Waimea Plains
Piezometric Survey

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water

1.0 Introduction

Over the past two years significant development of groundwater resources has occurred in northern Southland primarily due to the demand for pastoral irrigation. This increase in demand for groundwater abstraction highlighted the lack of information available for Environment Southland to effectively manage the resource.

Prior to 2002 limited information was held by Environment Southland to determine groundwater usage and piezometric levels across the Waimea Plain. The total number of bores recorded on the Environment Southland WELLS database at the end of 2001 was approximately 110. These records were mainly derived from drillers logs or the 1997/98 groundwater snapshot survey (Hamill, 1998).

This report documents the methodology and results of piezometric surveys undertaken in the Wiamea Plains area during 2002. The aim of these investigations was to provide more complete information on bore locations, groundwater usage and piezometric levels in the northern Southland area that could be utilised for groundwater resource management. This work is a component of the wider groundwater monitoring and investigation programs established by Environment Southland in early 2000.

The piezometric survey was undertaken in two parts. During February 2002 approximately 140 sites were surveyed in the area extending from Balfour to Mossburn. During November 2002 coverage of the survey was extended to include a further 160 sites in the Balfour/Riversdale/Wendonside area. At the completion of the November 2002 the number of bores, wells and springs recorded on the Waimea Plains had increased to approximately 460.

Results of the two surveys are combined to produce a single piezometric contour map of the Waimea Plains for this report. The seasonal water table variation of between 1-3 metres across the study area between the two surveys was considered unlikely to have a significant effect on piezometric contours when viewed at a regional scale.

Initial Site Identification

Similar methods were employed for both the February and November 2002 peizometric surveys. The initial phase of the survey involved site visits to all properties within the respective field areas. Wherever possible landowners were contacted regarding the location of bores, wells and springs on their property. Relevant details were recorded and permission sought to revisit the site to survey the wellhead elevation and groundwater level during the main survey.

In practice between 30-40 percent of landowners were unable to be contacted during initial site visits. Where contact was unable to be established, properties were only revisited if no suitable alternative sites existed in the surrounding area.

During site visits, details of bores, wells, springs and waterholes were recorded using a standard field sheet. The spatial location of relevant features was fixed using a handheld GPS unit. Information recorded included:

- Owners name

- Contact address
- Phone Number
- Description of feature (bore/well/spring/waterhole)
- Grid Reference (GPS)
- Description of bore location
- Depth
- Diameter
- Use
- Casing material
- Location Diagram
- Photo of wellhead

Details of bore locations were entered into the Environment Southland WELLS database and well numbers assigned to each feature. Field sheets were indexed with other hardcopy bore records.

2.0 Piezometric Survey

Differential GPS survey equipment was used to provide accurate wellhead elevations to enable relative groundwater levels to be determined. The February 2002 survey was undertaken using a RTK Trimble 4000 base and rover unit obtained from Geohire, New Plymouth. The November 2002 survey was undertaken using a Leica SR510 base and receiver unit on hire from TrueSouth Survey Services, Invercargill.

Both RTK GPS systems recorded survey information electronically, allowing direct downloading of field survey information onto Environment Southland ARCVIEW software.

Survey Methodology

Prior to commencement of field surveys relevant benchmarks were identified across the field area. Fortunately benchmark coverage was good along SH94 and SH6 which enabled relatively easy coverage of a majority of the survey areas. Benchmark locations and orthometric heights were identified from the Land Information New Zealand (LINZ) website (http://gdb.linz.govt.nz/cgi-bin/gdb.cgi).

Wherever possible the survey base station was set up on a known benchmark using data derived from the LINZ website. Once the base station was established the level accuracy was cross-checked by taking spot measurements on a least two nearby benchmarks. In general, the levels obtained during cross checking were within +/- 0.1 metres of the listed orthometric heights.

In practice, the distance over which an adequate radio link could be established between base station and rover unit to provide an accurate fix on spot height elevation varied between 4-12 km depending on atmospheric conditions. One of the major factors limiting the operational range of the rover unit was the presence of trees or shelterbelts on the line of sight.

