Forestry Commission

The Road Condition Survey

Presentation for Swedish Engineers – April 18th 2011

Alan Drake

Background

England, Scotland & Wales recognise that forest roads are a key part of forest infrastructure

England needs usage & condition survey of forest accesses to justify more investment

Wales wants a database of all civil engineering assets

Scotland wants to improve their road planning

Forestry Civil Engineering begins development of a stand-alone GIS tool to enable improved recording of road data including usage, construction and maintenance details.

Forestry Civil Engineering trials GPR, video and IRI in conjunction with Roadscanners.

Process

Part 1

Define the usage of each segment of road in terms of low, medium or high for timber traffic, light vehicles, cyclists, horses, walkers and other

Decide on the optimum surfacing solution for each usage combination

Record the actual condition against the optimum

Estimate the cost of moving to the optimum solution

Part 2

Assess the strength of roads for harvesting purposes

Record the condition of other features which include the sensitivity of the area to water (this determines the attention paid to side drains and culverts), the condition of side drains, surface potholes, road shape and vegetation

Transfer all data to ArcGIS

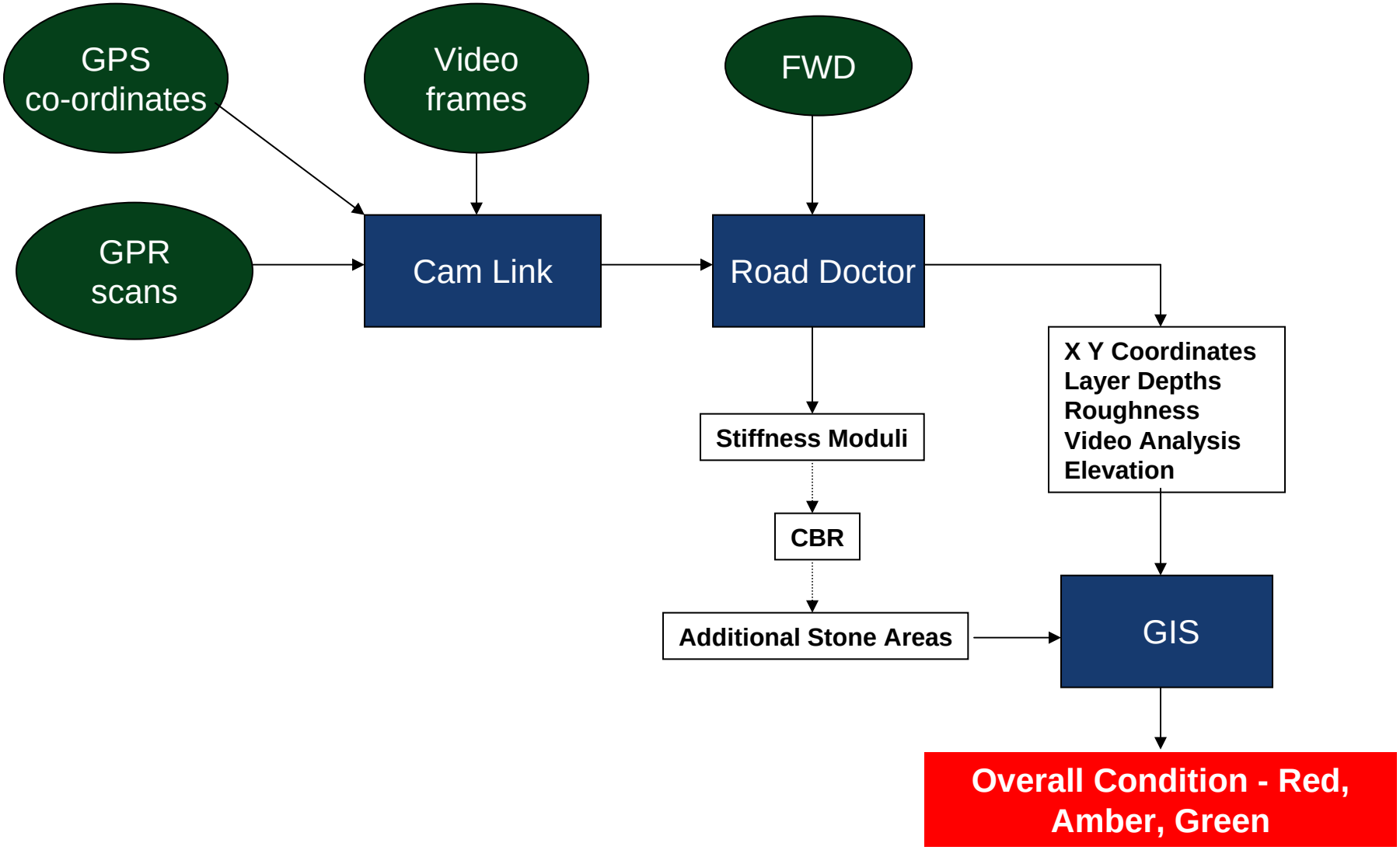
Process – Part 2

- Objective 1: Analyse the existing road structure using Ground Penetrating Radar (GPR), GPS, video, roughness and Falling Weight Deflectometer (FWD) data

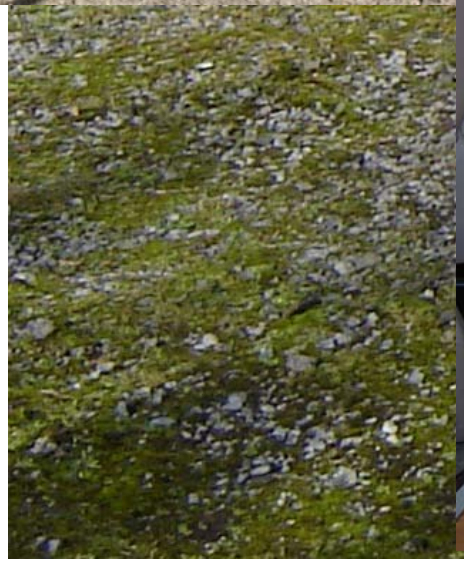
- Objective 2: Display the results in GIS in a format readily understood by all users.

