SMART GRID CONSULTANCY

SMART THINKING FOR A BRIGHTER FUTURE

NATIONAL GRID ELECTRICITY DISTRIBUTION

FLEXIBLE OPERATION OF WATER NETWORKS ENABLING RESPONSE SERVICES (FLOWERS)

FLOWERS D3-1 ANTICIPATED SOUTHWEST WATER AVAILABLE CAPACITY

VERSION 3.1 - 03/10/2022 (D. PENFOLD, G.MAJOR)

FLOWERS D3-1 ANTICIPATED SOUTHWEST WATER AVAILABLE CAPACITY

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FLOWERS D3-1 ANTICIPATED SOUTHWEST WATER AVAILABLE CAPACITY

Revision History		
Date	**Issue**	**Status**
20/07/2022	1	DRAFT
22/08/2023	2	DRAFT
04/10/2022	3.1	FINAL

2 Project Overview

The FLOWERS project will analyse the potential ability of South West Water's (SWW) network to embed energy flexibility capacity in the time difference (latency) between when drinking water and wastewater are pumped and stored, and when it is used by the system. It will explore methods of delivering latency flexibility and analyse the feasibility of implementing it on SWW's systems. It will define the regulatory compliance and commercial viability requirements for the creation of a latency flexibility product, which can be embedded within National Grid Electricity Distribution's (NGED) electricity network control rooms. If appropriate, a recommendations document will be produced identifying the next steps for the development of latency flexibility capacity in ED2.

3 Document Purpose

This document is one of several that will be published throughout the projects' lifecycle, which is primarily a desktop-based analysis that is designed to establish the efficacy and scale of potential innovations discussed in the previous section. The project will require the engagement of both water and electricity regulators to determine whether benefits will be permitted to go forward to BaU.

The intention of the following sections is to focus on the anticipated flexibility capacity, that could be realised based on the research carried out during the project to date and the influences that have been identified, which affect the amount of energy consumed (currently over 300 GWh) by SWW's demanding Drinking Water (DW) and Wastewater (WW) processes.

We will also discuss the analysed data and quantify the capacity for latency flexibility available across SWW's networks and NGED's constraint zones to pinpoint areas of greatest potential benefit. From this, a shortlist of potential case study areas will be produced, from which one will be selected.

It should be noted that at this point in the project timeline all the flexibility capacity numbers within this document are estimates based on discussions and meetings held with the SWW personnel as identified in section 6 below. The next phase of the project will be to identify several sites that can be used as case studies to prove or disprove the estimates detailed in this document.

4 Executive Summary

We have sought to quantify the amount of flexibility that could be available if the interventions identified in the D1-1 Feasibility Report V4 during the LFA1 phase were implemented.

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During the analysis it became apparent that, out of the SWW circa **2,207** electricity grid connected sites, only **468 (21%)** were connected via Half Hourly main meters (HH). The remainder are Non-Half Hourly main metered (NHH) sites, which do not have any half hourly supplementary metering. These sites have relatively low electricity demand and there is also no method of identifying their Maximum Demand (MD). For these reasons these sites have been excluded from this analysis.

The HH SWW sites have an MD of roughly **64.8MW** and it is possible to conclude that if all the LFA1 suggested interventions were implemented at the same time then an estimated **33.5MW** of flexibility could be realised.

Assuming NGED would need to purchase this flexibility using the Flexible Power (FP) process at £300/MWh this would cost in the region of £10,050 per hour.

It is unlikely that all the interventions could be implemented at the same time everywhere so taking a sliding scale of implementation from 1% to 50%, the following amount of flexibility could be realised.

Table 4-1Sliding Scale of Implementation All SWW Sites

Implementation level	1%	5%	10%	25%	33%	50%
MW Flexibility	0.33	1.67	3.35	8.37	11.04	16.73
Potential Flexibility Value to NGED per Hour (£)	£100	£502	£1,004	£2,510	£3,313	£5,020

Overlaying the current NGED Constraint Management Zones (CMZ) with the SWW site locations we have identified that **79** of the 468 HH SWW sites sit in current CMZs.

These 79 sites have a combined MD of **12.5MW** and if all the interventions were implemented at the same time, then circa **7.6MW** of flexibility could be realised. Again, using the same implementation sliding scale the following possible amount of flexibility could be realised in the current CMZ zones.

Implementation level	1%	5%	10%	25%	33%	50%
MW Flexibility	0.1	0.4	0.8	1.9	2.5	3.8
Potential Flexibility Value to NGED per Hour (£)	£23	£115	£229	£573	£757	£1,147

Table 4-2 Sliding Scale of Implementation CMZ Facing SWW Sites

5 Problem Statement

The specific problem, that this report is intending to resolve, is the development of a methodology to determine the amount of flexibility that could be realised when the proposed interventions are applied to the SWW HH estate.

