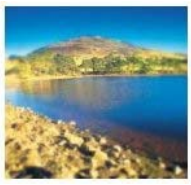



A96 Corridor Interim Report
Phase Three

Water Supply

A96 CORRIDOR INTERIM REPORT
PHASE THREE WATER SUPPLY

Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
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"Solutions with Ownership"

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1 Phase Three - Water Strategy for A96 Corridor in 8 five year stages

1.1 Introduction

The report for Phase One of this project was completed on 25 July 2006 and assessed the total demand that is likely to be required by the proposed A96 development at 2041 and proposed a strategy for providing a water supply to the required areas.

The Highland Council (THC) provided their initial estimate of the development likely to occur in five year timesteps from present until 2041 in their Starter Scenario and Commitments spreadsheets. Phase Two of the project studied the demand and supply requirements resulting from THC predictions in more detail by considering the phasing of Part Three infrastructure (trunk mains and services reservoirs). A second phase report was prepared later in 2006 and provided a template for this final (phase three) report which uses the finalised data issued by THC in December 2006 after their consultation process.

The changes between initial projections and final projections provided by THC are primarily

- increased 2041 demand for Inverness Water Supply Zone (WSZ) from 50 Ml/day to 58 Ml/day
- revised distribution and phasing of development
- notable increased demand at Inverness East and Nairn

THC has stated an aspiration to have all developments contribute equitably to funding all the 2041 infrastructure requirements. However, Scottish Water's infrastructure funding mechanism may not be capable of achieving this objective. It is presently implemented through a procedure defined by the Scottish Executive which is discussed in section 4 of this report.

The financial estimates included in all three reports on the provision of water supply to the A96 Corridor are high level budget figures. The confidence in these costs cannot be improved until detailed discussions have been held with SEPA and the full impact of environmental legislation and regulation on any proposal is identified.

1.2 Summary of Phase One Report

Phase One of this study examined the supply and distribution of water to the A96 corridor. Growth projections were used to forecast a total water demand in 2041. In addition to the A96 corridor region, water demand was forecast in Inverness and Nairn, the complete Inverness WSZ. This was necessary in order to evaluate the overall supply demand balance and works headroom as Inverness, Nairn and the A96 corridor are all currently supplied by same water treatment works.

The approach adopted in Phase One was to consider three different demand scenarios which represented high, medium and low probability of occurring. These three scenarios adopted different levels of risk arising from the various assumptions taken. We understand that the waste water assumptions are consistent with those taken for this study.

The three scenarios took into account a range of factors including levels of leakage, proposed growth and per capita consumption, enabling the sensitivity of the Supply Demand Balance to be assessed. For each scenario, the demand to 2041 in the A96 corridor was forecast. This varied between 14.9 ML/d to 20.5 ML/d; an increase over the existing (2006) demand level of between 7.4 and 13.3 ML/d. These results identified additional infrastructure requirements, including provisions for additional raw water supply, treatment works, new trunk mains and service reservoirs. However, the main focus from the Phase One report was the raw water supply and what would be required for the 2041 demand.

Several sources were considered to augment the existing raw water supply from Lochs Duntelchaig and Ashie to support growth along the A96 corridor. The forecast raw water demand shows that abstraction from two local augmentation options - the Rivers Farigaig or Nairn, would be sufficient to supply the A96 corridor in the short term. However, long term growth up to and beyond 2041 is predicted to exceed the yield of these smaller river sources.

Another option is to introduce Loch Ness as a new raw water source. The yield of Loch Ness is sufficient to comfortably supply the entire Inverness area including Nairn and the A96 corridor. One drawback associated with Loch Ness is the cost of pumping from the level of the loch to the existing Inverness Water Treatment Works. This could be minimised by pumping only when required, i.e. when the level available for supply in Lochs Ashie and Duntelchaig falls below a defined operational curve. To minimise costs, other options include possible conjunctive use of the River Farigaig and Loch Ness, or construction of a new treatment works in a different location The cost of the basic scheme; pumping from Loch Ness to the current treatment works at Loch Ashie, treating the additional raw water and installing new assets to supply the new A96 development was presented in Chapter 6 of the Phase One report.

1.3 Summary of Phase Two Report

Phase two of this study used the assumptions of phase one and a medium demand scenario. Further information was received from The Highland Council (THC) about phased development in the area until 2041. A range of factors were taken into account such as per capita consumption, current levels of leakage and proposed growth. Changes in demand were examined in 5 year stages until 2041. These varied as a result of new development, but also as a function of estimated changes in levels of leakage, changes in household occupancy and other variables.

Total water demand in the Inverness WSZ was shown to rise to approximately 50Ml/d. Sufficient raw water yield cannot be provided to service this demand from the existing sources and the phasing of additional water sources and water treatment works capacity were examined against phased demand increases.

Demand was predicted by THC to rise most in the first 5 years of proposed new development. As a result of this prediction an immediate requirement for two new service reservoirs for Tornagrain and Whiteness was identified to mitigate the impact on existing properties which are currently supplied directly from the trunk mains. Other service reservoir upgrades or additions are also required. Several options were discussed as possible ways to phase the required upgrade to the existing trunk main and compared with building a new or duplicate main capable of servicing the 2041 predicted demand in the immediate future.

2 Existing Situation

This section of the Phase Three report summarises and re-presents information detailed in the Phase One.

2.1 Population and Demand

The 2006 populations in Inverness, Nairn and the A96 corridor were determined using electoral zones. The table below indicates these zones and the associated demand from each under 2006 condition

		Population	Demand ML/d
Inverness	Ballifeary	2912	1.36
	Canal	2891	1.36
	Crown	3154	1.47
	Hilton	2925	1.37
	Inshes	2987	1.40
	Inverness Central	2625	1.24
	Lochardil	2961	1.39
	Merkinch	2996	1.40
	Milton	2918	1.37
	Muirtown	2742	1.29
	Raigmore	2998	1.40
	Scorguie	2886	1.35
	Loch Ness East	2631	1.24
	Loch Ness West	2764	1.30
	Inverness West	2859	1.34
	Culduthel	3264	1.52
Nairn	Nairn Alltan	2,634	1.07
	Nairn Auldearn	2,891	1.17
	Nairn Cawdor	2,644	1.07
	Nairn Ninian	2,902	1.17
A96 corridor	Ardersier, Croy and Petty	3317	1.43
	Drumossie	3169	1.48
	Culloden	3552	1.53
	Westhill and Smithton	3056	1.32
	Balloch	3249	1.40
TOTAL		**73,927**	**33.45**

Table 1: 2006 zones, population and demand for Inverness, Nairn, and the A96 Corridor

