Review of the Regional Sewage Treatment Strategy

May 2017



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1 Summary

In April 2011, Tynwald approved the former Isle of Man Water and Sewerage Authority incurring expenditure not exceeding £39,984,000 in order to undertake works associated with the Regional Sewage Treatment Strategy (RSTS) Phase 1 Programme.

This Phase 1 programme is anticipated to be complete in June 2017, at approximately £12M below the Tynwald approved budget. Sludge is a by-product of sewage treatment. The new sludge handling and processing facility at Meary Veg provides a cost-effective solution for sludge treatment and disposal, with capacity to accept sludge produced by new regional sewage treatment works. Sampling results show that the sewage treatment works constructed under RSTS Phase 1 achieve their environmental consent targets, and modelling of the Ramsey (Balladoole) STW shows that it will achieve the latest EU bathing water quality standards recently adopted by Tynwald as an objective. Considering the above, the RSTS strategy is considered a success.

This review of the RSTS also compares continuation of the regional treatment strategy (for the Peel catchment in particular), with central sewage treatment. The review has been prepared by Manx Utilities with specialist support where needed from a local Cost Consultant.

Updated cost analysis for the Peel catchment and central valley STWs shows that the regional treatment strategy provides a more cost effective solution compared with pumped transfer of flows to Meary Veg, with lower capital outlay and discounted whole life cost savings of approximately £5M.

Regional treatment is an appropriate strategy for the three coastal catchments (Peel, Laxey and Baldrine) which require first-time sewage treatment; collectively these form the RSTS Phase 2 programme.

2 Introduction

Phase 1 of the Regional Sewage Treatment and Sludge Disposal Strategy, comprising a 5-year programme of works, received Tynwald approval in April 2011.

Following completion of RSTS Phase 1 in June 2017, there will still be three coastal settlements on the Island (Peel, Baldrine and Laxey) where the public sewerage systems continuously discharge raw sewage to sea. An objective of the RSTS investment programme is to eliminate continuous raw sewage discharges, and the intention is that these catchments will receive sewage treatment in the RSTS Phase 2 investment programme.

The Programme for Government 2016-2021 assigns one specific action to Manx Utilities: '*Aim to complete the regional sewerage infrastructure by the end of this administration*'

The Environment and Infrastructure Policy Review Committee has decided to investigate the suitability of the regional structure of the IRIS scheme, specifically the decision to create regional works in the North and the West of the Island, and the suitability of the proposed sewage works in Peel.

This report reviews the suitability of the regional approach to sewage treatment by:

- Reviewing the background of the change from central sewage treatment to a regional strategy, and reporting the outcomes of the first phase of investment (RSTS Phase 1) against its cost and performance objectives;
- Outlining the public sewerage catchments which are proposed to comprise the second phase of the regional strategy (RSTS2);
- Reviewing progress to date in developing a regional sewage treatment solution for Peel;
- Comparing the operational and capital cost, and hence whole life costs of: regional treatment at Peel and local treatment for the central valley catchments, vs. pumped transfer of flows from these catchments to Meary Veg for central treatment.

3 Background to the Regional Sewage Treatment Strategy

The strategy for 'Integration and Recycling of Island's Sewage' (IRIS) was approved by Tynwald in 1992. It recommended a 'centralised' solution to sewage treatment, i.e. a single sewage treatment works (Meary Veg), connected to a new network of pumped mains transferring flows from the Island's public sewerage catchments. Approximately two-thirds of the Island's population (in the south, Douglas and Onchan and Union Mills) is now served by Meary Veg STW. Sludge and septage from private sewage treatment facilities is also processed at Meary Veg.

In light of increasing energy costs and emergent sewage treatment technologies deployed successfully for small communities in the British Isles, Mouchel Parkman were commissioned to carry out an independent review of the IRIS strategy. Their review examined all of the treatment and sewage disposal options. The review concluded that regional and local sewage treatment offered a more cost-effective solution for the remaining public sewerage catchments in the west and north of the Island.

The Regional Sewage Treatment Strategy was approved by Tynwald at the October 2007 sitting.