The Road Condition Survey Vehicle

System Overview



Ground Penetrating Radar



Global Positioning System

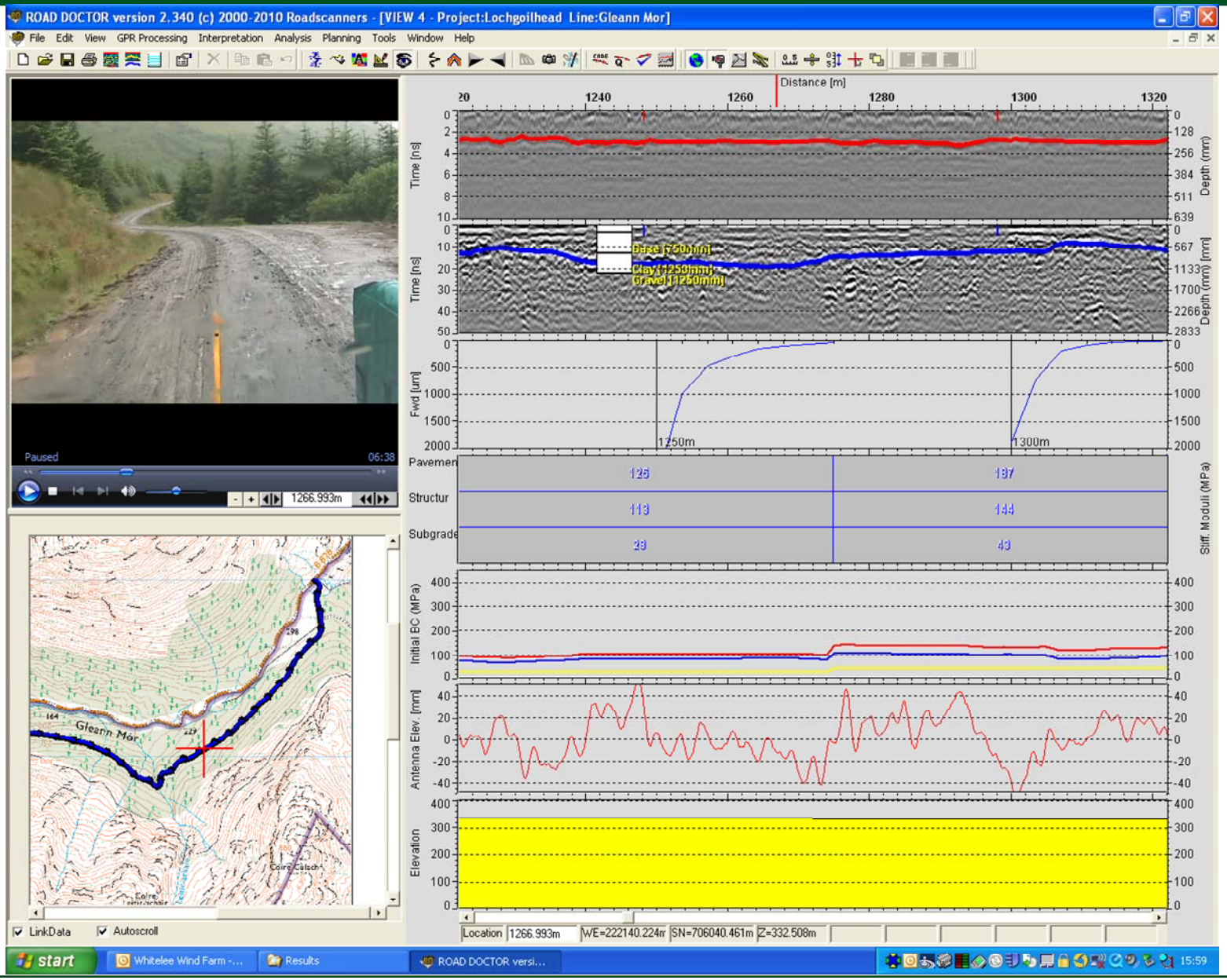
Video

Distance Measuring Instruments

CamLink & INCA

Falling Weight Deflectometer

Forestry Commission Road Doctor Results



Stone Depth Analysis

Civil Engineering Central Services | Gleann Mor Stone Depth Analysis | August 17th 2009