Key: Supplied by Inverness Branch of Trunk Main

Supplied by A96 Branch of Trunk Main

The data received from THC indicated number of units for Residential, Retail, Industry etc. The population was calculated using the Residential units and the General Register Office for Scotland (GRO) average occupancy rate. This was used to calculate the un-metered Domestic Demand using the Per Capita Consumption (PCC). The full methodology for these calculations is detailed in Phase One Report. The 2006 demand was calculated based on the following assumptions;

- GRO 2.19 Highlands Average → Number of Dwellings
- PCC 145 L/person/day → Domestic un-metered Demand
- Non Domestic un-metered demand → allowance made using standard calculation

2.2 Water Resources

The Inverness WSZ is fed from two sources, Loch Ashie and Loch Duntelchaig. It has a WR1 Water Framework Directive (WFD) driver identified by SEPA in the Q&S3b investment period. This will require a detailed hydrological and environmental study to be carried out which may result in the need to reduce abstraction and/or increase compensation flows. There is currently some uncertainty relating to the available yield from these sources which will only be clarified by these detailed studies. This is primarily due to a lack of calibrated flow data. An estimate for the combined yield, based on a HYSIM-AQUATOR model assuming maximum draw down, is 27.8 ML/d. However, the current volume abstracted is up to 33.0 ML/d as confirmed by telemetry data from Inverness WTW. On this basis, the current maximum abstraction exceeds the yield for the source. This means that during a dry year there is a significant risk of running out of raw water from these sources at the current level of demand.

Therefore investigation into a new or augmented source is a high priority. Scottish Water will work closely with SEPA to carry out the required studies and develop a range of options to address any current and predicted deficit.

2.3 Water Treatment Works

Water supplied to the Inverness Water Supply Zone is treated by a new works commissioned in 2005 located close to Loch Ashie. The treatment process involves pre-screening, coagulation, and conditioning (lime, ammonia, o-phosphate and chlorination) and membrane separation. The design capacity and present works output (based on May-July 2006 average flows) are presented in Table 2 below. On this basis, the plant currently has very limited headroom of 1.8 Ml/d at peak demand. This could potentially constrain growth in the area but this is being managed in the short term by demand management and leakage reductions which together is allowing current development to proceed and rezoning to be carried out. However a growth of demand in excess of the works capacity, which is predicted in the near future, will necessitate upsizing of the present WTW or construction of a new WTW. The phasing of proposed infrastructure will be discussed in the Section 3.

	Design Capacity (ML/d)	Current Average Day Demand (Ml/d)	Current Peak Demand (Ml/d)
Ashie WTW	39	30.6	37.2

Table 2 Ashie WTW, Capacity and Output

2.4 Trunk Main

Table 3 shows the pipe size and length of the existing Trunk Main between the former Balmore WTW and Nairn Water Supply Zone. Investigation of the existing asset conditions was carried out using flow data for the area. This data was obtained from a report carried out by RPS for Scottish Water, titled 'Carse of Ardesier and Castle Stuart Developments'. This report was produced to specifically address the needs of the two named developments and pre-dates the strategic A96 Corridor development plans announced by THC.

An analysis of the potential water supply conditions was carried out for these two developments individually in order to determine the impacts they will have on the supply in the area. The main conclusion reached was to increase the supply pressure in order to accommodate the growth in demand. Storage facilities were not included in this study, and have subsequently been requested for the Castle Stuart development, due to its size and associated peak load demand. In focussing on just these two developments, the report did not take into the account the overall effects which all the combined developments will have on the supply network along the corridor.

Flow data from the RPS report was used to assess the current operating condition of the existing trunk main. The outcome from this was the trunk main is presently close to capacity and spare capacity is being rapidly consumed by small pockets of new development. In order to accommodate the 2041 projected flow to the corridor, the trunk main will need to be replaced or duplicated. The main advantage of installing a duplicate main is the increased security of supply.

A strategic trunk mains model is required to allow the wide range of potential development scenarios to be studied. The model currently being prepared for the whole of the Four Firths area will be used together with more detailed all mains modelling as required. This information will allow a comprehensive picture to be obtained of existing asset information. These models will deliver a full appreciation of existing and potential future performance plus what improvements will be required in order to accommodate growth along the A96 Corridor up to 2041.

The general condition of the trunk main is understood to be poor with high levels of leakage. Of particular concern is the section of trunk running towards Nairn from the Fort George junction. This 150mm diameter section is undersized for the current flow and is understood to be susceptible to leakage. This length of main is not fundamental in supplying the two forecast major areas of demand, Whiteness and Tornagrain. However, growth in demand from Nairn is also forecast to be significant which would require reinforcement of this section of main.

Section of Trunk Main	Diameter of Pipe (mm)	Approx Length of Pipe (km)
Balmore WTW – Inshes SR	500	3.5
Inshes SR – Drumbuie SR	500	3.5
Drumbuie SR – Gateside SR	400	3.5
Gateside SR – Balnabual SR	350	4.5
Balnabual SR to Junction to Fort George SR	350 & 300	5.7
Junction – Fort George SR	150	6.5
Junction – Raitloan SR (Nairn)	150	9.6
Junction – Urchany SR	300	5.2

Table 3 Existing Trunk Main Dimensions

2.5 Service Reservoirs

Table 4 lists the existing Service Reservoirs along the Trunk Main towards Nairn along with their respective storage capacities.

Storage Reservoir	Storage Capacity (Ml)
Inshes	1
Drumbuie	0.682
Gateside	0.682
Balnabual	0.682
Fort George	0.682
Raitloan	5.45
Urchany	1.182

Table 4: Existing Service Reservoir Capacities

The level of storage currently provided by the service reservoirs fed from the trunk main is generally less than the minimum Scottish Water design standard. Additional demand placed on these reservoirs will require storage volumes to be upgraded in order to accommodate the proposed development in the A96 Corridor. Furthermore, there are areas within the A96 corridor which are currently supplied directly from the trunk main. This is common for small pockets of demand but not ideal, and introduces an increased risk of interruption of supply. However, major development at Whiteness and Tornagrain will have a detrimental impact on this direct supply arrangement and will necessitate provision of new service reservoir storage.

3 Infrastructure Required by 2041 - Illustrative

3.1 Introduction

The aim of this section of the report is to discuss the infrastructure required to supply the A96 Corridor until 2041 based on the final data provided by THC in December 2006. Phase One and Phase Two of this study and the two associated reports used the initial growth projections provided by THC.

