	621697.1	5695761.9	38 52 42.892 S	148 24 10.755 E	
(1097-1112)	2094	627828.2	5714746.5	38 42 24.065 S	148 28 12.471 E	19950
GAP07B1120	1034	622100.8	5695710.4	38 52 44.362 S	148 24 27.538 E	
(1113-1128)	2094	628208.9	5714623.5	38 42 27.853 S	148 28 28.308 E	19875
GAP07B1136	1039	622510.3	5695676.7	38 52 45.250 S	148 24 44.548 E	
(1129-1144)	2094	628589.5	5714500.6	38 42 31.641 S	148 28 44.145 E	19781.2
GAP07B1152	1044	622919.7	5695643	38 52 46.138 S	148 25 01.558 E	
(1145-1160)	2094	628970.1	5714377.7	38 42 35.428 S	148 28 59.983 E	19687.5
GAP07B1168	1048	623323.4	5695591.4	38 52 47.607 S	148 25 18.341 E	
(1161-1176)	2094	629350.8	5714254.8	38 42 39.215 S	148 29 15.821 E	19612.5
GAP07B1184	1053	623732.9	5695557.7	38 52 48.493 S	148 25 35.352 E	
(1177-1192)	2094	629731.4	5714131.8	38 42 43.001 S	148 29 31.660 E	19518.7
GAP07B1200	1058	624142.3	5695524	38 52 49.378 S	148 25 52.363 E	
(1193-1208)	2093	630106.3	5713991.1	38 42 47.368 S	148 29 47.272 E	19406.3
GAP07B1216	1063	624551.8	5695490.2	38 52 50.263 S	148 26 09.374 E	
(1209-1224)	2093	630487	5713868.1	38 42 51.153 S	148 30 03.112 E	19312.5
GAP07B1232	1067	624955.5	5695438.7	38 52 51.729 S	148 26 26.157 E	
(1225-1240)	2093	630867.6	5713745.2	38 42 54.937 S	148 30 18.952 E	19237.5
GAP07B1248	1072	625364.9	5695405	38 52 52.613 S	148 26 43.169 E	
(1241-1256)	2093	631248.2	5713622.3	38 42 58.720 S	148 30 34.792 E	19143.8
GAP07B1264	1077	625774.4	5695371.3	38 52 53.495 S	148 27 00.180 E	
(1257-1272)	2093	631628.9	5713499.3	38 43 02.503 S	148 30 50.633 E	19050
GAP07B1280	1081	626178.1	5695319.7	38 52 54.959 S	148 27 16.964 E	
(1273-1288)	2093	632009.5	5713376.4	38 43 06.286 S	148 31 06.474 E	18975
GAP07B1296	1086	626587.5	5695286	38 52 55.841 S	148 27 33.975 E	
(1289-1304)	2093	632390.2	5713253.5	38 43 10.067 S	148 31 22.316 E	18881.3
GAP07B1312	1091	626997	5695252.3	38 52 56.721 S	148 27 50.987 E	
(1305-1320)	2093	632770.8	5713130.5	38 43 13.849 S	148 31 38.158 E	18787.5
GAP07B1328	1096	627406.4	5695218.5	38 52 57.601 S	148 28 07.998 E	
(1321-1336)	2093	633151.4	5713007.6	38 43 17.629 S	148 31 54.001 E	18693.8
GAP07B1344	1100	627810.1	5695167	38 52 59.062 S	148 28 24.783 E	
(1337-1352)	2093	633532.1	5712884.7	38 43 21.409 S	148 32 09.844 E	18618.8
GAP07B1360	1105	628219.6	5695133.3	38 52 59.941 S	148 28 41.795 E	
(1353-1368)	2092	633907	5712743.9	38 43 25.770 S	148 32 25.461 E	18506.2
GAP07B1376	1110	628629	5695099.6	38 53 00.819 S	148 28 58.807 E	
(1369-1384)	2092	634287.6	5712621	38 43 29.549 S	148 32 41.305 E	18412.5
GAP07B1392	1114	629032.7	5695048	38 53 02.278 S	148 29 15.592 E	
(1385-1400)	2092	634668.3	5712498.1	38 43 33.327 S	148 32 57.150 E	18337.5
GAP07B1408	1119	629442.2	5695014.3	38 53 03.155 S	148 29 32.604 E	
(1401-1416)	2092	635048.9	5712375.1	38 43 37.104 S	148 33 12.994 E	18243.7

Line ID	SP	Easting	Northing	Latitude	Longitude	Length
GAP07B1424	1124	629851.6	5694980.6	38 53 04.031 S	148 29 49.616 E	
(1417-1432)	2092	635429.5	5712252.2	38 43 40.881 S	148 33 28.840 E	18150
GAP07B1440	1129	630261.1	5694946.8	38 53 04.906 S	148 30 06.629 E	
(1433-1448)	2092	635810.2	5712129.3	38 43 44.658 S	148 33 44.686 E	18056.2
GAP07B1456	1133	630664.8	5694895.3	38 53 06.362 S	148 30 23.414 E	
(1449-1464)	2092	636190.8	5712006.3	38 43 48.433 S	148 34 00.532 E	17981.2
GAP07B1472	1138	631074.2	5694861.6	38 53 07.236 S	148 30 40.427 E	
(1465-1480)	1964	635833.9	5709599.6	38 45 06.684 S	148 33 47.456 E	15487.5
GAP07B1488	1143	631483.7	5694827.9	38 53 08.109 S	148 30 57.439 E	
(1481-1496)	1963	636208.8	5709458.8	38 45 11.041 S	148 34 03.081 E	15375
GAP07B1504	1147	631887.4	5694776.3	38 53 09.563 S	148 31 14.225 E	
(1497-1512)	1963	636589.4	5709335.9	38 45 14.816 S	148 34 18.933 E	15300
GAP07B1520	1152	632296.8	5694742.6	38 53 10.435 S	148 31 31.238 E	
(1513-1528)	1962	636964.3	5709195.1	38 45 19.172 S	148 34 34.559 E	15187.5
GAP07B1536	1157	632706.3	5694708.9	38 53 11.306 S	148 31 48.251 E	
(1529-1544)	1962	637344.9	5709072.2	38 45 22.946 S	148 34 50.412 E	15093.8
GAP07B1552	1162	633115.7	5694675.1	38 53 12.177 S	148 32 05.264 E	
(1545-1560)	1961	637719.8	5708931.4	38 45 27.300 S	148 35 06.039 E	14981.3
GAP07B1568	1166	633519.4	5694623.6	38 53 13.628 S	148 32 22.051 E	
(1561-1576)	1961	638100.5	5708808.5	38 45 31.073 S	148 35 21.893 E	14906.3
GAP07B1584	1171	633928.9	5694589.9	38 53 14.497 S	148 32 39.064 E	
(1577-1592)	1960	638475.3	5708667.7	38 45 35.427 S	148 35 37.521 E	14793.8
GAP07B1600	1176	634338.3	5694556.2	38 53 15.366 S	148 32 56.078 E	
(1593-1608)	1960	638856	5708544.8	38 45 39.198 S	148 35 53.376 E	14700
GAP07B1616	1180	634742	5694504.6	38 53 16.815 S	148 33 12.865 E	
(1609-1624)	1959	639230.9	5708404	38 45 43.550 S	148 36 09.005 E	14606.3
GAP07B1632	1185	635151.5	5694470.9	38 53 17.682 S	148 33 29.878 E	
(1625-1640)	1958	639605.7	5708263.2	38 45 47.902 S	148 36 24.635 E	14493.8
GAP07B1648	1190	635560.9	5694437.2	38 53 18.548 S	148 33 46.892 E	
(1641-1656)	1958	639986.4	5708140.3	38 45 51.672 S	148 36 40.491 E	14400
GAP07B1664	1195	635970.4	5694403.4	38 53 19.414 S	148 34 03.906 E	
(1657-1672)	1957	640361.3	5707999.5	38 45 56.022 S	148 36 56.122 E	14287.5
GAP07B1680	1199	636374.1	5694351.9	38 53 20.861 S	148 34 20.693 E	
(1673-1688)	1957	640741.9	5707876.6	38 45 59.791 S	148 37 11.979 E	14212.5
GAP07B1696	1204	636783.5	5694318.2	38 53 21.725 S	148 34 37.708 E	
(1689-1704)	1956	641116.8	5707735.8	38 46 04.140 S	148 37 27.610 E	14100
GAP07B1712	1209	637193	5694284.5	38 53 22.588 S	148 34 54.722 E	
(1705-1720)	1956	641497.4	5707612.9	38 46 07.907 S	148 37 43.468 E	14006.3
GAP07B1728	1213	637596.7	5694232.9	38 53 24.033 S	148 35 11.510 E	
(1721-1736)	1955	641872.3	5707472.1	38 46 12.256 S	148 37 59.101 E	13912.5
GAP07B1744	1218	638006.1	5694199.2	38 53 24.895 S	148 35 28.524 E	
(1737-1752)	1955	642252.9	5707349.2	38 46 16.021 S	148 38 14.960 E	13818.7
GAP07B1760	1223	638415.6	5694165.5	38 53 25.757 S	148 35 45.538 E	
(1753-1768)	1954	642627.8	5707208.4	38 46 20.368 S	148 38 30.593 E	13706.3
GAP07B1776	1228	638825	5694131.7	38 53 26.617 S	148 36 02.553 E	
(1769-1784)	3205	650217.1	5729406.6	38 34 15.993 S	148 43 27.673 E	37068.8
GAP07B1792	1232	639228.7	5694080.2	38 53 28.059 S	148 36 19.341 E	
(1785-1800)	3205	650597.8	5729283.6	38 34 19.747 S	148 43 43.491 E	36993.8
GAP07B1808	1237	639638.2	5694046.5	38 53 28.919 S	148 36 36.356 E	
(1801-1816)	3205	650978.4	5729160.7	38 34 23.501 S	148 43 59.311 E	36900
GAP07B1824	1242	640047.6	5694012.8	38 53 29.777 S	148 36 53.371 E	
(1817-1832)	3205	651359	5729037.8	38 34 27.254 S	148 44 15.130 E	36806.3
GAP07B1840	1246	640451.3	5693961.2	38 53 31.217 S	148 37 10.160 E	
(1833-1848)	3205	651739.7	5728914.8	38 34 31.007 S	148 44 30.951 E	36731.3
GAP07B1856	1251	640860.8	5693927.5	38 53 32.075 S	148 37 27.175 E	
(1849-1864)	3205	652120.3	5728791.9	38 34 34.759 S	148 44 46.771 E	36637.5

Line ID	SP	Easting	Northing	Latitude	Longitude	Length
GAP07B1872	1256	641270.2	5693893.8	38 53 32.931 S	148 37 44.190 E	
(1865-1880)	3205	652501	5728669	38 34 38.510 S	148 45 02.592 E	36543.8
GAP07B1888	1261	641679.7	5693860	38 53 33.787 S	148 38 01.205 E	
(1881-1896)	3205	652881.6	5728546.1	38 34 42.261 S	148 45 18.414 E	36450
GAP07B1904	1265	642083.4	5693808.5	38 53 35.224 S	148 38 17.995 E	
(1897-1912)	3205	653262.3	5728423.1	38 34 46.011 S	148 45 34.235 E	36375
GAP07B1920	1270	642492.8	5693774.8	38 53 36.079 S	148 38 35.010 E	
(1913-1928)	3205	653642.9	5728300.2	38 34 49.761 S	148 45 50.058 E	36281.3
GAP07B1936	1275	642902.3	5693741.1	38 53 36.933 S	148 38 52.026 E	
(1929-1944)	3181	653885.2	5727749	38 35 07.482 S	148 46 00.508 E	35737.5
GAP07B1952	1279	643306	5693689.5	38 53 38.368 S	148 39 08.816 E	
(1945-1960)	3112	653868.3	5726395	38 35 51.402 S	148 46 00.883 E	34368.8
GAP07B1968	1284	643715.4	5693655.8	38 53 39.221 S	148 39 25.832 E	
(1961-1976)	3043	653851.3	5725040.9	38 36 35.322 S	148 46 01.260 E	32981.2
GAP07B1984	1289	644124.9	5693622.1	38 53 40.072 S	148 39 42.847 E	
(1977-1992)	2974	653834.4	5723686.8	38 37 19.242 S	148 46 01.636 E	31593.7
GAP07B2000	1294	644534.3	5693588.3	38 53 40.923 S	148 39 59.863 E	
(1993-2008)	2904	653811.6	5722314.9	38 38 03.744 S	148 46 01.789 E	30187.5
GAP07B2016	1298	644938	5693536.8	38 53 42.356 S	148 40 16.654 E	
(2009-2024)	2835	653794.7	5720960.9	38 38 47.663 S	148 46 02.167 E	28818.8
GAP07B2032	1303	645347.5	5693503.1	38 53 43.206 S	148 40 33.670 E	
(2025-2040)	2766	653777.7	5719606.8	38 39 31.583 S	148 46 02.545 E	27431.2
GAP07B2048	1308	645756.9	5693469.4	38 53 44.055 S	148 40 50.686 E	
(2041-2056)	2697	653760.8	5718252.7	38 40 15.502 S	148 46 02.923 E	26043.8
GAP07B2064	1312	646160.6	5693417.8	38 53 45.485 S	148 41 07.477 E	
(2057-2072)	2628	653743.8	5716898.7	38 40 59.421 S	148 46 03.302 E	24675
GAP07B2080	1317	646570.1	5693384.1	38 53 46.333 S	148 41 24.494 E	
(2073-2088)	2559	653726.9	5715544.6	38 41 43.340 S	148 46 03.681 E	23287.5
GAP07B2096	1322	646979.5	5693350.4	38 53 47.180 S	148 41 41.510 E	
(2089-2104)	2490	653709.9	5714190.5	38 42 27.259 S	148 46 04.061 E	21900
GAP07B2112	1327	647389	5693316.6	38 53 48.026 S	148 41 58.527 E	
(2105-2120)	2421	653692.9	5712836.4	38 43 11.178 S	148 46 04.441 E	20512.5
GAP07B2128	1331	647792.7	5693265.1	38 53 49.454 S	148 42 15.318 E	
(2121-2136)	2352	653676	5711482.4	38 43 55.097 S	148 46 04.821 E	19143.7
GAP07B2144	1336	648202.1	5693231.4	38 53 50.299 S	148 42 32.335 E	
(2137-2152)	2283	653659	5710128.3	38 44 39.016 S	148 46 05.202 E	17756.2
GAP07B2160	1341	648611.6	5693197.7	38 53 51.143 S	148 42 49.352 E	
(2153-2168)	2214	653642.1	5708774.2	38 45 22.935 S	148 46 05.583 E	16368.7
GAP07B2176	1345	649015.3	5693146.1	38 53 52.569 S	148 43 06.144 E	
(2169-2184)	2145	653625.1	5707420.2	38 46 06.853 S	148 46 05.965 E	15000
GAP07B2192	1350	649424.7	5693112.4	38 53 53.411 S	148 43 23.161 E	
(2185-2200)	2075	653602.4	5706048.3	38 46 51.354 S	148 46 06.122 E	13593.7
GAP07B2208	1355	649834.2	5693078.7	38 53 54.254 S	148 43 40.178 E	
(2201-2216)	2006	653585.4	5704694.2	38 47 35.273 S	148 46 06.505 E	12206.2
GAP07B2224	1360	650243.6	5693044.9	38 53 55.095 S	148 43 57.195 E	
(2217-2232)	1937	653568.5	5703340.1	38 48 19.191 S	148 46 06.888 E	10818.7

## 2 SYNOPSIS

### 2.1 OVERVIEW

The survey consisted of 77 pre-plotted lines with a total of 649.21 full fold square kilometres over the Elver 3D survey area located offshore Sale, Victoria in the Gippsland Basin. A final total of 1643.53125 full fold kilometres of surface coverage equivalent to 657.4125 full fold square kilometres were recorded.

The vessel used was the M/V Western Trident, which is a purpose built vessel owned by WesternGeco. The streamers, recording system and navigation performed satisfactorily. When weather conditions permitted the workboat was used for any streamer work, reducing down time appreciably.

The survey commenced with line GAP07B1008P001 on the 4th of April but due to a navigation system lock the first 44 shotpoints of the line were missed. The second sequence also had 125 shotpoints missed at the start of the line due to the positioning network and GPS systems crashing. Leakage was evident on the bird line, which was causing intermittent compass data on streamers 7 & 8. Recording during line run-ins and run-outs is only being done on the Southern end of prospect.

A helicopter crew change was conducted in the afternoon for the OMS Maritime crew on the 7th of April and the Lady Roula went in to Lakes Entrance for re-supply.

The workboat was launched twice for streamer maintenance on the 8th of April. Two birds were changed on cable 5 as well as MSX module 10 on cable 2 which failed the daily instrument test. The tail buoy STIC cable on streamer 4 was reconnected to the dummy section by using a CRX cable repeater module to supply power to the tail buoy. Both tail buoys 4 & 8 are now active, but still cannot be used for production since there are still no communications to their acoustic units. A pod of whales was sighted during the line change between sequences 17 & 18 at the northern end of the prospect, which caused the start of line to be delayed. All guns were shut down until they cleared the area and production resumed approximately 4.5Km down the line.

Whales were sighted again on the 9th of April during a line change on the Northern end of the prospect. The soft start of the guns was stopped twice on the line change to line GAP07B1488P024 and the start was delayed until Sp 1855. The last Whale was spotted when it passed only 500m away from the bow of the vessel.

The starboard workboat was deployed during a line change in the morning of the 10th of April to replace a section on streamer 7 but unfortunately the spare section got caught on the propeller. The operation was aborted and the workboat was recovered to carry out a complete check on its propeller. There was no serious damage found on either the section or the workboat. The port workboat was launched in the afternoon but had to be recovered to repair an exhaust cooling water problem. It was launched again once the repairs were completed to replace bird 15 on streamer 8 and to install a CRX on the tail of the same streamer to help the bird coil line leakage problem. Recording on line GAP07B1536P030 was stopped at the preplotted last shotpoint due to a fishing boat ahead. The start of this line was also delayed due to low separation between gun arrays 2 & 3 which had become tangled.

On the 11th of April, a fishing boat was spotted heading towards the Trident on a steady course and heading during the line in progress at midnight. The Bridge was not able to make contact on the VHF radio for more than an hour. When communication was eventually established the fishing vessel was requested to alter course and it complied.

The 12th of April started by recording the re-shoot lines in the western swath before moving over to start on the next swath. Sequence 38 was a re-shoot line of sequence 18 due to whale activity. Sequence 39 was a re-shoot line of sequence 8 due to auto fires array 1. Sequence 40 was a re-shoot of sequence 7 due to auto fires array 3. The workboat was launched in the morning to change section 9A on streamer 6.

The workboat was deployed twice on the 13th of April to carry out streamer maintenance. A section was changed on streamer 7 due to bird line leakage. A new patch which repaired a bug in the Trinav 3.01 system was installed. The bug computed the compass data based on a straight line rather than a chord as is the norm. Trinav 3.01 is designed for Q systems in which the distance between receiver groups is minimal and a straight line can be assumed.

The OMS Pioneer came alongside on the 14th of April in order to take as much fuel as possible before it departs back to Eden for crew change on the 18th. A total of 104.m<sup>3</sup> was received onboard before the operation was stopped due too much movement between the vessels.

The OMS pioneer came alongside again the next day to complete the fuel transfer. A total of 398 m<sup>3</sup> of fuel was transferred to Trident.

A WesternGeco Management visit consisting of John Bedingfield, Directing Manager Apache, Maurice Nessim, WG Vice President, Thomas Scoulios, WG regional Manager, Leif Larsen, WG Country Manager Australia and Richard Grattan, Navigation Supervisor was carried out on the 16th of April.

An input error which caused the wrong line name and the sequence being entered into the navigation system meant that pre-plotted line 1664 which was supposed to be shot as sequence 57 was shot as sequence 61. Sequences 57-60 had to be written off as dummy sequences. The correct line name on the SEG-D header tape for sequence 61 should be 1664P061 not 1664P057.

A difference was noticed in the current direction and speed was noticed on the 17th of April. This caused a drop in bottom speed in one direction and an increase in the other with a corresponding change in the water speed. The Southern Supporter was conducting a side scan sonar survey in the area during the night moving across the prospect NW to SE. It had finished by morning and moved away.

Sequence 68 was scratched on the 18th of April after the line was processed. This was due to the swell conditions which caused noisy compass data and poor streamer control. At start of sequence 72, Navpr1 crashed which meant that the data for water speed, the Shot Log and Source DC were unable to be recorded until the system was rebooted shortly after the line start.

Poor comparisons during the line changes on the port cables has been resolved after WesternGeco in Oslo reported that an incorrect tracking node was being used on the tail network. The change was made prior to sequence 69 and the comparisons on the tail groups proved acceptable on this line (4-5m). Comparisons remain good on the pre-plot section of the lines. The navigation supervisor from KL is re-issuing all P1-90 from both surveys with the corrected patch to compute the chord along the streamers; the patch arrived on the Elver survey prior to sequence 039.

The vessel lost power to the starboard engine on the line change to line GAP07B1728P077 on the 20<sup>th</sup> of April. The speed dropped to 2Kts, and the Shot control was switched to time mode. The vessel had also gone off course but the engine was restarted before the preplotted line commenced. The workboat was launched during the morning to change a compass/bird.

Recording of infill lines started on the 21<sup>st</sup> of April with sequence 84 being recorded as reshoot of sequence 046 (TRINAV crash) and then continued as infill coverage. Sequence 85 was recorded combining three parts. The first part was a reshoot of sequence 63 (helicopter operations). This was followed by infill and then continued with a reshoot of sequence (main engine problem). The OMS Pioneer came alongside to offload shipments and transfer fuel after arriving back on site.

The weather picked up during the night of the 23rd of April with strong near gale force South Easterly winds and rough, choppy seas and swell from the South. The seismic data were affected by swell bursts and noisier compass data. The streamer depth control was unstable during sequence 97 with streamer 7 coming to the surface for a portion of the line but fortunately the data from this streamer was not needed in the coverage so it was edited and the line was accepted. Sequence 96 was started as a reshoot of sequence 24 due to whales activity and the continued as infill. Sequence 98 was started as a reshoot of sequence 30 due to Source separation. The OMS Pioneer was released again at 09:45 to proceed to Eden to pick up fresh provisions.

A made a decision during the night to add two more infill lines which caused a very long line change and extended the end of job by at least 12hrs. The last shotpoint of the survey was at 16:24 on line GAP07B1904J101.

The vessel then commenced to recover and reconfigure the streamers before proceeding to the Santos 3D survey area.