It is also looking to determine what the associated benefit could be to the known NGED CMZs and wider distribution network.

An ongoing problem is that within the SWW sites, there is no energy half hourly submetering of the separate operational loads. Therefore, a methodology to determine what each operational loads demand is needed to be developed.

6 Key Contacts – Internal and External

The key personnel interacted throughout the project so far are as follows:

Name	Position	Company
Project Team (National Grid Electricity Distribution NGED, Smart Grid Consultancy SGC & South West Water SWW)		
Angus Berry	Head of Energy	SWW
James Haigh	Energy and Generation Engineer	SWW
Jade Kennerley	Energy and Carbon Technician	SWW
David Penfold	Project Manager	SGC
Gary Swandells	Director	SGC
George Major	Data Analyst	SGC
Emma Burns	Consultant	SGC
Nick Devine	Innovation Engineer	NGED
Stuart Fowler	Innovation Engineer	NGED
Drinking Water Services (DWS) Process Specialists		
Gary Furse	Resources & Production Operations Manager	SWW
Ben Morrell	Central Process Control Team Manager (DW R&P)	SWW
Richard Adams	Head of SWW DWS Networks	SWW
Tom Martin	DWS Network Area Manager	SWW
Wastewater Services (WWS) Process Specialists		
David Helicon	Principal Scientist (WW R&T)	SWW
Nick Gardner	Scientist (WW R&T)	SWW
Paul Lakeman	Regional Maintenance Manager (WW R&T)	SWW

Name	Position	Company
Daniel Woolf	WWS Recovery & Treatment Area Manager	SWW

7 Approach

The planned ingoing approach to the energy data analysis was to source all SWW sites, locational and energy usage data then overlay this with the NGED network substation locational data to identify which NGED substations were serving each of the SWW sites.

This merged data was then used to identify which of the SWW sites were serviced by a substation within an identified NGED CMZ. This is a section of the distribution network, where NGED have identified that, during certain months of the year and times of the day, the substation would benefit from having a reduction in energy demand to improve the associated local network resilience.

The datasets sourced from each network are as follows:

7.1 NGED Data

Primary level substation data was initially provided, which needed to be further refined to include secondary substations linked to SWW sites. The following information was contained in this dataset.

- All NGED substations serving SWW sites.
- Currently constrained primary and secondary substations.

7.2 SWW Data

The following information was contained in this dataset.

- All sites' locational data (circa 2,700 sites).
- Electricity MPAN numbers.
- Half Hourly (HH) sites electricity usage data
- Non-Half Hourly (NHH) sites annual electricity usage data.
- Any onsite generation HH data.
- End users water consumption.
- Weather specifically rainfall.

7.3 Potential Flexibility Capacity Approach

In parallel to the data mapping exercise, an assessment was carried out to evaluate the potential flexibility capacity that could be realised by the initiatives as identified within the previously released D1-1 Feasibility Report.

All SWW HH sites were categorised using SWW nomenclature. Then each of the flexibility initiatives was identified for which site type that it could be suitable.

The nomenclature used is as follows:

Site Type	Abbreviation	No. of Sites
Drinking Water – Water Treatment	DW WT	61
Drinking Water – Water Distribution	DW WD	61
Drinking Water – Power Generation (Hydro)	DW PG	3
Wastewater – Mains Distribution	WW MD	188
Wastewater – Sewage Treatment	WW ST	158

Table 7-1 Number of SWW sites by Group

Using the SWW data set, as discussed in 7.1 above, it was possible to identify each sites maximum demand, which was then further itemised into the maximum demand for the types of operation being undertaken at each site depending on the type of site e.g.

- Pumping
- Aeration
- UV Treatment

By doing this, it was feasible to estimate a maximum energy demand for each type of operation on each type of site thus creating a baseline for each operation.

The potential energy demand reduction that each initiative could realise was then estimated as a percentage energy demand reduction versus the baseline. This percentage has been based on discussions held during the LFA1 phase but will need validating in follow-up meetings with SWW catchment area managers.

Below is an example of this for clarity.

SITE NAME	PROPERTY NAME	Pumping Initiatives		Aeration blowers			UV to LED			Site Totals		
		Assumed Pumping % of Site Max Demand	Max Flex (kW)	Assumed Aeration % of Max Demand	% flex benefit	Max Flex (kW)	Assumed UV % of Max Demand	% flex benefit	Max Flex (kW)	Type	Current Max Demand (kW)	Max Flex (kW)
CENTRAL_STW_PLYMOUTH	Central STW	30%	798	30%	20%	160	30%	10%	80	WW ST	2,661	1,038

Table 7-2 Example Capacity Analysis

The above approach assumes that, as advised by SWW, pumping on a sewage treatment works accounts for approximately 30% of the energy load. Aeration similarly accounts for 30% and UV treatment for 30% with 10% being ancillary usage.