The changes between initial projections and final projections are primarily

- increase 2041 demand for Inverness WSZ from some 50 Ml/day to 58 Ml/day
- revised distribution and phasing of development
- notable increased demand at Inverness East and Nairn

This section studies the A96 Corridor demand in five year stages up until 2041 based on the final data provided by THC. This is based on different data to that used in the Phase Two report, and as a result, recommendations for the infrastructure necessary and when this would be required have been revised. In order to give an understanding of the scale of the A96 development in relation to other areas in the supply zone, Figure 1 has been produced based on this revised information to show relative demand up until 2041.

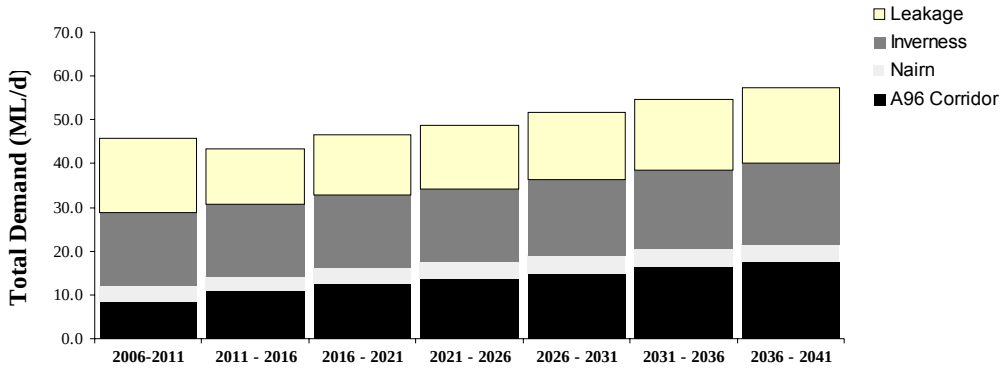

Figure 1: Demand from Inverness, Nairn and the A96 up to 2041

The total water demand in 2041 will determine provisions for the WTW and raw water resources which will be required. Whereas the phasing through to 2041 of this demand will determine the storage and distribution provisions that will be necessary along the A96 Corridor. The phasing of developments is significant in identifying which existing distribution assets will become stressed and therefore require investment. Figure 2 shows the major developments along the A96 Corridor and over which time period they are proposed to be built. These THC predictions indicate the majority of developments have their main growth period from 2006 to 2021. Tornagrain and Whiteness, among others, have a large impact on the demand along the A96 corridor and will ultimately have a significant impact on infrastructure required along the A96 corridor.

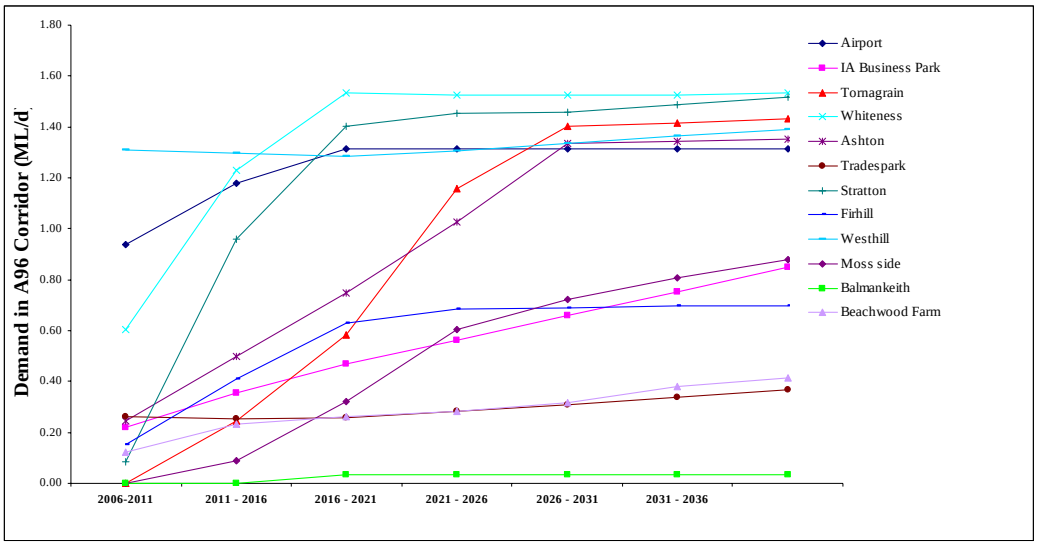

Figure 2: Phasing of A96 Developments

3.2 Raw Water Source

The Water Resource requirements have been detailed in the Phase One report. Given the scale of the proposed growth projected, the existing sources will not have sufficient reliable yield to supply the proposed demand up to 2041.

This Inverness water supply zone as fed from Loch Ashie and Loch Duntelchaig has a WR1 Water Framework Directive (WFD) investment driver identified by SEPA in Q&S3b (2010 – 2014). This will require a detailed hydrological and environmental study to be carried out which may result in the need to reduce abstraction and/or increase compensation flows. There is currently some uncertainty relating to the available yield from these sources which will only be clarified by these detailed studies.

The findings of the Phase One report were that there are a number of potential raw water resource augmentation options available in order to supply sufficient water for Inverness, Nairn and the A96 Corridor. It must be stressed that any development of existing and new sources of raw water will require to be carried out in full compliance with the Water Framework Directive as implemented by the Water Environment & Water Services (Scotland) Act 2003 and The Water Environment (Controlled Activities)(Scotland) Regulations 2005. Scottish Water as a Responsible Authority will work closely with SEPA to identify the issues associated with each option and potential mitigation measures. A preferred option will only be identified once detailed hydrological and environmental studies have been completed.

The level of leakage in the distribution network is currently being determined by the establishment of district meter areas (DMA's). Once the sustainable economic level has been agreed with SEPA this will be factored into all discussions on the augmentation of raw water supplies. Leakage reduction work is presently underway as part of the solution to current increased demand from new development and rezoning of areas of Inverness.

Supplementary supply options were considered, involving investigating the options of utilising the River Farigaig and River Nairn. Although these have the potential to ease to problem in the short term, their yield would not be sufficient to meet 2041 demand. Pumping raw water from Loch Ness was identified as one alternative option as this would increase the yield by a sufficient volume to meet the 2041 demand. Loch Ness is relatively close to the existing sources however, there is a significant head difference between Loch Ness and Inverness WTW. There could also be significant environmental issues in relation to the mixing of raw waters from different sources.

There is a pumped storage hydro scheme at Loch Mhor operated by Scottish and Southern Energy which is approximately 10km South of Loch Duntelchaig. This system pumps water from Loch Ness at present and may offer an alternative option for consideration. The requirements of The Water Environment (Controlled Activities)(Scotland) Regulations 2005 and the economic value of green energy generation from hydro-power and our experience of securing a mutually acceptable commercial agreement with power companies will make the evaluation of this option complex in advance of the production of cost / benefit analysis rules by SEPA.