Distance (m)	X-coord(m)	Y-coord(m)	Depth(mm)	Subgrade Stiffness (MPa)	CBR	CBR Rounding	Design Depth (mm)	Additional Depth Required (mm)	Notes		CBR	Design Thickness
0	222759.974	706998.395	506.26	35	2.927472175	3	550	50	Additional stone required <50mm		0	850
1	222760.602	706997.869	497.961	35	2.927472175	3	550	52.039	Additional stone required		2	700
2	222761.469	706997.377	481.362	35	2.927472175	3	550	68.638	Additional stone required		3	550
3	222762.333	706996.88	473.063	35	2.927472175	3	550	76.937	Additional stone required		4	475
4	222763.19	706996.371	456.464	35	2.927472175	3	550	93.536	Additional stone required		5	425
5	222764.048	706995.863	448.165	35	2.927472175	3	550	101.835	Additional stone required		6	375
6	222764.933	706995.403	431.566	35	2.927472175	3	550	118.434	Additional stone required		7	325
7	222765.817	706994.943	423.267	35	2.927472175	3	550	126.733	Additional stone required		8	300
8	222766.702	706994.483	381.77	35	2.927472175	3	550	168.23	Additional stone required		9	275
9	222767.586	706994.023	398.369	35	2.927472175	3	550	151.631	Additional stone required		10	250
10	222768.47	706993.564	439.865	35	2.927472175	3	550	110.135	Additional stone required		11	240
11	222769.345	706993.086	456.464	35	2.927472175	3	550	93.536	Additional stone required		12	230
12	222770.217	706992.602	481.362	35	2.927472175	3	550	68.638	Additional stone required		13	220
13	222771.088	706992.117	547.757	35	2.927472175	3	550	2.243	<10mm stone required - IGNORE		14	210
14	222771.943	706991.605	572.655	35	2.927472175	3	550	0	No stone required		15	200
15	222772.795	706991.087	597.553	35	2.927472175	3	550	0	No stone required		16	190
16	222773.647	706990.569	622.451	35	2.927472175	3	550	0	No stone required		17	180
17	222774.492	706990.041	647.349	35	2.927472175	3	550	0	No stone required		18	170
18	222775.335	706989.509	672.247	35	2.927472175	3	550	0	No stone required		19	160
19	222776.178	706988.977	705.444	35	2.927472175	3	550	0	No stone required		20	150
20	222776.99	706988.4	730.343	35	2.927472175	3	550	0	No stone required		>20	150
21	222777.794	706987.81	730.343	35	2.927472175	3	550	0	No stone required			
22	222778.597	706987.219	738.642	35	2.927472175	3	550	0	No stone required			
23	222779.367	706986.586	746.941	35	2.927472175	3	550	0	No stone required			
24	222780.126	706985.941	680.546	35	2.927472175	3	550	0	No stone required			
