ATKINS

Meadowhead Development Options Review

October 2005

Notice

Document History

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Meadowhead Development Options Review

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1. Introduction

The purpose of this study was to undertake a development strategy review for the Meadowhead catchment, to permit Scottish Water (SW) to present an overview report on strategic drainage requirements for identified developments. It is anticipated that SW's report will be presented to the Ayrshire Joint Structure Plan & Transportation Committee.

The Meadowhead catchment is approximately 35km south west of Glasgow and comprises the larger towns of Annick Water, Ayr, Barassie, Irvine, Kilmarnock, Prestwick and Troon.

Developments considered as part of this study are limited to the provision of new housing in the Ayrshire region up to 2011. Some non-effective housing developments were defined as those that could possibly take place beyond 2011. The use of this development data permits the analysis of changes in the Meadowhead catchment following the hydraulic model's completion in 2001 and the effects of future developments on the performance of the sewerage system.

This study identifies options to manage the developments' effects on the sewerage system. These options can be categorised as individual storage at combined sewer overflow (CSO) locations and the provision of interceptor sewers linking CSOs to new or improved wastewater treatment facilities.

Strategic options considered in this report address the impact of future developments only and do not address other sewerage deficiencies or other regulatory drivers.

2. Design Methodologies

2.1 Data Sources

Hydraulic modelling of the Meadowhead sewerage systems was undertaken using InfoWorks software. The hydraulic model used for this study was the model used for a recently completed Meadowhead Q&S III UID Investment Review for SW. The model has been updated to include developments up to the year 2004 and is considered representative of the current sewerage system. The model originated from up-to-date DAP models, combined to form the Meadowhead Macro Model, used for SW's Meadowhead Bathing Beach Study. Winter and summer variants of the hydraulic model reflect sewer infiltration at different times of the year. The hydraulic model has been used in accordance with the Meadowhead Macro Model User Manual.

New development data has been added to the model in accordance with section 3.3 of the Meadowhead and Stevenson Development Impact Assessment Report. In summary, development data sources were Housing Land Supply 2004-2011, NAC, EAC and SAC Urban Capacity Studies, Greenfield Development and Kilmarnock East Developments. Future developments account for a population increase of 48,940, resulting in an additional average population flow of 93.5 l/s and an additional infiltration flow of 37.3 l/s.

A Scottish Water scheme at Moorfield, on the Irvine Valley Trunk Sewer, was added to the model, providing approximately 1028m^3 of new storage for sewer flows. The development at Fardalehill has been added to the model, accurately reflecting 2017m of 450mm diameter foul sewer downstream of Fardalehill Pumping Station.

No changes were made to the operating regime at Meadowhead Wastewater Treatment Works.

The model was simulated with a year of stochastically generated synthetic rainfall data, calibrated against historical data for Prestwick, which is referred to as time series rainfall (TSR). Simulation results, using TSR, permitted the quantification of CSO annual spill frequencies, total annual spill volumes and individual spill volumes for each TSR event.

2.2 Limitations

In addition to the limitations stated in the Meadowhead Macro Model User Manual, it should be noted that the macro model, made up of individual sewer models, has not been verified against observed flow survey data. This results in a lower level of confidence in model predictions in areas of the sewer systems which interact.

Planned developments located further than 2km from the modelled sewer network have been considered unlikely to be connected to the sewer network due to their being geographically remote or too small a scale to be economically connected to the network. Reasonable assumptions have been made with respect to the point of connection of planned developments to the sewerage system. Larger developments are assumed to connect further down the sewer system or at multiple locations in order to limit the likelihood of flooding from local, small diameter sewers.

An allowance of 165 litres/head/day consumption was applied to the model to create population-generated flows. A single diurnal flow profile was applied to the Meadowhead catchment, based on profiles previously generated for individual areas.

An infiltration flow was applied to all future development areas, equivalent to 40% of the population-generated flows.

Instabilities in the hydraulic model have limited the ability of the model to accurately reflect flooding within the catchment. These instabilities are considered to be as a result of the complexity of the model and limitations of the modelling software.

The sewer models were produced to investigate CSO performance and are unlikely to accurately reflect flooding, for higher return period design storm events.

This study focuses on developing strategic solutions to address the impact of planned developments on the sewerage system. Issues surrounding on-site storage of flows within planned developments and localised sewerage improvements immediately downstream of the points of connection have not been considered in detail as part of this study.

2.3 Assessment of Development Impact

Model limitations concerning instabilities and the lack of confidence in the model's flooding predictions highlight the need to treat flood analysis results with a high degree of caution.