The location of the two existing sources, Lochs Duntelchaig and Ashie, along with Lochs Ness and Mhor can be seen in relation to each other in Figure 3 below.

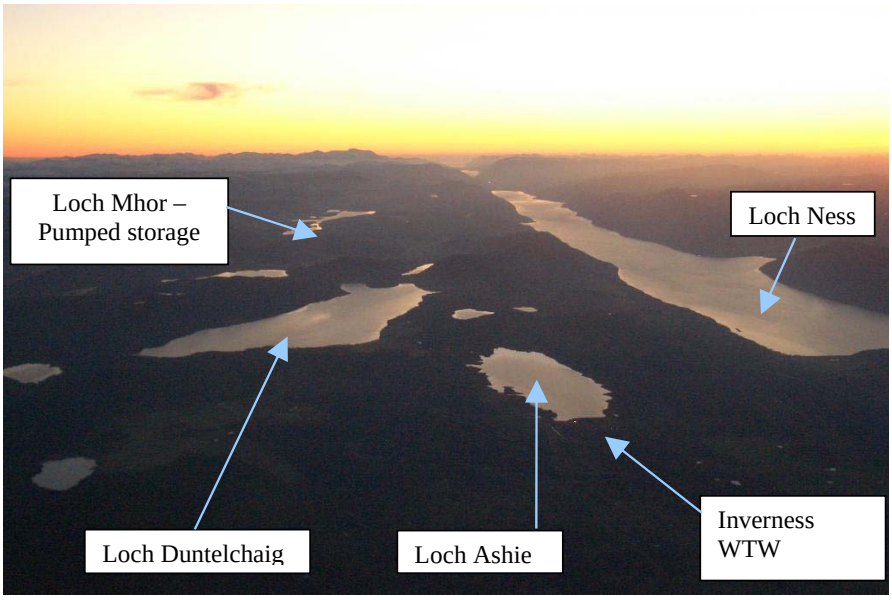

Figure 3: Aerial view looking South West from Inverness

3.3 Water Treatment Works

The current and future demand characteristics are shown in Figure 4, showing the proposed demand from Inverness, Nairn and the A96 corridor in relation to the existing supply and design capacity of the existing WTW.

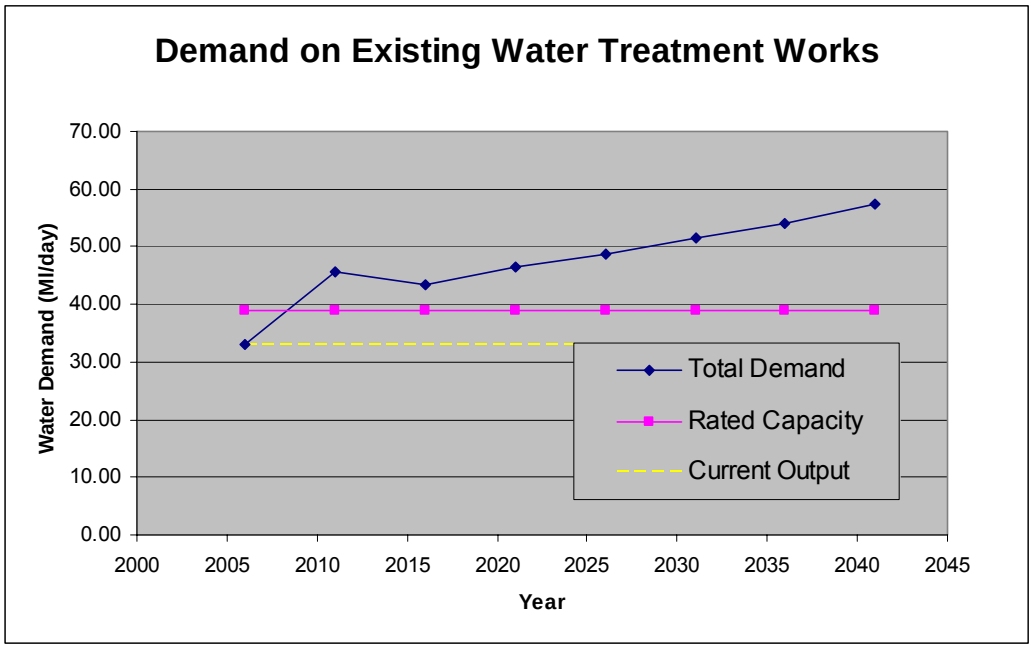

Figure 4: Demand on Existing Works from Inverness WSZ

The demand is forecast to increase significantly over the first five years and then drop slightly during the next five. This reduction is a result of assumptions regarding improvements in the leakage levels over the first five years. From 2011, the leakage levels are assumed to remain constant. The growth in the graph is derived from THC predictions of developments in the A96 Corridor and at Inverness and Nairn.

While SW has an agreed leakage reduction target with WICS for the period up to 2008 this has not been attributed to specific WSZ's. Indicative leakage levels have also been identified up to 2010 at business level. Predictions of leakage reduction beyond 2010 have not been made due to the high degree of uncertainty. The work being carried out at present will be targeted at the areas where leakage reductions are viable. At the time of reporting, a leakage reduction team is working in the Inverness area with the aim of permitting current development to connect to the system.

Figure 4 indicates that if leakage reduction work is unsuccessful, the demand levels will outgrow the capacity of the works in the next few years. Beyond this point, although the demand might reduce with leakage reduction work, demand is predicted to remain beyond the WTW capacity.

Comment: Was this done? What was the outcome? Would do haven't

If the level of demand management and leakage reduction is greater than that assumed, then this may prolong the period of which existing assets can adequately service new development. Effective demand management and leakage reduction could result in the overall demand on the treatment works satisfying demand towards 2020 however, this would be heavily reliant upon customer contributions towards demand reduction.

Regardless of the uncertainties surrounding the demand and leakage management, the overall requirements on the existing WTW are such that additional capacity will ultimately be required. These activities may simply delay the time by which this additional capacity must be delivered. The shortfall in the existing works must be quantified using committed development figures as early as possible in order to allow sufficient time for the licensing of additional resources by SEPA and procurement of a new or extended WTW by Scottish Water.

As discussed in the Phase One report, expansion the existing WTW located at Loch Ashie is likely to be the preferred option. The advantage of this approach is that some plant items will be able to service the new WTW, i.e. mechanical, electrical control. This is likely to reduce the capital cost of the new WTW. An alternative new WTW could be feasible since a location could be chosen closer to the supply zone or raw water source potentially reducing the capital and operating costs. However, the logistics of finding an appropriate site and obtaining planning approvals could count against this option.