## 2.2 SURVEY PRODUCTION BY LINE

Seq	Line	Dir	FCSP	LCSP	KM	KMFF	CMP	SQKMFF
001	GAP07B1008P001	017	1053	2202	21.56250	19.55625	345.00000	7.822500
002	GAP07B1312P002	197	2046	433	30.26250	17.92500	484.20000	7.170000
003	GAP07B1024P003	017	1006	2462	27.31875	20.43750	437.10000	8.175000
004	GAP07B1328P004	197	2093	654	27.00000	18.71250	432.00000	7.485000
005	GAP07B1040P005	017	1011	2431	26.64375	20.32500	426.30000	8.130000
006	GAP07B1344P006	197	2093	572	28.53750	18.63750	456.60000	7.455000
007	GAP07B1056P007	017	1015	1204	3.56250	3.56250	57.00000	1.425000
007	GAP07B1056P007	017	1960	2431	8.85000	2.53125	141.60000	1.012500
008	GAP07B1360P008	197	2092	1332	14.26875	14.26875	228.30000	5.707500
009	GAP07B1072P009	017	1020	2431	26.47500	20.15625	423.60000	8.062500
010	GAP07B1376P010	197	2092	524	29.41875	18.43125	470.70000	7.372500
011	GAP07B1088P011	017	1025	2431	26.38125	20.06250	422.10000	8.025000
012	GAP07B1392P012	197	2092	650	27.05625	18.35625	432.90000	7.342500
013	GAP07B1104P013	017	1030	2431	26.28750	19.96875	420.60000	7.987500
014	GAP07B1408P014	197	2092	640	27.24375	18.26250	435.90000	7.305000
015	GAP07B1120P015	017	1034	2431	26.21250	19.89375	419.40000	7.957500
016	GAP07B1424P016	197	2092	1849	4.57500	4.57500	73.20000	1.830000
016	GAP07B1424P016	197	1848	640	22.66875	13.59375	362.70000	5.437500
017	GAP07B1136P017	017	1039	2424	25.98750	19.80000	415.80000	7.920000
018	GAP07B1440P018	197	1853	1022	15.60000	13.59375	249.60000	5.437500
019	GAP07B1152P019	017	1044	2431	26.02500	19.70625	416.40000	7.882500
020	GAP07B1456P020	197	2092	670	26.68125	18.00000	426.90000	7.200000
021	GAP07B1168P021	017	1048	1613	10.61250	10.61250	169.80000	4.245000
021	GAP07B1168P021	017	1614	2419	15.11250	9.01875	241.80000	3.607500
022	GAP07B1472P022	197	1964	620	25.21875	15.50625	403.50000	6.202500
023	GAP07B1184P023	017	1053	2431	25.85625	19.53750	413.70000	7.815000
024	GAP07B1488P024	197	1855	680	22.05000	13.36875	352.80000	5.347500
025	GAP07B1200P025	017	1058	2430	25.74375	19.42500	411.90000	7.770000
026	GAP07B1504P026	197	1963	660	24.45000	15.31875	391.20000	6.127500
027	GAP07B1216P027	017	1063	2430	25.65000	19.33125	410.40000	7.732500
028	GAP07B1520P028	197	1962	1045	17.21250	15.20625	275.40000	6.082500
029	GAP07B1232P029	017	1067	2430	25.57500	19.25625	409.20000	7.702500
030	GAP07B1536P030	197	1688	1050	11.98125	9.97500	191.70000	3.990000
031	GAP07B1248P031	017	1072	2430	25.48125	19.16250	407.70000	7.665000
032	GAP07B1552P032	197	1961	1584	7.08750	7.08750	113.40000	2.835000
032	GAP07B1552P032	197	1583	625	17.98125	7.91250	287.70000	3.165000
033	GAP07B1264P033	017	1077	2430	25.38750	19.06875	406.20000	7.627500
034	GAP07B1568P034	197	1961	631	24.95625	14.92500	399.30000	5.970000
035	GAP07B1280P035	017	1081	2430	25.31250	18.99375	405.00000	7.597500
036	GAP07B1584P036	197	1960	731	23.06250	14.81250	369.00000	5.925000
037	GAP07B1296P037	017	1086	2376	24.20625	18.90000	387.30000	7.560000
038	GAP07B1440A038	197	2092	1844	4.66875	4.48125	74.70000	1.792500
039	GAP07B1360A039	197	1331	765	10.63125	4.25625	170.10000	1.702500
040	GAP07B1056A040	017	1205	1939	13.78125	14.15625	220.50000	5.662500
041	GAP07B1600P041	197	1960	700	23.64375	14.71875	378.30000	5.887500
042	GAP07B1920P042	017	1270	3542	42.61875	36.30000	681.90000	14.520000
043	GAP07B1776P043	197	3205	2466	13.87500	13.87500	222.00000	5.550000
043	GAP07B1776P043	197	2465	1121	25.21875	23.21250	403.50000	9.285000
044	GAP07B2096P044	017	1322	2789	27.52500	21.91875	440.40000	8.767500
045	GAP07B1616P045	197	1959	1073	16.63125	14.62500	266.10000	5.850000
046	GAP07B1936P046	017	1346	3288	36.43125	34.42500	582.90000	13.770000
047	GAP07B1792P047	197	3205	2046	21.75000	21.75000	348.00000	8.700000
047	GAP07B1792P047	197	2045	695	25.33125	15.26250	405.30000	6.105000

Seq Line	Dir	FCSP	LCSP	KM	KMFF	CMP	SQKMFF
048 GAP07B2112P048	017	1327	2758	26.85000	20.53125	429.60000	8.212500
049 GAP07B1632P049	197	1958	1078	16.51875	14.51250	264.30000	5.805000
050 GAP07B1952P050	017	1279	3449	40.70625	34.38750	651.30000	13.755000
051 GAP07B1808P051	197	3205	1783	26.68125	26.68125	426.90000	10.672500
051 GAP07B1808P051	197	1782	755	19.27500	10.23750	308.40000	4.095000
052 GAP07B2128P052	017	1331	2675	25.21875	19.16250	403.50000	7.665000
053 GAP07B1648P053	197	1958	1083	16.42500	14.41875	262.80000	5.767500
054 GAP07B1968P054	017	1284	3380	39.31875	33.00000	629.10000	13.200000
055 GAP07B1824P055	197	3205	2727	8.98125	8.98125	143.70000	3.592500
055 GAP07B1824P055	197	2658	1150	28.29375	26.56875	452.70000	10.627500
055 GAP07B1824P055	197	1149	787	6.80625	0.00000	108.90000	0.000000
056 GAP07B2144P056	017	1336	2620	24.09375	17.77500	385.50000	7.110000
061 GAP07B1664P061	197	1957	722	23.17500	14.30625	370.80000	5.722500
062 GAP07B1984P062	017	1289	3311	37.93125	31.61250	606.90000	12.645000
063 GAP07B1840P063	197	3011	1139	35.11875	33.11250	561.90000	13.245000
064 GAP07B2160P064	017	1341	2551	22.70625	16.38750	363.30000	6.555000
065 GAP07B1680P065	197	1957	1092	16.23750	14.23125	259.80000	5.692500
066 GAP07B2000P066	017	1294	3241	36.52500	30.20625	584.40000	12.082500
067 GAP07B1856P067	197	3205	791	45.28125	36.65625	724.50000	14.662500
069 GAP07B1696P069	197	1956	760	22.44375	14.11875	359.10000	5.647500
070 GAP07B2016P070	017	1298	3172	35.15625	28.83750	562.50000	11.535000
071 GAP07B1872P071	197	3205	797	45.16875	36.56250	722.70000	14.625000
072 GAP07B2192P072	017	1350	2412	19.93125	13.61250	318.90000	5.445000
073 GAP07B1712P073	197	1956	732	22.96875	14.02500	367.50000	5.610000
074 GAP07B2032P074	017	1303	3103	33.76875	27.45000	540.30000	10.980000
075 GAP07B1888P075	197	3205	1154	38.47500	36.46875	615.60000	14.587500
076 GAP07B2176A076	017	1345	2482	21.33750	15.01875	341.40000	6.007500
077 GAP07B1728P077	197	1025	778	4.65000	0.00000	74.40000	0.000000
077 GAP07B1728P077	197	1955	1026	17.43750	13.93125	279.00000	5.572500
078 GAP07B2048P078	017	1335	2804	27.56250	25.55625	441.00000	10.222500
079 GAP07B1904P079	197	3205	915	42.95625	36.39375	687.30000	14.557500
080 GAP07B2208P080	017	1355	2343	18.54375	12.22500	296.70000	4.890000
084 GAP07B1936A084	017	1275	1345	1.33125	1.33125	21.30000	0.532500
085 GAP07B1840A085	197	3205	3012	3.63750	3.63750	58.20000	1.455000
085 GAP07B1840A085	197	2726	2659	1.27500	1.27500	20.40000	0.510000
087 GAP07B2224P087	017	1360	2274	17.15625	10.83750	274.50000	4.335000
088 GAP07B1744P088	197	1955	841	20.90625	13.83750	334.50000	5.535000
089 GAP07B2080P089	017	1317	2896	29.62500	23.30625	474.00000	9.322500
090 GAP07B1760P090	197	1954	725	23.06250	13.72500	369.00000	5.490000
091 GAP07B2064P091	017	1312	2965	31.01250	24.69375	496.20000	9.877500
096 GAP07B1488A096	197	1963	1856	2.02500	2.02500	32.40000	0.810000
098 GAP07B1536A098	197	1962	1761	3.78750	3.78750	60.60000	1.515000
098 GAP07B1536A098	197	1760	1689	1.35000	1.35000	21.60000	0.540000

### 2.3 SURVEY INFILL PRODUCTION BY LINE

Seq	Line	Dir	FCSP	LCSP	KM	KMFF	CMP	SQKMFF
081	GAP07B1696J081	197	1640	1097	10.20000	8.19375	163.20000	3.277500
082	GAP07B2096J082	017	1322	1797	8.92500	4.61250	142.80000	1.845000
082	GAP07B2096J082	017	1568	2420	15.99375	15.99375	255.90000	6.397500
083	GAP07B1664J083	197	1957	1088	16.31250	16.31250	261.00000	6.525000
084	GAP07B1936A084	017	1357	3100	32.70000	32.70000	523.20000	13.080000
085	GAP07B1840A085	197	3001	2737	4.96875	4.96875	79.50000	1.987500
086	GAP07B1840J086	197	2100	1139	18.03750	16.03125	288.60000	6.412500

Seq	Line	Dir	FCSPKCSPKM			KMFF	CMP	SQKMFF
089	GAP07B1536A089	197	1678	1050	11.79375	9.78750	188.70000	3.915000
092	GAP07B1584J092	197	1960	1064	16.81875	14.81250	269.10000	5.925000
093	GAP07B1168J093	017	1400	2201	15.03750	13.03125	240.60000	5.212500
094	GAP07B1360J094	197	2092	998	20.53125	18.52500	328.50000	7.410000
095	GAP07B1104J095	017	1030	2201	21.97500	19.96875	351.60000	7.987500
096	GAP07B1488A096	197	1845	1036	15.18750	13.18125	243.00000	5.272500
097	GAP07B1216J097	017	1200	2200	18.76875	16.76250	300.30000	6.705000
099	GAP07B1280J099	017	1081	2200	21.00000	18.99375	336.00000	7.597500
100	GAP07B2032J100	017	1303	2110	15.15000	15.15000	242.40000	6.060000
101	GAP07B1904J101	017	2500	3312	15.24375	13.23750	243.90000	5.295000

## 2.4 SURVEY TOTAL

### Total Survey Production - Prime

KM	KMFF	CMP	SQKMFF
2145.37500	1643.53125	34326.00000	657.412500

### Total Survey Production - Infill

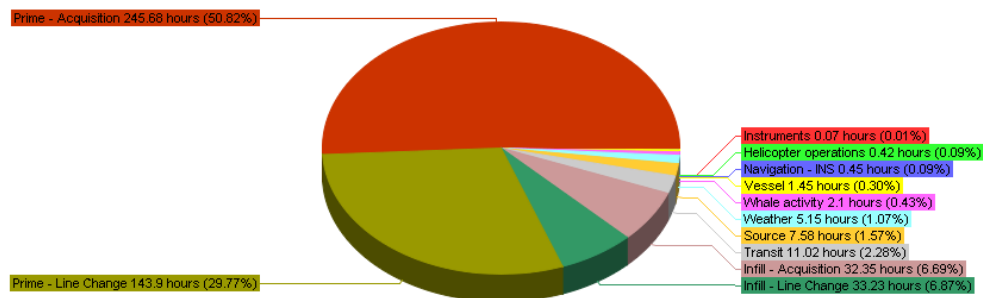
KM	KMFF	CMP	SQKMFF
278.64375	252.26250	4458.30000	100.905000

## 2.5 3D STATISTICAL SUMMARY

Code	Description	Duration
01	Prime - Acquisition	245.68
02	Prime - Line Change	143.90
03	Infill - Acquisition	32.35
04	Infill - Line Change	33.23
10	Weather	5.15
19	Transit	0.02
23	Whale activity	2.10
30	Source	7.58
33	Navigation - INS	0.45
35	Instruments	0.07
36	Vessel	1.45
41	Helicopter operations	0.42

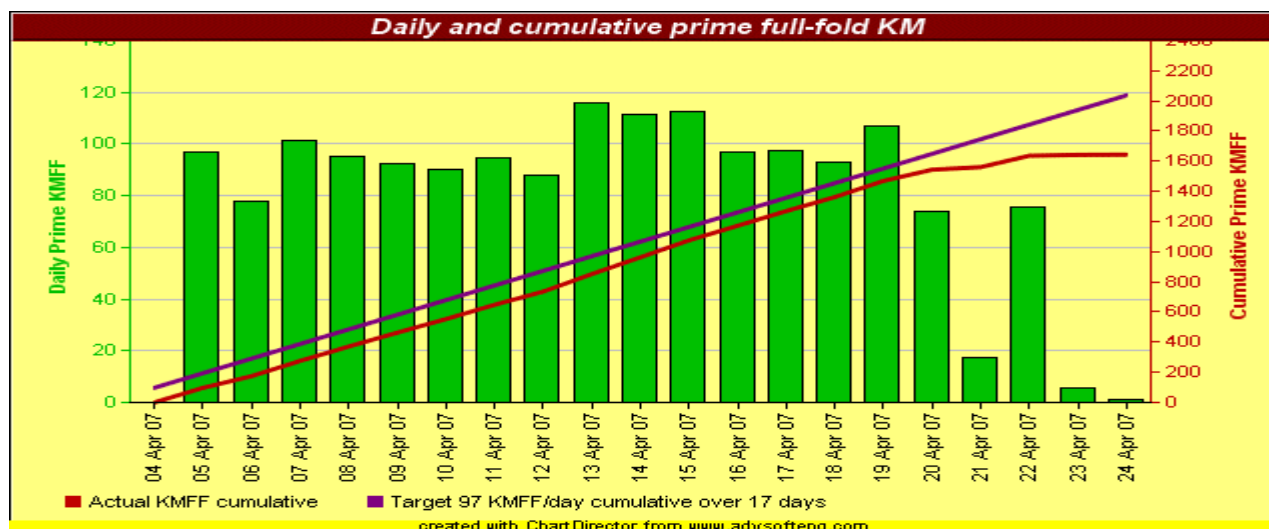
**Total Survey Timing = 472.400 Hours**

### Elver 3D - Timing Breakdown



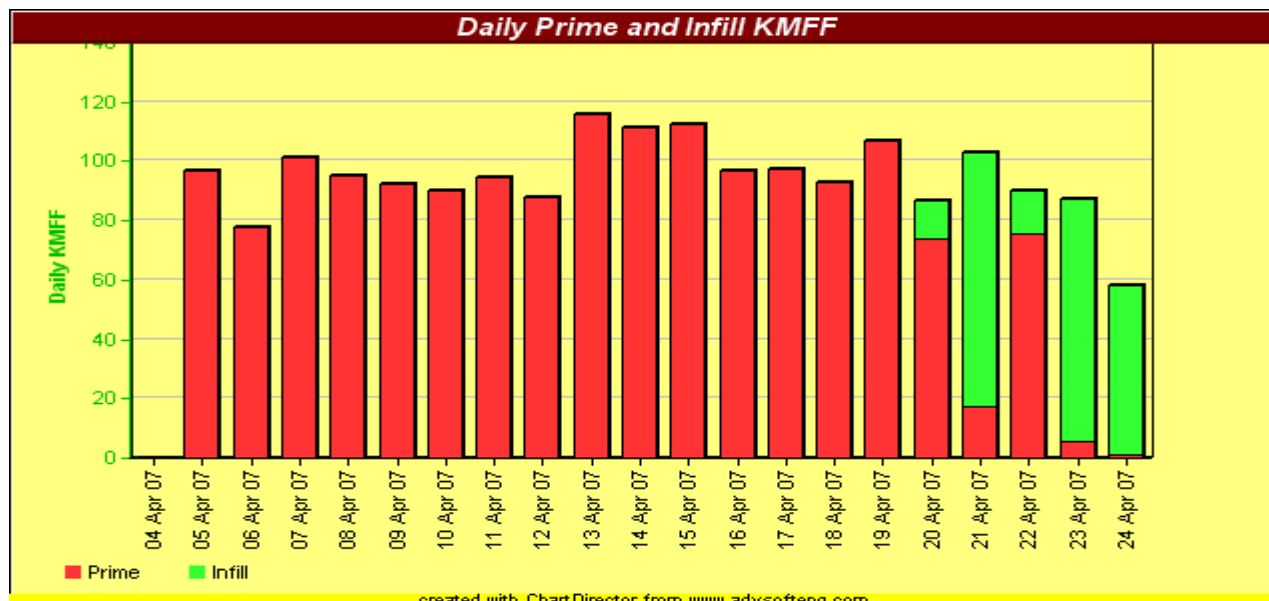
created with ChartDirector from www.advsofteng.com

### 3D Daily and Cumulative Full Fold Kilometres



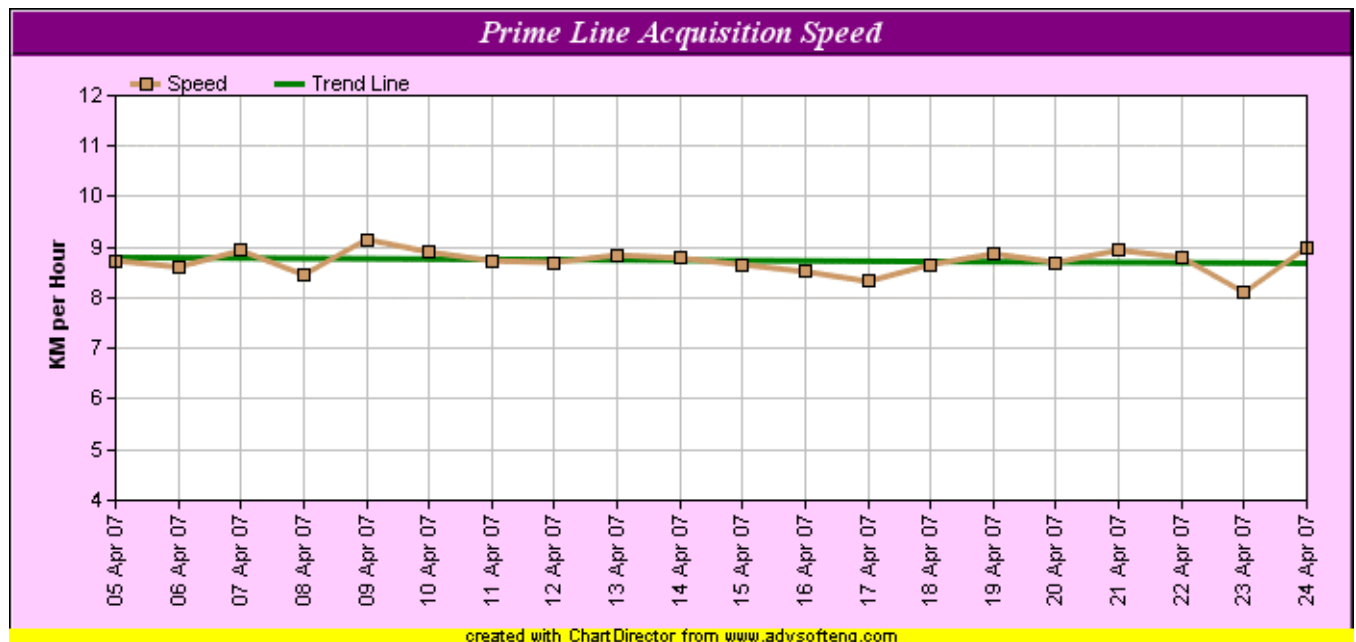
created with ChartDirector from www.advsofteng.com

### 3D Daily Prime and Infill

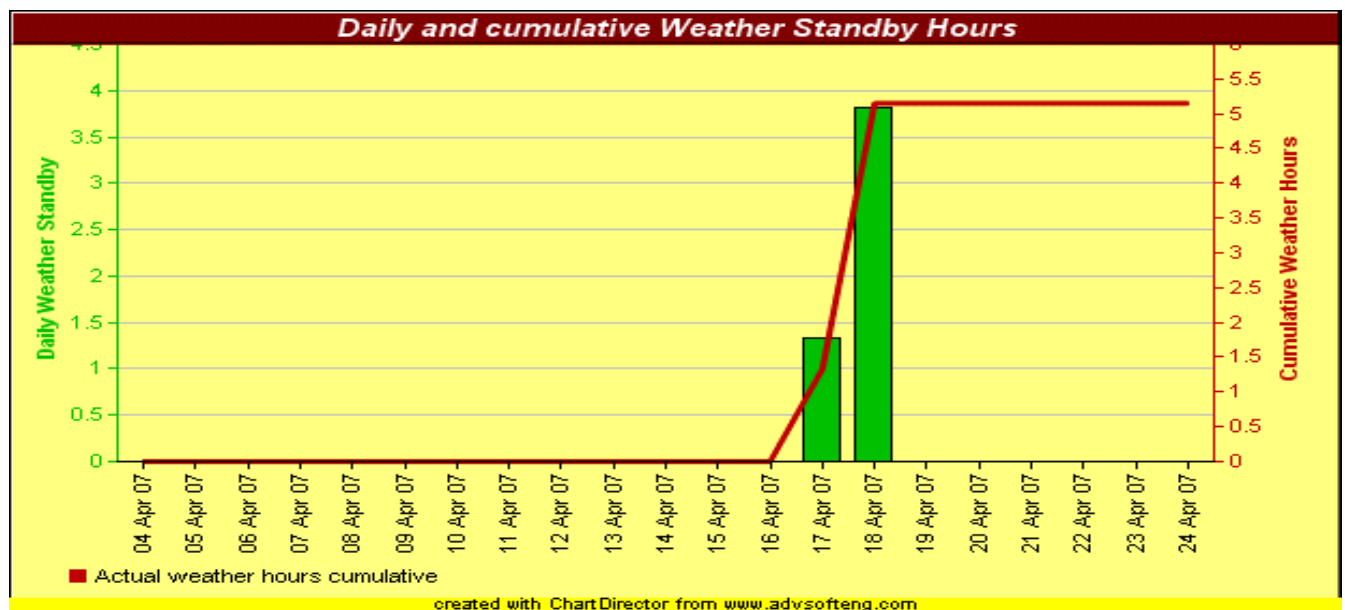


created with ChartDirector from www.advsofteng.com

### 3D Acquisition Speed



### Marie 3D Weather Standby



## 2.6 TECHNICAL SUMMARY

The following is a brief description of individual equipment performance throughout the survey:

### Recording Instruments

For this survey the Western Trident was fitted with 8 Thompson Marconi Sentry digital solid streamers interfaced to the TRILOGY acquisition system. The TRILOGY Information Manager (TIM) has a primary purpose of providing a data exchange mechanism between all of the TRILOGY subsystems. The data exchange focuses on making the important information from each TRILOGY subsystem accessible to other systems or applications reducing redundancy and manual procedures. The primary TIM user interface is called LINDA (Line Data Analyser), which allows the user to browse and edit the information stored in the database, generate reports and manage recording media.

The TRILOGY subsystem components are TRINAV, TRIACQ, TRISOR, OMEGA and Supervision. These provide a comprehensive array of real time on screen displays, showing:

#### TRIACQ

- RMS analysis of seismic data which includes, Trace RMS analysis, shot average, dynamic line average, relative sensitivity and relative source amplitude.
- SEG-D header analysis which includes Water depth, vessel speed, source pressure, source timing delay, bird depths etc.

#### Omega2 processing system

- Brute stack plot, Near Trace plots, FK plots etc (displayed with Seisview visualization tool in the Omega system).
- CMS values

A full set of daily tests was automatically carried out each day showing the recording system and streamer were within contract specification. The system generally operated faultlessly but a problem with the Seisnet1 SCSI caused a few problems with system hang ups at the start of the survey meant. A total of 10.55 hours were lost the recording instruments during the survey.

Observer's reports were automatically generated using LINDA. Faults from the recording system and array logging system were automatically generated at the completion of each line. The quality of the Observers logs was acceptable.

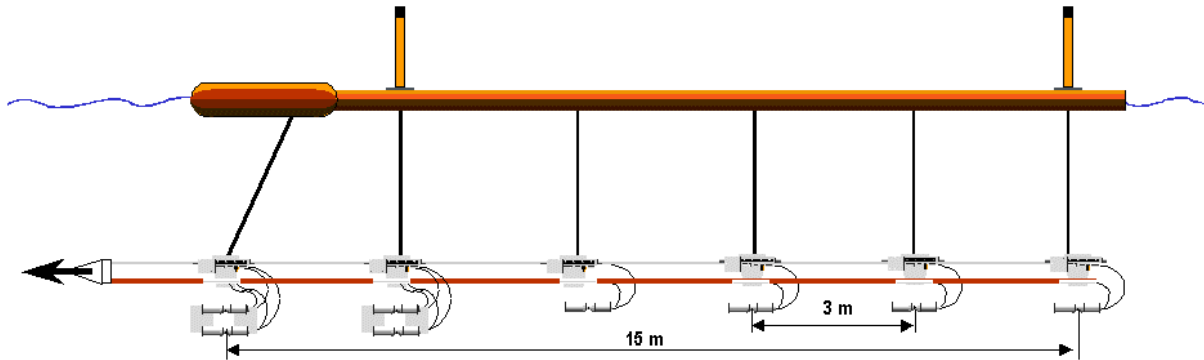
### Streamer

The Thompson Marconi Sentry digital solid streamers worked very well with only few minor problems. Several sections were replaced for bad traces during the survey by utilising the workboat.

Streamer depths were maintained at 8 metres. Noise levels on the data were monitored closely during QC processing. There was no downtime attributed to the streamers during the survey.

## Energy Source

The energy source utilised for this survey consisted of two WesternGeco 3147 in<sup>3</sup> arrays, fired alternately. Each array is composed of identically tuned Bolt gun sub-arrays operating at 2000 psi air pressure. The signature produced by the array composed of three sub-arrays has the same shape as that produced by a single sub-array while the overall acoustic output of the array is determined by the number of sub-arrays employed.



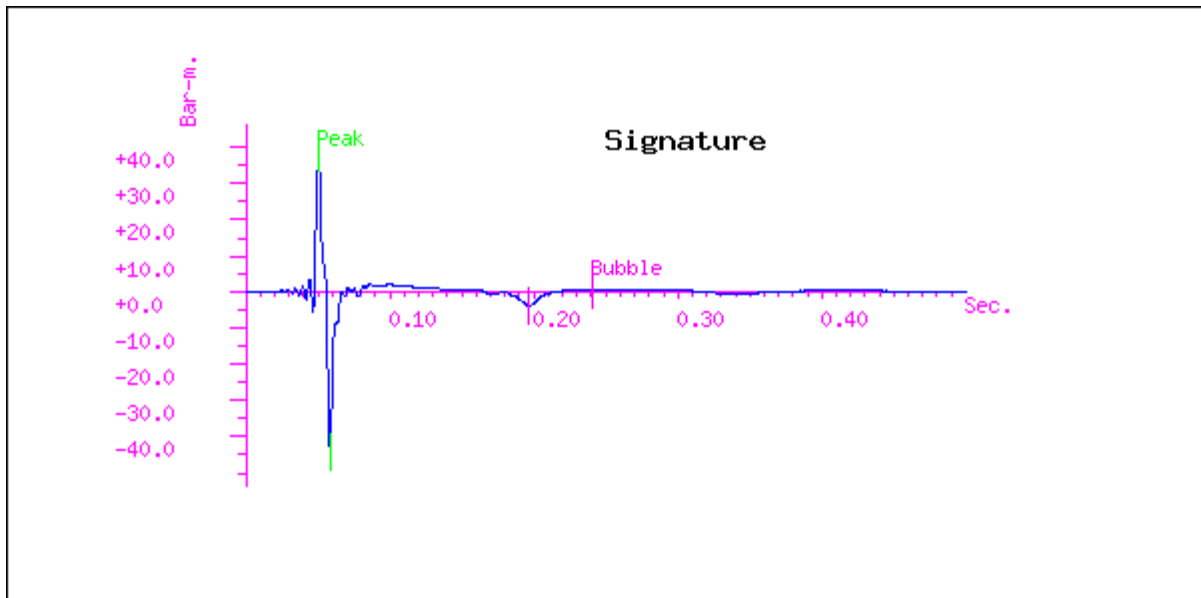
As indicated in the diagram, the sub-array is composed of six tuning elements; two 2-gun clusters and four single guns. The clusters have their component guns arranged in a fixed side-by-side fashion with the distance between the gun ports set to maximise the bubble suppression effects of clustered guns. A near-field hydrophone is mounted about 1 m above each gun station (one phone is used per cluster), one depth transducer per position is mounted on the gun's ultrabox, and a high pressure transducer is mounted at the aft end of the subarray to monitor high pressure air supply. All the data from these sensors are transmitted to the vessel for input into the onboard systems and recording to tape.