In September 2008, Aecom were commissioned to progress the Regional Sewage Treatment and Sludge Disposal Strategy, involving the production of a Business Case which set out a range of solutions and provided justification for the proposed primary options. The 'IRIS Regional Sewage Treatment Strategy Business Case Report' was received and the following recommendation approved in Tynwald at its 15 July 2009 sitting:

'*That Tynwald receives the Report by the Department of Transport and approves the recommendation that Tynwald endorses the 'IRIS Regional Sewage Treatment Strategy – Business Case Report' as the best and most appropriate approach to sewage treatment for the west, east and north of the Isle of Man.*'

The 'IRIS' strategy was investigated by the Standing Committee on Public Accounts; their report 'Renewal of the Island's Infrastructure for the Collection and Treatment of Sewage ('IRIS') 1991-2007' was debated in Tynwald on 16 November 2010.

The regional strategy was further developed into costed options, and presented as the 'Regional Sewage Treatment and Sludge Disposal Strategy 2011–2016'. Expenditure was approved by Tynwald on 11 April 2011:

'*That Tynwald –*

(1) approves the Isle of Man Water and Sewerage Authority incurring expenditure not exceeding £39,984,000 in order to undertake works associated with the Regional Sewage Treatment Programme (2011-2016) and comprising:

(a) Package sewage treatment plants at Patrick, Glen Maye, Dalby, Bride, Maughold Village, Port Lewaigue, Glen Mona and Corony; (b) Sewage treatment works at Jurby and Kirk Michael;

(c) Sewage treatment works at Ramsey, including the transfer of sewage from the Ramsey network; and

(d) Sludge treatment facility at Meary Veg.

(2) Authorises the Treasury to spend out of the Capital Transactions Account during the financial years ending 31st March 2012 to 31st March 2016, a sum not exceeding £39,984,000;

(3) Approves of and sanctions borrowings not exceeding £39,984,000 being made by Government, such borrowings to be repaid within a period of 50 years.'

4 Regional Sewage Treatment Strategy Phase 1

The Regional Sewage Treatment and Sludge Disposal Strategy 2011–2016 Business Case report framed the strategy into two distinct phases; Phase 1 comprised a 5-year programme of works. The principal schemes were: a regional treatment facility in the north (Balladoole STW) to provide first-time sewage treatment for Ramsey and Andreas; construction of a sludge handling and processing facility at Meary Veg to replace the existing sludge drier, and make provision for the additional sludge envisaged from the regional plants; medium-sized package Integral Rotating Biological Contactor (IRBC) facilities to replace the asset-life expired and basic treatment works at Kirk Michael and Jurby; nine local IRBC sewage treatment plants in the north and west of the Island.

The RSTS Phase 1 schemes are now complete, with the exception of Balladoole STW which is expected to be operational from mid-June 2017.

4.1 Treatment Standards

Environmental standards for treated effluent were determined by the DEFA Environmental Protection Unit (EPU).

In 1990, Tynwald adopted the EU Bathing Water Quality standard (76/160/EEC) '1976 BWD' which establishes a bacterial water quality standard for marine discharges affecting bathing beaches. The Island's bathing water quality standards were debated at the 15 March 2016 sitting of Tynwald, and an amended motion was supported:

'*Tynwald is of the opinion that the EU bathing water standards of 2006 be considered as an objective to bring the Island into parity with neighbouring countries for the protection of public health and in particular for those who wish to use the Island's beaches and bathing waters for recreation*.'

The influence of treated effluent from Ramsey (Balladoole) STW had been evaluated using dispersion modelling. The results indicated that secondary treatment, with the treated effluent

returned to sea via the existing outfall pipe, would be sufficient to comply with the more stringent 2006 EU Bathing Water Directive (2006 BWD) water quality standards at the Ramsey beach sampling point. Jurby and Kirk Michael STWs re-use their exiting outfalls. Bathing water quality was not modelled for these smaller works; however both STW layouts have space for the retrofit of tertiary treatment if it proves necessary to meet the 2006 BWD water quality standards.
The table in Appendix 2 shows sewage treatment works performance against their environmental discharge consent parameters. In respect of the works constructed under RSTS Phase 1, there is full compliance, with the exception of the small Glen Mona STW, which is likely caused by unlicensed discharges in the local sewerage catchment.

Improvements to the sewerage arrangements at Glen Wyllin following construction of a replacement STW at Kirk Michael, and the new STW at Jurby, have both resulted in 'good' beach water quality in 2016 measured against the 2006 BWD standards. Kirk Michael sampling point continues to show 'poor' water quality because of the influence of untreated sewage from Peel. Appendix 3 shows bathing water quality at monitored beach locations assessed according to the 2006 BWD.