Any new WTW is likely to have similar treatment process requirements as the existing WTW, especially if the upgrade/expansion option is progressed. Analysis of potential new raw water sources will be undertaken to confirm the suitability of the proposed treatment and identify whether any other design measures are needed. This will be essential if the Loch Ness supply option is carried out, as this water source is likely to have different water quality characteristics to the existing sources.

Illustrative costs are discussed in section 6.5 of the Phase One report – and reviewed in section 3.5 below. In order to demonstrate a likely progression of the development of raw water source and water treatment capacity the following table indicates actions that will be developed depending on actual development.

Part Three Assets will depend on planning consent and close liaison between THC and SW.

Part Four Assets will depend on the result of evolving planning and discussions between SW, SEPA and THC. In terms of yield, it might be anticipated that planning to 2010 would lead to developing the required new source thereafter. The WTW capacity might be managed up to and beyond 2015 with two 10Ml/d expansions required by 2020 and 2030.

3.4 Distribution Network

The THC Starter Scenario and Commitments are considered in relation to their location along the trunk main. This is to investigate how individual developments impact on the distribution network along the A96 corridor.

The existing GIS information for the area was expanded to create assumed DMAs along the corridor. This allowed the existing demands to be allocated to existing service reservoirs and allow a simple model to be created. The process is more complicated where a number of DMA's are connected to one of the existing reservoirs along the main.

Several areas take water straight from the main and have been identified through a network schematic issued by Scottish Water. The schematic used can be seen in Appendix A. This gives an existing situation where demand prior to development is set against the existing assets. The result of this analysis indicates the areas which currently have little headroom or where there is room for growth and therefore can supply extra demand.

The proposed developments up to 2041 can be allocated to the existing service reservoirs, with the exception of Whiteness and Tornagrain as detailed below. This is a hypothetical step as it not certain exactly where these developments will be situated or which developments will be allocated to which SRs. This is however an appropriate estimation for the purposes of this study.

The work carried out for this report is based on the assumption that three new service reservoirs will be required with potential augmentation of existing in order to accommodate the growth in demand. These will be required at Whiteness, Tornagrain and to the East side of Inverness. Scottish Water is studying the feasibility of a new storage reservoir for the Whiteness development to provide security of supply, and the second service reservoir is assumed to be placed to supply the new town of Tornagrain. This process allowed estimations of potential distribution infrastructure required and was used in detailing additional trunk main and service reservoir requirements.

Several other service reservoirs are currently operating with low storage, and due to large increases in demand, it is likely that either new service reservoirs or extensions to existing will be required by 2041. This will be described in the Service Reservoir section of the report.

3.4.1 Trunk Main

This section of the report investigates the trunk main required by 2041. The existing trunk main is running close to capacity and it has been assumed that this can only supply a relative small amount of additional demand. Increasing the pressure in the existing main is not sustainable due to the poor condition of sections of the existing main and increasing pressure would likely increase leakage levels. Upgrading requires to be carried out to sections of the main to increase the security of the current supply. New infrastructure required will be detailed with respect to the growth in demand resulting from development up to 2041 along the A96 corridor. It was assumed that the existing main will be sufficient to carry existing demand, and any new main will be sized relative to the growth from the 2006 levels.

The demand in 5 year increments was taken from THC Starter Scenario and Commitments data which produced a flow rate along the proposed dual main from 2011 to 2041. The results from this are shown in Table 5, with the plot showing the total demand along the A96 Corridor and demand on proposed dual trunk main shown in Figure 5.

Year	Demand from A96 (Ml/d)	Demand on New Main (Ml/d)	Flow entering additional main (l/s)
2006	10.68	0	0
2011	16.64	5.96	68.98
2016	18.8	8.12	93.98
2021	21.64	10.96	126.85
2026	21.78	11.1	128.47
2031	23.76	13.08	151.39
2036	25.05	14.37	166.32
2041	27.38	16.7	193.29

Table 5: Illustrative Demand and Flows along Proposed Additional Main

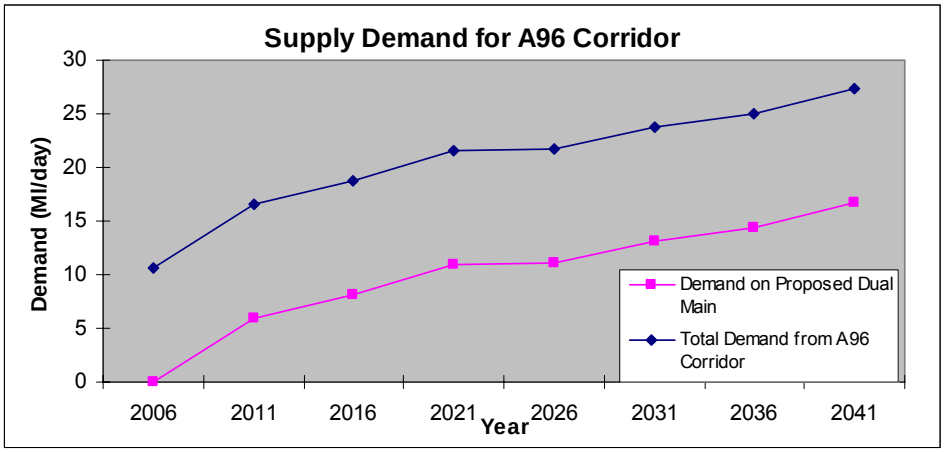

Figure 5: Supply Demand for A96 Corridor

A main would run in parallel with the existing main from the Balmore WTW, alongside existing towards Nairn WSZ. The allocation which is required at each service reservoir is then subtracted from these flows. The new demand, on top of existing demand, from the individual developments is converted into flow rates and this is then extracted from the total flow, as detailed in the table above. This procedure was carried out at 5 year timesteps from 2011 to 2041, and flows leaving the dual main are calculated for each service reservoir location. Again there is some degree of uncertainty regarding developments which are supplied directly from the main, and so it is unclear how these will be incorporated for new developments. In order to further these results, in terms of more detailed analysis, comprehensive predictive modelling would be carried out, but this is out with the scope of this study.

The flow in each section of pipe, between the service reservoirs, has been calculated by subtracting the known flow rates into each service reservoir. Table 6 below shows this process for the 2041 scenario, as an example. The total flow in the main is allocated to the individual service reservoirs relative to the proportion of total A96 Corridor development. Fort George service reservoir is not included in this process. This is because Fort George reservoir is constrained due to the small head which is available and is therefore predominantly used for Ministry of Defence purposes and less so for public supply. Note also that several locations are expected to need dedicated individual service reservoirs in place by 2041. The details of this are discussed in the next section of this chapter.