The capacity of flexibility is then calculated by assuming that in the case of pumping the demand load can be totally held off. For aeration and UV, the flexibility available is calculated by applying a % reduction to the baseline maximum demand.

We have not made any assumptions on the length of time these loads can be held off as this will need to form part of the case study. Therefore, the above is indicating what capacity could be provided.

It should be noted again that there is limited availability of sub meter data that would make estimating each initiative's potential flex capacity more accurate. This will need to be addressed as part of any follow-on trials.

7.4 HIGH LEVEL ANALYSIS OF SWW ENERGY CONSUMPTION

We have been able to identify the base energy demand of SWW HH sites with 468 sites having a combined maximum demand of **64.8 MW**.

Overlaying this with the current NGED CMZs there are 79 SWW sites within a CMZ meaning the maximum demand of SWW in CMZs is **12.5 MW.**

7.5 SOUTHWEST WATER SITE GROUPS AND ENERGY

As previously discussed, the SWW sites have been grouped with the respective energy demand identified as can been seen in figure 7-1 below.

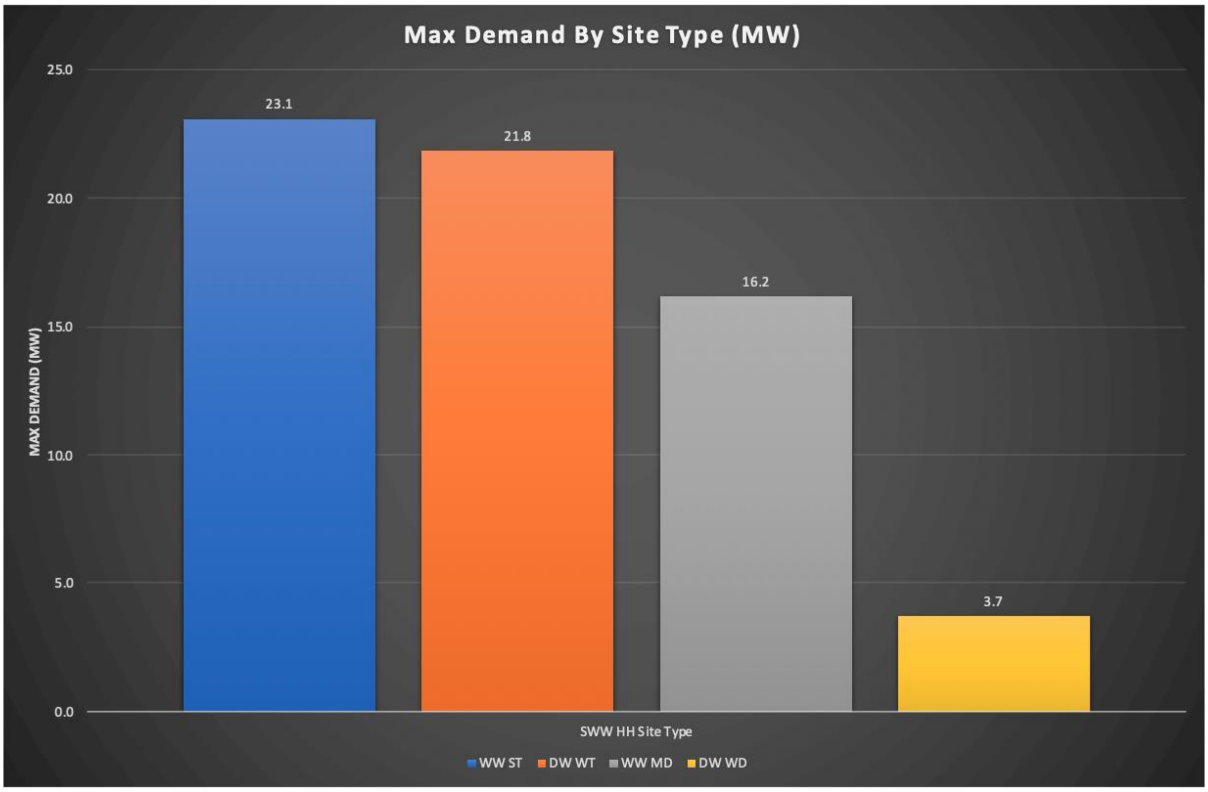

Figure 7-1Max Demand (MW) by Site Type

7.6 SWW SITES WITHIN CURRENT CMZS SUMMARY

The above grouping of SWW sites when overlayed with NGED CMZs provides the resulting maximum demand of SWW in CMZs as seen in figure 7-2 below.

