PROJECT ZERO
Affinity Water

## WATER NEUTRALITY AT NAV SITES

### SITE 2 REPORT

# Creating a water-neutral development using behaviour change and off-setting

## FINAL REPORT

May 2024

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# EXECUTIVE SUMMARY

Bidwell Water Savers was a trial to test the impact of a behaviour change campaign only (no technological interventions) on water use in the Bidwell West, 908-home new development in Houghton Regis, Bedfordshire.

A multi-channel marketing campaign asked residents to take one water-saving pledge that they felt they could manage. 382 residents (42%) took a pledge, and 55% of those showed an average of 32.9 litres a day savings vs. expected use post-campaign.

The campaign also impacted people who hadn't done the digital journey to officially take a pledge, with 44% of non-pledged homes seeing an average saving of 22.8 litres a day.

96% of residents surveyed had heard of Bidwell Water Savers (BWS), with 3 out of 4 residents surveyed stated the campaign changed their behaviour.

73% of respondents remember hearing about the campaign via email, 39% remember seeing the campaign on social media and 28% recall receiving a letter or leaflet from BWS. However, the activities which drove the largest number of pledge sign-ups were in-person events.

The launch event drove 15% of households to sign up in 4 hours. More than 50% of the pledge sign-ups came from the door knocking activity, which saw 840/908 doors knocked, 335 answered and drove over 200 pledges. Those customers were also offered Wizso tablets, which can be used to save-a-flush. The results from the 'Predictive Model' show the combination of the doorstep conversation, pledge and Wizso tablets saw an average of 51.1 litres a day saving vs. average 24.9 litres a day across all residents (not just savers).

Post campaign, Bidwell West residents were using 105 litres per person, per day. To reach water neutrality, off-setting was done to account for this volume. The off-setting took place in local non-household (NHH) properties, and delivered a total saving of 246,836 litres (1.49 litres per £1 spent).

As of March 2024 **we have created the world's first water-positive NAV site**, with the water reductions from the behaviour change campaign (delivered by Grapeviners Ltd) and the off-setting savings (delivered by H2OiQ) cancelling out the total water use of the site.

The future savings from this site will be monitored by smart meters (due to be installed Spring 2024) to better understand the degradation in savings once campaigning stops. The results will be reported in due course.

This campaign allows open data. To obtain any non-personally identifiable data please contact dx@affinitywater.co.uk.

# SITE 2: BEHAVIOUR CHANGE + OFF-SETTING

The objective of 'site 2' is to test whether through a combination of water-saving behaviour change with residents and offsetting in local non-household properties we can achieve 'water neutrality' for a large-scale housing development.

Behaviour change was delivered through a communications campaign, run by Grapeviners, the team behind Affinity Water's award-winning SOS: Save Our Streams campaign.

The offsetting was delivered by H20iQ. Experts in reducing water consumption, they survey properties, identify water inefficiencies, and install innovative water-saving equipment.

## The Site: Bidwell West

The 'Site 2' experiment took place on a NAV (new appointees and variations) site run by IWNL known as 'Bidwell West' in Houghton Regis, Bedfordshire (Affinity Water region). Bidwell West consists of six separate housing developments by different housebuilders.

The first residents on Bidwell West moved in around two and a half years before the trial. At the start of the trial 908 properties were occupied, but more houses and facilities continued to be built throughout and beyond. As such, we've modelled all figures we report based on the 908 properties who were consistently there throughout, however all residents were exposed to the campaign, even those who arrived midway through.

We had the opportunity to measure the impact with very clear data, due to IWNL's virtually leak free network.

Note: For the purposes of measurement and due to project design, we did a time-bound April to August 2023 campaign, however in future this is likely to be rolled out as an ongoing programme. Behavioural science shows a benefit to engaging people as they move house, we'd recommend for anyone rolling this out in future to maximise this by engaging at the time of purchase. Liaison on with developers early will be helpful.

# BEHAVIOUR CHANGE CAMPAIGN

## Objective

To test how much water, we could encourage residents to save during a five-month campaign period (1 April to 31 August 2023) through a behaviour change campaign.