4.2 Cost

Each RSTS Phase 1 project was reviewed at design stage, leading in most cases to more cost effective solutions, constructed by local contractors within a favourable tendering environment. Examples include: routing of the Andreas rising main via a direct corridor to Balladoole STW through farm land; retaining the existing outfalls (e.g. at Ramsey) following condition assessment; reviewing the treatment process and designing 'IRBC' solutions for all STW's including the large regional facility at Balladoole. The overall result is that the Phase 1 investment programme will be completed at almost £12M below the Tynwald approved budget.

The table below shows the financial performance of the RSTS Phase 1 projects. Outturn costs are compared with the Tynwald approved budget:

Table 4-1: Financial performance of the RSTS Phase 1 projects

RSTS1 Project	Approved Tynwald Funding	Status	Outturn
1. IRBC Phase 1 (Dalby, Patrick & Bride)	Included in 3 below	Complete	£560,746
2. IRBC Phase 2 (Glen Mona, Glen Maye and Corony)	Included in 3 below	Complete	£1,022,854
3. IRBC Phase 3 (Booilushag, Port Lewaigue & Maughold)	£7,446,000	Complete	£1,081,039
4. Jurby STW	£2,665,000	Complete	£996,886
5. Kirk Michael STW	£3,508,000	Complete	£1,548,357
6. MV Sludge Treatment Centre	£9,808,000	Complete	£9,158,378
7. Balladoole STW	£9,304,000	Construction (forecast completion June 2017)	£6,614,742
8. Riverside PS Refurbishment	Included in 10 below	Complete	£781,584
9. Vollan SPS	Included in 10 below	Complete	£3,730,872
10. Vollan Transfer main	£5,536,000	Complete	£961,034
11. Andreas SPS	£417,000	Complete	£449,639
12. Andreas to Balladoole Main	£0	Complete	£669,832
13.Andreas/Lake Road/Vollan Crescent CSO's	£0	Complete	£239,218
14. RSTS Phase 2 fees	£1,300,000	Closed	£304,204
Totals	**£39,984,000**		**£28,119,385**

5 Regional Sewage Treatment Strategy Phase 2 – Untreated coastal catchments

Following successful completion of RSTS Phase 1, there will be three coastal settlements on the Island where the public sewerage systems continuously discharge raw sewage to sea:

- Peel
- Laxey
- Baldrine

A brief overview of each catchment is given below.

5.1 Peel

The town has developed from the Harbour area, with the older, more-densely populated areas being located around the harbour and the newer, less-densely populated areas being located on the periphery of the catchment.

Peel is the third largest settlement on the Island, and the 2008 Business Case reported that the Population Equivalent (PE) of 6,124 was projected to rise to 7,973 by the design horizon of 2033.

These values were updated during the 2014 'Peel Sewage Treatment Works Feasibility Study' to 9,243 PE by a design horizon of 2040.

The Peel sewer network drains by gravity to a pumping station located along the promenade at Shore Road. The pumping station lifts untreated and unscreened (raw) sewage to a manhole on the road outside the pumping station. From there it flows through a sea outfall to a discharge point in Peel Bay, located to the east of the breakwater. Peel Pumping Station was constructed in 2001; at that time it was envisaged that Peel would be pumped via a multi-stage transmission scheme for treatment at Meary Veg. The pumping station comprises 3 dry-well pumps and a 2,500m^3 storage tank located under Shore Road.

Following extensive investigation, one deliverable site for a regional sewage treatment facility for Peel (in Government ownership), and one potentially deliverable site in private ownership, have been identified.

5.2 Laxey

Laxey village sewerage catchment is drained by a partially combined sewerage network. The catchment south of the Laxey River joins the main sewer (from the west) at a point north of the river near the new highway bridge; this is also the confluence with the northern branch of the sewer network. The main sewer then gravitates parallel to the river on the north bank, beneath Laxey Harbour Chalets (the 'Chalets'), and into a small (redundant) storage tank adjacent to the Harbour boat yard, from where raw sewage discharges via a 18" cast iron outfall just beyond the breakwater.

[redacted]

5.3 Baldrine

The Baldrine catchment sewerage network converges just below Clay Head Road junction, and the outfall pipe discharges raw sewage to sea at Garwick Bay.