25	222780.886	706985.296	580.954	35	2.927472175	3	550	0	No stone required			
26	222781.612	706984.613	539.458	35	2.927472175	3	550	50	Additional stone required <50mm			
27	222782.325	706983.917	514.56	73	9.23269365	9	275	0	No stone required			
28	222783.039	706983.22	506.26	73	9.23269365	9	275	0	No stone required			
29	222783.72	706982.493	531.158	73	9.23269365	9	275	0	No stone required			
30	222784.386	706981.751	539.458	73	9.23269365	9	275	0	No stone required			
31	222785.051	706981.009	564.356	73	9.23269365	9	275	0	No stone required			
32	222785.679	706980.236	589.254	73	9.23269365	9	275	0	No stone required			
33	222786.276	706979.437	663.948	73	9.23269365	9	275	0	No stone required			
34	222786.872	706978.639	746.941	73	9.23269365	9	275	0	No stone required			
35	222787.427	706977.812	846.533	73	9.23269365	9	275	0	No stone required			
36	222787.927	706976.95	854.833	73	9.23269365	9	275	0	No stone required			
37	222788.427	706976.088	854.833	73	9.23269365	9	275	0	No stone required			
38	222788.888	706975.206	846.533	73	9.23269365	9	275	0	No stone required			
39	222789.275	706974.287	813.336	73	9.23269365	9	275	0	No stone required			
40	222789.663	706973.369	796.737	73	9.23269365	9	275	0	No stone required			
41	222790.022	706972.439	805.037	73	9.23269365	9	275	0	No stone required			
42	222790.368	706971.504	805.037	73	9.23269365	9	275	0	No stone required			
43	222790.684	706970.56	780.139	73	9.23269365	9	275	0	No stone required			
44	222790.911	706969.59	746.941	73	9.23269365	9	275	0	No stone required			
45	222791.139	706968.619	763.54	73	9.23269365	9	275	0	No stone required			
46	222791.256	706967.63	780.139	73	9.23269365	9	275	0	No stone required			
47	222791.364	706966.639	788.438	73	9.23269365	9	275	0	No stone required			
48	222791.45	706965.645	796.737	73	9.23269365	9	275	0	No stone required			
49	222791.52	706964.651	805.037	73	9.23269365	9	275	0	No stone required			
50	222791.541	706963.655	763.54	73	9.23269365	9	275	0	No stone required			
51	222791.565	706962.658	672.247	73	9.23269365	9	275	0	No stone required			

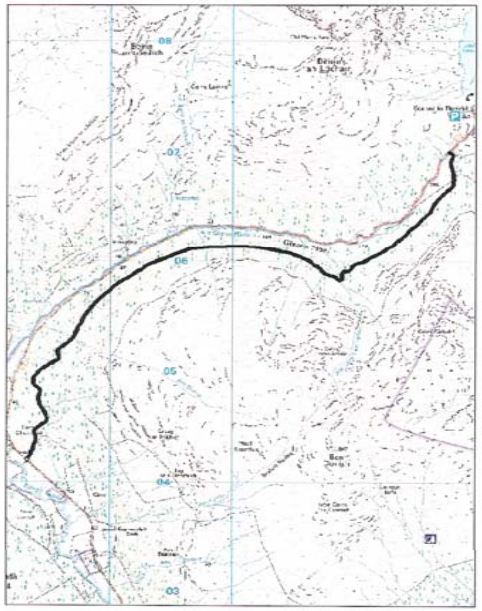
Forestry Commission

Forestry Civil Engineering

Road Condition Survey Results

Cowal & Trossachs Forest District
Gleann Mor Forest Road

Survey Date 17/6/09



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Calculation Rationale

	Metres
Total road length surveyed	5623
Total road length requiring additional stone	2621