Options to assess the impact of developments on the sewerage network have been developed based upon their impact on CSOs within the catchment.

TSR events have been used to identify the predicted existing and future performance of CSOs.

Improvement options do not take account of the cost of treating foul flows from the 48,940 additional people planned to inhabit future planned developments. These costs are considered to exist irrespective of which strategic improvement option is judged more appropriate. It is expected that such costs form part of developers' standard contributions to SW.

3. Predicted Sewer Flooding

Instabilities in the Meadowhead Macro Model limit the accuracy of flooding predictions and prevent a precise analysis of differing flooding volumes for existing and future scenarios.

The macro model was constructed to investigate CSO performance, rather than flooding. Similarly, the performance of individual DAP models was generally verified against low return period storm events, many of which were similar to TSR events. As a result, the model performance and reliability is better for TSR, low return period storm events compared to generated 1, 2, 5 and 10 year design rainfall events.

Due to the presence of instabilities and the reduced confidence in the model's flooding predictions, the strategic sewerage options considered for this study do not use the assessment of flooding volumes as a criterion for performance improvement. This approach was agreed with SW following the initial system performance appraisal. Targeted improvements to CSOs will generally reduce predicted flooding volumes near to the improved CSOs.

4. Predicted CSO Performance

4.1 Current CSO Performance & Meadowhead Q&S III Investment Review

Of the 124 CSOs within the Meadowhead catchment, 51 are classified as unsatisfactory, in terms of either spill frequency or their failure to pass forward Formula A flow. A recent study, undertaken for the Meadowhead Q&S III Investment Review, assessed the performance of each of the 124 CSOs within the catchment. This study analysed model simulation results to determine whether each CSO passed Formula A flow at first spill and whether the CSOs spilled more than 3 times per bathing season or 10 times per year. The study concluded that 77 of the CSOs were unsatisfactory.

Other than the above reference to the Meadowhead Q&S III Investment Review, this study does not consider the findings of the earlier investigation. Improvements necessary to improve the performance of CSOs to meet regulatory standards have not been considered. This study simply compares the existing CSO performance with their performance following the planned developments.

Some 41 CSO have been identified as failing to pass forward Formula A flows. When future planned developments are added to the model, the number of failing CSOs increases to 42, therefore having a minor impact.

4.2 Development Impact Upon CSOs

The Meadowhead Macro Model has been constructed from individual DAP models, each used specifically to investigate the performance of CSOs within the catchment. Generally, models have been locally verified against actual flow survey data, for rainfall events comparable to TSR events used for this study.

Comparisons between existing CSO performance and the predicted performance of CSOs following future developments showed an 8% increase in annual spill volumes. Results also showed that, on occasions, individual TSR events caused increases in CSO spills in excess of 8%.

The objective of this study was to develop strategic options to address the predicted increase in CSO spills for individual TSR, annual rainfall series events.

Strategic options considered in this report address the impact of future developments only and do not address other sewerage deficiencies or other regulatory drivers.

5. Options

5.1 Option 1: Localised CSO Storage Option

5.1.1 Proposed Option

Analysis of individual TSR series events has shown that the introduction of planned developments into the hydraulic model causes 90 CSOs within the catchment to spill more than they do currently. Spills from 50 of these CSOs are increased by more than 25m^3.

This option involves the construction of storage at each CSO where individual spill volumes increase by more than 25m^3. It is considered that the most economical way to provide this storage is in shaft tanks, generally constructed of segmental precast concrete rings. These shaft tanks are sized to hold the additional spill volume from the CSOs for the worst-case TSR event. Flows are returned to the sewer system, following the rainfall event, by pumps.

The resultant effect of providing storage to contain the increased spill volume for the worst-case TSR event is that the future annual spill volume and annual spill frequencies will be reduced from that predicted for the existing situation. This provides an environmental benefit, but increases the volume of sewage flows requiring treatment at Meadowhead WwTW. There is no simple way to resolve this conflicting situation, without the introduction of complex real time control devices and telemetry. These have not been considered in detail during this study.

Where the required storage is below 25m^3, it is considered that this could be achieved by providing attenuation and increased localised storage at the planned development. This would be a more economical solution than upsizing existing sewers or providing small volumes of storage at many CSO locations within the catchment. The development of storage options has been undertaken as a desktop exercise, based on analysis of predicted flows in existing and future sewerage networks.

Table 1 shows the storage required at each CSO in order to ensure that spill volumes are not increased, during individual TSR events when future planned developments are considered.