The allocated flows rates are then used to determine what flow will be expected in the pipe as it runs from Inverness area towards the Nairn area. The approximate pipe diameter required can be calculated from these flows. This allowed the estimate for the cost to be made, as seen in the column on the right side of the table. The costs estimations are indicative at this stage.

2041 Scenario

Total Flow (l/s) **193.29**

	SR Inlet flow (l/s)
Inshes	30.39
Drumbuie	25.00
Gateside	26.62
Balnabual	33.84
Tornagrain	19.46
Whiteness	20.85
Raitloan	31.36
Urchany	5.77
Total	**193.29**

Section of pipeline	Flow (l/s)	Diameter (mm)	Length (m)	Cost (£)
Before Inshes	193.29	750	3500	1067500
Inshes-Drumbuie	162.90	600	3500	927500
Drumbuie-Gateside	137.91	600	3500	927500
Gateside-Balnabual	111.28	600	4500	1192500
Balnabual-Tornagrain	77.44	450	5700	1168500
Tornagrain-Whiteness	25.23	300	3200	352000
Tornagrain-Raitloan	26.62	300	9600	1056000
Tornagrain-Urchany	37.13	300	5200	572000
				7263500

Table 6: 2041 Scenario for Illustrative flows and sizes of New Trunk Main

The same procedure was carried out for all 5 year increments from 2011 up to 2041, with different supply infrastructure being required by different timescales. As the growth increases there is an obvious increase in pipe size required from the largest being 300mm pipes in 2011 to the need for 750mm pipes by 2041. Table 7 shows an indicative summary of pipe size requirements for all the 5 year increments.

	Required Pipe Diameter (mm)			
Section of Pipe	2011	2016	2021 & 2026	2031 & 2036
Before Inshes	300	450	600	600
Insh-Drum	300	450	600	600
Drum-Gate	300	300	450	600
Gate-Baln	300	300	300	450
Baln-Torn	150	300	300	300
Torn-Whit	150	150	150	150
Torn-Rait	150	150	150	150
Torn-Urch	150	150	150	300
Approx Cost (£)	3664500	4472000	5224500	5992000

Table 7: Illustrative Phasing of Required New Mains up to 2041

These results show that there are different options for what infrastructure is required up until 2041. If infrastructure was to be built to serve a certain year then the pipe size requirements could be identified. However, building infrastructure in this manner is not a sustainable or cost effective option. In order to maximise the effectiveness of investment, many considerations must be taken into account. This study uses committed and planned development supplied by THC, however it must be noted that these values are the best estimate available at present and will be subject to change over the course of the timescale being considered. The pipe sizes listed above are indicative of the data provided by THC at the outset of this study, and along with the raw data itself, will be subject to change.

Changes in development could have a significant effect on both the phasing of required infrastructure, and the sizes of what infrastructure which is required. The indicative requirements for proposed pipes above could be changed significantly if the development growth characteristics change. For example, if Nairn developments became a priority, and the expected size of these is also increased, then this would have a large bearing on the pipe sizes required, as Nairn lies at the furthest point from the source and would require an increased pipe diameter the full length of the way along the Corridor.

Another major consideration which must be investigated when analysing the phasing of development along the corridor is the most demand intensive areas, such as Whiteness and Tornagrain. High demand areas must be considered when analysing phasing of the corridor development. It is understood that Whiteness is going ahead at present which will mean feeding from the existing trunk main supply as it is unlikely any new main will be in place in time for the demand from this development to begin. However as this demand increases, along with the introduction of Tornagrain, the existing mains will not have the capacity to supply the required demand.

These two areas are situated in the East section of the A96 corridor and therefore require that the new main is constructed at least as far as this to provide the required security of supply. Beyond these areas there lies Nairn and its surrounding areas. In terms of growth, Nairn has a significant allocation of development over the period of this study and will ultimately require an upgrade to existing distribution networks which, as stated previously, are under sized at present and are vulnerable to damage.

Considering all of these issues, it is recommended that a new main is installed from the existing Balmore WTW to Nairn. The sizing of this pipe is a slightly more complicated issue, as factors such as cost, operating efficiency and accuracy of predicted growth must be balanced against each other.

The most operationally effective method would be to install smaller pipes in the short-term and expand the pipe as the demand increases in order to allow the pipe to be used in the most effective way. However this is not a cost effective or sustainable option. By placing pipes for integral stages throughout the life of this study, then these pipes will need to be replaced in a short period of time. Therefore the most cost effective option, in terms of the whole life costing, is to install the pipes that will be required in the long-term.

A negative aspect of proposing a new main, sized relative to 2041 demand is the operation of this pipe in the years leading up to 2041 demand. As the demand increase is incremental, there may be water quality issues with running a dual main below its design conditions. This however, could be managed through integrating the flow from existing main in the short term, and by the sharp increase in flow in the first 5-10 years of the corridor development, from towns such as Whiteness and Tornagrain, which will be constructed in the first stages of the development programme.

It is recommended that the pipe sizes required in 2041 be installed when the dual main is constructed. If this results in an inefficient flow in the pipe in the first 10 years then there could be a compromise met by allowing the existing main to use the new main to relieve some of its overloading. This would have to be investigated further in the detailed modelling stage which is not within the scope of this study.

3.4.2 Service Reservoirs

New development in the A96 corridor will require some investment into new service reservoirs. This is illustrated in Table 8. As stated in the Phase Two report, several new service reservoirs are required in the area, notably at the two largest developments, Whiteness and Tornagrain, where the present scattering of houses have no service reservoir and are supplied directly from the main. Areas of demand of this scale require a specific level of individual storage as the capacity provided from the works will not be able to cope.

Supply Area	Current SR Capacity (Ml/day)	Estimated 2041 Demand on SR (Ml/day)	Extra Capacity Needed (Ml/day)	New SR likely to be required	Proposed Size of New SR (Ml/day)	Estimated Cost of New Service Reservoir (£millions)
Tornagrain	0	1.43	1.43	Y	2	1
Whiteness	0	1.53	1.53	Y	2	1
Inshes	1	2.23	1.23	Y	2.5	1.2
Drumbuie	0.68	2.82	2.14	Y	3	1.4
Gateside	0.68	4.14	3.46	Y	4.25	1.7
Balnabual	0.68	2.48	1.8	Y	2.75	1.3
Urchany	1.18	2.71	1.53	Y	3	1.4
Raitloan	5.45	5.52	0.07	N	-	-
					TOTAL	9

Table 8: Estimated cost of new service reservoirs likely to be required by 2041.