1. Additional stone depths of less than 10 mm have been disregarded.
2. Additional stone depths of between 10 and 50 mm have been rounded up to 50 mm.
3. Road width used for volume calculation = 3.5 m

Distance (m)		Length (m)	Design depth (mm)	Average additional depth required (mm)	Volume (m^3)
Start	End				
0	12	12	550	99	4.158
25	26	1	550	50	0.175
144	148	4	850	50	0.700
165	182	17	850	223	13.269
184	200	16	850	83	4.648
242	295	53	475 - 700	135	25.043
313	332	19	700 - 850	77	5.121
334	354	20	850	225	15.750
361	368	7	850	52	1.274
488	575	87	475 - 850	262	79.779
625	660	35	850	167	20.458
691	694	3	850	52	0.546
775	791	16	700	119	6.664
798	825	27	700	225	21.263
875	887	12	850	164	6.888
895	904	9	850	67	2.111
906	925	19	850	139	9.244
1031	1039	8	475	72	2.016
1044	1048	4	475	57	0.798
1054	1156	102	475 - 700	135	48.195
1165	1180	15	850	165	8.663
1194	1199	5	850	70	1.225
1214	1221	7	700 - 850	135	3.308
1224	1234	10	700	69	2.415
1374	1434	60	475 - 850	356	74.760
1463	1464	1	475	50	0.175
1474	1481	7	700	65	1.593
1486	1491	5	700	51	0.893
1493	1497	4	700	50	0.700
1498	1524	26	700	113	10.283
1630	1675	45	850	101	15.908
1678	1680	2	850	52	0.364
1950	2028	78	700 - 850	150	40.950
2071	2133	62	700 - 850	329	71.393
2152	2175	23	700	122	9.821
2225	2331	106	850	390	144.690

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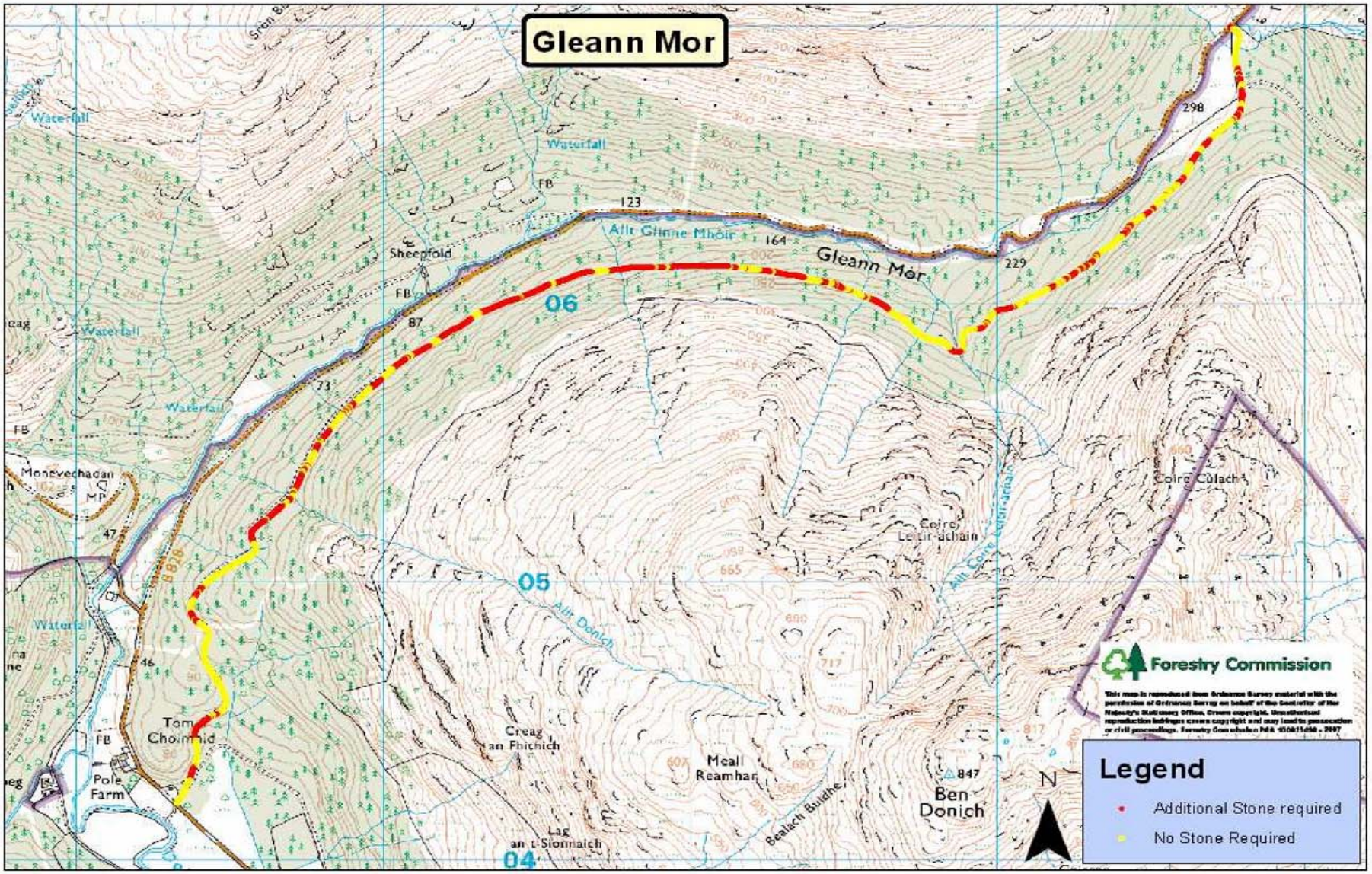
Forestry Commission Stone Distribution Map