1. What per household saving can we achieve by 31 August?
2. What savings can we sustain a year post-campaign?
3. Can we alter behaviour of the whole household, not just the bill payer?
4. Can we understand the impact of the behaviour change campaign on consumption?

We chose to focus on per household consumption (PHC) rather than per capita consumption (PCC) as we don't have accurate occupancy data for all properties, although we do have that for customers who signed up for the campaign through official channels.

## Desired outcomes

Residents in Bidwell...

- think about their water use more.
- have a more accurate view on what behaviours/water sources use the most water.
- think of excess water use as a bad thing (i.e. don't take water for granted).

This all results in them using less water in their homes and engaging in water-saving behaviours.

We end the campaign with fully engaged residents in water usage, having provided them with lifelong habits and advice that support them in using water wisely.

## How we measured success

Key measures of success are:

- How many **litres were saved** by **engaged households** daily through the campaign period (April-August 2023) + one year post campaign (Sept 2024)
- How many **litres were saved** by **all households** daily through the campaign period (April-August 2023) + one year post campaign (Sept 2024)
- Percentage of **engaged households.**

We'll cover the methodology in more depth later.

# How we approached the problem

## Phase 1: Research and Ideation

The brief we set ourselves was to create a campaign which sticks in the minds of Bidwell residents, and reminds them at the point of over-use, to conserve water.

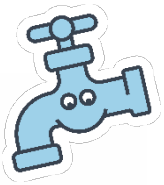
The campaign must be scalable, and assets need to be re-usable for a future toolkit for a water company of any size. This campaign should be a template for future campaigns.

The campaign must be measurable, to determine which elements were successful and the overall impact on behaviour change.

## Starter concept: Lead with Water Neutrality concept

We considered and explored many options before landing on the final idea. Water neutrality is not a concept many people are familiar with, even within the water industry. It is also quite complex to explain, so initially we explored territories which led with the concept of creating a water neutral housing development.

The first concept we chose was 'The Water Bank', to explain the concept of saving within the banking analogy. Here is a snapshot of the messaging and campaign construct:



### The Idea: 'The Water Bank'

Welcome to a different kind of bank.

We exist because we don't have enough water saved up, for our area to thrive.

This might surprise you, but we're not as water wealthy as you might expect.

So, The Water Bank exists to help build up reserves.

The more savings we all make as a community, the better off we'll all be.

So, we're going to encourage you, as a community, to make savings daily.

### What we're asking people to do

It couldn't be easier to make savings at The Water Bank.

It involves zero effort and the humble tap.

You all have one.

All YOU have to do to help is **turn off your taps sooner**. It's as easy as that.

And the more you do it, the more savings we make, and therefore the better off we all become.

### Media channel choices available

| | Paid | Owned / Earned |
|---|---|---|
| **Postcode specific (our 808 homes only)** | TV (ITV Hub - 30 sec)<br>Facebook ads (15 sec)<br>Twitter ads (15 sec)<br>YouTube bumper ads (6 sec)<br>Instagram ads (15 sec)<br>Digi-vans<br>Door drop - launch pack and follow-up postcard/s<br>Digital audio ads (digital radio, podcast, Spotify) | Facebook group / page posts<br>Experiential event/installation<br>Email<br>Website |
| **Houghton Regis area** | Tiktok ads (30 sec) | Local Facebook Groups e.g. What's on in Houghton Regis |
| **Luton and Dunstable region** | Luton and Dunstable Gazette advertorial and press wrap (4-page ad around front cover) | PR coverage |

**Hi Jane**

**Welcome to The Water Bank.**
**We're not a money bank, but a water bank.**
**And we're here to help you to save water.**

Why? Well, **England's not as lush, green and drizzly as you might think.**
In our corner of the country there's less rainfall each year than parts of East Africa.
We're simply not as water wealthy as you might think.

**You won't believe how easy it is to save: simply turn your taps off, sooner.**
When brushing your teeth or washing your hands, washing the dishes or filling **the kettle, try not to leave the tap running longer than it needs to.**
It sounds simple, but it really does make a difference.