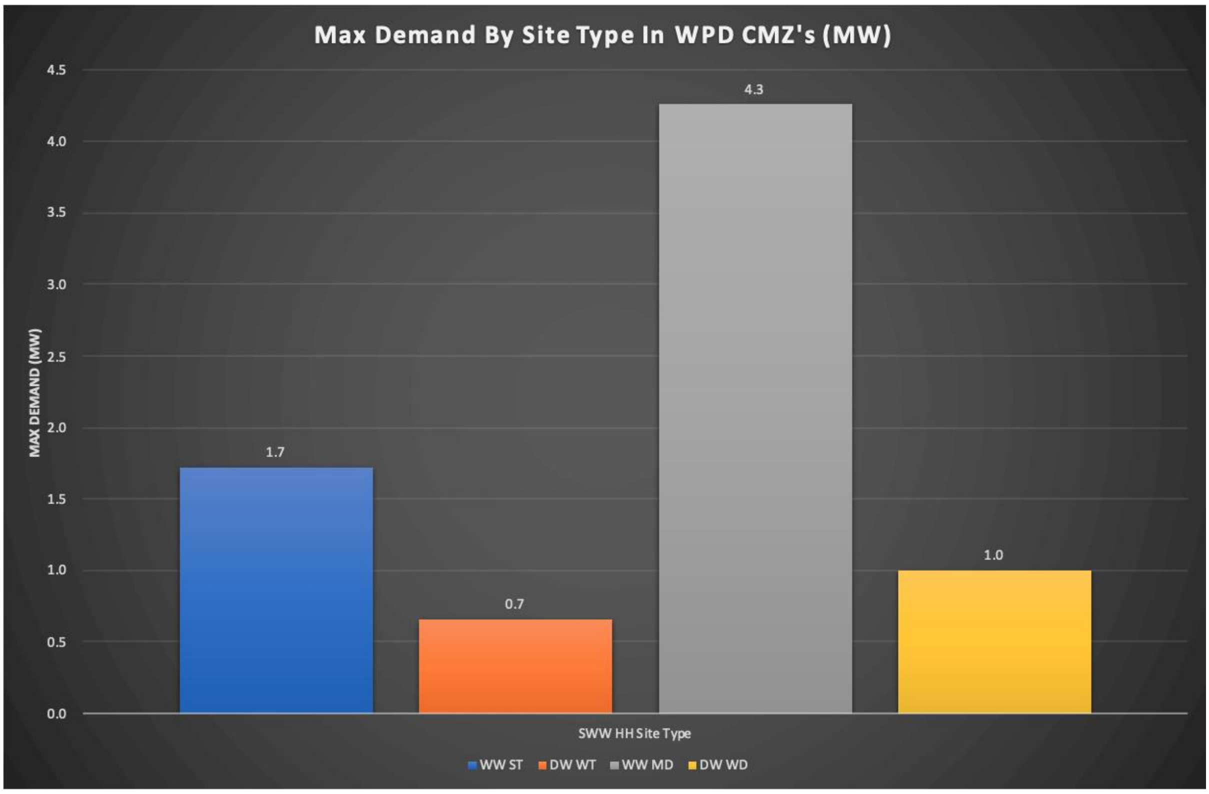

Figure 7-2 Max Demand (MW) by Site Type in NGED CMZs

The fore mentioned figure 7-2 is for the current (2022) Constrained Management Zones (CMZs) that have been identified by NGED. Sites that are not included within the current CMZs could become a constrained zone depending on future demand, generation increases or issues pertaining to lifecycle costs of distribution assets.

As can be seen in figure 7-3 when taking into account the SWW sites that are in CMZs the relative importance of wastewater mains distribution i.e. Pumping Stations increases.