A total of 7.58 hours were lost to the source arrays during the survey. The 3147 in<sup>3</sup> array was used throughout the survey with only occasional low volume shots when single guns failed to operate. A rigorous maintenance schedule was maintained on the array strings and individual elements were replaced at the specified time regardless of their performance.

The Western Trident has three LMF compressors with a capacity of 6600 SCFM. One compressor maintained air pressure with the other two normally being rotated through to allow maintenance to be carried out. No downtime was recorded due to the compressors.

Figure 1 3147 in<sup>3</sup> Gun Array Far Field Signature

Peak to peak. in bar-m	Zero to peak in bar-m	Primary to bubble (calculated peak to peak)	Bubble period to first peak (s.)
82.7	38.2	18.1	0.1905



Band-pass filter: n4-003-200L.flt

Figure 2 Amplitude spectrum

**Amplitude spectrum. Units are db. relative to 1 microPascal / Hz. at 1m.**

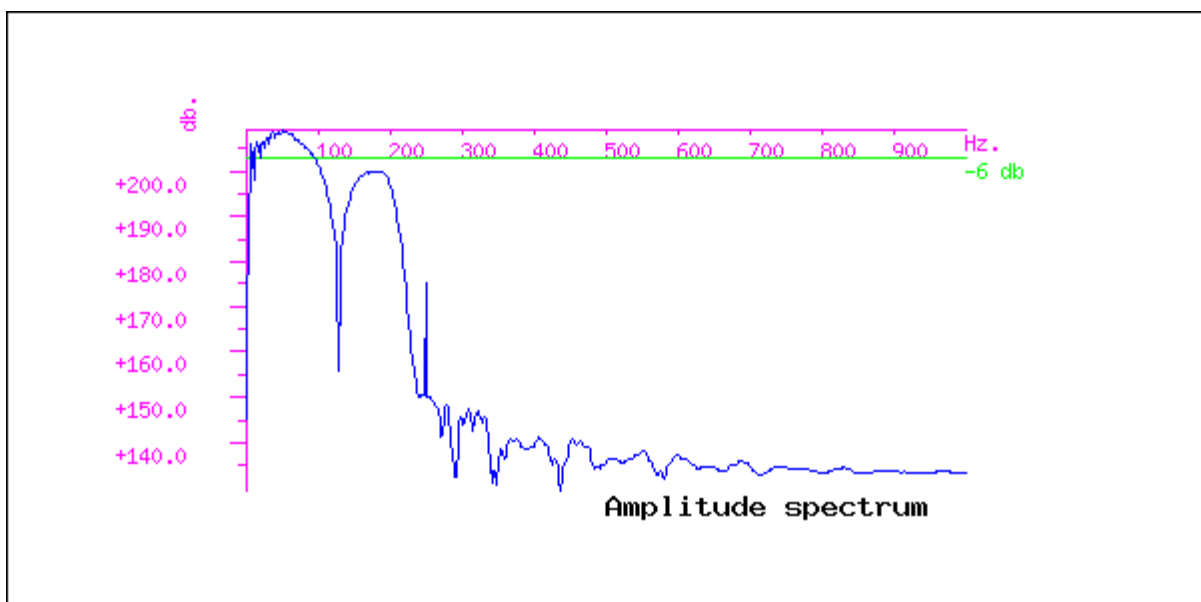
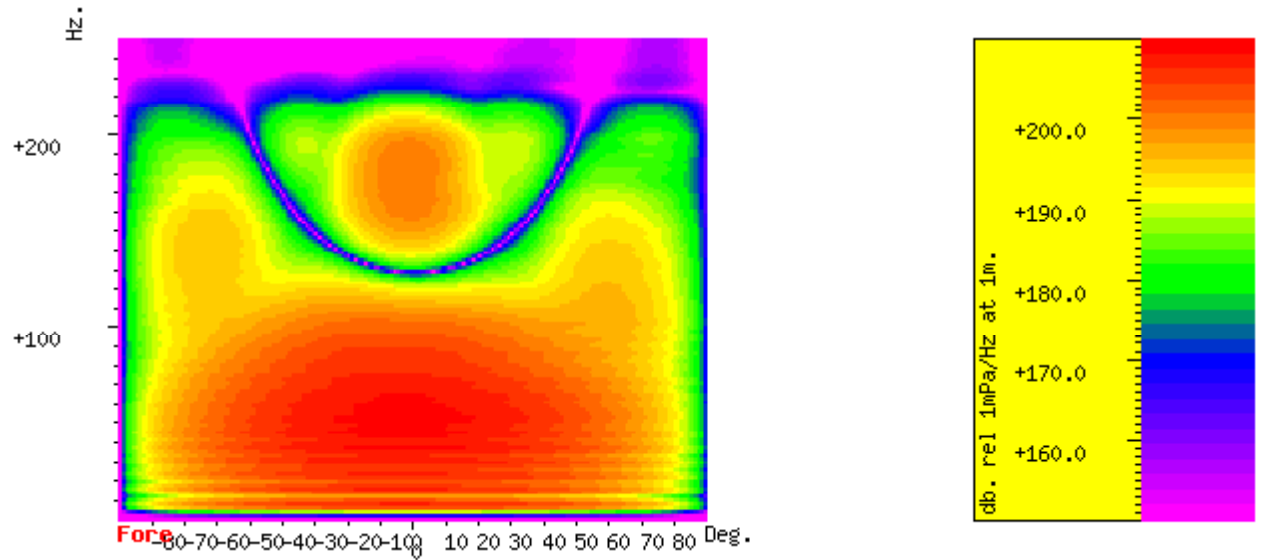
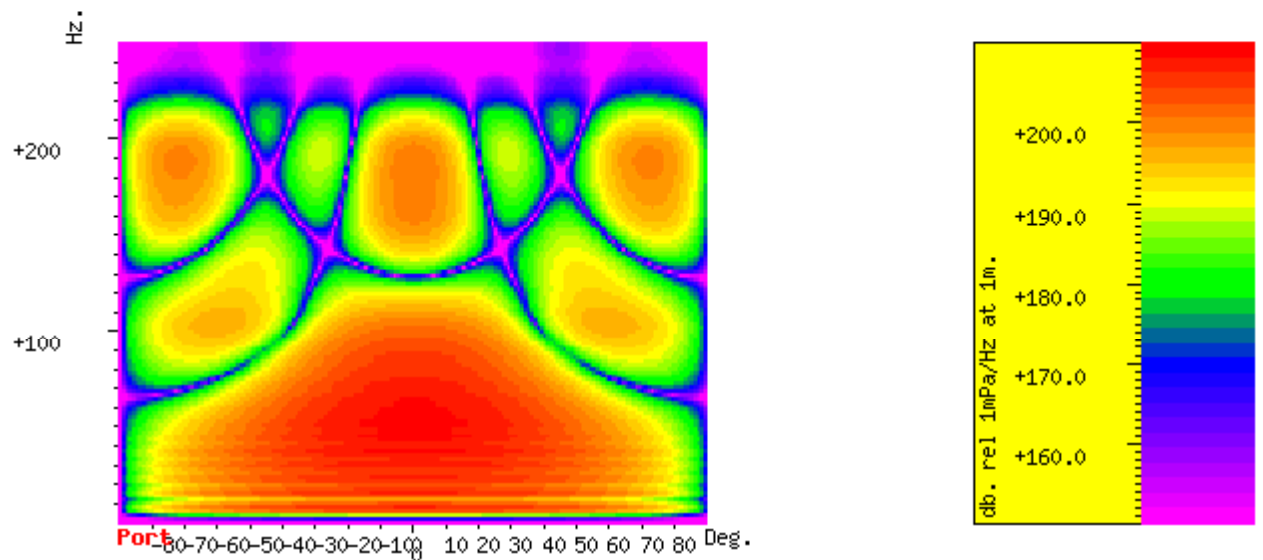


Figure 3 Source Directivity Plots

**Inline directivity, bearing = 0 degrees**



**Crossline directivity, bearing = 90 degrees**



## SEISMIC SPECIFICATIONS

### Main Particulars

Streamers	Thompson Marconi, Sentry/Guardian Solid streamer
Tow Points	16
Sub Arrays	6

### Energy Systems

Gun Controller (Type & Manufacturer)	Source Synchronizer System (SSS), Input/Output Trisor 1.5.1 WesternGeco
Guns (Manufacturer, Type & Capacities)	Bolt 1500LL and 1900 LL (30cu in to 660 cu in)
Nominal Source Pressure	2000 psi
Pressure Release	Electro-magnetic solenoid.
Sensor Return	Bolt pressure drop sensor
Timing Resolution	0.1ms
Source	1 x 8 guns, various volumes. Max 4 arrays per side
Total Compressor Capacity	6600 SCFM
Compressors (Manufacturer & Capacity)	3 x LMF Compressors
Near Field Phone (Manufacturer & Type)	WesternGeco 6 per array
Far Field Phone (Manufacturer & Type)	NA
Depth Indicators	WesternGeco 6 per array

### Streamer System

Streamer (Manufacturer & Type)	Thompson Marconi, Sentry Solid Streamer
Streamer Deflector Type	Monowing MKI and MKII
Section Breaking Strength (Typical)	60 kN
Typical Towed-streamer Stress	1000-1818 kg
Streamer Capacity (Max)	
Sentry Solid Streamer	72,000m
Streamers vs. Length (Max)	
Sentry Solid Streamer	10 x 6,000m
Streamer Spread (Max Configuration)	1050m 8 x 150m x 6000m using 6 x Monowing
Streamer Control Device	DigiCourse, 5011
(Manufacturer & Type)	
Recording System	Input/Output MSX 24A Input/Output MSX with
(Manufacturer & Type)	WesternGeco TRIACQ 5 front end

### Recording System

Format	3-byte SEG-D, 8036 rev 2
Media	IBM 3590E tape (20GIG)
Device	6 x 3590e IBM tape drives
Other Systems	MSX version 2.0111 with WesternGeco TRIACQ 5.3304 front end
Single & Multi-trace Plotter	OYO, GS624
(Manufacturer & Type)	
System	Triacq QC 3.0 WesternGeco
Software	Triacq QC
Hardware	Sun V880
System	Multi Node PC Cluster Processing System
Software	Linux Redhat 9 Omega 2.0.3.3
Hardware	3 x Dell Precision workstation 650.

Hardware (continued)	2 x INTEL SR2300 2U tape servers. 10 x IBM 3590e tape drives. 4 x Jaguar 3592e tape drives. 3 x INTEL SR2300 2U Oracle servers. 16 x IBM x330 IU processing nodes. 4.5 Tbytes total hard disk space. OYO GS-636 Thermal Plotter. OYO GS-624 Thermal Plotter. HP DesignJet 650C.
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## Navigation Systems

Instrument Room Gyrocompass (Manufacturer & Type)	Sperry, MK227
Source Positioning System (Manufacturer & Type)	Seatex, Seatrack 330
Global Positioning System (GPS) Receivers (Manufacturer & Type)	2 x Veripos Ultra Systems 1 x C & C Technologies C-Nav. 1 x C-Nav Receiver. Dual frequency. 1 x Novatel OGM3 Receiver. Dual frequency. 1 x Posnet – SARGAS Dual Frequency. 1 x Posnet – Stand Alone. 1 x TriNav GPS 1 x Trimble MS750 Receiver. Dual frequency. 3 x Trimble 4000SSE Receiver. Dual frequency.
DGPS QC System (Manufacturer & Type)	WesternGeco TRINAV 3.0
Integrated Navigation System (Manufacturer & Type)	WesternGeco TRINAV 3.0
3-D Quality Control System (Manufacturer & Type)	WesternGeco TRINAV 3.0
3-D Binning System	TRINAV 3.0 2 x Sun Blade 150 Workstation 2 x Sun Blade 1500 Workstation 2 x Sun Fire 440 Workstation
Tail Buoy (TB)	
Buoy (Manufacturer & Type)	WesternGeco T98
TB Navigation (Manufacturer & Type)	WesternGeco, Seatrack 220 GPS Unit
Onboard TB Positioning (Manufacturer & Type)	Seatrack
Ultra-short Baseline (USBL) Acoustic Positioning System (Manufacturer & Type)	NA
Acoustic Positioning System (Manufacturer & Type)	Sonardyne SIPS 2
Current Profiler (Manufacturer, Type & Frequency)	RDI, ADCP, 1.5MHz
Temperature/Salinity Dip Profiler (Manufacturer & Type)	1 x Sippican, Sippican 1 x Valeport, Mk600
Echo Sounder (Manufacturer & Type)	Simrad, EA500
Transducer Frequency & Theoretical Range	1 x 18 kHz to 8100m, 1 x 200 kHz to 740m
Transducer Draft	-7.42m

## 2.6 VESSEL

The M/V Western Trident is a purpose built vessel for seismic operations and is one of the largest vessels in the WesternGeco fleet. She was delivered in November 1999. The vessel has carried out many complex 3D surveys in various locations worldwide. She is capable of towing 12 x 6,000m TMS Sentry Solid streamers with a maximum separation of 1,200m when using the Monowings. The vessel is built to DNV+1A1 ICE-1A, EO Helideck classification and to the satisfaction of the rules and regulations of SOLAS 1974. International load line requirements are according to international load line convention of 1966.



The vessel has been well maintained over the years and is kept in a tidy and presentable condition. There are adequate numbers of showers and toilets available and the stewards worked hard to keep cabins and amenities clean. Offshore Marine Services in Australia supplied the marine crew. All seismic personnel were from various countries and contracted to WesternGeco.

The instrument room is large and well laid out with plenty of working space for all personnel. The arrays and streamer deployment area's are on separate decks with extra storage available on the top deck. The work areas are spacious with plenty of safe working space for both array mechanics and streamer handling. There are two workboats, which are situated, midship on either side of the vessel.

The galley and mess areas are clean, well laid out and maintained. House keeping on the whole was very good. Crew entertainment is provided by a well-equipped gymnasium and sauna, as well as a spacious video room and a separate day room. Communications are through Vsat and Inmarsat. The client has the option of an office close to the instrument room with network connections, phone, printer and a computer if required or may have the same set up installed in his cabin if he so desires.

**Vessel Specifications**

Ships Name	Western Trident
Call Sign	3FE09 (Three, Foxtrot, Echo Zero, Nine)
International Maritime Org. (Imo) No.	9187502
Owner	Seismic Shipping INC
Previous Name	N/A
Flag State & Port Of Registry	Panama, Panama
Panama Official No.	27927-Pext-2
Date Of Build	1-Mar-99
Yard No. And Type Of Vessel	Build 241, Type UT
Yard Built	Ulstein Shipyard, Ulsteinvik, Norway
Date Converted / Power Upgraded	11/2003 Monowing upgrade
Yard Converted	BMV Bergen
Classification Society And Class	DNV, +1A1, EO, HELDK, ICE-C
Class Id No.	20519
Classification Machinery System	PMS, CMS
Class Approved Maintenance System	TM-Master, Windows based
International Safety Management, (Ism) Code Compliance	DNV SMC. Valid until 05-Oct-11
Safe Manning Certificate (Minimum)	No.M3026 (10 crew)

**Principal Particulars**

Gross Tonnage (Grt)	8369
(Grt) National & International	8369
Gross Tonnage (Grt) Suez Canal	8862.6
Net. Reg.Ton (Nrt) Panama Canal	n/a
(Nrt) National & International	2511
Net. Reg. Ton (Nrt) Suez Canal	6913.12
Lightship Displacement	4667
Dead Weight	4568
Length Over All (Loa)	92.50m
Length Between Perpendiculars	80.10m
Breadth (Moulded)	23.00m
Breadth (Extreme)	25.00m
Depth (Moulded)	9.00m
Draft (Max)	7.30m (Summer)
Draft (Mean)	6.40m (Design)
Air Draft (To Higest Antenna)	32.70m (Summer draft)
Helicopter Deck Rating	Sikorsky S-92 / 11.0t Max
Helicopter Deck Diameter (D-Value)	22.80m
Helicopter Deck Markings Standard	CAA / CAP437 / BHAB

## Capacities and Endurance's

Cable / Towpoints / Subarrays	TMS Solid / 16 Tow Points / 10 Sub arrays
Bollard Pull	142t x 100% power
Fresh Water Capacity	446 M <sup>3</sup>
Fresh Water Maker Production	2 x 12 tons / 24 Hrs.
Potable Water System	Evaporators, 2 x Alfa Laval De-Salt.
Fuel Capacity, All Tanks Topped	3526 M <sup>3</sup>
Fuel, Useful For 100 % Consumption	3286 M <sup>3</sup>
Fuel Type	Gas oil
Fuel Tank Heating	N/A
Lub. Oil, Engine Oil (M <sup>3</sup> )	30 M <sup>3</sup>
CYLINDER OIL, HP COMPRESSORS (M <sup>3</sup> )	7 M <sup>3</sup> cylinder oil, 7 M <sup>3</sup> screw compressor oil.
CABLE OIL, KEROSENE (Clean/Dirty)	11 M <sup>3</sup> clean / 7 M <sup>3</sup> dirty
BALLAST, SEA WATER (M <sup>3</sup> )	3150 M <sup>3</sup>
Speed, Transit, Max. In Calm Sea	15 Knots
Speed, Transit Economy, Ditto	12 Knots
Consumption Of Fuel , Full Speed	36 M <sup>3</sup> / 24 Hrs
Consumption Of Fuel, Economy Speed	26 M <sup>3</sup> / 24 Hrs
Operational Endurance	86 Days (+4 days safety)
Endurance Of Fuel During Survey	85 days, operating with 10 streamers
Consumption Of Fuel In Port	3 M <sup>3</sup> / 24 Hrs
Safety Equipment Certificate	70 Persons

## Bridge Navigation Equipment

Radar No 1	FURUNO FAR 2835S (s-band)
Radar No 2	FURUNO FAR 2825 (x-band)
Radar No 3	N/A
Ecdis	Maris 9000
Gyro Compass	SIMRAD RGC 11
Auto Pilot	SIMRAD AP9 Mk3 / SJS500 Joystick/Autotrack System
Gps Receiver	2 x FURUNO GP 150
Speed Log	BEN ANTHEA Electro. Mag. Furuno DS-80 Doppler Log with bridge wing repeaters
Echo Sounder	SKIPPER GDS 101
Radio's, Vhf, GMDSS*, Type 1	3 x SAILOR RT 5022 VHF / DSC
Radio's, Vhf, GMDSS*, Type 2	3 x NAVICO AXIS 250 (portable)
Radio's, Vhf	8 x MOTOROLA GP340 (portable)
Radio's, Uhf	1 x Motorola GM 300 BASE STATION
12 x Motorola GM 328 (Portable)	
Radio Direction Finder	N/A
Weather Facsimile	FURUNO DFAX-208 Mk2
Navtex Receiver	McMURDO NAV 7
Ups, Power Supply To All GMDSS Radio's	FN Electro Converter/Charger with lead acid battery back up.
Helideck Monitoring System	SEATEX HMS 100.

**Communication Equipment, Compliant With GMDSS Requirements**

Radio Station Licence No.	06-11-2003/1 Panama
Class / Corr. Category	A1, A2, A3. GMDSS
Ship / Air Craft Radio	JOTRON TR-6101 (fixed) + 2 x Dittel FSG 5
Helicopter Beacon	SAC DS410 (410 KHz. I.D. 'T R I D')
Automatic Identification System (AIS)	SAAB 24 AIS CLASS A TRANSPONDER
Transmitter / Receiver, Main (Mf)	SKANTI TRP 9000
Transmitter / Receiver, Reserve (Mf)	N/A
Transmitter / Receiver, Main (Vhf)	3 x SAILOR RT 5022 VHF, DSC
Transmitter / Receiver, Main (Dsc)	SKANTI DSC9000 MF/HF DSC
	CONTROLLER/RECEIVER
Ais. Automatic Identification System	SAAB R4 AIS TRANSPONDER SYSTEM
Radio, Portable, VHF	8 x MOTOROLA GP340
4 x MOTOROLA GP300	
Booster Unit For Portable Radio (Uhf)	N/A
Emergency Radio Beacon (Epirb)	JOTRON TRON 40S 406/121.5 MHz SERIAL 130AD14503 JOTRON TRON 40S 406/121.5 MHz SERIAL 01406247
Radar Transponder	2 x JOTRON TRON SART 9 GHz
Radio, Lifeboat, Vhf	3 x NAVICO AXIS 250 (portable)

**Satellite Communications**

MMSI Number	357 270 000
Inmarsat Type B	NERA SATURN B. Tel:335 726 910 Fax:335 726 911 Data9600: 335 726 912
Inmarsat Type C	2 x SKANTI CAPSAT 435 726 910 and 920
V-Sat Uk	44-207 576 6870
V-Sat Usa	1-713 296 5370
Telefax Machine	USE IMARSAT B LINE
Internal E-Mail & Pc-Network	Eudora, Ethernet
E-Mail Address To Vessel	captain@trident.vessel.int.slb.com

**Safety Equipment Crew**

Lifeboat Type / Capacity/ No. Of Boats	2 x Norsafe 70 Pers each.
Engine, Lifeboat	Sabb type 4L 186 LB
Liferafts Type /Capacity	Viking, 4 x 25 Pers and 2 x 20 Pers.+ 1 MOB raft x 6 Pax
Number Of Life Rafts	6 rafts total. + 1 MOB
Lifejackets Nos.	142 (Seamaster-1983)
Survival Suits, Thermo Insulated	70 (Koppernaes)
Working Suits, Thermo Insulated	30 x 'Mustang' + 10 'Aqua' Dry suits.
Man Overboard Boat (Mob) Type	Norsafe Magnum, 7.5 mtr.
Engine, Mob And Speed Of Boat	Yanmar 4LH-STE 4 Cyl. Turbo. Appr. 25 knots
Waterjet And Gear Drive, Mob	Hamilton 212 water jet, ZF Hurth gear, HSW 630
Work Boats	2 x 25 FOOT NORPOWER WORKBOATS
Engine Work Boat And Speed	NOGVA/CUMMINS type 6BT5.9M 210HP 15Kn

**Fixed Fire Extinguisher System**

Engine Room	Inergen, Zenith Electro. 103 pcs. Bottles w/volume 50 ltr Pressure: 300 bar
Separator Room	N/A
Incinerator Room / Galley Ducting	Inc. Room: Inergen. / Galley: CO <sup>2</sup>
Tape Store	Inergen, Zenith Electro
Cable Store	N/A
Steamer Winch Room	Streamers covered by fixed water fog system.
Helicopter Deck	AFFF 3%. Two Unitor FJM 80 foam monitors
Paint Store	Fixed water fog system.
Chemical Store	N/A
Main Foam Pump, Aff Foam Mixture	7.5 M <sup>3</sup> /h, 11 Bar, Grundfoss CR8-100/9. 3% mix.
Main Fire Pump	1xAllweiler NB 40-200/01/194, 50 M <sup>3</sup> /h @ 7 Bar.
	1xAllweiler NAM 80-250/01/208, 170M <sup>3</sup> /h @ 8 Bar
Water Spray Pumps For Streamers	2xAllweiler NAM 125-315/01/326, 240M <sup>3</sup> /h @ 5 Bar
Emergency Fire Pump	1xAllweiler NB 40-200/01/189, 40 M <sup>3</sup> /h at 7 Bar.
Fire Detection Monitoring System	1 x SERVOTEKNIK BMS-904

**Hull Outfitting**

Anchor	Maker: ABB Zamech Ltd. Type: SPEC 4320
	1 x 4340 Kgs + 1 x 4320 Kgs
Windlass	1 x Ulstein Brattvaag BFM 22U.050, low pressure hydraulic (40 Bar)
Mooring Winches	N/A
Capstan No 1	2 x ODIM Type: 3M3117/OCF801 (Gun deck)
Capstan No 2	N/A
Decks Crane 1, Capacity/Reach/Location	1 x Norlift GPFO 250 0814, D-deck Port, frame 36.
	Max. lift 8 tons
Decks Crane 2, Capacity/Reach/Location	1 x Norlift GPFO 250 0814, D-deck Stbd, frame 36
	Max. lift 8 tons
Decks Crane 3, Capacity/Reach/Location	HYDRALIFT 1, KMCV 1400-6T (10M) RB600.
Decks Crane 4, Capacity/Reach/Location	N/A
Anti Rolling Damping System	Ulstein Passive Stabilisation System
	Tk.No.8 Roll Reduction Frd 398 M <sup>3</sup>
	Tk.No.37 Roll Reduction Aft 312 M <sup>3</sup>
Heeling Tanks, Volume And Fuel/Fw/Sw	SWB Tanks No 6 & 7 Total capacity 382m <sup>3</sup> & 392m <sup>3</sup>
BUNKER CONNECTIONS, Locations	1 x forecastledeck centre, frame 117,
	2 x main deck Stbd. and port side, frame 57.
BUNKER CONNECTIONS, Type(S)	1 x 4" pipes w. standard flanges on forecastle deck, 2 x 7" with std. flange on main deck.
	One fitted with 3" camlock female.
BUNKER HOSE Length & Dimension	N/A
Crew Accommodation, No Of Bunks	64 bunks
Single Berths Cabins	21
Double Berths Cabins	20
Client Cabins, Single Berths	3
Business Conference And Training Rm	A -deck
Sauna And Fitness Room	A -deck

**International Oil Pollution Prevention (IOPP) Equipment**

Incinerator, Sludge And Waste Oil	Teamtec-Golar, OGS400C, 65 ltr IMO sludge/h. Max 400 ltrs solid waste / charge.
Bilge / Oily Water Separator	World Water Systems, 2500 OCD, 2.5 M <sup>3</sup> /h, through 15 ppm unit.
Oily Water / Sludge Holding Tanks Cap. Sewage Disposal Plant	Bilge W.tank:14 M <sup>3</sup> . Sludge/waste tk's.: 22 M <sup>3</sup> Hamworthy Super Trident, ST6A. Macerate, biological plant w. chem. Dosage facility. Max. flow 15 M <sup>3</sup> /24 Hrs. BOD5 6 Kg's/ 24 Hrs.
Oil Spill Absorbent / Damage Control	2 x Set Oil Spill Kit inc. sorbent booms/pads, granules & dispersant.