[redacted]

6 RSTS Phase 2 – Regional Sewage Treatment Solution for Peel

In April 2008, Dalrymple Associates were appointed to undertake an independent assessment of potential sites for a sewage treatment works in the west of the Island. Their final report issued in May 2008 concluded that two sites were particularly suitable:

1) Farm land zoned for industrial development close to the town boundary behind the oil storage depot and power station;
2) Farmland (Ballaterson Farm) off the Glenfaba Road.

The land zoned for industrial development and close to the Peel power station and the industrial area was considered the 'preferred site' on the following basis:

a) The site was close to Peel sewage pumping station
b) The site was close to the sea outfall
c) The site was at a low elevation
d) The site was zoned for industrial development

The 2009 'regional sewage treatment and sludge disposal business case' included an outline design for a new STW at Peel located at the preferred site. The design concept was presented to the Peel Town Commissioners (PTC); they were asked to support the undertaking of an Environmental Impact Assessment (EIA). However, the 'preferred site' was not accepted by the PTC and they voted not to support the progression of an EIA.

Consequently, Peel was not included in the RSTS Phase 1 investment programme.

In March 2013, Manx Utilities' predecessors commissioned Arcadis to 'provide a review of alternative options for the location of a proposed STW to treat sewage from the Peel catchment'. The review considered the two sites identified in the Dalrymple report, and an additional site on Government owned land at Knockaloe farm.

A coastal dispersion modelling study concluded that the provision of secondary treatment for the Peel catchment would provide compliance with the 1976 EU Bathing Water Quality Directive. The modelling also demonstrated that tertiary treatment (e.g. UV irradiation of the treated effluent during the bathing season) would enable compliance with the requirements of the more stringent

2006 EU Bathing Water Quality Directive utilising the existing outfall. An alternative would be to extend the outfall, however this would incur additional costs and construction risk.

Based on an assessment of quantitative and qualitative criteria, the land zoned for industrial development and close to the Peel power station and the industrial area remained the preferred option.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

7 Regional vs. Central Treatment – Scheme Descriptions

To answer the question as to whether a regional sewage treatment approach remains appropriate for Peel, this scenario and the alternative central treatment strategy have been costed for comparison.

7.1 Design Concept

The design concept is that the Flow to Full treatment (FFT) would be transferred to Meary Veg (central treatment) or a regional STW at Peel and replacement local STW's for the central valley. Flows above FFT would be retained in storm tanks, either to be passed forward or, should the storm tanks become full, screened to <6mm prior to discharge through the existing sea outfall at Peel and/or to local watercourses.

To maximise the benefit of a transmission main from Peel to Meary Veg, it is assumed that the local 'central valley' STW's could be replaced with injector pumping stations under the central treatment scenario.

7.2 Regional Treatment

A Regional sewage treatment approach for Peel would comprise the following principal elements:

1. Modifications to Peel Pumping Station (PS) to enable transfer of FFT flows to a new STW servicing the Peel catchment
2. Construction of a STW to treat the sewage generated in the Peel catchment
3. Construction of transmission and return mains between Peel PS, the new Peel STW, and the existing marine outfall
4. Construction of a replacement STW for the St John's catchment
5. Rationalisation consideration, insofar as the sewage from the St John's catchment could be transferred for treatment at the new regional STW at Peel
6. Construction of a replacement STW for the Ballagarey catchment
7. Construction of a replacement STW for the Crosby catchment
8. Construction of a replacement STW for the Glen Vine catchment

9. Rationalisation consideration, insofar as Glen Vine sewage could be transferred to a replacement local STW at Crosby (or vice versa).

7.3 Central Sewage Treatment

Central sewage treatment at Meary Veg would comprise the following principal elements:

1. Modification to Peel PS to enable transfer of FFT flows to St John's
2. A new 300mm diameter transmission main from Peel to St John's (approximately 4,400m)
3. Construct a new PS inclusive of storm storage and overflow screening facilities at St John's capable of a pumping forward FFT of 83l/sec (68l/sec for Peel and 15l/sec for St John's), to the existing 600mm diameter gravity sewer between Union Mills and the Quarter Bridge
4. Construct a new 400mm diameter transmission main from St John's to Union Mills (approximately 9,350m)
5. Construct a new Injector PS with storm storage and overflow screening facilities at Crosby capable of injecting 10l/sec into the St John's to Union Mills transmission main
6. Construct a new Injector PS with storm storage and overflow screening facilities at Glen Vine capable of injecting 7l/sec into the St John's to Union Mills transmission main
7. Construct a new Injector PS with storm storage and overflow screening facilities at Ballagarey capable of injecting 10 l/sec into the St John's to Union Mills transmission main
8. Construct a new PS at QuarterBridge (with catastrophic overflow protection to the adjacent River Douglas) capable of a pump forward FFT value of 120l/sec
9. Construct a new 400mm diameter PE transmission main between Quarter Bridge and White Hoe PS(approximately 2,000m)
10. Modifications at Meary Veg STW to enable treatment of the increased flows

8 Regional vs. Central Treatment - Cost Comparison Considerations

8.1 Capital Cost Estimates

Capital cost estimates have been prepared using tendered cost information for pumping stations, pipelines and STW's from the RSTS Phase 1 programme, augmented where necessary by estimates prepared by a local Cost Consultant. This has enabled Capital Expenditure (CAPEX) construction cost estimates to be made for the principal elements within the regional and central treatment scenarios.

Professional fees, specialist surveys, third party costs and planning costs have been estimated as 15% of the capital construction costs, derived from an average of actual fee costs during the RSTS Phase 1 programme.

The replacement of key elements of plant and equipment has been considered over the 25 year operational lifetime, where appropriate based on information provided by Manx Utilities operational staff.

8.2 Operational Costs

Operational expenditure estimates have been prepared using actual cost data from Manx Utilities sites including: staff, power, telephone & telemetry, engineering maintenance, sludge disposal and consumable costs.

The cost per M^3 of passing forward flows at the Whitehoe PS, and of treating flows at Meary Veg STW, has been derived using actual cost and flow data.

Collectively this has enabled estimation of total lifetime Operational Expenditure (OPEX).

A marginal cost of generation (6p per kWh) has been used in calculating electricity costs to Manx Utilities.

8.3 Whole Life Cost

Discounted CAPEX and OPEX have been combined to provide a Whole Life Cost (WLC) over a 25 year period.

Inflation has been estimated at 2% per annum, and a discount rate of 3.5% has been used in the Net Present Cost (NPC) calculations.

The NPC's of the regional and central treatment scenarios have been compared to determine the most cost effective strategy.

8.4 Centralisation - Meary Veg Modifications

A Headroom assessment has recently been completed at Meary Veg STW. A significant increase in flows would require additional plant and equipment:

1. New aeration blowers and distribution system (£300K)
2. New final settlement tank (£700K)

Capital investment of c. £1M would be required at Meary Veg to accommodate additional flows from the centralisation option.

8.5 Regional Treatment - Rationalisation Options

Significant work has already been undertaken to look at costs in the Central Valley and Peel. The Central Valley CAPEX estimates were initially undertaken by an independent Cost Consultant in August 2016, and these have been refined and reconsidered here.

8.5.1 Central Valley Rationalisation

There are effectively two treatment options within the central valley:

1. Construction of new STW's to separately treat the sewage generated in the Ballagarey, Crosby & Glen Vine catchments
2. Rationalisation consideration, insofar as Glen Vine flows could be transferred to a replacement STW at Crosby.

The cost of option 1 (separate sewage treatment plants) is estimated at £3,776,038, whilst the estimated costs of Option 2 (rationalisation) is £3,418,877. Option 2 is therefore preferred, and has been used in this analysis.

8.5.2 Peel STW

Significant work has also taken place with regards to estimated costs of the proposed regional STW at Peel, which dependent on the final site location, results in an estimated total lifetime cost in the range £16,547,130 - £17,564,951. The higher figure has been used in evaluating whole life costs of the regional treatment strategy.

8.5.3 Peel and St John's Rationalisation

There is the option to construct a new PS at St John's and transfer flows to Peel regional STW (estimated CAPEX £652k). Added to this would be the cost of a transmission main from St John's to Peel STW (c. 4000m), at an estimated capital cost of £2.1M. The capital cost for transfer of flow from St John's would therefore be c. £2.7M, which outweighs the estimated cost of providing a replacement STW for St John's catchment (c. £2.3M).