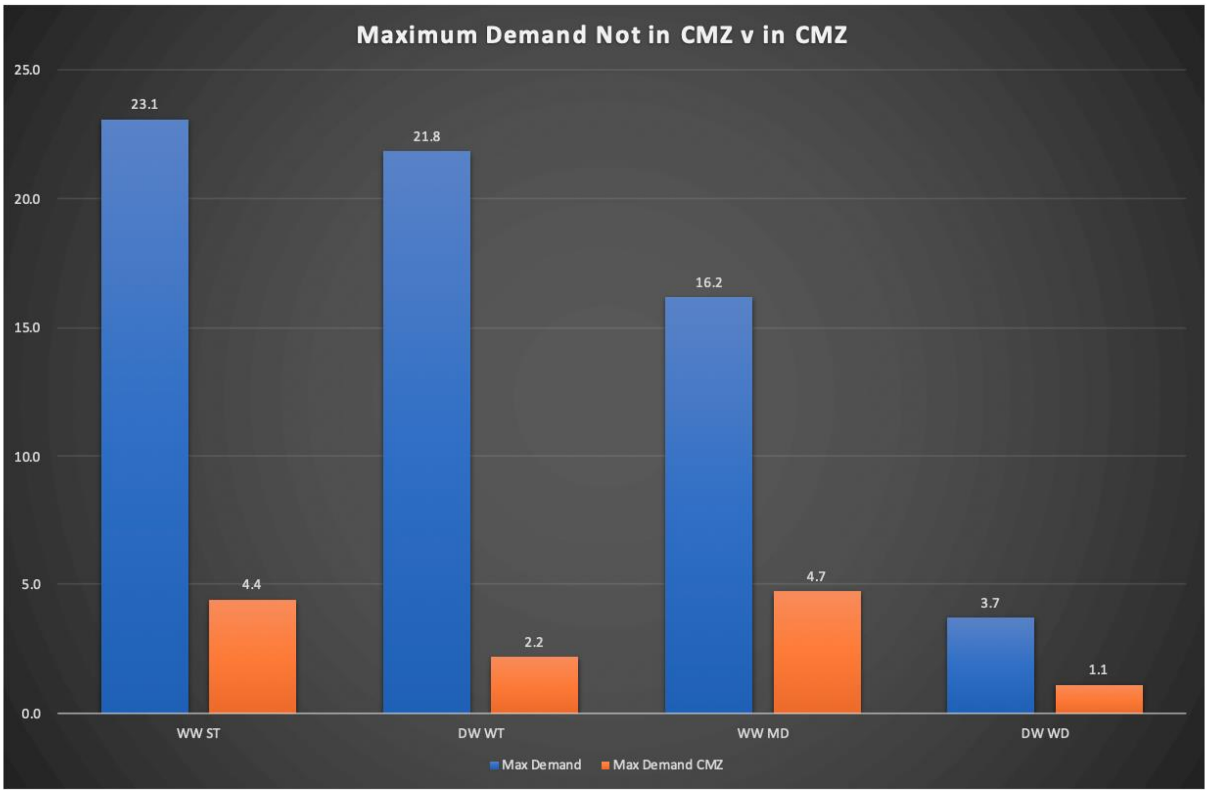

Figure 7-3 Maximum Demand Not CMZ vs In CMZ

7.7 External Impacts On Maximum Demand

The maximum demand of a SWW site at any point in time is influenced by various external factors. This section attempts to describe these with potential implications.

The impact of these external impacts on SWW sites' demand will need to be understood to assess the available capacity throughout the year.

7.8 Impact of Weather

The vast majority of UK sewage network has been designed as a combined sewage and rain water treatment system, this means that wastewater sewage treatment sites (WW ST) must cope with rainfall runoff.

Notably when a rainfall event occurs, especially when the storage tanks are 'on duty/called upon', energy consumption increases significantly. A positive correlation exists between rainfall events and energy demand.

Unfortunately, there is an element of randomness to the increase in energy demand caused by rainfall. In the data we have observed rainfall events of the same magnitude producing differing energy demand. This is assumed to be due to differences, caused by the time interval since previous rainfall, and saturation of the local topography.

Rainfall events also do not conform to a specific geographic area. Notably just because a rainfall event occurs in one location, known as the catchment area, the area that treats the influx of wastewater can be different. This can also be due to runoff associated with topography.

Very high-level analysis indicates that the impact on energy demand of rain events is in the region of an 18% increase from the steady state. Hence why using historic and forecast rainfall data is considered a significant factor that needs to be considered when determining SWW sites demand.

7.9 Impact of Location

The primary geographical influences are coastal vs non-coastal.

Coastal zones incur water ingress from the sea. This dramatically increases energy demand due to the need to pump sea water from the wastewater sewage mains and/or treatment works.

In urban areas, runoff is much higher as the built environment significantly reduces the ability for the soil to absorb the rainfall event. This again results in an increased amount of rainwater entering the wastewater network.

Topography also has an impact on SWW's energy consumption, for example the need to pump water over hilly terrains. High-level analysis indicates that the impact of this on energy demand sees rural sites having a 5% higher energy demand than urban sites. This will be refined further during the case study on the selected sites.

7.10 Impact of Population

The SWW region has a population that increases at certain times of the year, notably during the summer months.

In urban areas the impact of seasonal population change is slight, whereas in rural areas the seasonal change in population is more acute. It would be possible to analyse this in more detail once the case studies sites have been produced to understand the effect on available capacity.

It appears that the Exeter student population seasonally migrates prior to the arrival of the tourists, this assumption is currently based on limited data and will be explored further at a later stage of this project.

It is likely to be true that a difference exists in SWW energy demand when population changes in urban verses rural areas. This might require a separate subcategory once the impact on the maximum demand has been analysed.

Very high-level analysis indicates that the impact on energy demand when seasonal population grows is in the region of a 16% increase. This will be refined further during the case study on the selected sites.