In areas where no reliable survey benchmarks were available, temporary benchmarks were established to allow extension of the survey coverage. The procedure for the establishment of a temporary benchmark involved installation of a metal peg at an appropriate location. The elevation of the temporary mark was then accurately surveyed from a known benchmark. The base station was then transferred to the temporary benchmark and the elevation of the original benchmark recorded to cross check the accuracy of the new benchmark elevation before further surveying was undertaken.

Field Measurements

Each of the piezometric surveys was undertaken over the space of a week to ensure groundwater levels were comparable. At each site a wellhead reference elevation and groundwater level were measured. Not all bores recorded during initial site visits were surveyed due to time constraints on hire equipment. Sites that were located remote from survey coverage and would have required the establishment of additional temporary benchmarks stations were not surveyed. In addition, some sites that were in close proximity were not surveyed to expedite survey coverage.

The wellhead elevation of sites that were pumping at the time of the second site visit were recorded. A representative reduced groundwater level was then calculated for these sites based on the groundwater level measured during the initial site visit with allowance made for seasonal variation over the intervening period.

Wherever possible the elevation for each bore or well was measured directly from the water level reference point (eg. top of the casing). However, in situations where direct measurement of the reference point was not possible, ground surface elevation was recorded and a correction for reference point elevation noted.

3.0 Results

Appendix 1 contains a listing of corrected survey results. This data includes all sites measured including surveyed locations, wellhead and spot height elevations along with measured groundwater depths and reduced groundwater levels.

Measured depths to groundwater ranged from 0 to 23.9 metres below ground. In the February 2002 survey, groundwater levels in excess of 10 metres below ground surface were only recorded along the footslopes of the North Range. Elsewhere across the five Rivers, Castlerock, Oreti and Waimea Plains groundwater zones levels were less than 5 metres below the land surface.

In the November 2002 survey a number of bores on the Wendonside Terrace and along the southeast extension of the Longridge showed groundwater levels greater than 10 metres below the ground surface. Again, groundwater levels across the flat-lying Riversdale, Waipounamu and Knapdale groundwater zones were less than 5 metres below the ground surface.

Data from the two individual surveys was stored on separate files but also combined for the purpose of producing a regional piezometric contour map. The observed seasonal

groundwater level fluctuation of between 1-3 metres between the two surveys was assumed to have a limited effect on overall piezometric patterns at a regional scale.

Initial contour maps of reduced water table elevation were produced from the raw data using ARCVIEW Spatial Analyst. The resulting contours were used as a basis for production of the final contour maps. Where limited groundwater level data were available the estimated piezometric contours were matched with the measured depths to groundwater and topographic contours.

Figure 1 shows the interpreted piezometric contours for the Waimea Plain. The contours show a relatively complex regional groundwater flow pattern resulting from the interaction of topographic and geological features in the area as well as the hydraulic characteristics of the alluvial gravel aquifers.

Based on the interpreted piezometric contours, representative hydraulic gradients for the 10 groundwater zones covered by the survey are listed in Table 1

Groundwater zone	Piezomentric gradient	Flow direction	Controls on groundwater flow
Castlerock	0.0065	E/SE	Drainage from North Range Discharge to Murray Creek
Oreti	0.00625	E/SE	Relative Oreti River stage
Five Rivers	0.0065	E/SE to N/S	Drainage toward Irthing/Cromel/Acton Overall drainage toward Irthing confluence
Waimea Plains	0.0031	SE	Drainage divide between Oreti and Waimea Stream catchments at Lintley Longridge tertiary outcrops
Longridge	-	NE	Drainage toward Riversdale Aquifer
Riversdale	0.0028	SE	Drainage toward Mataura
Waiponamu	0.003	SE	Drainage toward Mataura/Waikaia confluence
Wendonside	0.0074	SE	
Cattle Flat	0.007	S/SW	Drainage parallel to Mataura River
Knapdale	-	S/SE	Drainage toward Mataura River

The main features of groundwater flow apparent from the interpreted piezometric contours include:

- Groundwater flow generally follows the topographic gradient

- A hydraulic divide separating the Oreti River and Waimea Stream catchments was observed in the Lintley area. This indicates there is no flow loss from the Oreti catchment further down the Waimea Plain. This observation is consistent with the results of concurrent gaugings undertaken on the Oreti River.

- A drainage divide occurs between the Waimea Plains and Riversdale groundwater zones due to the presence of uplifted Tertiary sediments which occur along the trend of Longridge and diagonally cross the Waimea Plains. The limestone outcrops at Kingston Crossing form part of this geological structure.