CSO Ref	CSO Name / Location	Storage requirement (m^3)
1	109 London Road, Kilmarnock	0
2	14 Walnut Road, Kilmarnock	0
3	2 Burns Avenue, Kilmarnock	6
4	2 Maxholm Road, Kilmarnock	116
5	22 Douglas Street, Kilmarnock	473
6	22 Holehouse Road, Kilmarnock	4
7	25 - 27 Loreny Drive, Kilmarnock	22
8	32 Old Street, Kilmarnock	6
9	36 New Mill Road, Kilmarnock	1
10	41 MacDonald Drive, Kilmarnock	0
11	46 Bruce Street, Kilmarnock	1
12	51 Main Road (behind), Crookedholm, Hurlford	72
13	54 Bruce Street, Kilmarnock	1
14	80 Carron Avenue, Kilmarnock	280
15	86 Carron Avenue, Kilmarnock	0
16	Ayrshire Metals, Cochrane St @ Victoria R/about	9
17	Barassie P.S., 72 Beach Road, Troon	125
18	Beach Drive NW corner of Magnum Centre, Irvine	0
19	Beach Road, Beach Park P.S., Irvine No1	2
20	Cross Keys, 142 Harbour Street, Irvine	0
21	Dean Park Pavilion, Kilmarnock	69
22	Elvinside Farm, Galston Road, Hurlford	603
23	Galston Road, Hurlford Bridge, Hurlford	12
24	Gatehead Storm Tanks, near A759	16582
25	Gillsburn Gardens, Kilmarnock	0
26	Gottries Road Overflow, 3F Gottries Cres, Irvine	0
27	Grassyards Road, 20 Kay Park Terr, Kilmarnock	4
28	Green Street, Kilmarnock	36
29	Harbour Pumping Station, 1 Titchfield Cottage, Harbour Road, Troon	0
30	Holmes Road, Western Intercepting Sewer Holmes Road, Kilmarnock	1150
31	Howard Park, Kilmarnock	543
32	Irvine 19, Williamsfields, (Sports Club); next to 64 Harbour Street, Irvine	0
33	Irvine River Weir Overflow, behind 4 Williamfield Grove	482
34	Kirkstyle School; near 33 Carron Avenue, Kilmarnock	1
35	Loans/Muirhead/Barassie 2, Barassie PS, Near 72 Beach Road, Barassie	0
36	Loreny P.S., 4 Umberly Road, Kilmarnock	0
37	Magnum Car Park (Side of Magnum), Irvine	0
38	Marr Screening Chamber, Troon	44
39	Meadowhead Treatment Works - Inlet Works Emergency Screen Chamber	0
40	Meadowhead Treatment Works, Irvine	9056
41	No.11 Furnace Court (behind); Hurlford	1830
42	No.6 Cheapside Street (behind); Kilmarnock	419
43	Pan Rocks Emergency Overflow, North Shore Road @ Barassie Street, Troon (140m beyond MLWM)	153
44	Rear 75 Dean Street, Kilmarnock	129
45	Rowallan Tanks; opp 136 Glasgow Road, behind Rowallen Creamery, Kilmarnock	166
46	Scott Ellis Siphon, where A77 crosses River Irvine, South of Linfern Avenue East, Kilmarnock	0