**Machinery Equipment**

Air Source, Hp Compressors	3 x LMF 57/138 - 207 - E60, 1 x LMF off-line compressor, V17/5518-E60, 75 cfm.
Air Capacity, Each And Total (Cfm)	3 x 2000 cfm, total 6000 cfm
Hp Compressor Drive Motors	3 x ABB motors, AMA450 L6L BAFMH, 1 MW, voltage / freq. Controlled.
Main Engine Or Electric Prop. Motors	2 x Bergen Diesel BRM9, 5400 BHP (3975 Kw Ea)
Auxiliary Engines (Generator Drive)	2 x Caterpillar 3516STD 1.4 MW each. 440V 60Hz
Redundancy Propulsion, Az-Thruster	N/A
Vessels Total Brake Hp / Kw For Prop.	10800 BHP, 7900 KW.
Main Engines, Power Supply	N/A
Propeller Type, Main Propulsion	2 x 4 blade CPP in nozzle, diam. 4.2 mtr, 125 rpm
Propeller and Thruster Control	Ulstein-Liaaen electro / hydraulic control.
Propeller Blade, Spare	N/A
Generators / Alternators	2 x A.van Kaick shaft gen's, DSG 114 M1-6W, 440V, 60 Hz, 3000 KVA each
El. Power, Useful, Out From M.S.Board	> 7000 KW
Ups Power To Instrument Room	1 x Siemens UPS Masterguard S5280, 73 KVA, 15 min. battery back-up.
Power Supply Instr.Room Back -Up	1 x Siemens UPS Masterguard S5280, 73 KVA, 15 min. battery back-up.
Emergency & Harbour Gen. Engine	1 x Caterpillar 3406 DITA, 345 KW
Emergency & Harbour Generator	1 x Caterpillar SR4-3450, 315 KW, 440V, 60 Hz
Fuel Back-Up System For Aux. Eng.	N/A
Cooling System For Aux. Engines	Independent FW cooling.
Bow Thruster	2 x Sondex FW/SW coolers
Stern Thruster	Ulstein-Liaaen 800 TV, 1.1 MW, 440Volt, 60 Hz.
Fresh Water Generator (Fwg)	N/A
Boiler, Exhaust Gas & Oil Fired	2 x Alfa Laval De-Salt. 12 T/24hrs each
Steering Gear	1 x Pyro E 1130, 406 KW
	2 x Ulstein Tenfjord, type SR662

**HSE**

Full compliance with SOLAS, Marpol 73/78 and other relevant maritime and industrial standards,  
**E&P Forum and IAGC requirements**

Hospital and medical facilities	2 beds with trauma equipment and NMD/WHO medicine chest
Environmental management	Marpol 73/78
Waste segregation onboard	Biodegradable, incinerated, or stored for onshore disposal
Refuelling at sea procedures	In place

## 2.7 SAFETY SUMMARY

The vessel fully adheres to the health and safety requirements as set out by SOLAS. All machinery and seismic equipment is maintained on a computerised planned maintenance system. HSE audit recommendations are implemented through QUEST which highlights deficiencies identified during audits and sets target dates for the completion of work along with whom or which department is responsible. Regular cross audits are held to improve and bring to attention any problems in operations or work practises. All emergency exits and routes to exits are adequately marked. A fully integrated alarm system is in place and is tested on a regular basis. Flashing lights are fitted to alert personnel when equipment on the gun deck is either being pressurised or test fired. Fire fighting equipment is positioned at all necessary locations about the vessel. The streamer reels are covered by a foam deluge system. All lifting equipment on the gun deck consists of stainless steel chains and shackles. Lifting points on deck heads were not used unless they had been rated. All certification is current. More than adequate abandonment equipment is carried on board.

Emergency procedures are laid down and prominently displayed about the vessel. Vessel plans showing emergency escape routes along with the location of all emergency equipment are also prominently displayed. Emergency fire/boat and man-overboard drills are held on a weekly basis. Current policy, hazards, near misses and topics arising are dealt with during the HSE meetings held for all crew once a trip.

Procedures for handling trailing gear during deployment and recovery were clearly laid down and followed closely. Procedures are under constant review as both the equipment and therefore the handling techniques change. Procedures are also in place for two-boat operations, helicopter operations and at-sea personnel transfers. Safety 'toolbox' meetings were held with all personnel involved prior to any operation. A Permit to Work system was in place for all hot work (burning, welding, and cutting), confined space entry, work aloft, work on high-pressure systems and electrical systems.

Comprehensive first aid and medical supplies are carried onboard. A Medic was onboard and medical advice was on hand through International SOS in Sydney and Singapore.

All seismic personnel have completed an offshore survival course, which covers survival at sea; fire fighting, first aid and helicopter underwater escape training. The Master, Chief Officer and some senior seismic personnel have undertaken advanced first aid and HSE management courses. There was also a fully qualified paramedic onboard.

The waste management system in place onboard consisted of all food waste being separated prior to incineration. All glass and metal were separated for disposal ashore. Dirty oil, PVC and plastic refuse was also stored separately for disposal onshore in line with MARPOL regulations.

The standard of accommodation and general housekeeping was very good.

**HSE Details for Survey**

<b>Incidents/Accidents</b>		<b>Exposure Hours</b>	
<b>Type</b>	<b>Cumulative</b>	<b>Group</b>	<b>Cumulative</b>
Fatality	0	Client	982
Lost Time Incident	0	Maritime	10311
Medical Treatment Case	0	Seismic	15221
First Aid Case	0	3rd Party	6383
Restricted Work Case	0		
Material Loss or Damage	0		
Environmental Incident/Damage	0		
Near Miss	1		
Hazard	0		
Unsafe Act	0		
<b>Total Incidents</b>	<b>1</b>	<b>Total Hours</b>	<b>32897</b>
		<b>Total Man Days</b>	<b>1370.70833333</b>

<b>Activity</b>	<b>Cumulative</b>
Safety Drills	2
Safety Meetings	2
Boat Launches	15
Boat Transfers	3
Toolbox Meetings	74
Helicopter Landings	4
Safety Audit - Internal	0
Safety Audit - External	0

**Comments**

<b>Date</b>	<b>Comments</b>
06 Apr 07	A general muster and fire drill was conducted at 12:45. This was followed by a safety meeting.
07 Apr 07	The FRC was launched to transfer equipment to the OMS Pioneer. A crew change for the marine crew was carried out by helicopter.
08 Apr 07	Five safety induction tours were conducted for new crew members. The workboat was launched twice for streamer maintenance.
10 Apr 07	The workboat was launched twice for streamer maintenance. The OMS Pioneer departed the survey area at 17:00 for resupply in Eden.
12 Apr 07	The workboat was launched for streamer maintenance.
13 Apr 07	A fire drill was conducted at 12:45 and this was followed by a safety meeting. The workboat was launched twice for streamer maintenance.
14 Apr 07	The OMS Pioneer came alongside to transfer fuel and supplies.
15 Apr 07	The OMS Pioneer came alongside at 09:14 to transfer fuel. The Lady Roula departed the survey area for a crew change at Lakes Entrance at midnight.
16 Apr 07	A management team came out to the vessel for a visit by helicopter.
17 Apr 07	One safety induction tour was carried out.
20 Apr 07	An ISPS desktop drill was carried out. A MOB was conducted. The workboat was launched to replace a bird.
21 Apr 07	The OMS Pioneer came alongside for a fuel transfer.
22 Apr 07	2 SIPP training courses were conducted.
23 Apr 07	The OMS Pioneer departed for Eden at 09:45.

## 2.8 RECOMMENDATIONS & CONCLUSION

- The vessel had just been in dry dock in Singapore for installation of a complete new recording system, gun arrays and new version of Trinav prior to the survey. This caused a few problems with people not being fully up to speed on the new systems. Although, Field Support personnel did sail from Singapore, it would have been more beneficial for them to have stayed onboard until the survey was underway and any teething problems had been rectified.
- The overall appearance of the vessel is very good and should be commended.
- The overall OH&S performance delivered by both the Marine and Seismic crews went a long way to maintaining a safe and comfortable work environment.
- Constructive use of Medic (first aid course, safety instruction)

The over all performance of the seismic crew was excellent, the level of expertise of the senior seismic crew members was above average but there were quite a few new personnel who still require further training although their work was carried out in a professional manner, any problems encountered were quickly brought to the client's attention.

Safety standards by both marine and seismic crew were high with close cooperation during drills.

### 3 NAVIGATION

#### 3.1 OVERVIEW

The positioning objectives were to navigate the vessel safely, steer the defined “steered point the centre of sources” and determine all receiver group coordinates within the required tolerances, correctly co-register these coordinates with seismic records and to achieve the required coverage criteria for the 3D marine seismic survey.

This survey was acquired, recorded and processed onboard using the WGS84 Datum, with all mapping and final reporting carried out using Universal Transverse Mercator (UTM), Zone 55S (147° East) projection. Client approved geodetic and transformation facts are appended in Appendix Geodetic Parameters on the CD.

Western-Geco provided three independent DGPS systems, CNAV, Subsea7-Veripos and TRINAV 3 using a combination of Veripos and CNAV solutions. CNAV and Veripos systems had an independent GPS receiver and antenna.

CNAV and VERIPOS DGPS positioning systems computed the vessel DGPS position and also combined to compute the rGPS float and gun tracking system through TRINAV GPS VERSION 3.0.1. The in-sea rGPS units were Seatrack pods incorporated with Ashtech GPS receiver card.

TRINAV 3.01 (Integrated Navigation System) provided the real-time vessel positioning, survey line selection and navigation management. Real-time coverage was displayed on the same system binning, and also available in offline mode for accessing the coverage for infill selection.

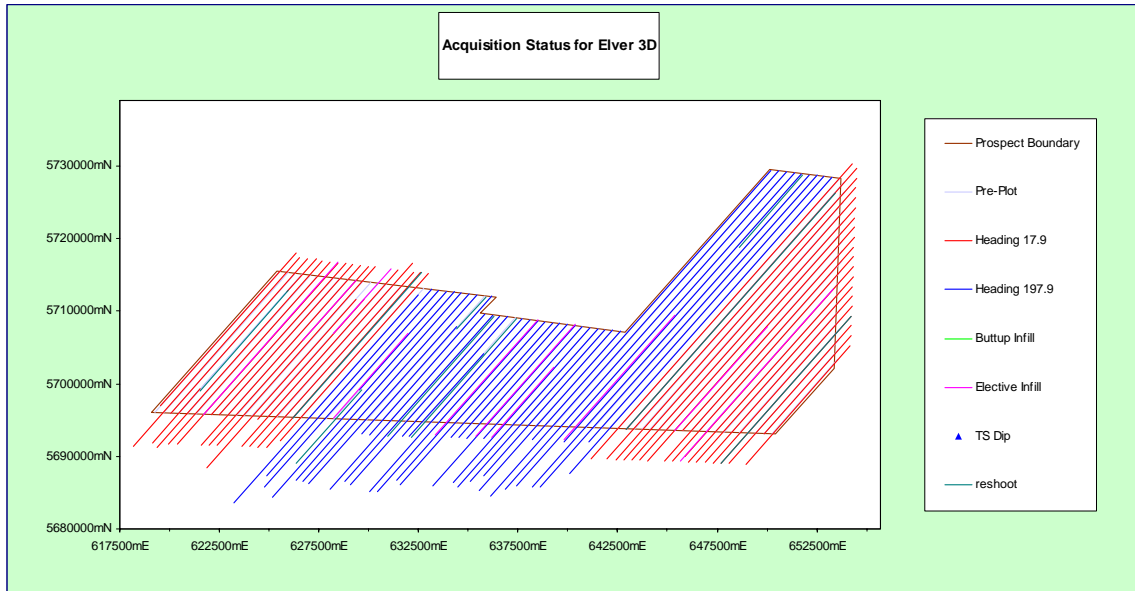
Sonardyne SIPS-2 was used for positioning the streamer acoustic networks. The front and tail acoustic networks were co-positioned by Seatrack rGPS mounted on each gun-float, tailbuoy and 2 outer gun strings. One (1) intermediate mid-streamer acoustic network enhanced and aided in streamer modelling and monitoring of streamer separation.

Streamer modelling and depth control was by DigiCourse 5011 series depth controller and compass “birds”. Bathymetry data was acquired using the Simrad EA-500 echo sounder and the water velocity profile measured using a Veleport Vessel steering was complemented with a Litton C Plath SR180 gyrocompass and the Robtrack autopilot system.

During online acquisition, most of the positioning and navigation systems were operated from a series of terminals and monitors fitted within the prominent navigation console in a newly well set out instrument room. Post-processing was also carried out using TRINAV 3.

### 3.2 METHODOLOGY

Owing to its shape, the prospect was divided into 3 swaths please refer to the diagram below. Lines shot on the outer edges of the survey were shot to the north and the central swathes to the south, this arrangement allowed for turns of approximate 3.5km radius which was optimal for the vessel towing an 8 by 4km streamer configuration. Data was collected during line changes on the southern edge of the block only.



The steered point was the centre of the source which was approximately 328m astern of the vessel reference point. Run-ins were set at 5.5km in both directions. This was the optimal run-in to ensure that the active parts of the streamers were straight as the stack built up, whilst maintaining minimal line change time.

The maximum / minimum speed over the ground was 4.7/4.2 knots and the average speed over the ground used was 4.9 knots.

Shot-point interval was 18.75m and the average shot time was 7.7 seconds. The navigators were instructed to steer the centre of sources the infill was acquired at the end of the survey and amounted to 15.35%. Steering on the centre of source was to allow future surveys to be shot over the same point in 4C or 4D mode.

### 3.3 SOURCE AND STREAMER GEOMETRY

#### 3.3.1 Streamer Separations

For the major part of the survey, the source and streamer geometry was very consistent falling within 10% of the nominal separations, with only a few isolated lines recorded where an individual streamer separation dropped outside the 10% specification. Streamer shape was consistent with the exception of the two outer streamer separations which were least stable but still acceptable. Over the period of the survey, the outer streamer separation averaged 690m thereby maintaining the expected coverage as outlined in the table below:

##### Front-end streamer Separations

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	1 to 7
MIN	77.81	101.40	87.60	97.90	91.56	98.11	87.84	663.83
AVG	95.53	104.26	91.73	103.42	95.01	99.60	101.37	690.93
MAX	115.82	105.59	95.75	110.44	99.54	100.88	119.25	725.54

Source separation was not as good and averaged 45.1 but was generally within specification as given in the table below:

##### Source Separations

	1 to 2
MIN	42.8
AVG	45.1
MAX	48.1

Tail and Mid end separations were generally good as given in the following tables:

##### Mid streamer Separations

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8
MIN	75.94	93.24	64.94	99.61	84.47	72.39	94.02
AVG	94.86	101.66	83.20	114.77	98.21	85.99	106.69
MAX	116.80	108.87	96.14	130.04	107.30	97.02	124.08

##### Tail-end streamer Separations

	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	1 to 7
MIN	88.39	75.95	54.33	93.35	85.86	63.71	91.50	88.39
AVG	107.21	88.84	78.78	119.64	102.45	82.69	108.57	107.21
MAX	132.20	102.78	99.55	149.47	119.73	97.84	133.16	132.20

Any deficiency in the coverage of the far offset groups was compensated for by the use of an expanded bin grid that increased the cross line width of the far bin to 100m a list of the binning parameters are given below in Binning and Coverage section. Infill during this survey was good despite shooting the centre of source most of the infill was completed at the end of the survey.

The centre source to near group offset (streamers 4 and 5) averaged 242m which is longer than the planned figure of 150m; the geometry of the spread meant this was the optimal value.

Vessel to Centre of Source	328m
Vessel to Centre of First Group	570m
CFG – Centre of Source (Seismic Offset)	242m

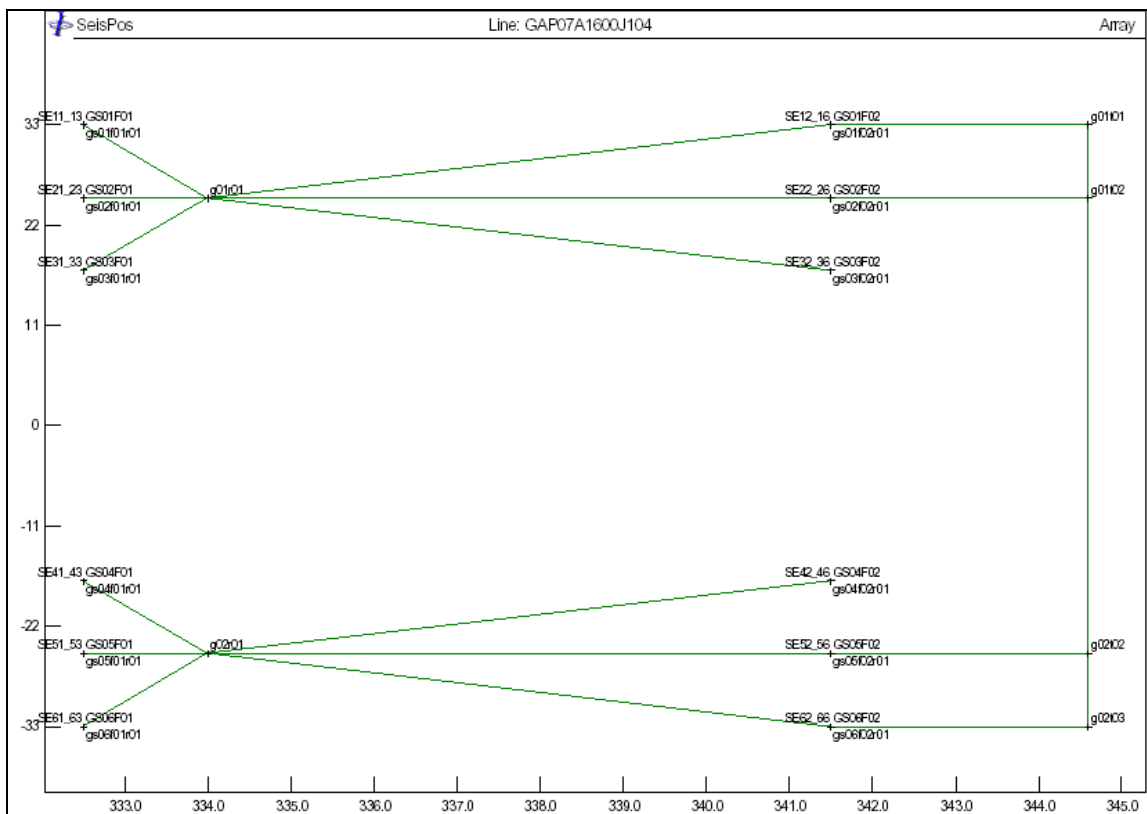
### 3.3.2 Sub array separations

Sub array offsets were good as given in the table below:

#### Source Separations

	1-2	2-3	4-5	5-6
MIN	8.2	7.3	7.7	7.2
AVG	8.7	8.0	7.9	7.5
MAX	9.8	8.4	8.2	7.9

The pods are located on the outer and centre gun strings please refer to the diagram below



Graphical statistics of source and streamer geometry are presented in Appendix Quality Control Plots on the CD.

### 3.3.3 Streamer misclosures and rotations

#### Streamer misclosures

The along line misclosures were generally very low and consistent, indicating that the streamer used were of the correct length and that the streamer definition data parameters entering into TRINAV and the stretch factor used by the mathematical model set input in TRINAV were also correct.

#### Elongation

	S1	S2	S3	S4	S5	S6	S7	S8
MIN	-3.14	-3.56	-3.33	-3.46	-3.13	-3.30	-3.84	-2.21
AVG	-1.05	-1.38	-1.09	-1.12	-0.77	-0.78	-1.30	0.21
MAX	2.50	2.64	3.44	4.03	5.62	6.36	6.34	8.04

#### Streamer Rotation

The observed rotations ranged from 0.4° to -0.3° and the average for the prospect was calculated to be 0.08° the higher values occurred during the infill period and the general trend is considered good thus confirming the given magnetic declination value.

#### Streamer rotations

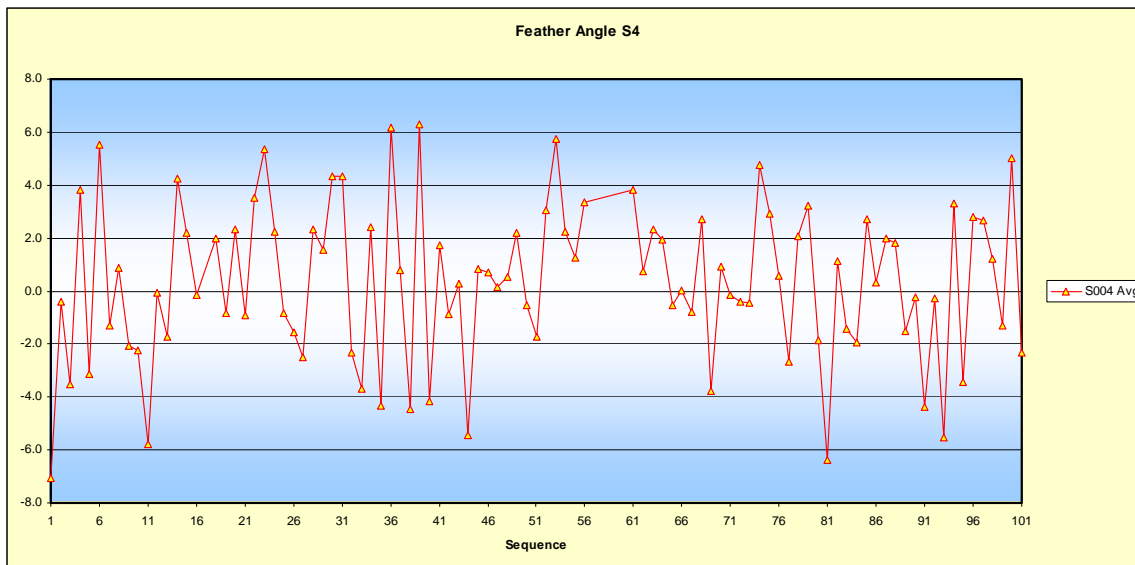
	S1	S2	S3	S4	S5	S6	S7	S8
MIN	-0.19	-0.17	-0.44	-0.32	-0.42	-0.71	-0.32	-0.32
AVG	0.12	0.19	0.06	0.02	0.02	0.06	0.06	0.12
MAX	0.32	0.41	0.25	0.33	0.20	0.25	0.27	0.31

### 3.3.4 Tides, Currents and Feather

The currents were generally small with a southerly direction around 0.5 knots; however the current increased to between 1 and 1.5 knots for the final 20 sequences which coincided with poor sea conditions.

	S1	S2	S3	S4	S5	S6	S7	S8
MIN	-7.38	-7.54	-7.24	-7.06	-6.98	-7.05	-6.78	-6.80
AVG	0.10	-0.06	0.16	0.34	0.11	0.00	0.24	0.14
MAX	6.10	5.97	6.14	6.30	5.97	5.81	6.17	6.18

The feather for the survey generally ranged from between 0 and  $\pm 6^\circ$  as given in the plot below the consistent feather angles resulted in minimal infill.



### 3.3.5 Binning and Coverage

#### TRINAV Binning System

The On-Line and Off-Line data bases remained separated. The system operated by the navigators was run on an SUN Fire V440 work stations. The on line TRINAV system was configured to accept source and receiver positioning data from the TRINAV system in real time. It then displayed this information in a series of plots which were used to steer the vessel to achieve optimum coverage.

The final P1/90 data was copied across, via the Ethernet, to the off-line TRINAV where it was added to a database of accepted positional data. The off line system was used to generate plots of bin coverage from this database, with colour coded GIF files generated from the various displays for transmission via the Internet to Supervision for the client.

One advantage of this system was the ability to change parameters during the survey. The grouping of the streamers could be altered, the required percentages of hits in any bin could be changed, flexi-binning applied, and lines added or rejected from the coverage plots at any time without causing any major problems. Once the database was amended, then the revised coverage plots could be compiled. The scale of these coverage plots could be varied in order that the coverage could be examined in detail, making decisions on infill far simpler. A reasonable amount of flexi-binning was allowed on the survey. A tapered liner expansion was used during this survey and the parameters are given in the table below:

Binning Parameters	Streamer Segments			
	Nears	Near / Mids	Far / Mids	Far
Nominal Fold Coverage	16 fold	16 fold	16 fold	16 fold
Flex Binning Technique	Linear taper	Linear taper	Linear taper	Linear taper
Static Bin Width	25 metres	25 metres	25 metres	25 metres
Flex at beginning of Segment	50.00%	112.50%	175.00%	237.50%
Flex at end of Segment	112.50%	175.00%	237.50%	300.00%
Near Trace Bin Width (Flexed)	37.50 metres	53.125 metres	68.75 metres	84.375 metres
Far Trace Bin Width (Flexed)	53.125 metres	68.75 metres	84.375 metres	100.00 metres
Coverage Parameters (with Flex applied)	Coverage (%)		Minimum Fold	
Near trace coverage	90%		14	
Near-Mid trace coverage	90%		14	
Near-Far trace coverage	90%		14	
Far trace coverage	90%		14	
Total			56	

A full set of coverage displays (Flex applied and Non Flex) are located in the Appendix Coverage Plots on the CD.

The vessel was steered to the centre of source

The binning grid was configured correctly with the parameters detailed in Appendix Positioning Parameters.

The Elver 3D prospect was comprehensively covered to within specification with an overall infill percentage recorded as 15.35%. The infill percentage was low as the feather angles and currents were consistent and the survey.

### 3.3.6 Calibrations

The last independent static verification of the positioning equipment was carried out by Thales (Singapore) 19th May 2002. Equipment verified was DGPS, rGPS and gyros, all were verified to be well within normal tolerances. Other verifications had been carried out by WG since. Standard checks and verifications are part of the ongoing work as procedures are in place to replace dockside static verifications.

#### DGPS

A health check was made on the prime DGPS system's at the Loyang Dock in Singapore on the 5th April 2005 with using a Total Station from pre-defined geodetic control relative to the WGS-84 datum. Resulting C-O's were better than 0.5m.

#### rGPS

Re-radiation checks were made on transit to the survey area. The results were deemed acceptable.

#### Acoustics

Verification of the acoustic pods was achieved in post processing by comparing the Observed ranges against the nominal (known) ranges on selected inline baselines in the network. In addition this verification also confirmed that the velocity of propagation computed from the TS-dips were correct.

#### Streamer Compasses

No pre or post survey calibrations of the streamer compasses were performed, as the manufacturer does not recommend this is necessary. Bias checks were performed on a line-by-line basis during the survey to confirm the integrity of the compasses.