- The remnant Quaternary gravel deposits of the Longridge groundwater zone drain toward the Riversdale aquifer and effectively increase the recharge area for this aquifer system.

- Goundwater flow on the lower floodplain terraces of the Riversdale and Waiponamu groundwater zones generally follows the Mataura River. This indicates the potential for groundwater/surface water interaction in these aquifer systems in response to relative river and groundwater stage heights.

- Groundwater recharge to the Wendonside groundwater zone may occur from the Mataura River over the reach upstream of the Ardlussa Bridge.

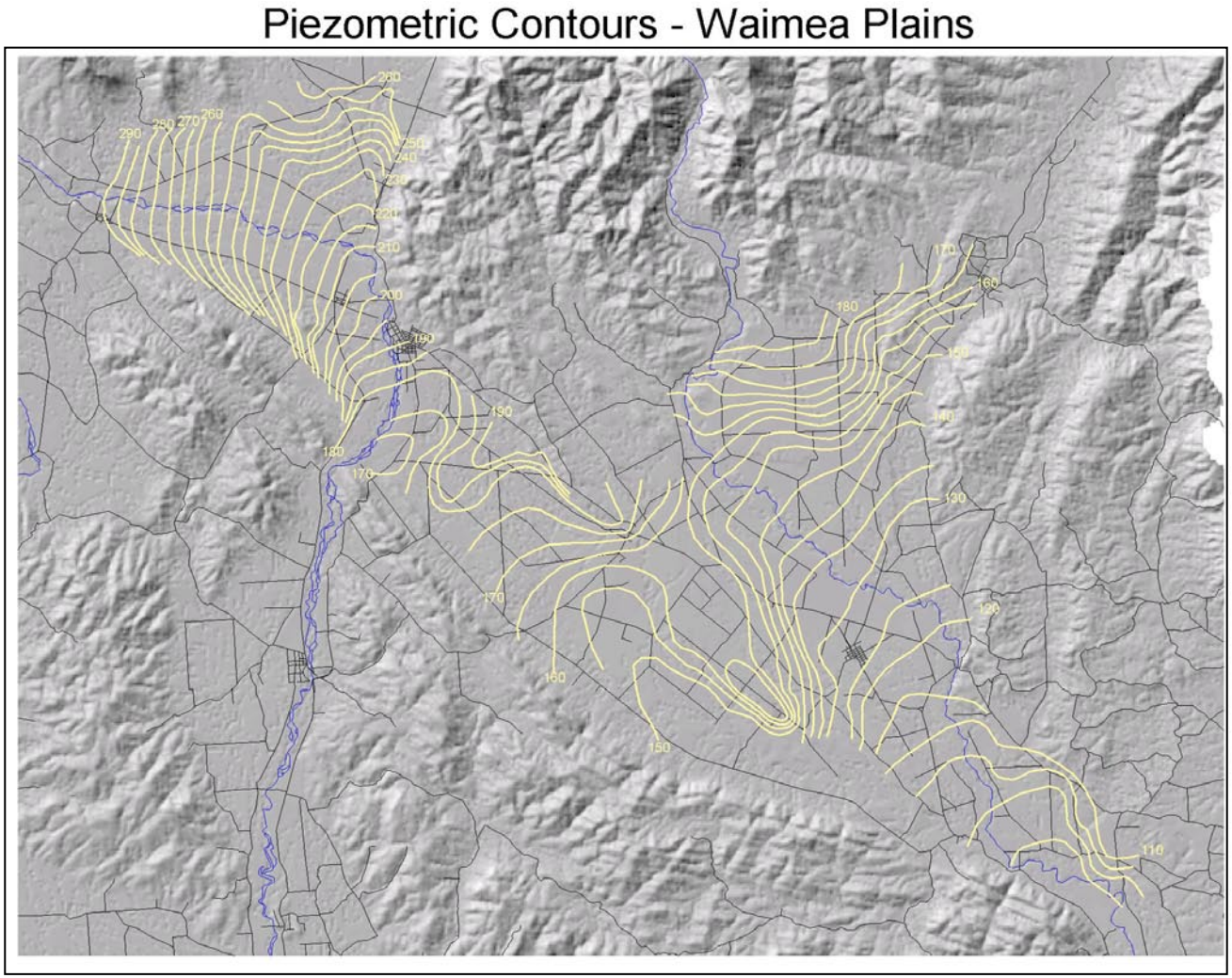

Figure 1: Piezometric Contours for the Waimea Plains (mamsl)