Furthermore, the additional load being transferred to Peel (1,692 PE) would require a c. 20% increase in the size of the Peel STW, which broadly equates to an increased capital cost of £2.2M.

Therefore, rationalisation through transfer of flows from St John's to Peel is c. £2.6M more expensive than separate treatment solutions for these catchments.

9 Treatment Strategy Cost Comparison

The comparison of the Regional and Central strategic treatment options is shown in the table below:

Table 9-1: Cost Comparison of Regional and Central Sewage Treatment Strategies

Option	Lifetime Capital Cost*	Lifetime Operational Cost*	Discounted Whole Life Costs (NPC)
Peel	£13,275,350	£6,871,790	£17,564,951
St John's	£2,607,040	£1,746,440	£3,606,987
Central Valley	£3,708,876	£2,397,164	£5,076,281
Total Regional Treatment	**£19,591,266**	**£11,015,394**	**£26,248,219**
Central Treatment	**£20,667,261**	**£17,328,181**	**£31,335,048**
		Difference	**£5,086,829**

The table above shows that the regional treatment strategy provides a more cost effective solution, with lower capital outlay, and discounted whole life cost savings of approximately **£5M.**

*NB – Lifetime capital cost and operational cost are not discounted, and therefore do not sum to the discounted whole life costs in column 4.

10 Overall Comparison

The table below considers and compares not only the commercial aspects but also the technical environmental and operational aspects of each option.

Table 10-1: Commercial, technical, environmental and operational comparison for each option

Comparison Field	Regional Treatment	Central Treatment
Technical	Known, proven, trusted and simple technology	Known, proven, trusted and simple technology
Environmental	Provides an environmentally acceptable treatment solution Continuous discharge of treated effluent into the river Dhoo Visual impact of STWs Land procurement required	Provides an environmentally acceptable treatment solution with intermittent (storm flows only) discharges into the river Dhoo Relatively high long-term energy consumption Major easement procurement required, and land procurement for a PS in QuarterBridge area
Planning	Planning permission would be required	Construction could generally proceed under the Permitted Development Order, although transfer PS may need planning approval
Operational Risks	Poor maintenance and/or operational management could lead to an increased risk of odour complaints The continued discharge of treated effluent into the river Dhoo means that failure to comply with licence conditions brings with it prosecution potential.	Relatively high number of fixed assets increases risk of plant and equipment failure Poor maintenance and/or operational management could lead to an increased risk of odour complaints
Commercial		
a. Capital Costs	Lower capital outlay	Higher capital outlay
b. Operational Costs	Relatively low operational costs	Significantly higher operational cost
c. Whole Life Cost	The best option	A more expensive option

11 Conclusions

11.1 Regional Sewage Treatment Strategy Phase 1

Comparing project outcomes with the regional strategy aims, this brief review concludes that Phase 1 of the regional sewage treatment strategy has (and in the case of Balladoole STW, is likely to) successfully achieved its public health and environmental goals at a considerable saving against the approved budget.

There has been no major technical innovation within the industry in terms of sewage treatment processes since the RSTS Phase 1 strategy was approved, and the Integrated Rotating Biological Contactor (IRBC) plants designed for the RSTS Phase 1 programme are being used more frequently by UK water companies as they seek low odour, low energy, and low maintenance solutions.

11.2 Regional Treatment - Rationalisation Options

Technically and environmentally there is no great difference between the options, however with the estimated CAPEX being marginally less and with significant OPEX savings that could be realised, the review concludes that the regional treatment approach remains valid, and forms an appropriate basis for the RSTS Phase 2 programme of works.

Appendix 1 - Local Sewage Treatment Works Catchment Descriptions

A number of existing inland local sewage treatment works require improvement having reached the end of their serviceable asset lives, or because of other factors affecting their capability to meet environmental discharge consent standards. These schemes are separately identified and **do not** form part of the RSTS Phase 2 programme.

1.1 St John's

St. John's is designated as a Service Village in the Island's Strategic Plan.

The 2008 Business Case reported that the Population Equivalent (PE) of 1,005 was projected to rise to 1,395 by a design horizon of 2033.

Making an allowance for medium density development on of all land currently zoned for residential development, the estimated current (2015) and future (2040) Population Equivalent is 1517 and 1692 respectively.