CSO Ref	CSO Name / Location	Storage requirement (m^3)
47	Scott Ellis Tanks, New Mill Road, South of Samson Avenue, Kilmarnock	10954
48	Southhook P.S., Southhook Road, Kilmarnock	2
49	St Marnock Street @ St Marnock Place; Kilmarnock	6
50	West of Greenholm Street at footbridge, Kilmarnock	55
51	Williamfield Storm Overflow	1639
52	11 Cross Street, Galston	2
53	14 – West Road CSO, Irvine	1573
54	2 George Street Overflow, Ayr	5
55	9 Kilmaurs Road, Crosshouse	24
56	Annick Water, Irvine	12
57	Auchans PS EO	0
58	Ayr PS Storm Pumps, Ayr	36100
59	Bankhead Avenue CSO	0
60	Beldevere View, Galston	2
61	Bellisle Golf Course, Ayr	865
62	Bourtree Hill PS EO, Annick	0
63	Breahead Screens EO	1
64	Brieryside PSEO, Prestwick	631
65	Brown Street, Newmilns	0
66	Burns Street Overflow, Tarboulton 7108/485	3
67	Cambusdoon EO, Ayr	0
68	Campbell Place PS CSO, Annick	0
69	CSO, IVS south of Nethercraig – between Gatehead and Drybridge	1662
70	Dalmellington Road off Annfield Burn CSO, Ayr	1
71	Esplanade PSEO - 7119/-, Prestwick	78
72	Esplanade PSEO, Prestwick	0
73	Former Darvel STW Darvel, Kilmarnock	1982
74	Former Galston STW (low)	79
75	Fullarton, Irvine	4
76	Garrier Bridge CSO, Springside	2
77	Girdle Toll PS EO, Annick	0
78	Goldfields CSO, Irvine	967
79	Greenan PS EO, Ayr	137
80	Greenside, Newmilns	1
81	Holmsbridge PS CSO, Springside	0
82	Holmsford Bridge CSO, Springside	1
83	Holmston PS No. 1 CSO, Ayr	0
84	Holmston PS No. 2 CSO, Ayr	2
85	Holmston Storm Tank, Ayr	16
86	Kilmarnock Road CSO, Springside	3
87	Kilmaurs PS Tank EO	389
88	Kilwinning Rd, Irvine	5
89	Kirkton Road, Fenwick	17
90	Lamont Drive, Irvine	1
91	Larch CSO, Crosshouse / Knockentiber	1
92	Loundon Road West, Newmilns	17
93	Low Green Siphon, Irvine	23
94	Mason Holms Syphon, Newmilns	2
95	McIntyre Court PSEO - 7342/-, Prestwick	0

CSO Ref	CSO Name / Location	Storage requirement (m^3)
96	Morton Park Darvel, Kilmarnock	411
97	Nelson Street Syphon	2
98	Newmilns Road Pumping Station; Galston (G6)	0
99	Newton EO, Ayr	58
100	No name, Irvine CSO	0
101	Olympic Complex CSO No1, Dundonald	38
102	Olympic Complex CSO No2, Dundonald	26
103	Pan Rock PS, Troon	955
104	Perceton Village PS CSO, Annick	6
105	Polwarth Street, Galston	53
106	Pow Burn Storm Tanks, Prestwick	269
107	Pow Burn EO	28
108	Pow Burn CSO	71
109	Puddleford, Irvine	173
110	Queens Crescent, Newmilns	3
111	Red Burn PS (Kilwinning Road), rear of 19 Fairways, Irvine	0
112	Shewalton PS CSO, Annick	0
113	Sillars Meadow, Irvine	94
114	Smithfield Crescent Overflow, Tarboulton	51
115	St Andrews Caravan Park CSO , Prestwick	6162
116	St Andrews PSEO - 7341/- Prestwick	5941
117	St Quivox, Prestwick	0
118	Strath Yard, Newmilns	67
119	Tarryholme PS EO, Annick	0
120	Water of Fail CSO, Tarbolton	52
121	Waterside Septic Tank, Irvine	49
122	Montgomery Street CSO, Irvine	0
123	Thistle PSEO, Irvine	1
124	Ayr PS EO, Ayr	0

Table 1: Storage Requirements To Maintain Performance of CSO Following Planned Developments.

The total storage volume required is 104,175m^3. 74 CSOs require less than 25m^3 of storage, 34 of which require no storage at all.

CSO requiring large (greater than 1,000 m^3) volumes of storage are:

Gatehead Storm Tanks
Holmes Road CSO, Kilmarnock
Meadowhead WwTW
No 11 Furnace Court, Hurlford
Scott Ellis Tanks, Kilmarnock
Williamsfield Storm Overflow
14 West Road CSO, Irvine
Ayr PS Storm Pumps
CSO, IVS South of Nethercraig
Former Darvel STW
St Andrews Caravan Park CSO, Prestwick
St Andrews PSEO, Prestwick

5.1.2 Risk & Value Considerations

Opportunities may exist to increase pumping rates at Gatehead Storm Tanks, Barassie Pumping Station, Pan Rocks Pumping Station and at Ayr Pumping Station. This would reduce the volume of storage required at each location but would require modifications to pumping stations and rising mains, the extent of which is unknown and falls outside of the scope of this study. Increasing pumping rates in this way would also be likely to increase the peak load on Meadowhead WwTW, the associated costs of which cannot be quantified with the information available.

In some instances the provision of storage at a CSO will reduce the frequency of spills at downstream CSOs. This could, in turn, reduce the amount of storage required to be provided in order to accommodate planned future development flows. Such detailed analysis has not been undertaken as part of this study as the resultant reduction in storage volumes is likely to be small and will have a negligible effect on the construction estimate.