Cost Saving

• Total length of road to be upgraded	5623 m
• Length requiring additional stone	2621 m
• Length requiring no additional stone	3002 m
• Budget unit cost of upgrading	£20.84/m
• Stone production, haulage and application	£18.00/m
• Saving = 3002 x 18	£54,036

Data Storage

- Too much data for storage on Forest District servers
- Dedicated area provided on a Silvan House server
- Road Doctor Viewer installed on the server
- Remote access to be given to Civil Engineers

- Next version of “Forester” GIS will be able to display all outputs shown in the following table:

GIS Data Input - .csv file

Civil Engineering Central Services | Road Condition Survey GIS Input Data Example | Date

Distance	X	Y	Z	Tot_St_De	Base_Dept	Pave_Dept	Ant_Bounc	Drains	Potholes	Veg	Shape	CBR	Add_Depth	Weather
0	378483.5	600169.3	210.4	414.967	129.086	27	10.96	0	3	1	0	0	0	Light Rain
1	378483.7	600168.4	210.314	423.267	157.772	30	90.54	0	3	1	0	0	0	Light Rain
2	378484	600167.4	210.246	431.566	157.772	35	120.9	0	3	1	0	0	0	Light Rain
3	378484.2	600166.5	210.187	481.362	167.334	41	121.07	0	3	1	0	0	0	Light Rain
4	378484.5	600165.5	210.144	547.757	148.21	45	72.38	0	3	1	0	0	0	Light Rain
5	378484.7	600164.5	210.1	564.356	164.943	60	64.01	0	3	1	2	2	0	Light Rain
6	378484.9	600163.5	210.063	539.458	191.239	65	32.14	0	3	1	2	2	0	Light Rain
7	378485.2	600162.6	210.026	564.356	141.039	67	43.51	0	3	1	2	2	0	Light Rain
8	378485.4	600161.6	209.989	580.954	152.991	66	32.56	0	3	1	2	2	0	Light Rain
9	378485.6	600160.6	209.955	614.152	176.896	69	21.12	0	3	1	2	2	0	Light Rain
10	378485.9	600159.7	209.92	639.05	200.801	73	-19.08	0	3	1	2	2	21.08	Light Rain
11	378486.1	600158.7	209.86	647.349	179.286	74	-10.42	0	3	1	2	2	12.42	Light Rain
12	378486.3	600157.7	209.767	647.349	157.772	65	7.93	0	3	1	2	2	0	Light Rain
13	378486.4	600156.7	209.673	647.349	181.677	69	18.71	0	3	1	2	2	0	Light Rain
14	378486.6	600155.8	209.584	663.948	198.41	77	17.66	0	3	1	2	2	0	Light Rain
15	378486.7	600154.8	209.507	680.546	176.896	81	-33.99	0	3	1	2	2	35.99	Light Rain
16	378486.8	600153.8	209.431	680.546	152.991	93	-47.99	0	3	1	2	2	49.99	Light Rain