7.11 Data That Is Missing

The largest area of data that would be majorly beneficial to the project is sub metered energy usage of the differing processes within each category of SWW site. This should be investigated as part of any future NIA funded trials.

8 Potential Outcomes

8.1 Southwest Water Energy Capacity Attainable - Summary

As discussed earlier in this document, section 7.3, each of the flexibility initiatives identified in LFA 1, was grouped, and matched to the type of SWW sites that they could be relevant to. By implementing this method we were able to estimate the potential flexible capacity for each initiative.

As discussed earlier it is unlikely that all the interventions could be implemented at the same time everywhere so taking a sliding scale of implementation from 1% to 50% Table 8-1 shows the amount of flexibility could potentially be realised for all SWW sites*1

Site Type	Current Max Demand (MW)	Initiative Activation Level Flex (MW)						Max Flex (MW)
		1%	5%	10%	25%	33%	50%	
DW WD	3.7	0.03	0.17	0.34	0.84	1.11	1.68	3.4
DW WT	21.8	0.07	0.33	0.65	1.64	2.16	3.27	6.5
WW MD	16.2	0.15	0.73	1.46	3.64	4.80	7.28	14.6
WW ST	23.0	0.09	0.45	0.90	2.25	2.97	4.50	9.0
Grand Total	**64.8**	**0.33**	**1.67**	**3.35**	**8.37**	**11.04**	**16.73**	**33.5**

Table 8-1 Potential MW Flexibility In All SWW HH Sites

*1 Note this is for the 468 SWW HH sites.

Table 8-2 details the same information as Table 8-1 but is further refined to show SWW sites that are in current CMZs.

Site Type	Current Max Demand (MW)	Initiative Activation Level Flex (MW)						Max Flex (MW)
		1%	5%	10%	25%	33%	50%	
DW WD	1.1	0.01	0.05	0.10	0.25	0.33	0.50	1.0
DW WT	2.2	0.01	0.03	0.07	0.16	0.22	0.33	0.7
WW MD	4.7	0.04	0.21	0.43	1.07	1.41	2.13	4.3
WW ST	4.4	0.02	0.09	0.17	0.43	0.57	0.86	1.7
Grand Total	**12.5**	**0.08**	**0.38**	**0.76**	**1.91**	**2.52**	**3.82**	**7.6**

Table 8-2 Potential MW Flexibility In CMZ Facing SWW HH Sites

The data in the above tables has been created by estimating what each group of initiatives could feasibly reduce the relevant sites maximum demand by when implemented. The next section will explain these groupings, the calculations, and assumptions.

As part of the case study sites identification all the above estimates need to be validated with the local area managers and site teams to confirm whether the initiatives can be implemented at each specific site and what the max demands are for each technology.

8.2 Initiatives Estimated Energy Avoidance Attainable - Detail

The opportunities identified during the workshops and control room surveillance have been classified into one of 5 initiative groups. The summary data tables seen in section 8.1 has considered four of the five initiative groups and has excluded the out-of-scope opportunities.

- **Low hanging fruit** – opportunities that are achievable, feasible and have clear benefits.
- **More challenging** – opportunities that require some further investigation. It may be concluded these are too limited or risky or are possible but require internal SWW investment (for which FLOWERS outcomes may support the business case).
- **Worthwhile with focus** – opportunities where focus needs constraining to identify the mutual electricity and water network benefits.
- **Energy management/efficiency** – opportunities that align with energy management rather than flexibility.
- **Out of scope** – opportunities which relate to other projects but could be of interest.

For each initiative, it was identified which categories of site (as described in section 7.3) the initiative could be implemented in. Furthermore, each initiative was assigned an energy demand reduction category. This was done to avoid duplication of energy demand reduction by unintentionally implementing an initiative on the same piece of equipment at the same time and overestimating the available demand reduction.

The three energy demand reduction categories used are;

1) Pump Energy Demand
2) Aeration Blowers Ramping
3) UV LED

The following sections identify which initiatives were allocated under which category and which type of sites they could be pertinent to. As you can see in the following sections most of the initiatives are related to shifting the usage times of pumps.

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8.2.1 Low Hanging Fruit

LOW HANGING FRUIT	DRINKING WATER			WASTE WATER			
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	ENERGY DEMAND REDUCTION CATEGORY	REACH
DWS & WWS - turndown/switch off of pumps	YES	YES	N/A	YES	YES	PUMPING	4
DWS & WWS - Review all set points are as needed for current demand and operating as expected	YES	YES	N/A	YES	YES	PUMPING	4
DWS & WWS - Produce pumping profile based on a model that creates a schedule for control room.	YES	YES	N/A	YES	YES	PUMPING	4
WWS - Increasing and reducing aeration blowers for biological treatment	N/A	N/A	N/A	N/A	YES	AERATION BLOWERS RAMPING	1
DWS - Drinking water reservoir pre-filling	YES	N/A	N/A	N/A	N/A	PUMPING	1
Onsite Hydro & CHP generation	N/A	N/A	YES	N/A	N/A	OTHER	1
WWS - Re-Profiling levels of storage	N/A	N/A	N/A	N/A	YES	PUMPING	1