Appendix 1: Survey Results

Piezometric Survey Waimea Plains 11-15 February 2002

Site	Corrected WL	Elevation	Water table elevation	Easting	Northing
E43/0006	2.80	269.42	**266.62**	5501367	2151453
E43/0013	1.76	258.28	**256.52**	5501056	2153910
E43/0015	1.05	255.95	**254.90**	5500694	2153655
E43/0016	2.44	255.88	**253.44**	5500337	2154452
E43/0017	0.00	266.73	**266.73**	5500642	2150423
E44/0006	3.32	293.50	**290.18**	5494318	2138764
E44/0007	4.32	173.12	**168.80**	5480916	2154760
E44/0008	4.04	164.65	**160.61**	5474532	2169633
E44/0009	5.44	165.59	**160.15**	5475305	2166884
E44/0010	3.13	157.02	**153.89**	5476456	2162524
E44/0011	3.80	214.45	**210.65**	5489384	2151302
E44/0012	4.75	209.24	**204.49**	5489207	2152029
E44/0013	2.14	222.50	**220.36**	5494019	2151191
E44/0014	2.34	257.01	**254.67**	5496507	2144970
E44/0015	2.22	257.65	**255.43**	5499053	2149355
E44/0016	3.96	283.63	**279.67**	5492900	2140559
E44/0035	2.38	179.00	**176.62**	5479529	2161189
E44/0036	5.15	157.13	**151.98**	5472955	2164446
E44/0070	3.05	188.56	**185.51**	5480197	2157071
E44/0076	3.89	170.56	**166.67**	5472403	2160959
E44/0083	4.15	250.60	**246.45**	5496221	2146463
E44/0084	4.77	252.71	**247.94**	5495111	2146005
E44/0085	3.04	227.58	**224.54**	5494441	2150342
E44/0086	2.05	236.75	**234.70**	5495561	2148784
E44/0087	1.62	212.65	**211.03**	5492517	2152821
E44/0088	1.55	223.73	**222.18**	5493121	2150740
E44/0089	0.00	233.48	**233.48**	5496147	2148956
E44/0090	3.80	234.46	**230.66**	5497632	2153590
E44/0091	3.34	275.76	**272.42**	5497968	2155403
E44/0092	2.61	237.14	**234.53**	5495418	2154041
E44/0093	2.45	248.01	**245.56**	5495423	2154436
E44/0096	0.57	256.42	**255.85**	5498081	2145161
E44/0097	3.09	255.78	**252.69**	5497583	2145245
E44/0098	2.43	248.37	**245.94**	5497344	2146603
E44/0099	1.27	243.63	**242.36**	5497458	2147327
E44/0100	1.32	257.58	**256.26**	5498911	2144984
E44/0101	2.28	254.99	**252.71**	5498754	2148615
E44/0103	1.57	257.84	**256.27**	5499467	2150541
E44/0105	2.17	256.86	**254.69**	5499985	2151323
E44/0106	1.78	248.04	**246.26**	5499096	2152103
E44/0107	4.09	235.59	**231.50**	5497322	2152723
E44/0108	2.15	228.78	**226.63**	5496386	2152655
E44/0111	0.67	285.28	**284.61**	5496080	2140648
E44/0112	1.63	275.07	**273.44**	5497159	2141694
E44/0114	2.25	270.10	**267.85**	5497196	2142818