The sewer network connected to and currently being treated at the St John's STW extends to the south to include the Lower and Upper Foxdale areas, whilst all of the sewage in the St. John's catchment gravitates to the existing STW that is located adjacent to the old Mart. The treated effluent from the works flows by gravity to the Foxdale Stream (a tributary of the River Neb) located along the southern boundary of the site.

1.2 Crosby

Crosby is designated as a small village in the Island's strategic plan and consists of residential developments, of which the majority are located north of the A1. Crosby STW was constructed in 1960 and is located at the southern end of the catchment, accessed via the Old Church Road. The works is bordered by the Heritage Trail to the north, and the River Dhoo to the south. In July, 1983 the works was refurbished and access improved.

Treated effluent flows by gravity to the River Dhoo.

Making an allowance for medium density development on of all land currently zoned for residential development, the estimated current (2015) and future (2040) Population Equivalent is 531 and 895 respectively. This is significantly higher than the previous estimates undertaken in the RSTS 2008 Business Case which recorded 205 and 226 for current and future populations respectively.

Based on the current catchment population this works is severely undersized and replacement is required urgently.

1.3 Glen Vine

This settlement is also designated as a small village in the island's strategic plan, and consists of a small number of residential developments and single dwellings located along the A1. Glen Vine STW is located between the A1 and the Heritage Trail and was constructed approximately 40 years ago. Treated effluent from the works flows by gravity to the River Dhoo located approximately 200 metres to the west of the site.

Making an allowance for medium density development of all land currently zoned for residential development, the estimated current (2015) and future (2040) Population Equivalent is 368 and 433 respectively.

1.4 Ballagarey

Ballagarey is a small residential area east of Glen Vine, and is considered too small to appear in the Island's strategic plan settlement hierarchy.

Ballagarey STW is located next to the heritage trail approximately 200 metres south of the Ballagarey Road/Al junction. The current estimated (2015) and future (2040) Population Equivalent is 839 and 910 respectively.

Treated effluent from the works flows by gravity to the River Dhoo approximately 100 metres to the southwest of the site.

The existing works has performed poorly against both the current and the proposed new consent levels and its physical condition is poor. It is programmed for replacement in 2017.

1.5 Ballaugh

Ballaugh has been designated a Small Village in the Strategic Plan for the Island, and is therefore unlikely to experience significant development.

The catchment is comprised of single dwellings along the A3, and a number of small housing developments to the north of the A3. The estimated population equivalent for Ballaugh is 632.

Most of the catchment gravitates to the STW inlet where a pumping station lifts the sewage for treatment. There is a small pumping station located in the southwest corner of the catchment which transfers the sewage from a small number of cottages into the network at Ballacrosha Cottage.

The Ballaugh STW is located to the north of the catchment and is accessed via a laneway off of the A10.

The treatment works is believed to have been constructed in the 1950's, and does not have any storm water holding facilities. Effluent from the works is discharged to Ballaugh Stream near the northern and eastern site boundaries.

1.6 Sulby

Sulby has been designated as a Service Village in the Strategic Plan for the Island and is therefore unlikely to experience significant development. The village is located in the north central region of the island with most development located to the south and west of the A17/A3 junction.

The catchment is almost entirely residential, being comprised of a small number of housing developments. The estimated population equivalent for Sulby is 422.

There are 2 network pumping stations and an inlet pumping station which lifts all of the sewage discharged at the works.

Sulby STW is located approximately 200 metres to the east of the A17/A3 junction, accessed via a laneway off the A3. Sulby STW is believed to have been constructed approximately 40 years ago. The effluent flows by gravity to the Sulby River located approximately 10 metres to east of the site boundary. The works does not have any storm water holding facility and is prone to flooding from Sulby river.