5.1.3 Construction Estimate

The estimated cost of constructing storage tanks, of varying volumes as shown in Table 1 and on Plans 1A to 13A is £68.4m.

This estimate is based upon SW's Cost Schedule. Unit costs have been interpolated where information is not available. The estimate includes proposed shaft tank storage, associated pumping stations and limited, localised sewer improvements in order to accommodate the proposed improvements.

The estimate includes an allowance of 12% for utility apparatus diversions, due to the location of the proposed sewers within highways and for traffic management during the works.

The estimate does not include for costs associated with detailed feasibility studies, detailed design, contract administration or site supervision, SW operational support costs, SW overheads or costs associated with any other investigative or exploratory work.

5.2 Option 2: Strategic Interceptor Sewer Option, Combined with Localised Storage & Wastewater Treatment

5.2.1 Proposed Option

This option involves the construction of small diameter (225mm to 375mm) sewers to intercept additional spill flows from CSOs within the catchment, where CSOs are located in clusters or along the line of existing trunk sewers. These interceptor sewers carry additional spill flows downstream rather than permitting increased spill flows from CSOs. This option is shown on Plans 1B to 13B. Table 2 shows the storage requirements for the option, where the provision of additional interceptor sewers is not considered to be cost-effective. Table 3 indicates the proposed lengths of interceptor sewer.

As a consequence of intercepting these spill flows, the predicted future spill frequency and annual spill volume will decrease, providing an environmental benefit and increasing the flows treated at Meadowhead WwTW. The option requires additional treatment capacity at Meadowhead WwTW and additional storm storage capacity. For the purpose of this study, it is assumed that existing spill flows from Meadowhead WwTW should not be caused to increase as a result of the planned future development and the proposed strategic option.

Most notably, this option reduces the requirement for large, pumped-return, storage tanks at Gatehead Tanks CSO, CSO-IVS at Nethercraig, No 11 Furnace Court CSO and Former Darvel STW CSO. The proposed interceptor sewer deals with spill volume increases from all CSOs to the north and east of Meadowhead WwTW with the exception of Scott Ellis Tanks CSO and Kilmaurs PS Tank Emergency Overflow. Scott Ellis Tank CSO would require 10,954m^3 of storage to accommodate the planned future developments; it is considered that provision of localised storage near to the existing tanks would be more cost effective than constructing additional interceptor sewers and increasing the diameter of interceptor sewers downstream. Kilmaurs PS Tank Emergency Overflow is located remotely from the Irvine Valley Trunk Sewer and storage at this location is more cost effective than construction of an interceptor sewer.

Construction of strategic interceptor sewers, ranging from 225mm to 375mm diameter, provides an effective way of reducing spill volumes at CSOs to maintain their current performance. 225mm diameter sewers connect CSOs within Darvel to Newmilns and CSOs within Irvine Town. 300mm diameter sewers carry flows down through Hurlford to Kilmarnock, where 375mm diameter interceptor sewers carry flows through Eardale, Gatehead, past Gatehead Tanks to Meadowhead WwTW. 375mm diameter sewers connect Drybridge and Dundonald CSOs. Interceptor sewers generally follow the line of existing trunk sewers, particularly the Irvine Valley Trunk Sewer and the Irvine Town Trunk Sewer.

Interceptor sewers reduce the need for storage tanks for the majority of CSOs to the north and east of Meadowhead WwTW, by carrying flows directly to the Works.

CSOs located within pumped catchments to the south of Meadowhead WwTW cannot be cost-effectively linked with interceptor sewers due to their remote geographic locations, their predicted large increases in individual spill flows (particularly at Ayr PS and St Andrews Caravan Park CSO and EO) and the requirement to either provide storage at the downstream pumping stations or

increase pumping capacities to Meadowhead WwTW. The extent of modifications to Meadowhead WwTW could not be fully determined during this study however simulation results suggest an increase in flow volume of 25% arriving at the Works during the annual TSR event series; the costs associated with this element of the option should be treated with some degree of caution, pending a more detailed investigation.