E44/0115a	0.00	270.57	**270.57**	5497653	2143082
E44/0115	3.72	262.32	**258.60**	5496751	2144155
E44/0117	16.91	279.97	**263.06**	5490465	2139649
E44/0118	1.06	281.49	**280.43**	5493366	2140476
E44/0121	2.28	261.49	**259.21**	5492996	2144039
E44/0122	2.80	259.05	**256.25**	5491657	2144775
E44/0123	3.26	252.94	**249.68**	5491774	2145286
E44/0125	2.53	244.48	**241.95**	5490799	2146743
E44/0126	11.16	195.19	**184.03**	5484904	2152813
E44/0127	1.31	203.00	**201.69**	5488258	2152458
E44/0129	0.00	179.97	**179.97**	5483682	2152960
E44/0131	2.06	200.71	**198.65**	5488732	2153295
E44/0134	0.74	224.23	**223.49**	5485676	2149252
E44/0136	2.63	242.71	**240.08**	5490189	2147067
E44/0137	5.93	248.77	**242.84**	5489014	2147128
E44/0138	2.54	210.48	**207.94**	5487779	2151060
E44/0139	15.95	213.06	**197.11**	5486908	2150546
E44/0140	0.80	173.78	**172.98**	5481622	2156820
E44/0141	8.72	184.74	**176.02**	5484694	2157185
E44/0142	1.75	187.76	**186.01**	5485876	2155429
E44/0143	1.50	191.94	**190.44**	5487230	2154915
E44/0145	10.74	186.88	**176.14**	5483762	2157746
E44/0146	2.64	171.90	**169.26**	5480210	2154543
E44/0147	3.36	191.02	**187.66**	5478329	2157643
E44/0148	2.88	181.70	**178.82**	5477408	2158599
E44/0149	1.96	175.60	**173.64**	5475867	2159753
E44/0150	1.91	175.69	**173.78**	5475928	2159812
E44/0151	0.00	173.53	**173.53**	5475866	2159823
E44/0152	3.73	177.18	**173.45**	5476539	2160407
E44/0153	2.36	183.26	**180.90**	5479398	2159157
E44/0154	2.07	176.96	**174.89**	5477844	2160294
E44/0155	1.81	178.03	**176.22**	5478312	2160079
E44/0156	0.00	180.62	**180.62**	5481846	2158188
E44/0157	5.50	175.84	**170.34**	5481293	2155824
E44/0159	2.02	183.82	**181.80**	5479869	2160185
E44/0160	2.19	182.94	**180.75**	5478903	2159788
E44/0161	1.74	188.94	**187.20**	5480267	2160041
E44/0162	0.00	190.77	**190.77**	5478304	2164359
E44/0163	5.32	177.73	**172.41**	5475474	2161176
E44/0167	5.98	157.40	**151.42**	5471423	2166594
E44/0200	4.20	181.95	**177.75**	5483643	2155907
E44/0203	2.50	289.35	**286.85**	5494488	2139691
E45/0094	5.10	149.38	**144.28**	5467849	2169058
E45/0121	7.84	152.94	**145.10**	5468924	2168782
E45/0122	0.87	163.97	**163.10**	5467722	2165687
F44/0006	6.07	170.18	**164.11**	5474741	2171360
F44/0020	3.88	141.74	**137.86**	5474769	2176486
F44/0052	7.10	167.74	**160.64**	5470753	2170882
F44/0054	3.12	150.84	**147.72**	5476879	2173147
F44/0055	2.74	151.63	**148.89**	5477283	2173210
F44/0056	7.00	139.37	**132.37**	5473982	2177448
F44/0057	4.50	136.79	**132.29**	5472396	2176374

F44/0058	4.74	138.90	**134.16**	5472946	2176550
F44/0059	2.31	134.07	**131.76**	5472425	2177765
F44/0060	5.07	165.65	**160.58**	5474445	2172955
F45/0268	6.08	146.75	**140.67**	5467935	2171495
Bench Marks					
A1QR		239.46		5477773	2166014
ADR8		238.65		5495422	2154147
ADR9		241.51		5495835	2154318
ADRA		259.54		5497121	2154902
ADX4		243.25		5490260	2154142
ADX7		181.09		5483600	2155953
ADXF		225.74		5489987	2149366
ADXH		241.56		5490796	2147527
ADXU		175.72		5481477	2155323
ADXV		178.91		5482598	2155801
ADXY		169.55		5475949	2168949
ADY0		164.85		5476448	2167602
ADYV		136.10		5472304	2177372
ADYW		137.65		5472525	2176125
ADYX		140.83		5472940	2174830
B3PW		165.98		5476349	2167957
ST PATRICKS TRIG		162.52		5479358	2162068
Spot Heights					
BALFOUR1		156.89		5475070	2164052
CROMEL		244.38		5497882	2147137
1002		226.17		5489987	2149366
FIVERIV SPIT		252.06		5496916	2145440
FIVRIV 1		263.79		5499986	2154788
FIVRIV 2		269.86		5499890	2155078
FIVRIV 3		253.49		5500208	2154098
FIVRIV 4		259.14		5500767	2153015
FIVRIV 5		265.07		5501389	2152977
FIVRIV 6		265.50		5501146	2151958
FIVRIV 7		253.77		5499726	2151730
IRTHING		211.65		5493225	2153692
IRTHING 2		224.76		5495771	2153256
JVILLE1		170.42		5480246	2157343
JVILLE2		169.19		5479980	2159869
JVILLE3		161.75		5478090	2160356
OPP 1354		257.85		5499467	2150541
ORETI BRIDGE		290.07		5494537	2139731
OSWALD STREAM		278.55		5496558	2141665