Appendix 2 – STW Compliance

Sewage Treatment Works	Type	License Limits				12 months to end of April 2017								
		pH	BOD	SS	NH4	No of Samples	Max Fails Allowed	Fails				Performance Against License	Ref
			mg/l	mg/l	mg/l			pH	BOD	SS	NH4		
Ballagarey Aero	Aerated	5.5 <	136	189	23	19	3	0	4	6	2	FAIL	1
Ballagarey Bio	RBC	5.5 <	166	125	51	19	3	0	0	0	3	PASS	
Ballaugh	Filterbed	5.5 <	211	171	35	24	3	0	0	0	4	FAIL	2
Booilushag	IRBC	5.5 <	60	34	5	18	3	1	0	1	1	PASS	
Bride	IRBC	5.5 <	40	60	30	23	3	3	1	1	0	PASS	
Corony	IRBC	5.5 <	40	60	30	20	3	0	1	0	0	PASS	
Crosby	Filterbed	5.5 <	46	55	17	14	2	0	0	0	0	PASS	
Dalby	IRBC	5.5 <	40	60	n/a	23	3	0	0	0	0	PASS	
Glen Maye	IRBC	5.5 <	38	60	7	22	3	1	0	0	0	PASS	
Glen Mona	IRBC	5.5 <	40	60	4	19	3	9	0	0	7	FAIL	3
Glen Vine	Filterbed	5.5 <	41	85	11	19	3	0	0	0	0	PASS	
Jurby	IRBC	5.5 <	40	60	n/a	23	3	0	0	0	0	PASS	
Kirk Michael	IRBC	5.5 <	40	60	n/a	24	3	0	2	0	0	PASS	
Patrick	IRBC	5.5 <	26	60	5	21	3	0	0	0	3	PASS	
Port Lewaigue	IRBC	5.5 <	40	60	n/a	20	3	0	1	0	0	PASS	
St John's	Filterbed	5.5 <	50	58	18	22	3	0	0	0	2	PASS	
Sulby	Filterbed	5.5 <	65	69	23	22	3	0	0	0	1	PASS	

1 This old works is programmed for replacement in 17/18
2 This old works is programmed for replacement in 18/19
3 Potentially an issue with high levels of ground water infiltration and low alkalinity. Investigations are ongoing with regard to groundwater infiltration, and testing of the influent for alkalinity is due to commence imminently. Possible solutions are to reduce infiltration or dose a chemical to increase alkalinity. DEFA are aware of the situation and no adverse environmental impacts have been reported.

Appendix 3 – Bathing Water Quality (from DEFA)

Bathing water quality at the monitored beach locations assessed according to the 2006 EU Directive

As specified in the 2006 EU Bathing Water directive, the assessments are based on analytical data for each four year period up to the end of the relevant bathing season, apart from where a preliminary assessment has been made using just three years' data. This minimises the effect of short term influences such as an unusually sunny or unusually wet bathing season on the overall rating for the beach, however it also means that improvements such as may result from better sewage treatment can take several years to become fully evident.

Table of all monitored beach locations for the 10 years to 2016:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Assessment period	2004-2007	2005-2008	2006-2009	2007-2010	2008-2011	2009-2012	2010-2013	2011-2014	2012-2015	2013-2016
Bay ny Carrickey	POOR	POOR	POOR	POOR	POOR	POOR	POOR	GOOD	GOOD	GOOD
Castletown	POOR	POOR	SUFFICIENT	SUFFICIENT	GOOD	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
Derbyhaven	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
Douglas Summerhill	POOR	POOR	POOR	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	POOR	POOR	POOR
Douglas Central	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR
Douglas Broadway	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR
Fgnella Beach	POOR	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	POOR	POOR
Garwick	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	SUFFICIENT
Glen Wyllin	-	-	POOR*	POOR	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	GOOD
Jurby	SUFFICIENT	SUFFICIENT	GOOD	SUFFICIENT	POOR	SUFFICIENT	SUFFICIENT	GOOD	EXCELLENT	GOOD
Kirk Michael	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR
Laxey	POOR	POOR	POOR	POOR	POOR	POOR	SUFFICIENT	SUFFICIENT	SUFFICIENT	POOR
Peel	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR
Port Erin	POOR	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT
Port Grenaugh	-	-	POOR*	POOR	POOR	POOR	POOR	POOR	POOR	SUFFICIENT
Port Lewaigue	-	-	POOR*	POOR	POOR	POOR	POOR	POOR	POOR	POOR
Port Soderick	GOOD	GOOD	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	GOOD	EXCELLENT	EXCELLENT	EXCELLENT
Port St Mary	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	SUFFICIENT	GOOD	GOOD	GOOD
Ramsey	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR
			* 2007-2009							

The chart that follows gives a graphic indication of performance since assessment to the 2006 directive commenced. The chart clearly shows the improving trends over the past decade, the top of the combined bars indicating the total number of locations meeting at least the minimum standard (designated "sufficient"), and the top of the green+blue bars indicating the number designated "good" or better.