CSO Ref	CSO Name / Location	Storage requirement (m^3)
1	109 London Road, Kilmarnock	0
2	14 Walnut Road, Kilmarnock	0
3	2 Burns Avenue, Kilmarnock	6
4	2 Maxholm Road, Kilmarnock	0
5	22 Douglas Street, Kilmarnock	0
6	22 Holehouse Road, Kilmarnock	0
7	25 - 27 Loreny Drive, Kilmarnock	0
8	32 Old Street, Kilmarnock	0
9	36 New Mill Road, Kilmarnock	0
10	41 MacDonald Drive, Kilmarnock	0
11	46 Bruce Street, Kilmarnock	0
12	51 Main Road (behind), Crookedholm, Hurlford	0
13	54 Bruce Street, Kilmarnock	0
14	80 Carron Avenue, Kilmarnock	0
15	86 Carron Avenue, Kilmarnock	0
16	Ayrshire Metals, Cochrane St @ Victoria R/about	9
17	Barassie P.S., 72 Beach Road, Troon	125
18	Beach Drive NW corner of Magnum Centre, Irvine	0
19	Beach Road, Beach Park P.S., Irvine No1	2
20	Cross Keys, 142 Harbour Street, Irvine	0
21	Dean Park Pavilion, Kilmarnock	0
22	Elvinside Farm, Galston Road, Hurlford	0
23	Galston Road, Hurlford Bridge, Hurlford	0
24	Gatehead Storm Tanks, near A759	0
25	Gillsburn Gardens, Kilmarnock	0
26	Gottries Road Overflow, 3F Gottries Cres, Irvine	0
27	Grassyards Road, 20 Kay Park Terr, Kilmarnock	0
28	Green Street, Kilmarnock	0
29	Harbour Pumping Station, 1 Titchfield Cottage, Harbour Road, Troon	0
30	Holmes Road, Western Intercepting Sewer Holmes Road, Kilmarnock	0
31	Howard Park, Kilmarnock	0
32	Irvine 19, Williamsfields, (Sports Club); next to 64 Harbour Street, Irvine	0
33	Irvine River Weir Overflow, behind 4 Williamfield Grove	0
34	Kirkstyle School; near 33 Carron Avenue, Kilmarnock	1
35	Loans/Muirhead/Barassie 2, Barassie PS, Near 72 Beach Road, Barassie	0
36	Loreny P.S., 4 Umberly Road, Kilmarnock	0
37	Magnum Car Park (Side of Magnum), Irvine	0
38	Marr Screening Chamber, Troon	44
39	Meadowhead Treatment Works - Inlet Works Emergency Screen Chamber	0
40	Meadowhead Treatment Works, Irvine	9056
41	No.11 Furnace Court (behind); Hurlford	0
42	No.6 Cheapside Street (behind); Kilmarnock	0
43	Pan Rocks Emergency Overflow, North Shore Road @ Barassie Street, Troon (140m beyond MLWM)	153
44	Rear 75 Dean Street, Kilmarnock	0
45	Rowallan Tanks; opp 136 Glasgow Road, behind Rowallen Creamery, Kilmarnock	0
46	Scott Ellis Siphon, where A77 crosses River Irvine, South of Linfern Avenue East, Kilmarnock	0

CSO Ref	CSO Name / Location	Storage requirement (m^3)
47	Scott Ellis Tanks, New Mill Road, South of Samson Avenue, Kilmarnock	10954
48	Southhook P.S., Southhook Road, Kilmarnock	0
49	St Marnock Street @ St Marnock Place; Kilmarnock	0
50	West of Greenholm Street at footbridge, Kilmarnock	0
51	Williamfield Storm Overflow	0
52	11 Cross Street, Galston	0
53	14 – West Road CSO, Irvine	0
54	2 George Street Overflow, Ayr	5
55	9 Kilmaurs Road, Crosshouse	20
56	Annick Water, Irvine	12
57	Auchans PS EO	0
58	Ayr PS Storm Pumps, Ayr	36100
59	Bankhead Avenue CSO	0
60	Beldevere View, Galston	0
61	Bellisle Golf Course, Ayr	865
62	Bourtree Hill PS EO, Annick	0
63	Breahead Screens EO	1
64	Brieryside PSEO, Prestwick	631
65	Brown Street, Newmilns	0
66	Burns Street Overflow, Tarboulton 7108/485	3
67	Cambusdoon EO, Ayr	0
68	Campbell Place PS CSO, Annick	0
69	CSO, IVS south of Nethercraig – between Gatehead and Drybridge	0
70	Dalmellington Road off Annfield Burn CSO, Ayr	1
71	Esplanade PSEO - 7119/-, Prestwick	78
72	Esplanade PSEO, Prestwick	0
73	Former Darvel STW Darvel, Kilmarnock	0
74	Former Galston STW (low)	0
75	Fullarton, Irvine	0
76	Garrier Bridge CSO, Springside	2
77	Girdle Toll PS EO, Annick	0
78	Goldfields CSO, Irvine	0
79	Greenan PS EO, Ayr	137
80	Greenside, Newmilns	1
81	Holmsbridge PS CSO, Springside	0
82	Holmsford Bridge CSO, Springside	1
83	Holmston PS No. 1 CSO, Ayr	0
84	Holmston PS No. 2 CSO, Ayr	2
85	Holmston Storm Tank, Ayr	16
86	Kilmarnock Road CSO, Springside	3
87	Kilmaurs PS Tank EO	389
88	Kilwinning Rd, Irvine	5
89	Kirkton Road, Fenwick	17
90	Lamont Drive, Irvine	1
91	Larch CSO, Crosshouse / Knockentiber	1
92	Loundon Road West, Newmilns	3
93	Low Green Siphon, Irvine	23
94	Mason Holms Syphon, Newmilns	0
95	McIntyre Court PSEO - 7342/-, Prestwick	0