Piezometric Survey Waimea Plains 11-15 November 2002

Site	Corrected WL	Elevation	Water table elevation	Easting	Northing	
E44/0174	4.44	171.322	**166.88**	2169503	5483930	
E44/0197	1.9	175.548	**173.65**	2169114	5484487	
E44/0206	1.55	175.133	**173.58**	2169762	5478955	
E44/0207	5.55	170.644	**165.09**	2169672	5476308	

E44/0208	4.59	168.079	**163.49**	2169711	5475759	
F44/0008	2.37	140.573	**138.20**	2181885	5481729	
F44/0011	2.77	139.962	**137.19**	2181900	5481235	
F44/0012	16.64	188.355	**171.72**	2171768	5482954	
F44/0013	2.45	182.518	**180.07**	2183449	5490641	
F44/0014	1.53	132.4186	**130.89**	2177743	5470850	
F44/0015	2.31	130.6786	**128.37**	2180438	5472426	
F44/0018	2.55	188.679	**186.13**	2178523	5485871	
F44/0024	1.67	125.0436	**123.37**	2182163	5471467	
F44/0026	1.67	130.7266	**129.06**	2180185	5472575	
F44/0027	3.67	152.666	**149.00**	2175266	5480297	
F44/0029	4.39	162.133	**157.74**	2174747	5470103	
F44/0030	3.22	147.437	**144.22**	2176770	5478617	
F44/0037	1.67	146.695	**145.03**	2182991	5484736	
F44/0040	1.98	147.241	**145.26**	2176886	5479828	
F44/0048	2.27	119.766	**117.50**	2184055	5470137	
F44/0055	2.23	151.772	**149.54**	2173205	5477288	
F44/0059	1.67	134.2386	**132.57**	2177761	5472427	
F44/0061	8.84	211.716	**202.88**	2174996	5486895	poor acc
F44/0067	1.03	163.522	**162.49**	2173369	5471717	
F44/0069	22.72	183.232	**160.51**	2178434	5483079	
F44/0072	4.68	157.372	**152.69**	2184460	5487345	
F44/0074	5	159.043	**154.04**	2173375	5480672	
F44/0080	2	122.19	**120.19**	2182902	5470444	
F44/0081	2.2	121.962	**119.76**	2182902	5470450	
F44/0082	1.99	125.1846	**123.19**	2182134	5471324	
F44/0084	0.54	160.322	**159.78**	2174070	5470821	
F44/0085	3.87	131.983	**128.11**	2183304	5477309	
F44/0086	1.74	135.91	**134.17**	2183340	5479630	
F44/0087	2.99	132.593	**129.60**	2183651	5477421	
F44/0088	2.54	131.966	**129.43**	2183445	5477800	
F44/0090	1.6	126.14	**124.54**	2184165	5474879	
F44/0091	18.83	179.827	**161.00**	2171011	5471611	
F44/0092	2.69	142.262	**139.57**	2183312	5482184	
F44/0094	2.79	130.287	**127.50**	2183747	5476155	
F44/0095	>3.54	131.796		2183463	5476761	
F44/0097	2.03	123.4326	**121.40**	2182971	5471456	
F44/0099	2.47	165.16	**162.69**	2170042	5482080	
F44/0103	2.56	136.2916	**133.73**	2176444	5471409	
F44/0104	1.42	127.6586	**126.24**	2180689	5471331	
F44/0105	1.99	130.155	**128.17**	2177775	5470140	
F44/0106	2.03	172.737	**170.71**	2170772	5485454	
F44/0107	5.46	131.296	**125.84**	2182602	5475148	
F44/0108	3.27	129.766	**126.50**	2182232	5474420	
F44/0109	3.08	129.316	**126.24**	2182349	5473984	
F44/0110	1.88	130.753	**128.87**	2182046	5475694	
F44/0112	1.51	132.181	**130.67**	2180784	5474581	