#### Gyro

The previous static Calibration was made on the 25th June 2005 at Pusan, South Korea.

The C-O differences between each direction shot were all within tolerance and the readings were considered good.

A static calibration was not deemed necessary for this survey as the gyro is continually monitored against GPS.

#### Echosounder

A lead-line verification of the draught was made prior to the survey in Singapore which confirmed the draught and validity of the echo sounder reading. Several TS-Dips were performed during this survey and they were all very close to historical data from the US Navy.

### 3.4 PERFORMANCE APPRAISAL

#### 3.4.1 DGPS Systems

Throughout the survey excellent reliability and accuracy was observed with the DGPS solutions used. Comparisons were <5m for most of the survey. The two prime systems CNAV and Veripos proved reliable the former being the more consistent. TriGPS was the least reliable network solution and was disabled for sections of lines when the comparisons were > 2m.

The following systems were made available:

Software	Diff. corrections	Diff. corr. delivery	Supplier
CNAV	CNAV	Inmarsat L	C&C Technologies
Veripos-Ultra	SUBSEA 7	Spotbeam	SUBSEA 7
TriGPS	SUBSEA 7 & CNAV	Spotbeam	SUBSEA 7 & C&C

The vessel used a cocktail of available systems for positioning that were input into the Prime Estimator; a bad system was automatically or manually taken out of the solution. CNAV was considered prime positioning system for this survey.

Veripos and the prime CNAV system were set to the 3D positioning mode for the entire survey. The final computations of the Geoid - Spheroid separations were from the inbuilt EGM96 model. TriGPS was set to height aiding using 2.308m derived from the IGRF-10 Data Model based on the centre of the block.

QC of the DGPS systems was basic and included PDOP, HDOP, the Number of satellites in view and the Spheroid heights. Graphs of the above were produced after each line from TRINAV in addition data was extracted from the P2-94 files. PDOP values were consistently higher for CNAV and the number of satellites in view was always greater in the VERIPOS system.

WG, providing two totally independent sources of corrections and a multitude of different processors of this data, along with a TRINAV GPS integrity monitor located in Sale that ensured vessel positioning was always of a high standard.

The integrity monitor essentially worked as a tail buoy located in Sale where the received pseudo ranges were transmitted to the vessel, real-time, via VSAT. The location of the monitor station was known and the computed location was compared with the known location. Normally the c-o was less than 2m for this project.

#### CNAV

Supplied by the American company, C & C Technology uses a “global” network of reference stations to track all GPS satellites in orbit around the world and send the raw GPS signal measurements back to a “Network Processing Hub” (NPH). The NPH then calculates and models in real time all of the individual GPS satellite Orbital Corrections and also the individual GPS satellite clock offset values (from the broadcast ephemerides – IODE). These corrections are then transmitted to the mobile user via geostationary communication satellites (description taken from the C-NAV Operations Manual).

The advantage to the CNAV approach is theoretically that, since corrections are related to individual satellites and not reference stations, the user's distance from a reference station is no longer a factor in positioning quality.

CNAV has traditionally performed very well and is in the author's opinion an excellent system. CNAV was designated the 'Primary' GPS system. A stand-alone QC system is available from C&C Technologies to access the quality of the GPS on a line by line basis but was not made available for this survey.

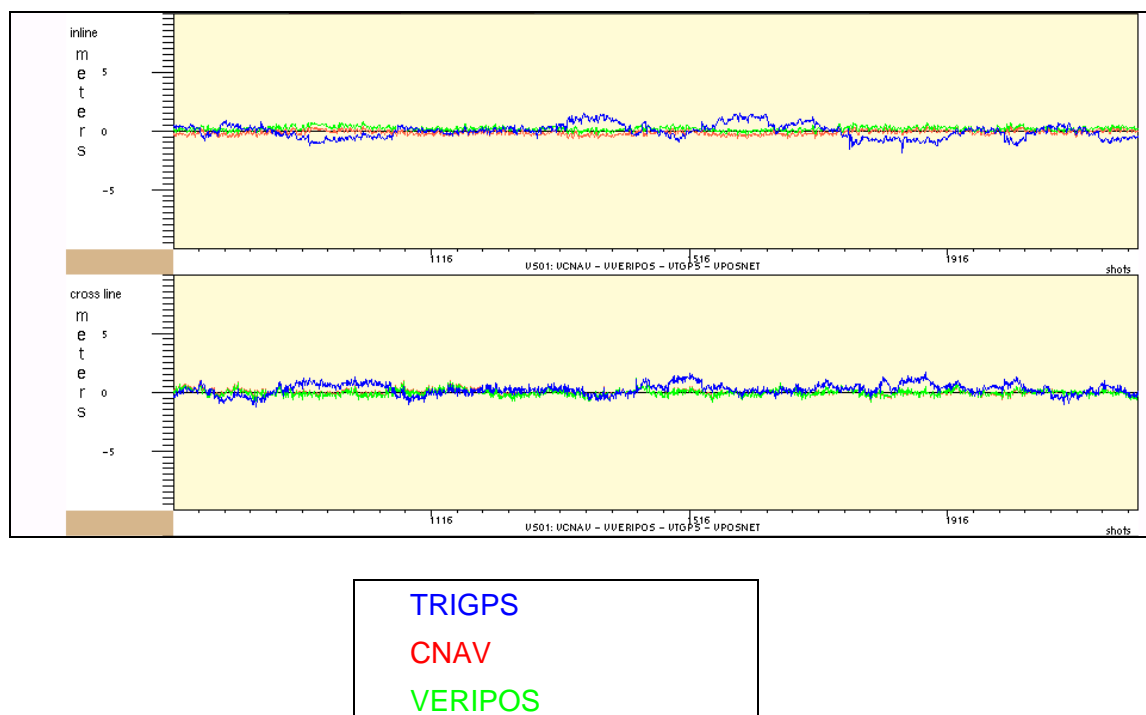
## Veripos

Veripos is a similar system to the Furgo Multifix network system and performed very well. Several local reference dual frequency reference stations were utilised for this system. Stations used on this survey are given on the CD.

## TriGPS

TriGPS is a proprietary WG network solution and it was the least stable of the three systems. TRINAV utilised a combination of the CNAV and the Veripos solutions.

The following plot from sequence 003 was typical of the differences noted during this survey.



The above differences are considered good and the DGPS positioning met the positioning specifications throughout this survey. End of line comparisons can be found on the CD.

### 3.4.2 In-water Systems

#### rGPS

rGPS positioning system used was Seatrack, provided by Kongsberg with their 220 type pods were placed on the tailbuoys and 330 type pods placed on the gun strings. A few position jumps in individual buoy positions were observed, but these jumps were small and easily detected and did not result in any shot point edits as the data was adequately interpolated. Noise levels did increase during periods of poor sea conditions but were acceptable. With the exception of the following the tailbuoy outages the tailbuoys proved reliable throughout the survey. TB4 and TB8 were inactive for the entire survey as the stic cables on these buoys were causing leakage along streamers 4 and 8.

The performance of all the rGPS has been excellent during this survey with only minor outages occurring on sequences 049 and 067 which did not affect the accuracy of the network. Gun string pods were particularly good with not one failure occurring during this survey. Loss of TB8 did prove troublesome as outlined in the Onboard Processing section below, but in theory it loss should have not proved a problem as 6 pods were active for the majority of the survey (Sequences 001 – 076)

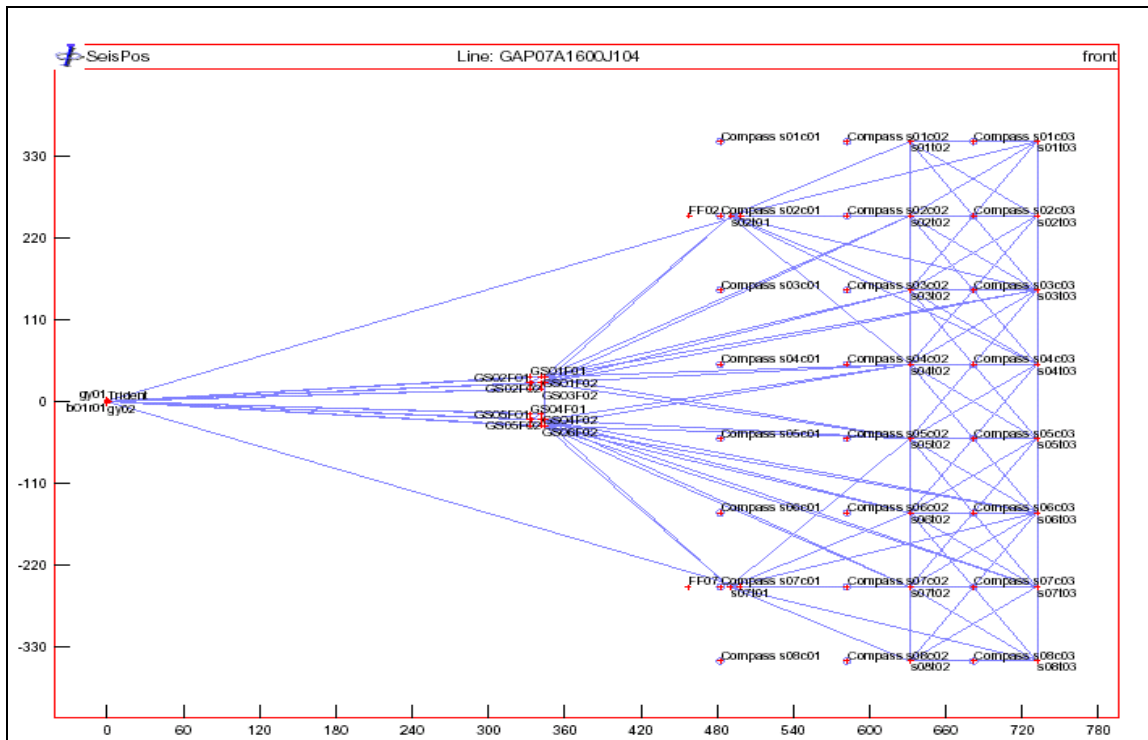
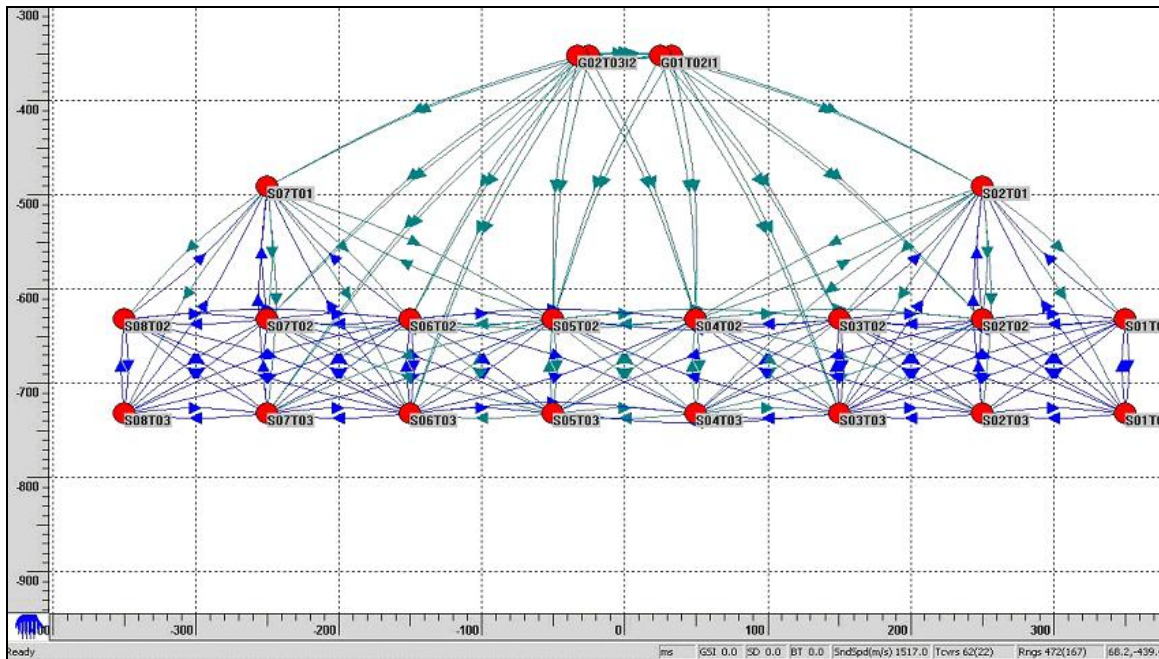
#### Acoustics

Sonardyne's SIPS 2 acoustic system was used. The placement of the acoustic units on the streamer was fairly conventional and he units were located as follows:

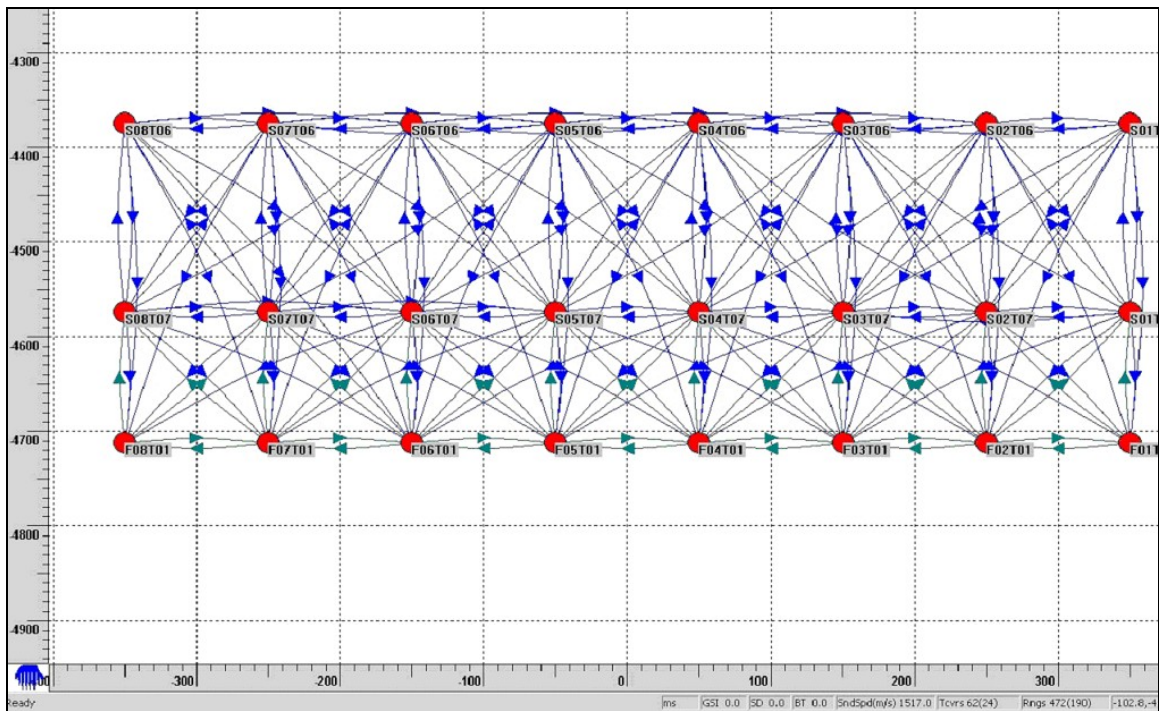
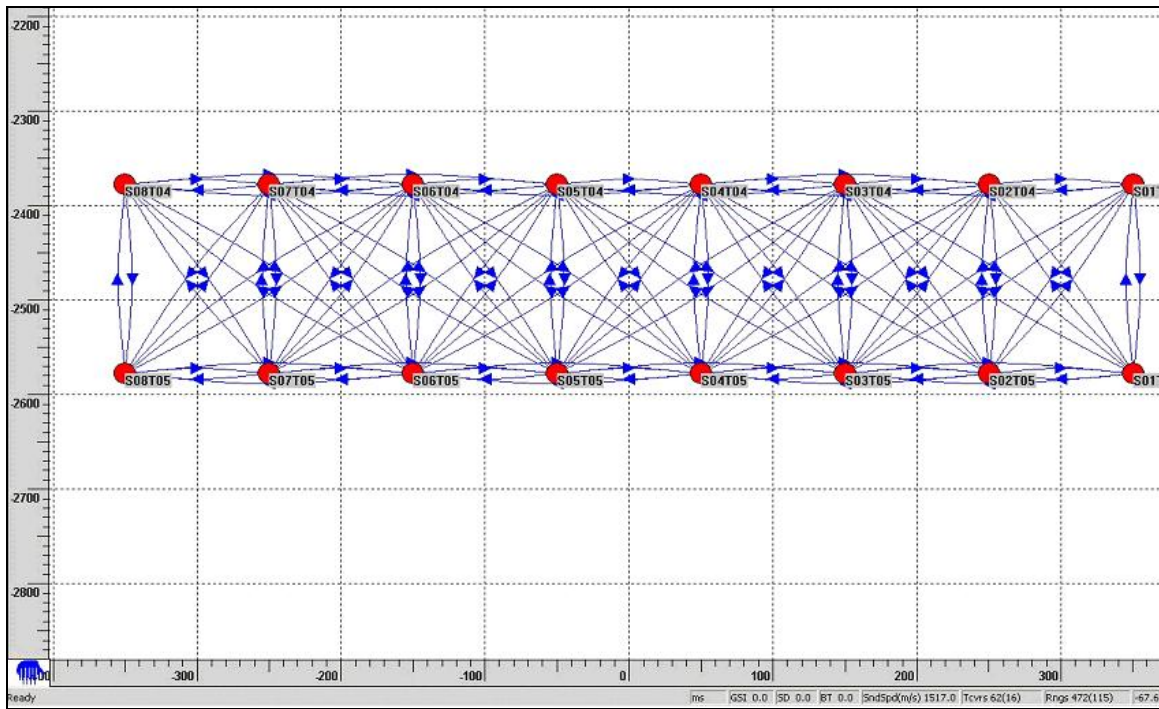
Network	Number of Pingers
Starboard Front Float	Positioned in front of streamer 2
Port Front Float	Positioned in front of streamer 7
Front	2 per streamer
Mid	2 per streamer
Tail	2 per streamer plus 1 tail buoy
Source	1 unit each on outer and centre gun strings

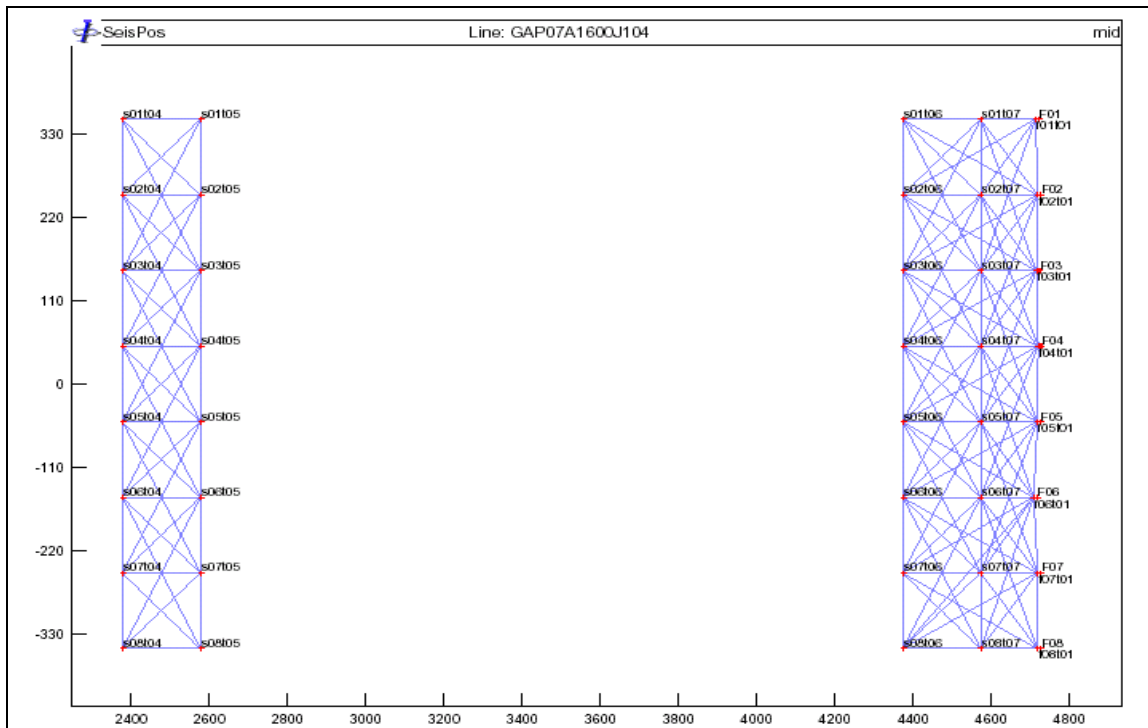
Please refer to the following diagrams:

## FRONT NETWORK



## MID and TAIL NETWORKS





The performance of all the acoustics was good the following lists those sequences in which outages occurred:

Sequence Range	Pods
001 - 101	F4T1 F8T1
077 - 101	F6T1
053 - 072	S5T5

The loss of 3 tail acoustics towards the end of the project was not ideal but having 5 active tailbuoys and tail acoustics meant the positioning specifications were met. Gun ranges were satisfactory throughout the survey thus improving the quality of the front network. On the few occasions sea conditions were poor the acoustics were not unduly affected. Seabed reflections were not an issue due to the deep water on this block they generally occur in depths <100m.

Data for the speed of sound in water was collected through a Valeport temperature salinity probe drop and calculation of the surface velocity via known inline acoustic ranges within the network. The latter option was seen to agree reasonably well with the values derived from the Valeport sensor. Measurements from the US Naval site agreed with the various drops made during this survey.

The propagation velocities used for the acoustics during this survey was:

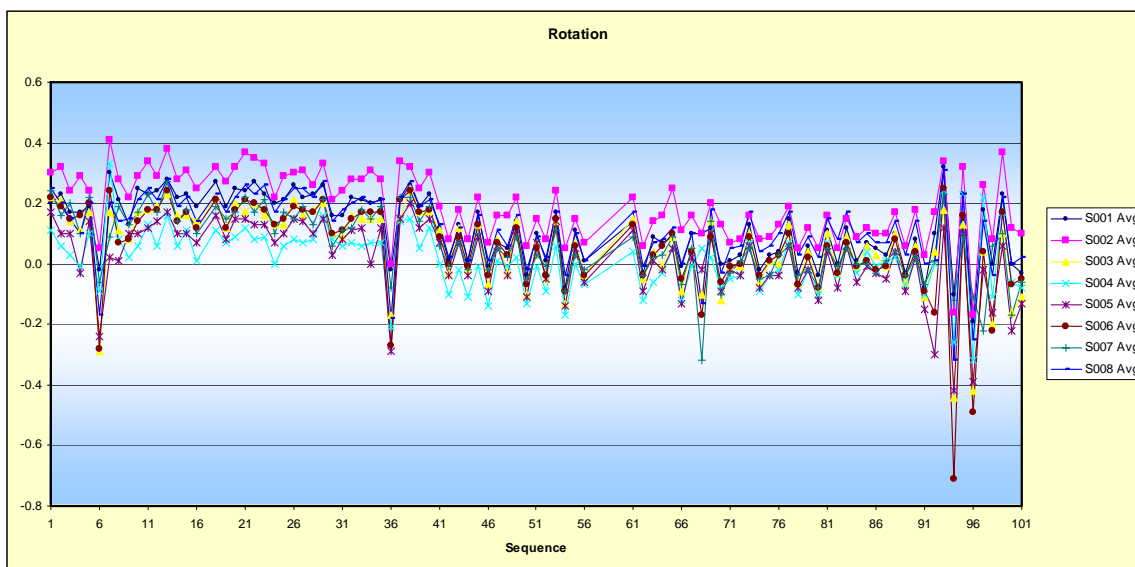
Sequence 001 to 026, 1513.04m/s  
Sequence 027 to 101, 1519.58m/s

## Streamer compasses

Digicourse model 5011 Digibird Compass Units were used for streamer depth measurement, depth control and magnetic heading measurement. Eighteen units were mounted on each streamer and the distances along the cable and between each bird are given below:

Bird	Bird No	Dist	Delta
1	3	87.7	
2	4	-12.1	-99.8
3	5	-111.9	-99.8
4	6	-311.5	-199.6
5	7	-511.1	-199.6
6	8	-710.7	-199.6
7	9	-1010.1	-299.4
8	10	-1309.5	-299.4
9	11	-1608.9	-299.4
10	12	-1908.3	-299.4
11	13	-2207.7	-299.4
12	14	-2507.1	-299.4
13	15	-2806.5	-299.4
14	16	-3105.9	-299.4
15	17	-3405.3	-299.4
16	18	-3704.7	-299.4
17	19	-3904.3	-199.6
18	20	-4004.1	-99.8

Streamer rotations throughout the survey were good thus confirming the given magnetic declination from the IGRF2000 model value of 13.544 degrees. The graph below plots the rotation values throughout the survey.



The TRINAV and SeisPos processing systems carries out a "dynamic calibration" of compasses on an ongoing basis and generates a compass calibration report for each line. The Navigation Representatives reviewed these after each sequence.