The sizing of the two new reservoirs for the new towns of Tornagrain and Whiteness, must consider all the demand which could be utilized in the area, and not just sized for the individual developments. The data collected from THC states that the Tornagrain and Whiteness demands will grow to approximately 1.43 and 1.53 Ml / day respectively. In order to give suitable design capacity, each reservoir is required to provide adequate storage.

There are several options available with regards to the sizing and exact location of these service reservoirs. The new reservoirs could be located and sized so as to only provide storage for the two individual developments, which would mean least cost associated as they would be relatively small. Another option could be to locate the reservoirs in an area which could allow them to serve neighbouring developments to relieve stress on existing adjacent service reservoirs. In this case the reservoirs will require to be sized about the single demand from either Tornagrain or Whiteness to allow for the extra load.

It is recommended that in order to supply adequate storage to both these two developments and other developments in the area, the two reservoirs should be sized at approximately 2Ml concrete storage tanks. The estimated costs for these are £1 million for each.

The phasing of these reservoirs is relatively straight-forward. The Whiteness development is set to start construction in the next couple of years and so the reservoir here would require to be installed as and when the houses are built. Also, the Whiteness development has a relatively short growth period and would therefore required full capacity within a short timescale. The Tornagrain development however has different growth behaviour. It is projected to come into place in between 2011 and 2016 and grow at a steady rate up to its 2041 level. Therefore there are options to construct the service reservoir here in stages and upgrade the capacity as more demand comes online. This has to be considered along with the issues regarding sizing in relation to neighbouring developments in order to identify what service reservoir capacity is required.

Comment: New Plans????

A third new service reservoir at Inshes should be considered, as present reservoirs are running at a level close to capacity. It is understood that the existing service reservoir at Inshes is presently supplying the East sections of Inverness, which is not accounted for in the pipe sizing calculations carried out for this report. Therefore any new demand arising from future development will require additional storage provisions.

The area to the East of Inverness is currently supported by several existing service reservoirs, which we understand to be operating at a level close to capacity, in order to provide the required storage durations. New information, as detailed by THC and Master Planners, shows a great increase in demand by 2041. This will in turn mean that storage provisions in this area may become stretched. Existing reservoirs would need to be greatly upsized, and therefore it is recommended that construction of a new reservoir in this area should be considered.

For additional new service reservoirs, the specific detail of location and design of storage requirements should be addressed at the detailed design stage.

Comment: MORE INFORMATION NEEDED?

3.4.3 Overall Distribution Costs

The overall cost of infrastructure which is required is highly dependant on whether the short term solution is used or whether the 2041 scenario is adopted. It is acknowledged that the development up to 2041 is an estimate; however this is seen as a realistic scenario and should therefore not be undervalued. Therefore it is recommended that the infrastructure constructed reflects the demand estimated for 2041. Although this will create several issues when considering funding, it is seen as the most sustainable and most long-term cost efficient approach. Therefore the recommended infrastructure costs are detailed as follows, below in Table 8.

Item	Cost (£million)
2041 Pipe work requirements	7.26
New Service Reservoirs	9.00
TOTAL	16.26

Comment: WHAT DO WE DO ABOUT THE NEW TREATMENT WORKS?

Table 9: Overall Distribution Cost Estimates

These costs cover pipework and service reservoir requirements, classed as Part 3 assets. This does not take into account any costs incurred for upsizing treatment works or developing additional raw water sources. The cost of new service reservoirs is derived from the information in Table 8, and assumes that these reservoirs must be rebuilt rather than upsized. No estimate of cost is given for upsizing the existing service reservoir at Raitloan.

4 Funding Options for Required Infrastructure

4.1 Introduction

The purpose of this section is to discuss potential funding of new or improved infrastructure resulting from the growth of development along the A96 Corridor. The framework in place for funding of water supply networks, described in this section, is found in 'Guide for Obtaining New Water and Waste Water Services' issued by Scottish Water in April 2006. Infrastructure will be required as a result of the increased development along the A96 Corridor, and therefore the developers are required to put up the most significant contribution.

Scottish Water has an obligation under the Water (Scotland) Act 1980 to provide a service to its customers by takings its services to a point at which the customer can connect to it, at a reasonable cost. The result of this is that Scottish Water pays a Reasonable Cost Contribution (RCC) to the cost of the connection, the amount of which is determined by number and type of properties being connected. The maximum amount Scottish Water pay, for 2006/2007 water supply connections, is around £1,300 per property. Further upstream than this, i.e. treatment works and inlets from raw sources are very different as the developer has no responsibility for this.

Scottish Water will levy an Infrastructure Charge at the time of granting technical approval to developer's proposals. This is currently £256.23 per 'equivalent household' for water and the same for wastewater.

Infrastructure Part	Responsible party
Part 1	Developer
Part 2	Developer + RCC
Part 3	Developer + RCC
Part 4	Scottish Water

Table 10: Breakdown of Water Supply Assets

- Parts 1 assets are local house distribution
- Parts 2 assets are DMA distribution
- Parts 3 assets are trunk mains and service reservoirs
- Parts 4 assets are raw water reservoirs down to Water Treatment Works outlets

These cost procedures are based on what Scottish Water has in place at present for funding new connections. As the scope of this study is to look to 2041, it is anticipated that several major contributors to this may change. For example, Scottish Water's funding programme is allocated by WICS in 4-year cycles, which in terms of the time-scales covered in this project, means a significant amount of input factors may change in between now and 2041. Therefore any funding guidance provided in this report is based solely upon the current Scottish Water procedure and may be subject to change in subsequent years.

4.2 Source and Treatment Works (Part 4 Assets)

The raw water source and treatment works are the responsibility of Scottish Water as part of their obligation to provide a potable water supply to its customers, regardless of demand from the area. This means that any increase in demand which is to come from any area within the Water Operational Area has to be incorporated into the extracted yield.

Therefore any new infrastructure required at the treatment works or in utilising a new source, will be provided by Scottish Water. Scottish Water will be responsible for financing these improvements hence a detailed evaluation of all options will be carried out in order to identify the most cost effective option in the long term as it is widely recognised that these improvements will be necessary. The full extent of works required will become apparent once uncertainties such as leakage are clarified further. This will be the most significant uncertainty as it will have a direct impact on the Distribution Input. The implications of the WFD on raw water sources will also become more certain in the near future.

4.3 Trunk Main (Part 3 Assets)

It has been identified that a new trunk main will be required by 2041. The developers will fund the new required infrastructure. SW is responsible for contributing to the developer a RCC once the connected property has a habitation certificate. This creates an issue with regard to timing of finances, as SW make payment once the development and required supply infrastructure has been built. This means that developers will accept a financial risk in the short term.