F44/0113	2.8	133.4026	**130.60**	2179223	5472618	
F44/0114	2.49	129.6376	**127.15**	2180144	5472409	
F44/0115	5.7	167.107	**161.41**	2172413	5470376	
F44/0116	2.09	161.191	**159.10**	2174637	5470103	
F44/0118	0	164.018	**164.02**	2171628	5472857	
F44/0122	2.42	167.134	**164.71**	2170043	5482959	
F44/0123	3.5	166.225	**162.73**	2170183	5482114	
F44/0125	3.57	151.308	**147.74**	2175507	5479858	
F44/0127	2	144.099	**142.10**	2177457	5477440	
F44/0128	2.5	147.246	**144.75**	2176427	5478878	
F44/0130	0.57	138.939	**138.37**	2178648	5476414	
F44/0131	0.54	138.161	**137.62**	2179054	5476576	
F44/0132	4.85	157.046	**152.20**	2173981	5480362	
F44/0133	5.56	150.174	**144.61**	2177053	5479815	
F44/0139	23.96	181.974	**158.01**	2178822	5482766	
F44/0141	2.97	143.622	**140.65**	2181927	5483362	
F44/0142	5.92	142.481	**136.56**	2181479	5481421	
F44/0144	2.57	196.473	**193.90**	2177009	5487116	
F44/0145	3.13	165.639	**162.51**	2180720	5486586	
F44/0146	2	164.493	**162.49**	2180851	5486543	
F44/0148	3.35	194.714	**191.36**	2176701	5486982	
F44/0149	11.32	196.698	**185.38**	2175915	5486403	
F44/0155	1.35	188.973	**187.62**	2180557	5489696	
F44/0156	3.55	186.77	**183.22**	2181009	5489788	
F44/0158	4.97	153.877	**148.91**	2183923	5486740	poor acc
F44/0159	3.91	147.9	**143.99**	2174752	5476142	
F44/0160	1.32	154.73	**153.41**	2181236	5485340	
F44/0164	20.2	158.334	**138.13**	2180032	5479300	
F44/0165	11.78	184.778	**173.00**	2180451	5485613	
F44/0166	5.01	186.59	**181.58**	2178818	5485289	
F44/0167	14.05	182.67	**168.62**	2178786	5483644	
F44/0170	4.11	146.339	**142.23**	2175292	5475860	
F44/0171	20.99	189.553	**168.56**	2172431	5482443	
F44/0172	1.85	162.886	**161.04**	2173568	5473993	
F44/0173	1.93	157.29	**155.36**	2171405	5478606	
F44/0174	1.81	156.295	**154.49**	2172000	5478549	
F44/0175	2.2	153.854	**151.65**	2172784	5478019	
F44/0176	3.34	142.61	**139.27**	2176398	5475061	
F44/0177	1.08	129.602	**128.52**	2179075	5471181	
F44/0178	14.495	183.355	**168.86**	2178483	5484091	
F44/0179	2.66	190.197	**187.54**	2178462	5486532	
F44/0180	2.75	140.954	**138.20**	2181880	5481730	
F45/0167	2.19	115.107	**112.92**	2182092	5465690	
F45/0171	1.52	91.214	**89.69**	2191540	5458855	
F45/0172	2.13	97.722	**95.59**	2190177	5460611	
F45/0173	4.39	102.73	**98.34**	2189418	5461857	
F45/0179	3.65	88.486	**84.84**	2192447	5456269	