The compass data quality was good for the majority of the survey due to the calm sea conditions however sequence 068 was scratched due to poor compass data. Lines shot at the end of the

survey during the infill period were considered marginal in the increased seas but were acceptable. Lines affected by poor sea conditions are listed in Elver Stats\_map\_comments.xls found in the Processing appendix on the CD. Outages through this survey were few and are listed below:

Sequence Range	Compass
022-030	S5C15
082-101	S5C15
024-029	S5C9

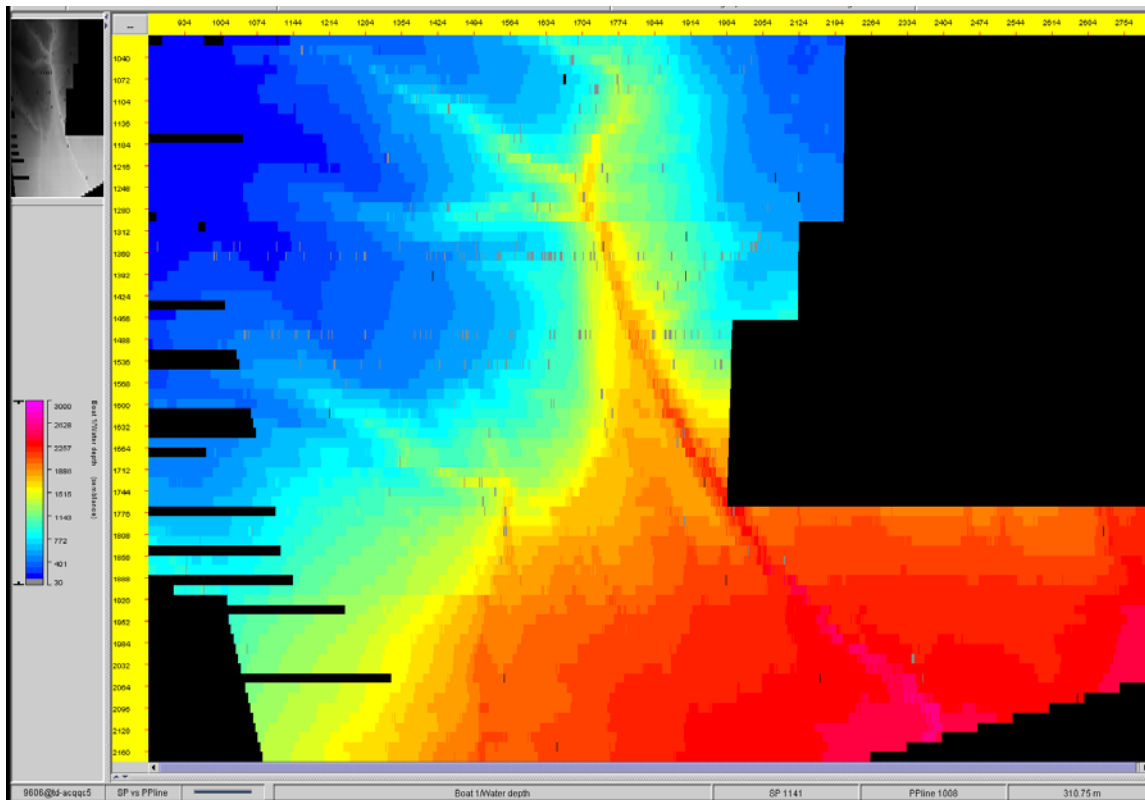
### **Gyrocompasses**

Two Litton C Plath SR180 gyrocompasses were available and designated as Gyros 1 and 2; gyro 2 was less reliable and was made inactive in processing on most lines. Gyro 1 performed well throughout the survey. Comparisons to an rGPS baseline onboard (WG's RT Calib) agreed reasonably with the gyro data. The main purpose for the gyros was to facilitate antenna offset computations and the position of the echo-sounder. All antennas were within 1.0m from each other so any gyro error would only have a small effect on positioning any errors gyro on the echo sounder position would also be negligible over a 46m offset.

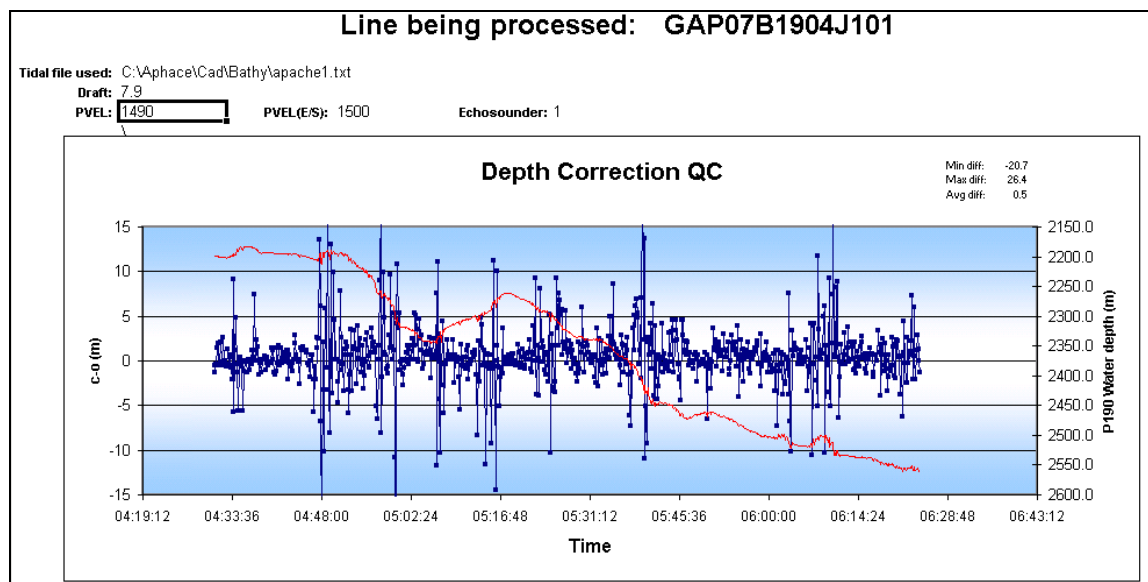
### **Echo-sounder**

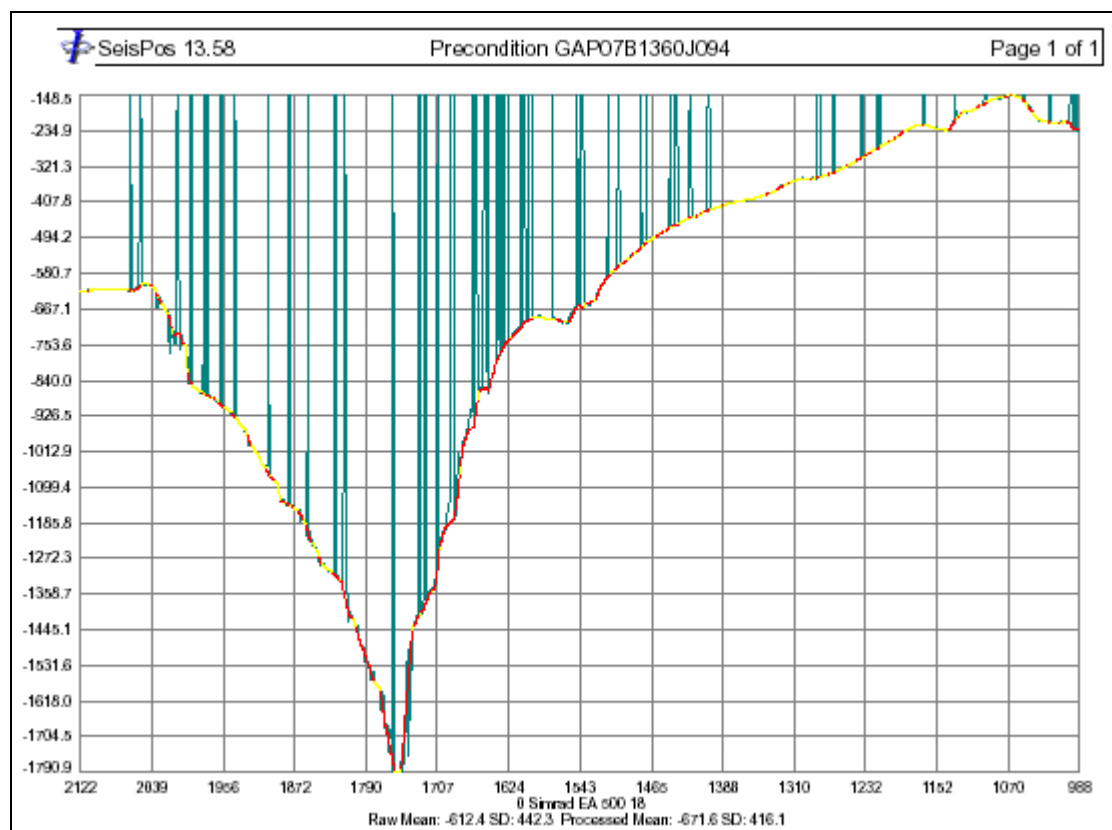
The echo sounder, a Simrad EA 500 with a 18 kHz transducer was set to 0 m draft correction and a fixed propagation velocity of 1500 m/s to provide raw data to P294 data records. In addition 200 and 38 kHz transducers were available but as the vessel was operating in water depths of up to 3000m the 18 kHz transducer was the best option.

Depths recorded in the P190 files were all draught, velocity and tidal corrected to MSL. A standard draught correction of -7.9 m was used during this survey. No pitch and roll corrections were made to the final data set. Confirmation of the reduced soundings was made after each line. The survey was shot over varying depths from 250 to 3000m as the following chart indicates the deeper depths were to the east of the block.



Noise levels increased during the deeper water depths and where rapid changes of depth were noted the following indicates typical noise levels noted during this survey:





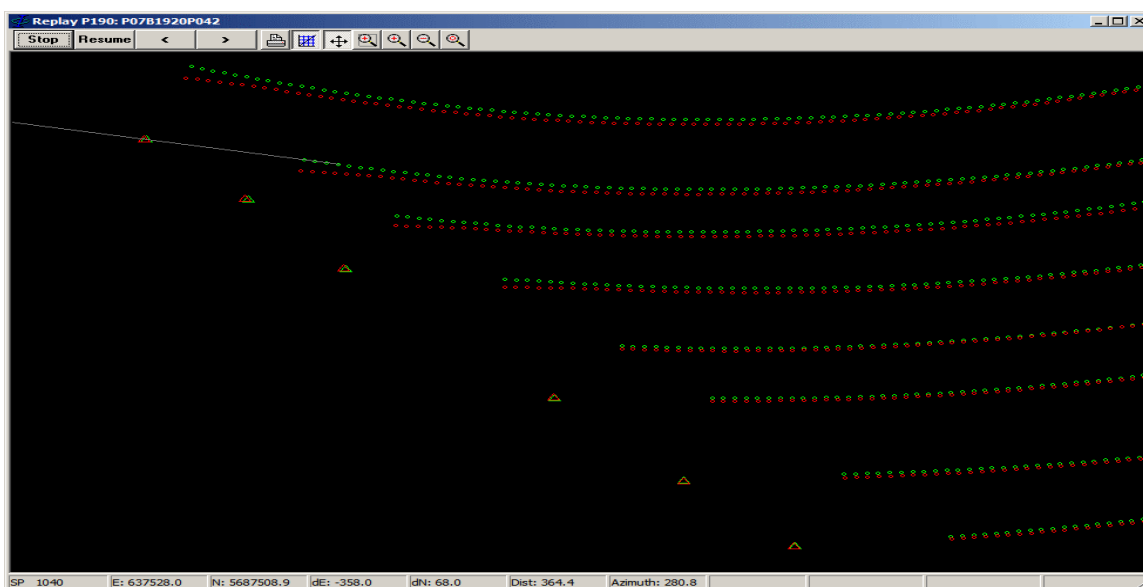
Propagation velocities used for water depth computations (based on the US Naval model) for this survey are listed below:

Sequence 001 to 044, 1500.00m/s  
 Sequence 045 to 095, 1490.00m/s  
 Sequence 096 to 098, 1500.00m/s  
 Sequence 099 to 101, 1490.00m/s

### 3.4.3 Onboard Processing

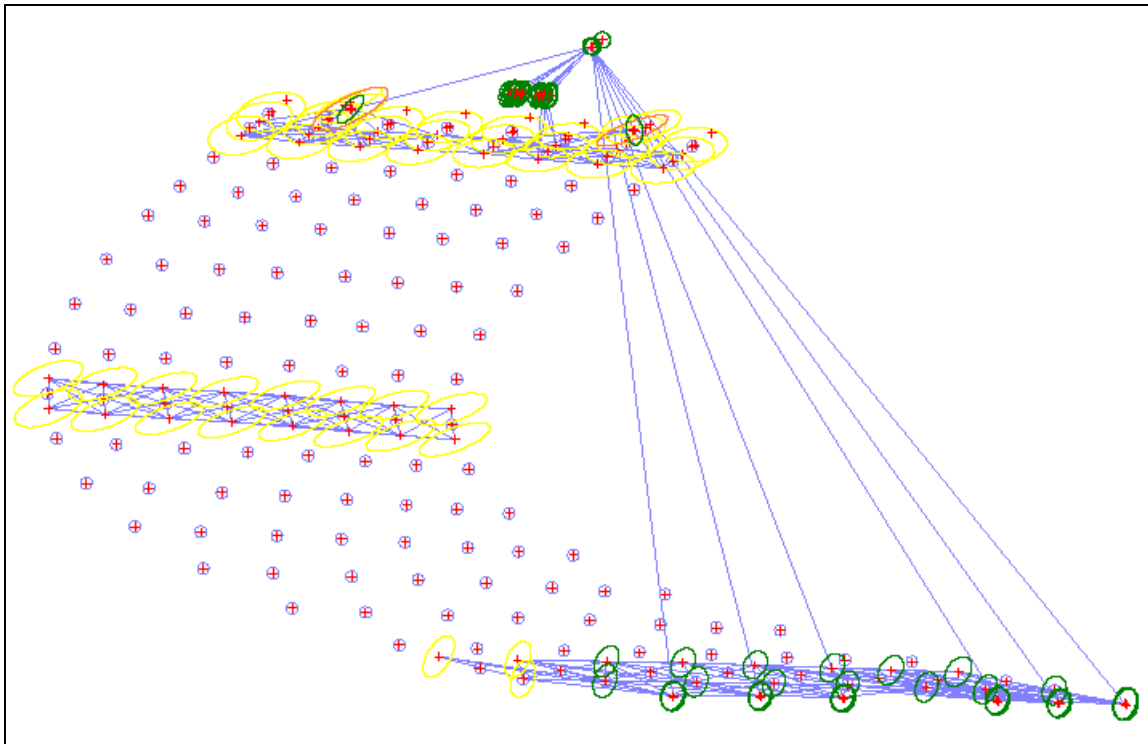
WG performed their routine onboard processing using their UNIX based fully integrated TRINAV navigation system. Following processing, data were exported in UKOOA P190 format. The production of final P190 tapes was usually completed within 4-8 hours of the completion.

Prior to the start of the Marie survey the contractor upgraded the navigation systems from TriNav 2.6 to Trinav 3.1 the latter being used ideally to resolve Q networks and not conventional networks as the case on the Western Trident. Problems with the processing system were noted on both surveys and indeed all lines from Marie and sequences 001 to 039 of Elver were reprocessed as the initial version of Trinav assumed straight line computations between compasses and not the chord or arc. Despite resolving this problem comparisons between SeisPos and Trinav remained high during lines shot in the line changes. The following plot from P1-Tools clearly shows that the Trinav streamers (in red) do not match the tailbuoy positions which presumably are correct as both datasets agree. The line from the SeisPos data in green would clearly bisect the tailbuoys. S1 – S4 have good agreement and TB4 and TB8 are passive.



The problem was resolved after WG Oslo reported that an incorrect tail tracking node has been due to the failure of TB4 and TB8 the error ellipses were higher on the nodes closer to the tailbuoys and it appears Trinav automatically uses the node with the lower value which in this case was incorrect. The change was made prior to sequence 069 comparisons on the following lines have been reasonable although the near mids on S8 were higher than normal on lines short with a sharp bend until the completion of the survey. Comparisons along the pre-plots sections of the lines were always good.

As mentioned above lines shot in the run-in and run-outs proved more difficult to process, the following plot is typical of the network shaping during such periods:



Apart from the above problems processing was mainly trouble-free in the calm sea conditions. Noisy compasses did prove troublesome on those lines shot in poor sea conditions and sequence 068 was scratched as a result.

TRINAV was used to post process the navigation data and P190 and P294 files were produced. Processing was performed by a survey crew member; final quality control was made by the navigation shift leader or the Chief Navigator before passing on the P294 and P190 files to the client navigation representative for confirmation of the processing.

Noted some errors in times and shot point for the start and end of line details from the observer logs due to confusion in shooting in the line changes the corrected times and shot points are given in the Elver Map database in Appendix \*\*. Noted busts in the bathymetry on the occasional line but this was always corrected.

Statistics extracted from TRINAV after each line did indicate that the positioning specifications were being met during this survey please refer to the Elver database in Appendix \*\*. In conclusion TRINAV finally proved acceptable but the use of a system designed for a completely different type of survey does appear odd; the arrival of Trinav 4 is eagerly awaited as this should resolve some of the problems encountered on this survey according to the contractor.

### External Positioning Quality Control

Positioning was considered acceptable after carrying out the following QC procedures:

- 1) Import of the PAC file into the project database and subsequent analysis of this.
- 2) Analysis of the contractor QC files/plots.
- 3) Import and verification of the P190 data set.
- 4) Graphical and numeric QC of the P190 data using SeisPos.
- 5) Processing of P294 data and comparison of resulting "System" data with contractor P190.
- 6) Inspection of P294 and P190 configuration.
- 7) P190 and P294 file and header checks.
- 8) Data frequency, detecting missing data.
- 9) Vessel, tail buoy, source, receiver and cmp position and spacing.
- 10) Acoustic, compass, gyro, echo sounder and GPS data inspection.
- 11) Source sequencing.
- 12) Compass heading and depth bias checks.
- 13) Real-time vessel, streamer (individual receiver locations) source and observation modeling.
- 14) Check of water depth correction in P190 data.

Post-processed QC statistics were obtained from the contractors PAC file and relevant statistics were extracted and graphed to plot trends in the data please refer to the CD. Comparisons between SeisPos and Trinav are included in the processing appendix.

#### 3.4.4 Survey Personnel

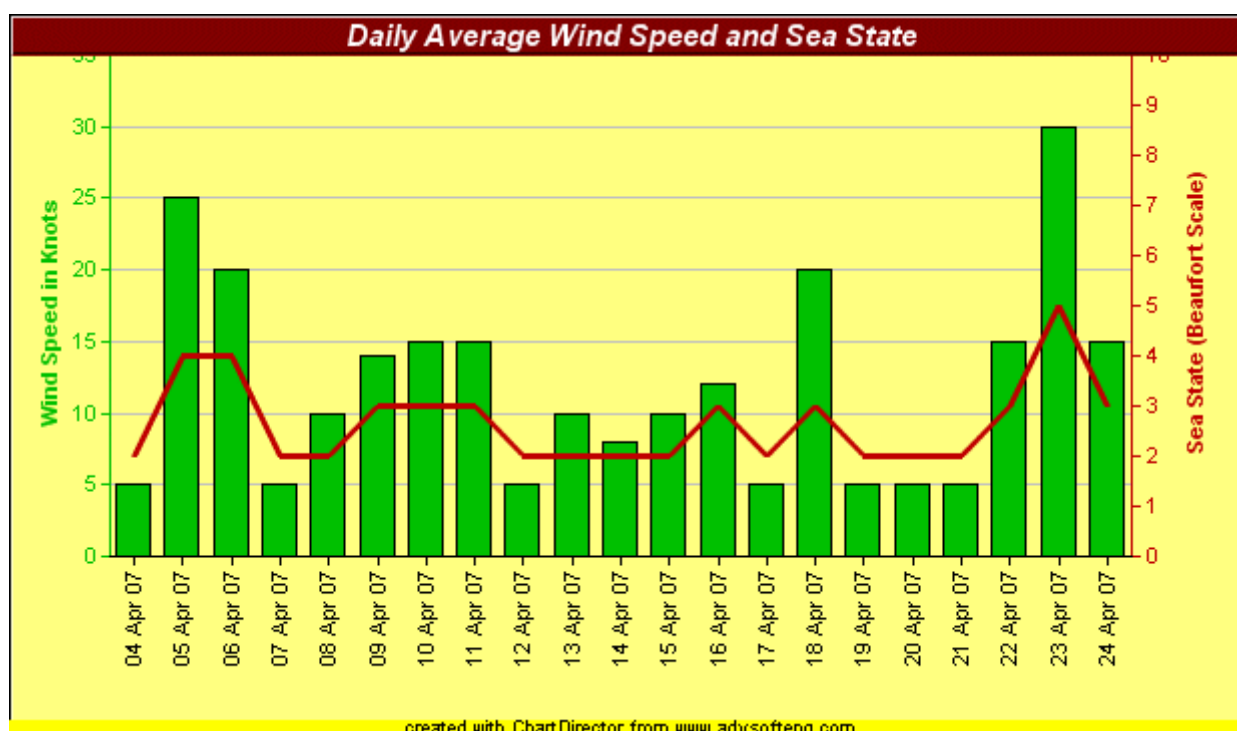
The navigation shift leader from the initial crew remained onboard until the 16th April and his inclusion benefited the new crew working on the newly installed Trinav 3 system. Problems encountered on the earlier survey were resolved despite the problems outlined in the Onboard Processing section. All crew members proved to be professional and were always helpful and communicative.

## 4 ENVIRONMENT

### 4.1 WEATHER

It was possible, via the 'World Wide Web', to access data about local environmental conditions from [www.buoyweather.com](http://www.buoyweather.com). Information was reported daily with a 7 day forecast. Wind direction and weather forecasts were also down loaded from the Bureau of Meteorology Weather Service. Further information such as tidal movements were available the admiralty pilot for the area.

This is an area of intense weather conditions with a predominant south east swell throughout the year driven by strong low-pressure systems in the southern ocean. Swell height averaged between 1.0 and 3.0 metres with wind strength varying between 5 to 20 knots. There were occasions when swells exceeded 4.0 metres and wind strength was >40.0 knots. The weather in this area should be considered volatile and hard to accurately predict at any time.



### 4.2 TIDES, CURRENT AND FEATHER

The survey is being conducted during April where the offshore wave conditions are much more variable. Prevailing winds are south westerly, with wave heights of 3 to 5 metres, increasing to 6- 8 metres as storm fronts move into the area from the west. Prevailing Streamer feather angles remained well within contract specifications for the entire survey.

### 4.3 NAVIGATION HAZARDS

The survey was conducted in relatively open waters of around 150 to 1700 metres depth to the east of Sale, Victoria. The survey area is located near regular shipping lanes however very few vessels were seen during the survey and those that were, were readily contacted and kept clear of the survey area.

#### **4.4 ENVIRONMENTAL**

In keeping with modern survey practice environmental protection played an important role in the operating practices of WesternGeco, in line with Apache's own environmental concerns and the contract requirements. Survey operations were carried out under procedures designed to minimise any environmental impact at all times.

Off shore refuelling was conducted during the survey without any problems being encountered. Great care was taken to follow International Maritime Regulations with regard to the disposal of garbage and waste. The Western Trident is equipped with an incinerator so that where possible most of the waste could be burnt. Ash from the incinerator was stored for proper disposal ashore. Putrescibles were discharged over the side in compliance with MARPOL regulations. Garbage that was unsuitable for burning was segregated and stored on board the vessel for proper disposal ashore. In addition the ship operates a garbage separation scheme to separate plastics, glass and metal waste. Hazardous wastes such as lithium batteries and chemicals were stored for proper disposal under the manufacturer's guidelines.

The overall environmental performance of the crew was up to modern industry standards with no garbage disposal to the sea.

#### **4.5 CETACEAN REPORTING**

The survey was carried out during the known whale migration period. All watch keepers were instructed to keep watch for any Cetaceans. A dedicated MMO was engaged for the survey and has submitted a separate report for the survey. Two line sequences were interrupted due cetacean sightings and these were completed at a later date. For more information please refer to the MMO report.

On all lines, the acoustic energy source was gradually brought up to maximum capacity over a 30-minute period (soft start) to give sufficient notice to any marine life that might have been in the area. A low volume array element was run during all line changes.

#### **4.6 FISHING**

Fishing activity was low in the area. The Western Trident broadcast the position and intent during the day. A navigation broadcast requesting all vessels to give the Western Trident a 4-mile clearance was broadcast at 6 hourly intervals.

#### **4.7 CORAL REEFS**

There are no reefs shown in the survey area. The vessel operated in water depths ranging from 150 to 17000 metres with the streamers towed at a depth of 8 metres and the source arrays at 7 metres. No physical damage was caused in the survey area.

#### **4.8 CONCLUSION**

The Western Trident and associated operations had no detrimental impact on the local environment during the seismic survey. The only discharges into the sea were small quantities of food scraps and sewage waste, which fell within MARPOL guidelines.

## 5 INSTRUMENT TESTS

The Daily tests consist of 6 files, which were recorded to Tape. The Tests can be run either manually or from the default scripts on the MSX recording system.

These tests were as follows:

File 1: T13, 0dB, 15.625Hz Sine Wave

File 2: T2, 0dB, 15.625Hz Sine Wave, No Hydrophones. Spec: DRD +/- 4%, THD < 0.0005%

File 3: T2, -60dB, 15.625Hz Sine Wave, No Hydrophones. Spec: DRD +/- 4%, THD < 0.5%

File 4: T5, Pre-Amp Input Shorted, No Hydrophones. Spec: Noise < 2.9uV (-114dB FS)

File 5: T6, Impulse, No Hydrophones. Spec: Spectral Response +/- 10%, Amplitude Difference.

Before the beginning of the survey a complete set of instrument tests was performed.

The Monthly tests consist of 26 files, which were recorded to Tape

These tests were as follows:

File 1000: T13, Dummy File

File 1001: T13, Special Bit Pattern, All Ones

File 1002: T13, Special Bit Pattern, 50/50

File 1003: T13, Special Bit Pattern, All Zeros

File 1004: T13, 0dB, 15.625Hz Sine Wave

Files 1005/1015: T2, 15.625Hz Sine Wave, stepped 0dB through to -100dB, No Phone connected.

File 1016: T5, Pre-Amp Input Shorted, No Hydrophones. Spec: Noise <2.6uV (-114dB FS), No Phone connected.

File 1017: T10, Common Mode, +4dB, 15.625 Hz Sine Wave, Phones connected.

File 1018: T6, Impulse, No Hydrophones. Spec: Spectral Response +/- 7% Amplitude difference.

The result of the End of Job instrument tests verified the system. Comparing results from all the instrument tests showed that the system was stable and in specification throughout the survey.

**6 DIARY****April 4th 2007**

Start	Category	Comment
13:00	MO	Transit to the Elver 3D survey.