The method of getting developers to fund any new required infrastructure is relatively straight forward as Scottish Water has a single point of finance. The developer will initially pay the costs of the required infrastructure, and then they will receive a RCC from Scottish Water calculated in accordance with the Provision of Water and Sewerage Services (Reasonable Cost)(Scotland) Regulations 2006. If the forecast housing units as issued by THC are applied with a certain degree of confidence, then it appears that the cumulative RCC would be sufficient to cover the cost of the required new trunk main.

A major risk associated with this method is the phasing of the developments. This method creates an issue for such a large and staged development like the A96 Corridor. As the development will be undertaken throughout the next 35 years, and the required infrastructure will be needed in the short term then there is a timescale issue. There is an issue with getting Infrastructure Charge (IC) payments from developers who will not be constructing their developments for thirty years. Contributions from these developers are needed now in order to construct the required infrastructure; however these developers may be reluctant to contribute as their developments are subject to changes.

As some developments are potentially thirty years away from the process then an issue is raised with regards to the accuracy of the predicted growth and getting these developers to contribute to the installation of new infrastructure now, which is when it is required.

SW understands that developments which are going ahead at present, i.e. Whiteness and Carse of Ardesier, will not be contributing to future trunk main works. This is not a sustainable practise and is not an option in the long term for other developments. There will become a point where Scottish Water cannot allow any further developments to proceed on the existing infrastructure. This is the point where they will need to deploy a strategy for receiving funding for the new trunk main from developers. The issue of identifying this point will be difficult for Scottish Water, and will become more difficult the longer it is left. Scottish Water must work with THC to identify a strategy to receive the funding and set the enforcement procedure in place as soon as possible. If this is not set-up in the near future, then SW will have no option other than to allow small pockets of development to go ahead with only minor improvements to existing mains, as opposed to getting funding in place to construct a new dual main.

Comment: At this stage? ASK STEVE but we suggest that these should contribute to future trunk mains work

This issue of funding is prevalent in other services, such as wastewater, highways and electricity distribution provisions. The A96 Corridor is to experience a significant development and will require infrastructure to be greatly upgraded and increased. The question of how this is to be funded is relevant to all parties. We anticipate that a framework be drawn up to get up front investment to construct the required infrastructure which can then be paid back in the future. An option to achieve this could be for THC to act as the 'lead developer' for the A96 Corridor; however the risks associated with this would need to be managed effectively in order to protect THC from financial consequences. This would require that the developers make a commitment to the whole scheme in order to guarantee their investment. This process could become very complicated with specific agreements from a wide variety of parties. However it is recommended that this is the best option for a project which has these specific restrictions.

With regard to the options to SW for deliverables required, the infrastructure could be constructed in two ways. The trunk main could be sized in stages, in order to reflect the anticipated growth. The other option available is for the trunk main to be constructed to meet the 2041 projected demand levels. This option will be the most cost effective over the whole life of the project and will be a more straight forward option in terms of achieving a level proportion of finance from developers. If an accurate cost for required infrastructure can be produced from the start then both SW and THC will know the final costs and will be able to manage these more efficiently than having to constantly upgrade the mains as the development occurs.

4.4 Service Reservoirs (Part 3 Assets)

The funding behind the additional service reservoirs which will be required along the corridor is relatively straight forward. For Whiteness and Tornagrain, the reservoirs are constructed in order to serve these areas individually. Therefore the developers in these areas will be responsible for funding the construction of these.

For Inshes and others, new service reservoirs will serve a combination of smaller development areas. The cost should therefore be shared between relevant developers, and this may not be straightforward.

The cost of upsizing or upgrading existing service reservoirs will also be an issue, which will be more widespread throughout the whole corridor. The cost of this additional work would be added onto the distribution costs as it will be difficult to pin down individual developments which will require that existing reservoirs be upgraded.

There may be some issues if the reservoirs are to be linked to other neighbouring developments; where the developers here may have to contribute, but this would have to be confirmed once it is known exactly who will be using the storage provided by the reservoirs.

5 Conclusions

The conclusions at this stage of the study are that development will become constrained by reliable raw water availability, treatment capacity and water supply networks in the near future. The proposed development along the Corridor will have a net effect on the demand from the existing sources and along the existing distribution network. However, this will not be significantly affected by the location of developments.

The current water supply and treatment capacities appear to be approaching their upper limits with headroom in the existing service reservoirs and distribution mains very limited and unable to be distributed due to trunk mains sizing.

The current abstraction from existing sources is greater than the estimated yield at times of maximum demand. There is therefore an urgent requirement to investigate and develop an additional raw water source. This will have major environmental issues related to it which SW and SEPA will require to resolve in line with current legislation and regulations.

The rated capacity of the works is sufficient to cope with current demand; however this spare capacity will be used up quickly going on the proposed increase in demand from development along the corridor. Again there are uncertainties with respect to current leakage levels and projected sustainable leakage reduction targets which could affect these figures; however this will not become clearer until SW leakage works have been implemented.

The net effect of the A96 Corridor development will require new infrastructure to be built in order to ensure both sufficient raw water resources are available and also to allow distribution from the works to the customers. The new infrastructure required includes additional capacity to distribution main, possibly through a dual main and extra storage provisions, in the form of service reservoirs, to provide security of supply to end customers.

The funding of these specific requirements will be a complicated process with different bodies responsible for funding different assets. Water resource and treatment issues will be funded by SW, however distribution costs and service reservoirs will be funded by developers with RCC provided by SW. The full understanding of how this will operate is still unclear.

6 Recommendations

The infrastructure described in this report represents a summary of the options available to provide an adequate water supply necessary to service the final demand targets predicted by The Highland Council. Further certainty will be required on development numbers and timing before available options can be fully developed.

In order to clarify some uncertainties raised in the assumptions in this study, it is anticipated that a more detailed foresight into the exact effects of the WFD and leakage reduction targets will be achieved. The implications of WFD and CAR licensing are being investigated by SW and it is anticipated that this will allow a clearer vision of how the resources will be affected in the future. SEPA will be consulted in order to bring more clarity to this issue, and to assess how the new frameworks will affect sources, and therefore the Distribution Input into the system. Similar to this is the leakage reduction work being carried out by SW at present. With further definition of the targets at local level, it will target level of leakage will become more apparent, and thus allow a more defined future demand calculation to be made.

Comment: No further guidance issued – how to phrase this?

In order to fund these requirements, it is recommended that a special framework be put in place to allow the procurement of required work involved in the A96 Corridor development. This project has very specific and complicated issues that do not seem to lend themselves to the present procurement procedures. Therefore it is suggested that a new framework put in place to allow the infrastructure to be funded prior to investment being collected from the developers.

Appendix A – Schematic Distribution Model of Inverness Area