F45/0192	1.83	120.771	**118.94**	2180536	5467283	
F45/0195	6.27	120.602	**114.33**	2193685	5460015	
F45/0208	1.58	117.109	**115.53**	2183210	5468632	
F45/0213	3.97	166.888	**162.92**	2173847	5469014	
F45/0221	0.77	95.912	**95.14**	2190485	5460480	
F45/0228	2.31	114.269	**111.96**	2183237	5466550	
F45/0232	3.86	119.255	**115.40**	2193440	5459632	poor acc
F45/0279	3.58	88.224	**84.64**	2192497	5455988	
F45/0283	2.63	111.672	**109.04**	2182884	5464136	
F45/0286	1.97	99.414	**97.44**	2186880	5459645	
F45/0289	2.45	113.321	**110.87**	2183519	5466146	
F45/0304	3.15	168.213	**165.06**	2172992	5468287	
F45/0305	2.81	97.32	**94.51**	2188658	5459620	
F45/0332	2.78	116.974	**114.19**	2193642	5459425	
F45/0333	2.43	102.085	**99.66**	2187296	5461557	
F45/0334	1.72	106.956	**105.24**	2187293	5464409	
F45/0335	1.46	105.85	**104.39**	2186412	5464009	
F45/0336	4.55	116.821	**112.27**	2194021	5459307	
F45/0340	0.56	107.199	**106.64**	2188077	5463771	
F45/0341	0.43	94.376	**93.95**	2190645	5459415	
F45/0342	0.76	97.354	**96.59**	2191755	5459420	
F45/0343	10.23	118.883	**108.65**	2191775	5461015	
F45/0344	0	97.731	**97.73**	2194209	5457682	
F45/0345	7.2	122.671	**115.47**	2193575	5460265	
F45/0346	1.68	97.069	**95.39**	2189023	5459978	
F45/0347	1.33	97.286	**95.96**	2188970	5460309	
F45/0348	2.82	92.827	**90.01**	2190705	5458755	
F45/0350	2.02	105.254	**103.23**	2184361	5462028	
F45/0352	1.21	103.985	**102.78**	2184228	5461237	
F45/0353	4.58	106.374	**101.79**	2184899	5463577	
F45/0354	1.4	121.205	**119.81**	2180197	5467509	
F45/0355	1.13	113.733	**112.60**	2182239	5465515	
F45/0358	>17.00	154.85		2178788	5466780	
F45/0360	1.19	118.092	**116.90**	2184497	5469716	poor acc
F45/0361	1.4	129.278	**127.88**	2178840	5465699	poor acc
F45/0362	6.08	184.191	**178.11**	2175050	5466988	poor acc
F45/0364	4.46	143.57	**139.11**	2174260	5465984	poor acc
F45/0365	1.48	156.302	**154.82**	2174520	5469311	
F45/0366	5.65	158.214	**152.56**	2174931	5469115	
F45/0367	6.32	121.824	**115.50**	2187847	5465317	
F45/0369	2.75	107.542	**104.79**	2183519	5462322	
F45/0370	1.71	103.193	**101.48**	2185408	5460216	
F45/0373	3.35	96.53	**93.18**	2189185	5458755	
F45/0374	2.56	117.377	**114.82**	2183818	5468940	
F45/0376	1.88	107.232	**105.35**	2184677	5463807	
F45/0377	1.55	115.582	**114.03**	2182535	5466888	
F45/0378	17.52	179.6	**162.08**	2172494	5469864	

F45/0380	1.89	104.429	**102.54**	2184855	5461836	
F45/0381	0.28	129.3656	**129.09**	2178164	5469703	Dodgy bore
F45/0382	9.59	175.102	**165.51**	2174271	5468535	
F45/0383	1.29	132.452	**131.16**	2178113	5468024	
F45/0385	3.8	151.325	**147.53**	2176138	5468142	poor acc
F44/0182	2.78	122.532	**119.75**	5470461.3	2182911.3	

Spot Heights

sh1		142.903	**142.90**	5465366.3	2188009.8	
sh2		143.75	**143.75**	5463428.1	2190137	
sh3		109.155	**109.16**	5461926.6	2189706.8	
sh4		112.55	**112.55**	5458158.3	2194109.9	
sh5		112.006	**112.01**	5465848.7	2183016.9	
sh6		119.507	**119.51**	5467763.6	2180616.5	
sh7		149.963	**149.96**	5465807.5	2178964	
sh8		179.029	**179.03**	5480000.5	2170316.8	
sh9		158.655	**158.66**	5479952.5	2170480.5	
sh10		146.004	**146.00**	5484938.3	2182450.8	