**April 5th 2007**

Start	Category	Comment
00:00	MO	Transit to the Elver 3D survey.
00:01	DT	Trinav hang up causing a late start to line GAP07B1008P001.
00:09	SB	Recording line GAP07B1008P001. Late start due to a Trinav system hang up
02:42	SB	Line change.
04:47	DT	IPM positioning network hang up causing a late start to line GAP07B1312P002.
04:53	SB	Recording line GAP07B1312P002.
07:11	SB	Recording on the run out of line GAP07B1312P002. SP's 983-433 recorded.
08:21	SB	Line change.
09:22	SB	Recording on the run in to line GAP07B1024P003. SP's 746-1005 recorded.
09:57	SB	Recording line GAP07B1024P003.
12:26	SB	Line change.
14:37	SB	Recording line GAP07B1328P004.
16:56	SB	Recording on the run out of line GAP07B1328P004. SP's 988-654 recorded.
17:46	SB	Line change.
18:51	SB	Recording on the run in to line GAP07B1040P005. SP's 781-1010 recorded.
19:21	SB	Recording line GAP07B1040P005.
21:49	SB	Line change.

**April 6th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1344P006.
02:19	SB	Recording on the run out of line GAP07B1344P006. SP's 992-572 recorded.
03:15	SB	Line change.
04:24	SB	Recording on the run in to line GAP07B1056P007. SP's 785-1014 recorded.
04:51	SB	Recording line GAP07B1056P007.
05:15	DT	Line paused due to gun array 3 autofires. Continue down line while repairs are carried out.
07:01	SB	Recording line GAP07B1056P007.
07:33	SB	Line change.
09:40	SB	Recording line GAP07B1360P008.
11:18	DT	Line paused due to gun array 1 autofires. Continue down line while repairs are carried out.
12:03	SB	Line change.
13:53	SB	Recording on the run in to line GAP07B1072P009. SP's 790-1019 recorded.

14:22	SB	Recording line GAP07B1072P009.
16:57	SB	Line change.
19:12	SB	Recording line GAP07B1376P010.
21:35	SB	Recording on the run out of line GAP07B1376P010. SP's 992-524 recorded.
22:36	SB	Line change.
23:50	SB	Recording on the run in to line GAP07B1088P011. SP's 795-861 recorded. In progress at midnight.

**April 7th 2007**

Start	Category	Comment
00:00	SB	Recording on the run in to line GAP07B1088P011. SP's 862-1024 recorded.
00:20	SB	Recording line GAP07B1088P011.
02:49	SB	Line change.
04:59	SB	Recording line GAP07B1392P012.
07:13	SB	Recording on the run out of line GAP07B1392P012. SP's 1006-650 recorded.
08:00	SB	Line change.
08:58	SB	Recording on the run in to line GAP07B1104P013. SP's 800-1029 recorded.
09:27	SB	Recording line GAP07B1104P013.
11:56	SB	Line change.
14:14	SB	Recording line GAP07B1408P014.
16:28	SB	Recording on the run out of line GAP07B1408P014. SP's 1011-640 recorded.
17:21	SB	Line change.
18:17	SB	Recording on the run in to line GAP07B1120P015. SP's 804-1033 recorded.
18:46	SB	Recording line GAP07B1120P015.
21:14	SB	Line change.
23:27	SB	Recording line GAP07B1424P016. In progress at midnight.

**April 8th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1424P016.
01:44	SB	Recording on the run out of line GAP07B1424P016. SP's 1016-640 recorded.
02:35	SB	Line change.
03:33	SB	Recording on the run in to line GAP07B1136P017. SP's 816-1038 recorded.
04:01	SB	Recording line GAP07B1136P017.
06:29	SB	Line change.
08:34	SB	Delayed line start due to whale activity within the 3Km restriction zone.
09:07	SB	Recording line GAP07B1440P018. Late start due to whale activity.
10:52	SB	Line change.
13:08	SB	Recording on the run in to line GAP07B1152P019. SP's 814-1043 recorded.
13:39	SB	Recording line GAP07B1152P019.
16:13	SB	Line change.
18:17	SB	Recording line GAP07B1456P020.
20:32	SB	Recording on the run out of line GAP07B1456P020. SP's 1025-670 recorded.
21:19	SB	Line change.

22:18	SB	Recording on the run in to line GAP07B1168P021. SP's 830-1047 recorded.
22:48	SB	Recording line GAP07B1168P021. In progress at midnight.

**April 9th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1168P021.
01:13	SB	Line change.
03:15	SB	Recording line GAP07B1472P022.
05:11	SB	Recording on the run out of line GAP07B1472P022. SP's 1030-620 recorded.
06:05	SB	Line change.
07:08	SB	Recording on the run in to line GAP07B1184P023. SP's 823-1052 recorded.
07:38	SB	Recording line GAP07B1184P023.
09:59	SB	Line change.
11:55	SB	Delayed line start due to whale activity within the 3Km restriction zone.
12:09	SB	Recording line GAP07B1488P024. Start delayed due to whale activity. FGSP 1855.
13:53	SB	Recording on the run out of line GAP07B1488P024. SP's 1035-680 recorded.
14:42	SB	Line change.
15:52	SB	Recording on the run in to line GAP07B1200P025. SP's 828-1057 recorded.
16:22	SB	Recording line GAP07B1200P025.
18:49	SB	Line change.
21:01	SB	Recording line GAP07B1504P026.
22:56	SB	Recording on the run out of line GAP07B1504P026. SP's 1039-660 recorded.
23:44	SB	Line change.

**April 10th 2007**

Start	Category	Comment
00:00	SB	Line change.
00:50	SB	Recording on the run in to line GAP07B1216P027. SP's 833-1062 recorded.
01:20	SB	Recording line GAP07B1216P027.
03:43	SB	Line change.
05:41	SB	Recording line GAP07B1520P028.
07:36	SB	Line change.
09:25	SB	Recording on the run in to line GAP07B1232P029. SP's 837-1066 recorded.
09:55	SB	Recording line GAP07B1232P029.
12:15	SB	Line change.
14:33	DT	Start recording of line GAP07B1536P030 but rejected due to a gun string tangle.
15:08	SB	Recording line GAP07B1536P030. Delayed start due to a gun string tangle. FGSP 1688.
16:30	SB	Line change.
18:23	SB	Recording on the run in to line GAP07B1248P031. SP's 842-1071 recorded.
18:51	SB	Recording line GAP07B1248P031.
21:16	SB	Line change.
23:12	SB	Recording line GAP07B1552P032. In progress at midnight.

**April 11th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1552P032.
01:07	SB	Recording on the run out of line GAP07B1552P032. SP's 1054-625 recorded.
02:05	SB	Line change.
03:02	SB	Recording on the run in to line GAP07B1264P033. SP's 847-1076 recorded.
03:32	SB	Recording line GAP07B1264P033.
05:55	SB	Line change.
07:53	SB	Recording line GAP07B1568P034.
09:48	SB	Recording on the run out of line GAP07B1568P034. SP's 1058-631 recorded.
10:45	SB	Line change.
11:46	SB	Recording on the run in to line GAP07B1280P035. SP's 851-1080 recorded.
12:18	SB	Recording line GAP07B1280P035.
14:40	SB	Line change.
16:39	SB	Recording line GAP07B1584P036.
18:30	SB	Recording on the run out of line GAP07B1584P036. SP's 1063-731 recorded.
19:16	SB	Line change.
20:32	SB	Recording on the run in to line GAP07B1296P037. SP's 910-1085 recorded.
20:54	SB	Recording line GAP07B1296P037.
23:19	SB	Line change.

**April 12th 2007**

Start	Category	Comment
00:00	SB	Line change.
02:04	SB	Recording line GAP07B1440A038. This is a reshoot of a portion of sequence 18 due to whale activity.
02:36	SB	Recording overlap shotpoints of line GAP07B1440A038 due to whale activity. SP's 1853-1844 recorded.
02:37	SB	Line change after a reshoot due to whale activity.
03:54	DT	Recording overlap shotpoints of line GAP07B1360A039 due to gun autofires. SP's 1341-1332 recorded.
03:56	SB	Recording line GAP07B1360A039. This is a reshoot of sequence 8 due to gun autofires.
04:38	SB	Recording on the run out of line GAP07B1360A039. SP's 997-775 recorded.
05:11	DT	Line change after a reshoot due to gun autofires.
06:46	DT	Recording overlap shotpoints of line GAP07B1056A040 due to gun autofires. SP's 1195-1204 recorded.
06:47	SB	Recording line GAP07B1056A040. This is a reshoot of sequence 7 due to gun autofires.
08:24	DT	Recording overlap shotpoints of line GAP07B1056A040 due to gun autofires. SP's 1960-1969 recorded.
08:25	DT	Line change after a reshoot due to gun autofires.
11:13	SB	Recording line GAP07B1600P041.
13:05	SB	Recording on the run out of line GAP07B1600P041. SP's 1068-700 recorded.

13:58	SB	Line change.
14:43	SB	Recording on the run in to line GAP07B1920P042. SP's 1040-1269 recorded.
15:12	SB	Recording line GAP07B1920P042.
19:35	SB	Line change.
22:28	SB	Recording line GAP07B1776P043. In progress at midnight.

**April 13th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1776P043.
02:51	SB	Line change.
04:32	SB	Recording on the run in to line GAP07B2096P044. SP's 1130-1321 recorded.
04:57	SB	Recording line GAP07B2096P044.
07:40	SB	Line change.
10:36	SB	Recording line GAP07B1616P045.
12:29	SB	Line change.
14:34	DT	Delayed start to line GAP07B1936P046 due to a Trinav crash.
14:45	SB	Recording line GAP07B1936P046. Late start due to a Trinav crash. FGSP 1346.
18:55	SB	Line change.
21:37	SB	Recording line GAP07B1792P047. In progress at midnight.

**April 14th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1792P047.
01:53	SB	Recording on the run out of line GAP07B1792P047. SP's 1124-695 recorded.
02:51	SB	Line change.
03:27	SB	Recording on the run in to line GAP07B2112P048. SP's 1097-1326 recorded.
03:56	SB	Recording line GAP07B2112P048.
06:36	SB	Line change.
09:43	SB	Recording line GAP07B1632P049.
11:36	SB	Line change.
13:38	SB	Recording on the run in to line GAP07B1952P050. SP's 1049-1278 recorded.
14:06	SB	Recording line GAP07B1952P050.
18:18	SB	Line change.
21:04	SB	Recording line GAP07B1808P051. In progress at midnight.

**April 15th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1808P051.
01:07	SB	Recording on the run out from line GAP07B1808P051. SP's 1129-755 recorded.
02:10	SB	Line change.
02:56	SB	Recording on the run in to line GAP07B2128P052. SP's 1115-1330 recorded.
03:23	SB	Recording line GAP07B2128P052.
05:54	SB	Line change.
08:36	SB	Recording line GAP07B1648P053.

10:26	SB	Line change.
12:09	SB	Recording on the run in to line GAP07B1968P054. SP's 1054-1283 recorded.
12:40	SB	Recording line GAP07B1968P054.
16:53	SB	Line change.
19:40	SB	Recording line GAP07B1824P055.
20:40	DT	Line GAP07B1824P055 paused due to a power glitch causing the compressor to go off line. SP's 2726-2659 missed.
20:49	SB	Recording line GAP07B1824P055.

**April 16th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1824P055.
00:01	SB	Recording on the run out from line GAP07B1824P055. SP's 1134-787 recorded.
00:47	SB	Line change.
01:37	SB	Recording on the run in to line GAP07B2144P056. SP's 1106-1335 recorded.
02:09	SB	Recording line GAP07B2144P056.
04:32	SB	Line change.
07:09	SB	Dummy line during line change. This sequence doesn't exist.
07:10	SB	Dummy line during line change. This sequence doesn't exist.
07:11	SB	Dummy line during line change. This sequence doesn't exist.
07:12	SB	Dummy line during line change. This sequence doesn't exist.
07:13	SB	Recording line GAP07B1664P061.
09:01	SB	Recording on the run out from line GAP07B1664P061. SP's 1194-722 recorded.
09:48	SB	Line change.
10:36	SB	Recording on the run in to line GAP07B1984P062. SP's 1059-1288 recorded.
11:09	SB	Recording line GAP07B1984P062.
15:20	SB	Line change.
18:11	DT	Late start to line due to the vessel being off line because of helicopter operations.
18:35	SB	Recording line GAP07B1840P063.
22:29	SB	Line change.

**April 17th 2007**

Start	Category	Comment
00:00	SB	Line change.
00:15	SB	Recording on the run in to line GAP07B2160P064. SP's 1111-1340 recorded.
00:47	SB	Recording line GAP07B2160P064.
03:10	SB	Line change.
05:39	SB	Recording line GAP07B1680P065.
07:28	SB	Line change.
09:02	SB	Recording on the run in to line GAP07B2000P066. SP's 1064-1293 recorded.
09:36	SB	Recording line GAP07B2000P066.
13:44	SB	Line change.
16:40	SB	Recording line GAP07B1856P067.
20:54	SB	Recording on the run out from line GAP07B1856P067. SP's 1143-791 recorded.

21:44	SB	Line change.
22:40	SB	Recording on the run in to line GAP07B2176P068 but rejected and marked as DO NOT PROCESS after processing due to swell conditions causing noisy compass data. SP's 1115-1344 recorded.
23:15	SB	Recording line GAP07B2176P068 but rejected and marked as DO NOT PROCESS after processing due to swell conditions causing noisy compass data. In progress at midnight.

**April 18th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B2176P068 but rejected and marked as DO NOT PROCESS after processing due to the swell conditions causing noisy compass data.
01:23	SB	Line change after line scratched due to the weather conditions.
03:49	SB	Recording line GAP07B1696P069.
05:40	SB	Recording on the run out from line GAP07B1696P069. SP's 1096-760 recorded.
06:25	SB	Line change.
07:26	SB	Recording on the run in to line GAP07B2016P070. SP's 1068-1297 recorded.
07:57	SB	Recording line GAP07B2016P070.
11:33	SB	Line change.
14:26	SB	Recording line GAP07B1872P071.
18:41	SB	Recording on the run out from line GAP07B1872P071. SP's 1148-797 recorded.
19:30	SB	Line change.
20:19	SB	Recording on the run in to line GAP07B2192P072. SP's 1120-1349 recorded.
20:51	SB	Recording line GAP07B2192P072.
22:42	SB	Line change.

**April 19th 2007**

Start	Category	Comment
00:00	SB	Line change.
01:03	SB	Recording line GAP07B1712P073.
02:47	SB	Recording on the run out from line GAP07B1712P073. SP's 1101-732 recorded.
03:34	SB	Line change.
04:24	SB	Recording on the run in to line GAP07B2032P074. SP's 1073-1302 recorded.
04:57	SB	Recording line GAP07B2032P074.
08:18	SB	Line change.
11:12	SB	Recording line GAP07B1888P075.
15:25	SB	Line change.
17:06	SB	Recording on the run in to line GAP07B2176A076. SP's 1115-1344 recorded.
17:40	SB	Recording line GAP07B2176A076.
19:39	SB	Line change.
22:05	SB	Recording line GAP07B1728P077. In progress at midnight.

**April 20th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1728P077.
00:33	SB	Line change.
02:12	DT	Late start to line due to a MSX recording system hang up.
02:16	SB	Recording line GAP07B2048P078.
05:26	SB	Line change.
08:44	SB	Recording line GAP07B1904P079.

13:05	SB	Recording on the run out from line GAP07B1904P079. SP's 1157-915 recorded.
13:37	SB	Line change.
14:49	SB	Recording on the run in to line GAP07B2208P080. SP's 1125-1354 recorded.
15:23	SB	Recording line GAP07B2208P080.
16:59	SB	Line change.
19:48	SB	Recording infill line GAP07B1696J081.
20:57	SB	Line change.
22:54	SB	Recording on the run in to infill line GAP07B2096J082. SP's 1092-1321 recorded.
23:27	SB	Recording infill line GAP07B2096J082. In progress at midnight.

**April 21st 2007**

Start	Category	Comment
00:00	SB	Recording infill line GAP07B2096J082.
01:46	SB	Line change.
04:15	SB	Recording infill line GAP07B1664J083.
06:04	SB	Line change.
08:01	SB	Recording line GAP07B1936A084. Original line (sequence 46) was started late due to a Trinav crash.
08:10	DT	Recording overlap shotpoints of reshoot line GAP07B1936A084. Shotpoints 1346-1356 recorded.
08:12	SB	Recording infill portion of line GAP07B1936A084.
11:59	SB	Line change.
14:39	SB	Recording reshoot line GAP07B1840A085. Original line (sequence 63) started late due to helicopter operations.
15:05	SB	Recording overlap shotpoints of reshoot line GAP07B1840A085. Shotpoints 3011-3002 recorded.
15:06	SB	Recording infill portion of line GAP07B1840A085.
15:40	DT	Recording overlap shotpoints of 2nd reshoot portion of line GAP07B1840A085. Shotpoints 2736-2727 recorded. Original line (sequence 55) was missed due to a ship power problem that caused the compressor to go off line.
15:42	SB	Recording 2nd reshoot portion of line GAP07B1840A085. Original line (sequence 55) was missed due to a ship power problem causing the compressor to go off line.
15:50	DT	Recording overlap shotpoints of 2nd reshoot portion of line GAP07B1840A085. Shotpoints 2658-2649 recorded. Original line (sequence 55) was missed due to a ship power problem that caused the compressor to go off line.
15:52	DT	Line change after reshoot due to a ship power problem causing the compressor to go off line.
17:06	SB	Recording infill line GAP07B1840J086.
19:10	SB	Line change.
20:50	SB	Recording on the run in to line GAP07B2224P087. Shotpoints 1130-1359 recorded.
21:19	SB	Recording line GAP07B2224P087.
22:44	SB	Line change.

**April 22nd 2007**

Start	Category	Comment
00:00	SB	Line change.
01:17	SB	Recording line GAP07B1744P088.
03:01	SB	Recording on the run out from line GAP07B1744P088. Shotpoints 1110-841 recorded.
03:35	SB	Line change.
04:33	SB	Recording on the run in to line GAP07B2080P089. Shotpoints 1087-1316 recorded.
05:06	SB	Recording line GAP07B2080P089.
07:57	SB	Line change.
10:41	SB	Recording line GAP07B1760P090.
12:25	SB	Recording on the run out from line GAP07B1760P090. Shotpoints 1115-725 recorded.
13:17	SB	Line change.
14:05	SB	Recording on the run in to line GAP07B2064P091. Shotpoints 1082-1311 recorded.
14:35	SB	Recording line GAP07B2064P091.
17:40	SB	Line change.
20:52	SB	Recording infill line GAP07B1584J092.
22:47	SB	Line change.

**April 23rd 2007**

Start	Category	Comment
00:00	SB	Line change.
01:10	SB	Recording infill line GAP07B1168J093.
02:57	SB	Line change.
05:41	SB	Recording infill line GAP07B1360J094.
08:00	SB	Line change.
10:15	SB	Recording infill line GAP07B1104J095.
12:43	SB	Line change.
14:58	SB	Recording line GAP07B1488A096. Reshoot of sequence 24 due to whale activity.
15:13	SB	Recording overlap shotpoints of line GAP07B1488A096. Original line was started late due to whale activity. Shotpoints 1855-1846 recorded.
15:14	SB	Recording infill portion of line GAP07B1488A096.
16:56	SB	Line change.
19:04	SB	Recording infill line GAP07B1216J097.
21:23	SB	Line change.
23:32	SB	Recording line GAP07B1536A098. Reshoot of sequence 30 due to gun separations. In progress at midnight.

**April 24th 2007**

Start	Category	Comment
00:00	SB	Recording line GAP07B1536A098. Reshoot of sequence 30 due to gun separations.
00:09	DT	Recording overlap shotpoints of line GAP07B1536A098. Reshoot of sequence 30

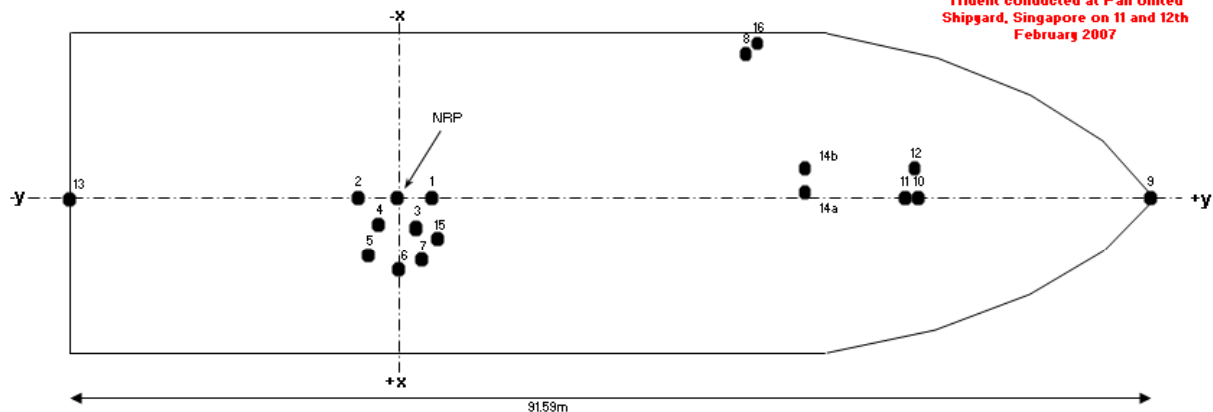
		due to gun separations. Shotpoints 1688-1679 recorded.
00:11	SB	Recording infill portion of line GAP07B1536A089.
01:32	SB	Line change.
03:50	SB	Recording infill line GAP07B1280J099.
06:30	SB	Line change.
11:49	SB	Recording infill line GAP07B2032J100.
13:30	SB	Line change.
14:30	SB	Recording infill line GAP07B1904J101.

## 7 MEASUREMENTS

### 7.1 GPS ANTENNA POSITION

Antenna Offsets							
Loc	Antenna/function	Y(m)	X(m)	Z(m)	Rx Type	Antenna	SYSTEM
		Along	Across	Above			
NRP	Reference Point	0.00	0.00	24.39			
1	TRINAV GPS	0.48	0.00	24.50	Novatel dual frequency	TRINAV GPS 2.6	
2	POSNET-1	-0.53	0.00	24.51	Trimble 4000 DS	WesternGeco Posnet Version 1.81, RTCM via CNAV RTG	
3	Veripos FWD	0.20	0.31	24.58	Topcon	Veripos Spotbeam	
4	Veripos AFT	-0.20	0.34	24.51	Topcon	Veripos Imarsat	
5	CNAV-1	-0.36	0.69	24.49	CNAV	C & C Technologies CNAV	
6	CNAV-2	0.00	1.10	24.54	CNAV	C & C Technologies CNAV	
7	Veripos Spotbeam	0.39	0.98	25.00	Spot, L-Band Decoder	Spotbeam RTCM Corrections	
8	rtCalb Antenna	17.67	-11.31	22.27	Leica MX9400	TRINAV GPS 2.6	
9	Bow Helideck	63.68	0.00	10.28	For X,Y Only	Bow Helideck	
10	ECHO, 18 kHz	46.88	0.23	-7.93	Echosounder	Simrad EA500.	
11	ECHO, 200 kHz	46.28	0.25	-7.93	Echosounder	Simrad EA500.	
12	ECHO, 38 kHz	46.89	-0.85	-7.94	Echosounder	Simrad EA500.	
13	STERN Stmr deck	-27.91	0.00	13.32	For X,Y Only	Stern Helideck	
14a	ADCP Stbd	28.71	-0.26	-7.91	RDI	Current Meter	
14b	ADCP Port	28.71	-0.58	-7.91	RDI	Current Meter	
15	Water Speed Log	0.39	0.45	-7.64	S80	Speed Log	
16	Mid ship TF load line	17.98	-11.48	0.00	Datum Value for Z=0 only	Z=0 vertical ref point at Tropical Fresh Water Load Line	

Positive heights are above the Tropical Fresh Water load line.

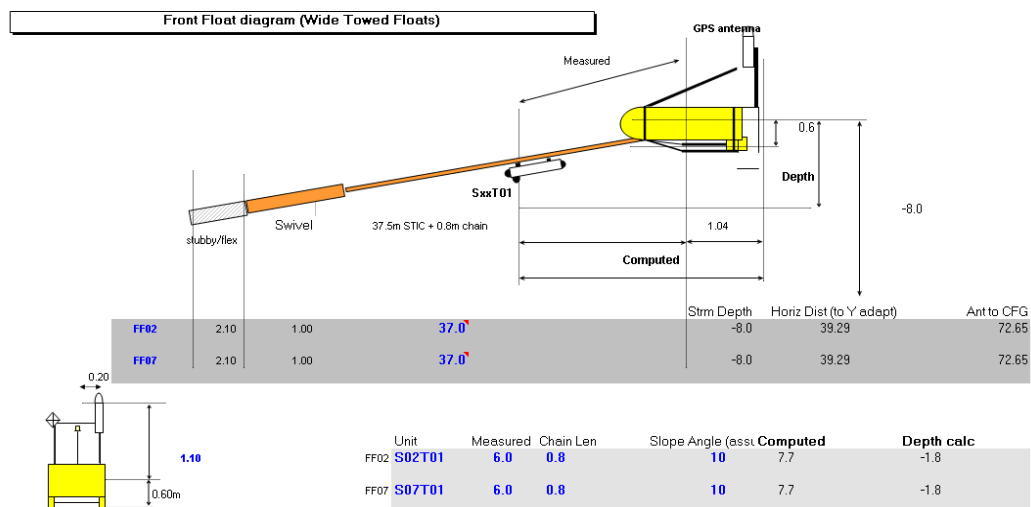


Data from Vessel Offset  
Measurement results for MV  
Trident conducted at Pan United  
Shippard, Singapore on 11 and 12th  
February 2007

	Client:	Apache Energy Limited	Date from	05-Apr-07
	Area:	Elver 3D	to	XXXXX
	Job #	9606	to	XXX

All dimensions in metres. Not to Scale.