8.2.2 More Challenging

MORE CHALLENGING	DRINKING WATER			WASTE WATER		
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	ENERGY DEMAND REDUCTION CATEGORY
DWS & WWS - Energy performance reporting, achievements sharing and Maintenance Management Information	YES	YES	YES	YES	YES	OTHER
WWS & DWS - Pump size increase and/or mismatch check verses volume requirements	YES	YES	N/A	YES	YES	PUMPING
WWS - Changing usage of infiltration pumping based on forecasting	N/A	N/A	YES	N/A	YES	PUMPING
WWS - Timing of UV treatment usage	N/A	N/A	N/A	N/A	YES	UV LED
WWS - Adjusting timing of grit removal paddle operation	N/A	N/A	N/A	N/A	YES	OTHER

8.2.3 Worthwhile with focus

6.4 WORTHWHILE WITH FOCUS	DRINKINNG WATER			WASTE WATER		
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	ENERGY DEMAND REDUCTION CATEGORY
DWS - Pump Variable Speed Drives	YES	YES	N/A	N/A	N/A	PUMPING
WWS - Sea water infiltration pumping.	N/A	N/A	N/A	N/A	YES	PUMPING
WWS - Storm Tanks usage to hold off treatment works	N/A	N/A	N/A	N/A	YES	PUMPING

8.2.4 Energy Management/Efficiency

ENERGY MANAGEMENT EFFICIENCY	DRINKING WATER			WASTE WATER		
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	ENERGY DEMAND REDUCTION CATEGORY
WWS & DWS - Power factor correction	YES	YES	N/A	YES	YES	OTHER
WWS & DWS Reducing energy usage with refurbished pumps	YES	YES	N/A	YES	YES	PUMPING
WWS - LED lighting for UV treatment	N/A	N/A	N/A	N/A	YES	UV LED
WWS - Ceramic filtration systems to reduce energy usage	N/A	N/A	N/A	N/A	YES	OTHER

8.3 Summary of Energy Demand Reduction Categories

The detail of the calculations for each initiative by site is included in a supplemental document “D3-1-Data”. The following is a summary of the assumptions and demand reduction by category.

The common assumption used across all the energy demand calculations is that each initiative would only be available for implementation 50% of the time.

8.3.1 Pumping

Nearly all SWW sites have some form of pumping, whether they are a treatment plant or purely a pumping station. The initiatives identified as pumping are shown in table 8-3. These have been combined into one demand number for ease of estimation.

LOW HANGING FRUIT	DRINKING WATER			WASTE WATER		ENERGY DEMAND REDUCTION CATEGORY
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	
DWS & WWS - turndown/switch off of pumps	YES	YES	N/A	YES	YES	PUMPING
DWS & WWS - Review all set points are as needed for current demand and operating as expected	YES	YES	N/A	YES	YES	PUMPING
DWS & WWS - Produce pumping profile based on a model that creates a schedule for control room.	YES	YES	N/A	YES	YES	PUMPING
DWS - Drinking water reservoir pre-filling	YES	N/A	N/A	N/A	N/A	PUMPING
WWS - Re-Profiling levels of storage	N/A	N/A	N/A	N/A	YES	PUMPING

MORE CHALLENGING	DRINKING WATER			WASTE WATER		ENERGY DEMAND REDUCTION CATEGORY
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	
WWS & DWS - Pump size increase and/or mismatch check verses volume requirements	YES	YES	N/A	YES	YES	PUMPING
WWS - Changing usage of infiltration pumping based on forecasting	N/A	N/A	YES	N/A	YES	PUMPING

WORTHWHILE WITH FOCUS	DRINKING WATER			WASTE WATER		ENERGY DEMAND REDUCTION CATEGORY
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	
DWS - Pump Variable Speed Drives	YES	YES	N/A	N/A	N/A	PUMPING
WWS - Sea water infiltration pumping.	N/A	N/A	N/A	N/A	YES	PUMPING
WWS - Storm Tanks usage to hold off treatment works	N/A	N/A	N/A	N/A	YES	PUMPING

ENERGY MANAGEMENT EFFICIENCY	DRINKING WATER			WASTE WATER		ENERGY DEMAND REDUCTION CATEGORY
Initiative	WATER TREATMENT (DW WT)	WATER DISTRIBUTION (DW WD)	POWER GENERATION (DW PG)	WASTE MAINS DISTRIBUTION (WW MD)	WASTE SEWAGE TREATMENT (WW ST)	
WWS & DWS Reducing energy usage with refurbished pumps	YES	YES	N/A	YES	YES	PUMPING

Table 8-3 Pumping Initiatives

As determined during the LFA 1 workshops and interviews, the assumption at treatment plants is 30% of the maximum demand is pumping and for pumping stations 90% of the sites maximum demand is pumping.