CSO Ref	CSO Name / Location	Storage requirement (m^3)
96	Morton Park Darvel, Kilmarnock	0
97	Nelson Street Syphon	2
98	Newmilns Road Pumping Station; Galston (G6)	0
99	Newton EO, Ayr	58
100	No name, Irvine CSO	0
101	Olympic Complex CSO No1, Dundonald	0
102	Olympic Complex CSO No2, Dundonald	0
103	Pan Rock PS, Troon	955
104	Perceton Village PS CSO, Annick	6
105	Polwarth Street, Galston	0
106	Pow Burn Storm Tanks, Prestwick	269
107	Pow Burn EO	28
108	Pow Burn CSO	71
109	Puddleford, Irvine	0
110	Queens Crescent, Newmilns	0
111	Red Burn PS (Kilwinning Road), rear of 19 Fairways, Irvine	0
112	Shewalton PS CSO, Annick	0
113	Sillars Meadow, Irvine	0
114	Smithfield Crescent Overflow, Tarboulton	51
115	St Andrews Caravan Park CSO , Prestwick	6162
116	St Andrews PSEO - 7341/- Prestwick	5941
117	St Quivox, Prestwick	0
118	Strath Yard, Newmilns	0
119	Tarryholme PS EO, Annick	0
120	Water of Fail CSO, Tarbolton	52
121	Waterside Septic Tank, Irvine	49
122	Montgomery Street CSO, Irvine	0
123	Thistle PSEO, Irvine	1
124	Ayr PS EO, Ayr	0

Table 2: Proposed Storage for Interceptor Sewer/WwTW Option to Maintain CSO Performance for Planned Developments.

The total volume of storage required is 72,312m^3. 21 CSOs require storage of greater than 25m^3.

Interceptor Sewer Diameter	Location	Length
225mm	North of Meadowhead , intercepting spills flows from CSOs in Irvine; through Darvel to Newmilns.	11,780m
300mm	Between Newmilns, Galston, Hurlford to Kilmarnock.	12,922m
375mm	Kilmarnock, Eardale, ad, Drybridge & Dundonald to Meadowhead WwTW	9,816m
TOTAL		**34,518m**

Table 3: Proposed Interceptor Sewer Pipe Summary

This option includes storage tanks at CSOs within pumped catchments to the south of Meadowhead WwTW, as per option 1.

5.2.2 Risk & Value Considerations

Opportunities to increase pumping rates at Gatehead Storm Tanks, Barassie Pumping Station, Pan Rocks Pumping Station and at Ayr Pumping Station have not been considered as part of this study due to the consequential effect on Meadowhead WwTW being difficult to determine, with the information available.

Provision of a strategic interceptor sewer, carrying CSO spill flows to Meadowhead WwTW will increase the peak flow to the treatment works and, by increasing the volume arriving at the works, will prolong the treatment processes. This option will necessitate modifications to existing treatment processes and provision of additional treatment and storm water storage capacity. These changes are in addition to the additional treatment capacity required to deal with the additional population inhabiting planned developments. It has not been possible to accurately determine the extent of the modifications required at Meadowhead WwTW during this study. As a consequence the construction estimate includes an allowance to increase treatment capacity by 25%.