## 7.2 OFFSET DIAGRAM & TOWING DIMENSIONS



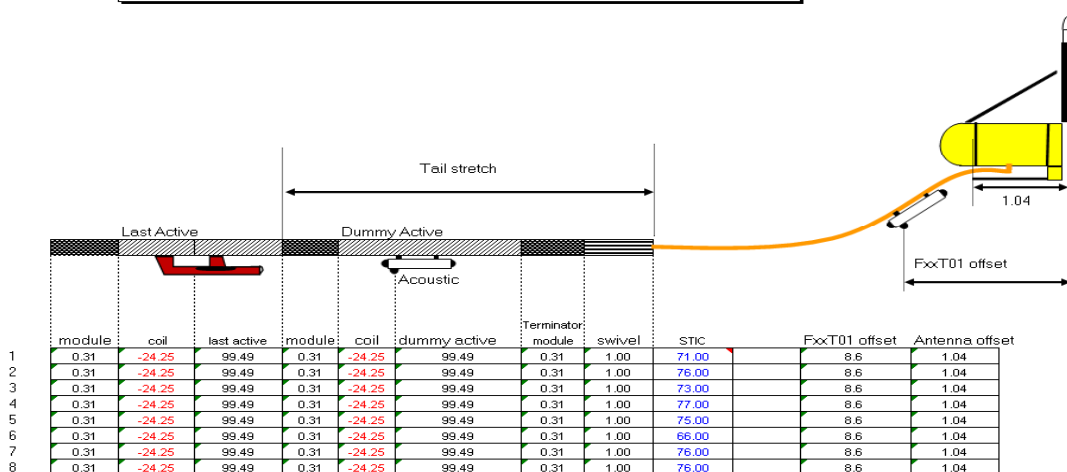
Client: <b>Apache Energy Limited</b>	
Area: <b>Elver 3D</b>	
Vessel: <b>Western Trident</b>	
Job #: <b>9606</b>	
Date from: <b>05-Apr-07</b>	Entered By: .....
to: <b>XXXXX</b>	
Seq. from: <b>001</b>	Checked By: .....
to: <b>XXX</b>	

All dimensions in metres. Not to Scale.

(N) Measurement is based on nominal offset

Unless otherwise indicated all measurements have been physically measured

### Tail sensor diagram



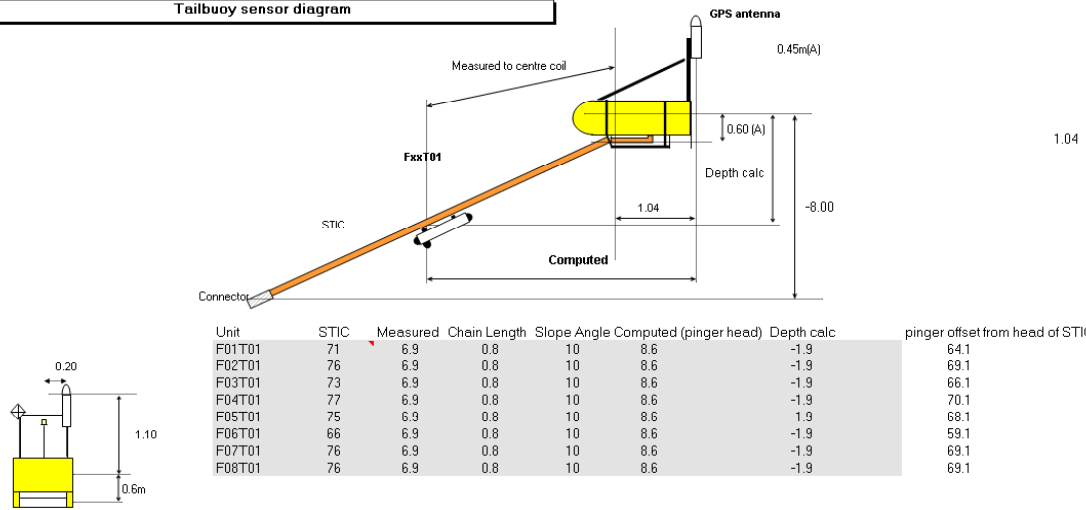
Tail Stretch = 101.11

Client: <b>Apache Energy Limited</b>	
Area: <b>Elver 3D</b>	
Vessel: <b>Western Trident</b>	
Job #: <b>9606</b>	
Date from: <b>05-Apr-07</b>	Entered By: .....
to: <b>XXXXX</b>	
Seq. from: <b>001</b>	Checked By: .....
to: <b>XXX</b>	

All dimensions in metres. Not to Scale.

Note: All values on this sheet are nominal.

Tailbuoy sensor diagram



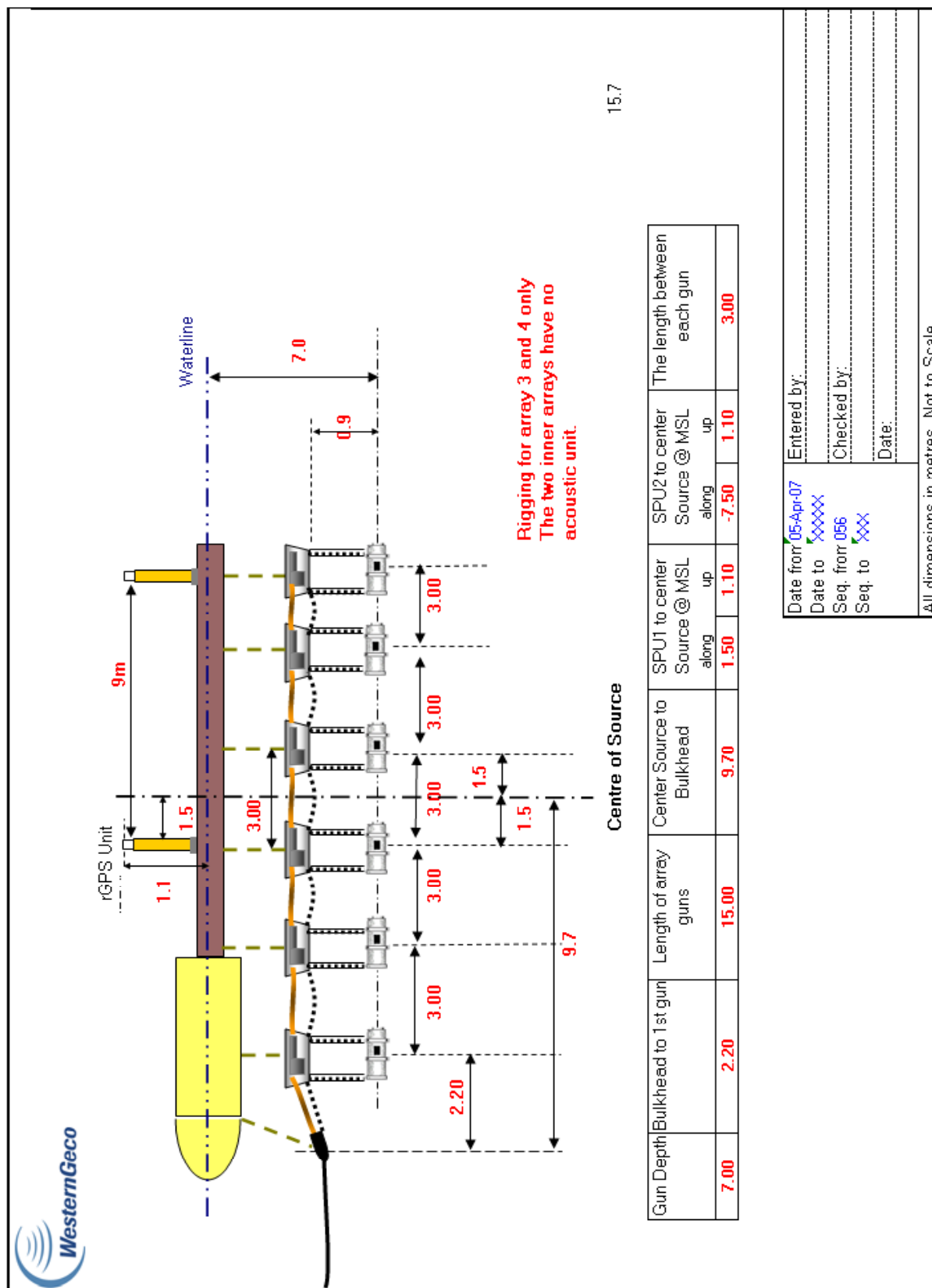
Client:	Apache Energy Limited	
Area:	Elver 3D	
Vessel:	Western Trident	
Job #	9606	
Date from	05-Apr-07	EnteredBy:
to	XXXXX	
Seq. from	001	Checked By:
to	XXX	

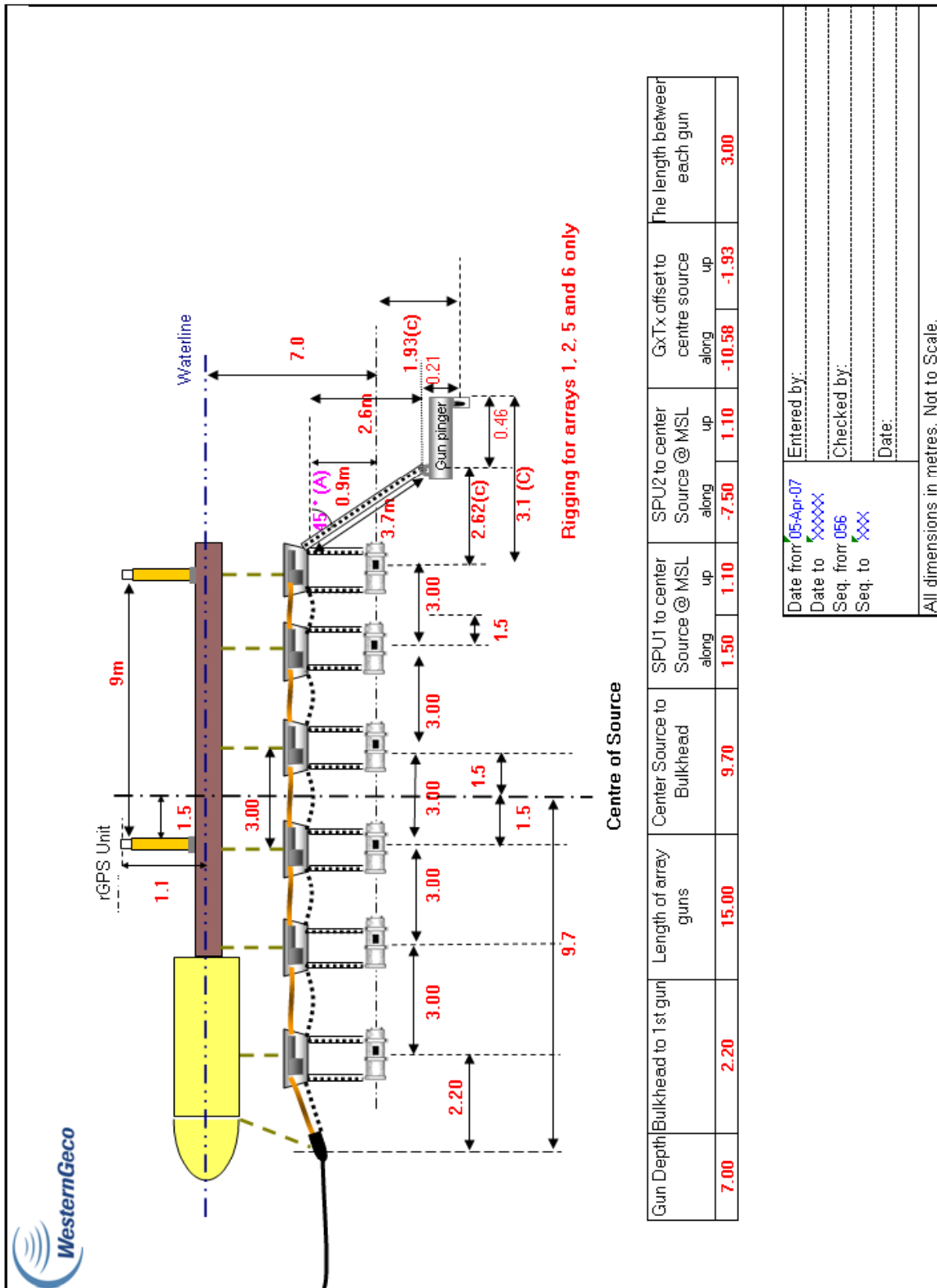
All dimensions in metres. Not to Scale.

(N) Measurement is based on nominal offset

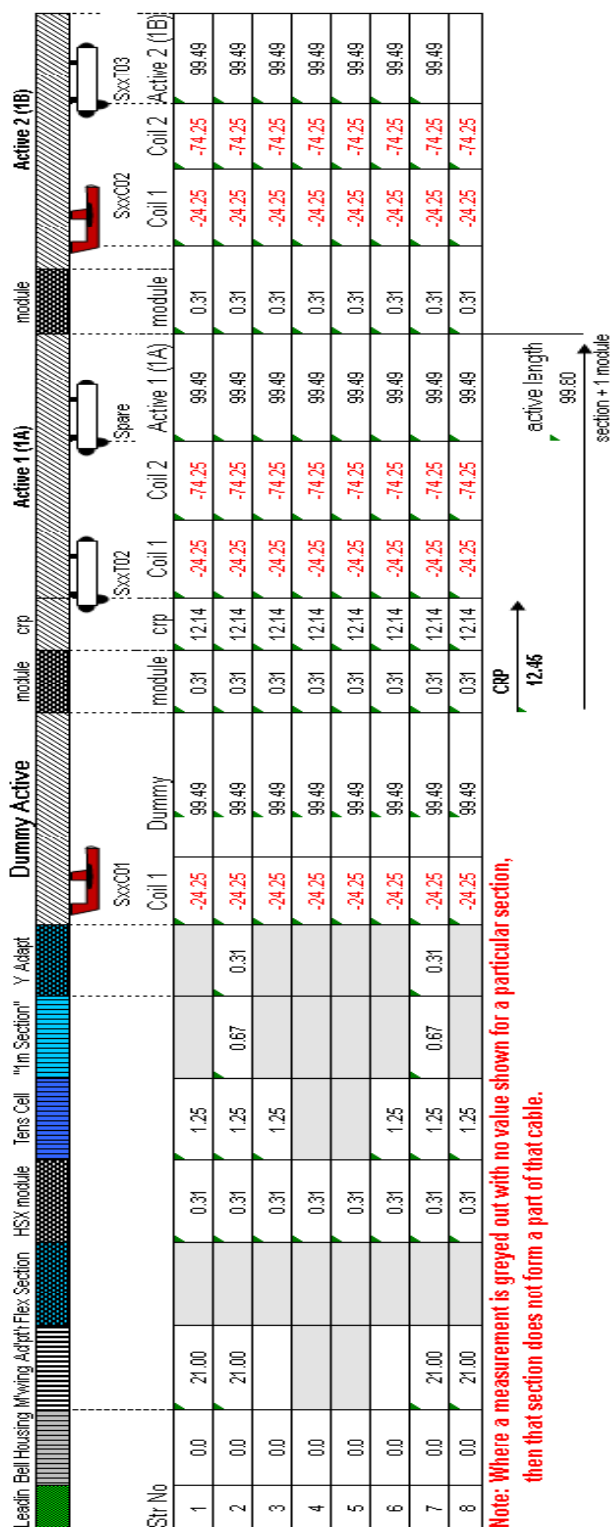
Unless otherwise indicated all measurements have been physically measured

### 7.3 ARRAY TOWING SYSTEM & CONFIGURATION






### Front sensor diagram

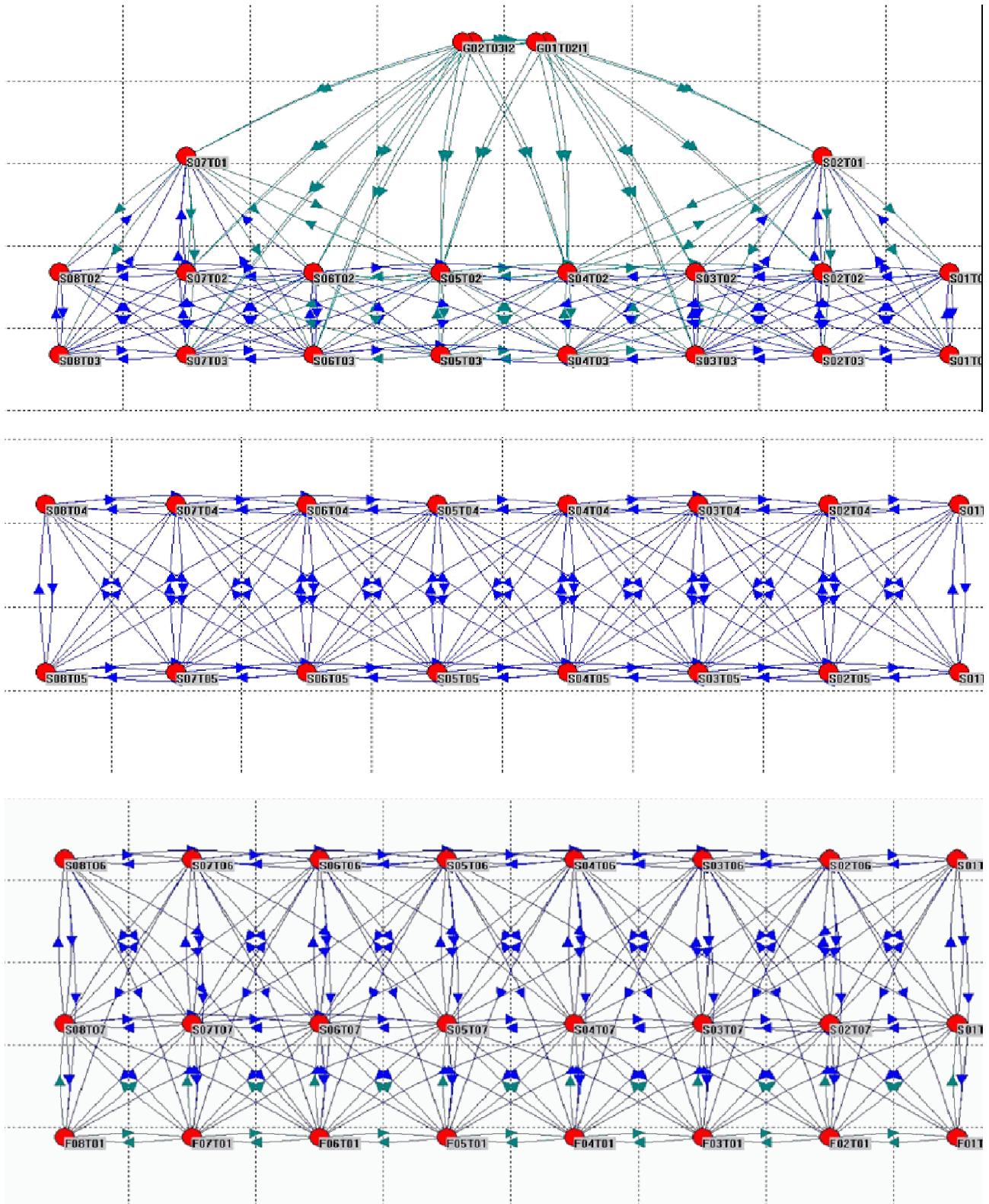


**Note:** Where a measurement is greyed out with no value shown for a particular section, then that section does not form a part of that cable.

Area: Elver 3D	
Vessel: Western Trident	
Job #: 9806	
Date from 05-Apr-07	Entered By:
to XXXX	
Seq. from 001	Checked By:
to XXX	

All dimensions in metres. Not to Scale.

## 7.5 ACOUSTIC NETWORK



## 8 APPENDICES

### 8.1 WESTERNGECO CONVENTIONS AND TERMINOLOGY

Glossary:

Active	: Active streamer section
BCU	: Bird Compass Unit, Digicourse series depth / compass unit
Module	: Streamer electronics module
dGPS	: Differential Global Positioning System. Satellite navigation systems
MOB	: Man overboard boat. A fast rescue craft designed for emergencies
Trilogy	: Data acquisition, streamer interface and recording system
Inmarsat B	: Telecom satellite communication system
DNP	: Do Not Process. Data acquired but not accepted.
rGPS	: Relative GPS system used for positioning source and tailbuoys
SPU	: Source Positioning Unit. rGPS units situated on sub-arrays
TRINAV	: Real Time navigation system
OMEGA	: Seismic processing system
TRIACQ	: Seismic recording system
TRISOR	: Digital energy source timing system
TRINAV	: Navigation QC system
TIM	: Trilogy Information Manager

### 8.2 LINE AND SHOT POINT NUMBER CONVENTION

Line/Job prefix: B

Sail Line Format: Sail line numbers had the format : GAP07Bxxxxyyzzz, where:

GAP = Apache survey identifier  
 07 = Year of acquisition  
 B = Elver 3D identifier  
 xxxx = Sail line number  
 yy = P, Primary, A, Reshoot or J, Infill  
 zzz = sequence number

Shot Point numbers : Incremented to the North Decremented to the South.

### 8.3 DESCRIPTION OF LINE LOG CONTENTS

The following provides details of the data recorded for each line in the Observers Line Logs. All items appear on the individual Line Logs found on the CD accompanying this report.

#### Line Statistics

Seq.	: Sequence number of line (Order in which lines were shot)
Sail Line	: Client specified line number
Date	: Date on which line was started
Dir.	: Nominal line heading
Start Time	: Time of start of line, local time
End Time	: Time of end of line, local time.
SOL	: Start of line column heading
EOL	: End of line column heading
FSP	: First Shotpoint
LSP	: Last Shotpoint
KM	: Total kilometres recorded
KMFF	: Total kilometres full fold
CMP	: Common map point
SQKMFF	: Square Kilometres Full Fold
Vessel Speed	: Vessels speed in knots at the start and end of the line.

#### Environment

Wind Speed	: Average wind speed in knots
Wind Dir.	: Average direction of wind
Water Depth	: Water depth below the transducer at the start and end of line
Swell	: Average swell height at the Start and End of line.
Sea State	: Sea conditions i.e. slight, moderate or rough at BOL/EOL

#### Streamers

SOL noise	: Ambient RMS streamer noise calculated at start of line
EOL noise	: Ambient RMS streamer noise calculated at end of line
Bad Channels	: The number of defective channels on the streamer. These can be classed as bad for several reasons, dead, noisy, spiking, leaking etc.
Feather	: The angle the streamer deviates off the line heading, negative numbers indicate port, positive numbers indicate starboard

#### Summary

Status	: Whether line complete or incomplete
Comments	: General summary of line quality and any particular aspect of the line which may require special attention.
Bad Records	: The number of bad shots or records on the line.

## 8.4 ECHOSOUNDER CALIBRATION

## Echo Sounder Check (In Port)



Vessel: Western Trident  
 Client: Apache Energy Limited  
 Job no. 9605  
 Location: Loyang, Singapore  
 E/S type: Simrad EA500  
 Serial no: 4139

Date: 17/02/2007  
 Check started (GMT): 11:33  
 Check ended (GMT): 11:37  
 E/S draught: 6.76 m  
 Vertical offset keel to E/S: 0.00 m  
 Bridge E/S reading N/A

Observed				
Draught (m)			Lead Line Depth (m)	
Bow	Mid-ships	Stern	Stbd (1)	Port (2)
6.60	7.20	7.00	10.10	10.30
Draught at E/S			LL Depth at E/S	
6.76			10.20	

Echo Sounder Readings	
Freq 2 (m)	Freq 3 (m)
38	200kHz
2.04	2.17
2.04	2.17
2.05	2.16
2.06	2.18
2.06	2.18
Average =	2.05
+ vertical offset keel to E/S transducer	-0.50
+ draught (keel to sea surface)	6.76
Total water depth (m)	9.31

Observed - Echo Sounder = 0.89 m Freq 2  
 Observed - Echo Sounder = 0.77 m Freq 3

\*Too Shallow for 18KHz transducer

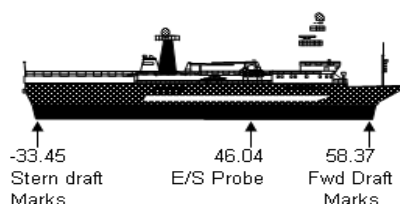
## Sounder Settings Check:

RangeA  
 Absorption coefficient  
 Transmit power  
 Transducer Depth  
 Speed of sound  
 two way beam angle  
 Transducer gain  
 Sample distance

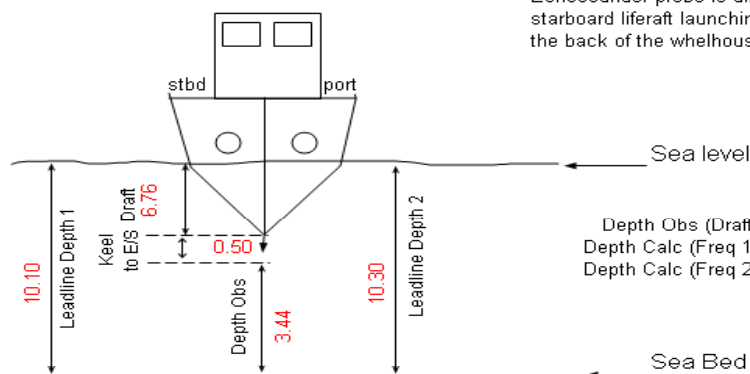
Factory Defaults  
(from manual)

xx.xx  
 3 dB/Km  
 2000 W  
 0.00  
 1500 m/s  
 -17 dB  
 25.01 dB  
 0.25

## Check ✓



Offsets above are relative to VRP  
 Echosounder probe is directly below the starboard liferaft launching davit - just behind the back of the wheelhouse.



Depth Obs (Draft) = 3.44  
 Depth Calc (Freq 1) = 2.05  
 Depth Calc (Freq 2) = 2.17

**Method:** The echo-sounder was tuned to the first return, without draught correction and speed of sound at 1500metres/second. Echo-sounder data was set to log to computer disc. The mid-ship draught marks of the ship were noted along with time. Measuring stations were established on the weather deck, at the ships bulwark, port and starboard, approximately 1.0 metre forward of the main mast (just aft of the sixth porthole counted aft from forward). A weighted steel tape measure was used to establish the distance to sea level and then to seabed level. The mid-ship draught mark was checked again along with the time. The echo sounder reading was taken as the mean reading between the time of draught observations.

**Results and Conclusion:** Given the limitations of the methodology, the differences between the measured and calculated depths are acceptable.

## 8.5 ASSOCIATED FILES ON CD ROM

The accompanying CD-ROM includes this report as well as a number of supporting documents as shown below.

### **Production Logs**

- Enquest Daily Reports
- WesternGeco Party Chief Daily Reports

### **Observers Logs**

- WesternGeco Observers Line Logs

### **Navigation Logs**

- Navigation Daily Logs
- Calibration Reports
- Coverage
- Logs
- Mapping
- Network
- Offsets
- Positioning
- Processing
- Parameters

### **Survey Documents**

#### **MMO Daily Reports**