By implementing the initiatives, i.e. holding pumping off, the assumptions generate a potential maximum demand shift of **31.4MW** from a total max demand of 65.4MW.

As discussed earlier it is unlikely that all the sites with pumping implement holding off pumping at the same time. So taking a sliding scale of implementation from 1% to 50% Table 8-4 shows the amount of flexibility that could potentially be realised for all SWW sites identified as having pumping.

Implementation level	1%	5%	10%	25%	33%	50%	Maximum
Pumping Flexibility (MW)	0.31	1.57	3.14	7.85	10.47	15.7	31.4

Table 8-4 Pumping Level of Flexibility MW by Implementation %

Looking at the same intervention in SWW sites that are facing current CMZ the potential maximum demand shift changes to **7.2MW** from a total max demand of 12.5MW.

Taking the same sliding scale of implementation from 1% to 50% Table 8-5 shows the amount of flexibility that could potentially be realised for SWW sites identified as having pumping facing CMZ.

Implementation level	1%	5%	10%	25%	33%	50%	Maximum
Pumping Flexibility (MW)	0.1	0.4	0.7	1.8	2.4	3.6	7.2

Table 8-5 Pumping Level of Flexibility MW in CMZ Facing Sites by Implementation %

8.3.2 Aeration Blowers Ramping

This initiative can only be implemented at wastewater sewage treatment plants. The assumptions used for demand reduction is that aeration accounts for 30% of the wastewater treatment works maximum demand and that this initiative would reduce demand by 20%.

These assumptions generate a potential maximum demand shift of **1.38MW**.

8.3.3 UV LED

This initiative again can only be implemented at wastewater sewage treatment plants. The assumptions used for demand reduction is that UV treatment accounts for 30% of the wastewater treatment works maximum demand and that this initiative would reduce demand by 10%.

These assumptions generate a potential maximum demand shift of **0.69MW**.

8.3.4 Other

Due to the nature of these initiatives, it has not been possible to estimate a baseline demand or any potential demand savings for this category of initiatives.

The timings of use of the SWW Hydro generation assets needs to be investigated further along with the usage of any onsite generation equipment, i.e. Combined heat and power (CHP) or Generators.

The impact of implementing any behavioural change programmes via improved energy reporting would need to be trialled as it could have a halo impact on all energy usage.

The flexing of grit paddle operation requires a baseline of energy usage to be understood from sub meter data which doesn't currently exist. This again needs further onsite investigation.

Power factor correction requires an understanding of the current power factor by site. This isn't held within the datasets provided so will need further investigation.

The ceramic filtration systems implementation is a wholesale change to the way a filtration operation works. This initiative looks at first review to be cost prohibitive as a retrofit, but this needs to be confirmed.

8.4 What If This Was Rolled Out Across All Water Utilities

As seen in section 8.1 above we have identified a sliding scale of implementation of flexibility ranging from 1% up to the theoretical maximum of 48% of the water utilities connected load. Therefore, the benefits for the wider water industry could be vast and are estimated using the assumptions as below.

1) SWW services a population of circa 1.4 million people and use circa 303 GWh (303,580,894 kWh) annually. This means per capita SWW uses 223 kWh per annum.
2) Taking the UK population of 67.22 million, assuming all UK water utilities use the same amount of electricity per capita as SWW, suggests that all UK water utilities use circa 14,994 GWh (14,994,127,537 kWh) per annum.
3) Applying the same ratio of the potential load that could be shifted verses kWh usage, as theorised earlier in this report, we can estimate a sliding scale of available energy flexibility from all UK Water Utilities as seen in table 8.6 below

Table 8-6 - Potential Flexibility All Water Utilities

Implementation level	1%	5%	10%	25%	33%	50%	Max
UK Utilities Potential Flexibility (MW)	16	78	156	390	515	780	1,560

9 NEXT STEPS – DESK TOP CASE STUDY

9.1 SWW

- Confirm the site-specific pumping capacities with SWW Area Managers
- Identify what the max demand is for pumps, aeration, and UV at each site and what ½ hourly period this occurs.
- Identify the impact of seasonality and population change on the energy demand for the identified initiatives.

9.2 NGED DATA

- Estimate the value of the potential flexibility to NGED in saved flexibility procurement costs.
- Assess if there would be any improved network assets lifecycle costs benefit analysis due to the SWW demand reduction.
- Undertake a review of local ANM sites to SWW sites that can flex demand to assess if the ANM can be curtailed or removed.