A variant of this strategic option is to construct a new wastewater treatment works near to the site of Gatehead Tanks. This would negate the need for 5300m of 375mm diameter interceptor between Gatehead Tanks and Meadowhead WwTW. The variant option would however require extensive modification or demolition of the existing Gatehead Tanks, construction of a substantial WwTW on land not currently owned by SW and potentially more complex consent negotiations. It is considered that the construction of strategic interceptor sewers terminating at Meadowhead WwTW is a less risk option, despite the fact that it may be more conservative in terms of cost. The option of constructing a new treatment works at Gatehead Tanks should be reconsidered in more detail if, by doing so, flows from Kilmarnock, Gatehead, Galston and Darvel could all be treated at the new works; this would provide spare treatment capacity at Meadowhead WwTW, which in turn could permit increases in pumped flows from Ayr, Barassie and Pan Rocks Pumping Stations. The exact routes of discharge rising mains from these pumping stations cannot be determined from the macro model and hence the ease with which they may be modified to deal with additional flows cannot be determined as part of this study. Increasing flows from the pumping stations would reduce or eliminate the need for storage at each location.

5.2.3 Construction Estimate

The estimated cost of constructing 21 storm tanks, of varying volumes and strategic interceptor sewers as shown in Tables 2 & 3 and on Plans 1B to 13B is £56.1M.

The estimated cost for provision of additional treatment capacity at Meadowhead WwTW is £8.4M. This cost should be treated with some caution at this stage due to the full extent of the modifications being unclear. The estimate for WwTW modifications is based upon the predicted 25% annual increase in flow volumes at the works, during the annual TSR events. Further refinement of this option is necessary in order to achieve a greater certainty as to the construction cost.

The total estimated cost of this option is £64.5m.

This estimate is based upon SW's Cost Schedule. Unit costs have been interpolated where information is not available. The estimate includes proposed shaft tank storage, associated pumping stations and limited, localised sewer improvements in order to accommodate the proposed improvements.

The estimate includes an allowance of 12% for utility apparatus diversions, due to the location of the proposed sewers within highways and for traffic management during the works.

The estimate does not include for costs associated with detailed feasibility studies, detailed design, contract administration or site supervision, SW operational support costs, SW overheads or costs associated with any other investigative or exploratory work.

6. Conclusions & Recommendation

Future developments planned by 2011 would cause annual spill volumes at CSOs within the Meadowhead catchment to increase by 8%. This report summaries two strategic options to limit the impact of planned developments on the performance of CSOs, based on Time Series Rainfall (TSR) events. Strategic options considered in this report address the impact of future developments only and do not address other sewerage deficiencies or other regulatory drivers.

Construction of storage tanks at individual CSOs limits the maximum spill volume at each CSO, during each TSR event to those volumes currently predicted. As a consequence, annual spill volumes and spill frequencies are reduced. Storage tanks are generally pumped back into the sewer system after storm flows have subsided; contributing additional flows to Meadowhead WwTW. This option is robust, satisfies this study's objective to maintain current CSO performances, but causes the prolonging of treatment processes at Meadowhead WwTW. The high cost of the option could potentially be reduced by considering whether CSOs may be permitted to spill more, within their current consents.

Construction of strategic interceptor sewers, ranging from 225mm to 375mm diameter, provides an effective way of reducing spill volumes at CSOs to maintain their current performance. This reduces the need for storage tanks for the majority of CSOs to the north and east of Meadowhead WwTW, by carrying flows directly to the Works. CSOs located within pumped catchments to the south of Meadowhead WwTW cannot be cost-effectively linked with interceptor sewers due to their remote geographic locations, their predicted large increases in individual spill flows (particularly at Ayr PS and St Andrews Caravan Park CSO and EO) and the requirement to either provide storage at the downstream pumping stations or increase pumping capacities to Meadowhead WwTW. The extent of modifications to Meadowhead WwTW could not be fully determined during this study; the costs associated with this element of the option should be treated with some degree of caution, pending a more detailed investigation.

It is recommended that the individual CSO storage option cost of £68.4m be considered as the outline construction cost associated with accommodating planned future developments, to 2011, in the modelled sewerage network; to permit no deterioration in the performance of CSOs within the Meadowhead catchment. The recommendation to use the CSO storage option as the basis for the construction cost estimate is due to the option being more robust at this stage and there being less uncertainty concerning the extent and cost of modifications at Meadowhead WwTW compared to the strategic interceptor sewer option. If further studies identify the true extent of works needed at Meadowhead WwTW, the strategic interceptor sewer option should be reconsidered.

It should be recognised that it would be more cost-effective to consider planned developments alongside solutions to address other sewerage deficiencies within the Meadowhead catchment, rather than in isolation. The cost of strategic options presented in this report will reduce if the option is progressed in conjunction with other CSO improvement projects necessary to meet SW's regulatory requirements.