17	378486.9	600152.8	209.355	639.05	169.724	80	-21	0	3	1	2	2	23	Light Rain
18	378487	600151.8	209.287	564.356	167.334	76	-17.81	0	3	1	2	2	19.81	Light Rain
19	378487	600150.8	209.243	497.961	138.648	74	-36.02	0	3	1	2	2	38.02	Light Rain
20	378487.1	600149.8	209.198	456.464	172.115	80	-36.72	1	3	1	3	3	39.72	Light Rain
21	378487.1	600148.8	209.153	431.566	181.677	101	108.67	1	3	1	3	3	0	Light Rain
22	378487.1	600147.8	209.108	431.566	143.429	74	-2.53	1	3	1	3	3	5.53	Light Rain
23	378487.1	600146.8	209.066	406.668	148.21	72	-15.24	1	3	1	3	3	18.24	Light Rain
24	378487.1	600145.8	209.025	406.668	176.896	70	-9.72	1	3	1	3	3	12.72	Light Rain
25	378487.1	600144.8	208.984	406.668	196.02	78	-12.83	1	3	1	3	3	15.83	Light Rain
26	378487.1	600143.8	208.943	406.668	157.772	85	-19.69	1	3	1	3	3	22.69	Light Rain
27	378487	600142.8	208.901	406.668	160.163	82	-1.52	1	3	1	3	3	4.52	Light Rain
28	378486.9	600141.8	208.881	414.967	176.896	90	14.66	1	3	1	3	3	0	Light Rain
29	378486.8	600140.8	208.862	439.865	152.991	90	6.46	1	3	1	3	3	0	Light Rain
30	378486.7	600139.9	208.843	464.763	136.258	85	-3.68	1	0	1	3	3	6.68	Light Rain
31	378486.6	600138.9	208.824	473.063	150.601	81	-2.2	1	0	1	3	3	5.2	Light Rain
32	378486.5	600137.9	208.805	473.063	167.334	80	14.01	1	0	1	3	3	0	Light Rain
33	378486.4	600136.9	208.787	464.763	133.867	82	9.09	1	0	1	3	3	0	Light Rain
34	378486.2	600135.9	208.768	448.165	129.086	85	3.82	1	0	1	3	3	0	Light Rain
35	378486.1	600134.9	208.75	431.566	124.305	78	-5.64	1	0	3	3	3	8.64	Light Rain
36	378485.9	600133.9	208.732	406.668	129.086	75	-0.95	1	0	3	3	3	3.95	Light Rain
37	378485.8	600132.9	208.713	406.668	148	75	1.92	1	0	3	3	3	1.08	Light Rain
38	378485.7	600132	208.7	448.165	144	75	-2.87	1	0	3	3	3	5.87	Light Rain
39	378485.5	600131	208.7	473.063	137	71	4.19	1	0	3	3	3	0	Light Rain
40	378485.3	600130	208.7	497.961	139	74	15.54	1	0	3	3	3	0	Light Rain
41	378485.1	600129	208.7	531.158	141	77	0.16	1	0	3	3	3	2.84	Light Rain
42	378485	600128	208.7	506.26	142	80	-16.06	1	0	3	3	3	19.06	Light Rain
43	378484.8	600127	208.7	473.063	145	86	-1.18	1	0	3	3	3	4.18	Light Rain
44	378484.6	600126.1	208.7	406.668	148	90	-0.45	1	2	3	3	3	3.45	Light Rain

And finally…….

tack så mycket!