In the UK, we're lucky to have quality water on tap, 24 hours a day.
So it's easy to forget just how valuable this precious resource is.
**Join The Water Bank today**, and you'll help your community's water wealth now and for generations to come.

**Let's start saving together.**
Sign up today at www.TheWaterBank.com/join or call 0800 000 000.

Happy saving

The Water Bank team

However, as a communications message it became a too convoluted 'why' to explain before getting to the 'how' of what we need people to do. As such, we set aside this idea in favour of one which led on the action we need people to take.

## Evolved concept: Lead with action

We turned to the behaviour change insight that having one singular ask of people is far more likely to result in action. At this point we reviewed all the behaviour change actions we could choose from.

We did an analysis of each water saving action using the COM-B model:

**Capability:**

- percentage of people who could take up action (e.g. do they have a dishwasher to be able to switch to / use the eco button on)

**Opportunity**:

- percentage of estimated people who don't already do it
- savings potential per action
- savings potential per week
- how often the action is taken per person, per week

**Motivation:**

- level of friction/feasibility per action

Note: we used confidential research conducted by Affinity Water to make this assessment.

Figure 1: Assessment of impact and feasibility of various water-saving actions

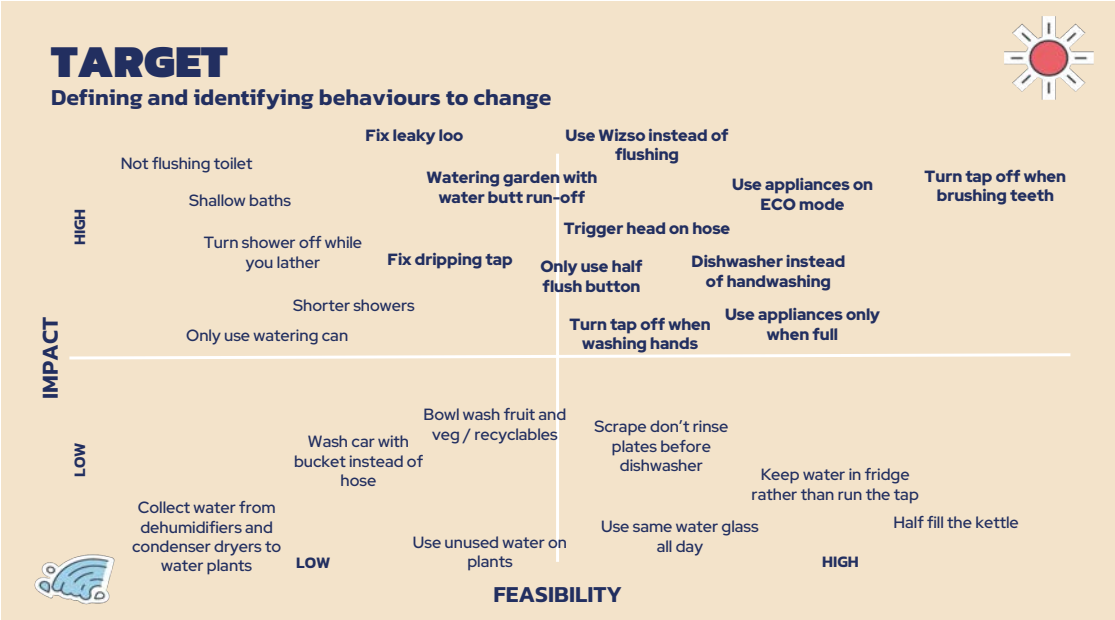


Figure 2: Refinement model – showing of the highest impact/most feasible actions, which has the greatest potential for savings.

*pre-SOS campaign survey 2021
**estimation

# REFINEMENT MODELLING

**Of high impact and feasibility options – which have greatest saving potential?**

| Action | Saving per action (litres) | Number of actions per person, per week | Saving per person, per week | % of customers estimated to not already do this action* | Saving per week of those eligible | % of those who might take it up** | Saving per week of potential changers (litres) | Number of people taking it up | Comparison saving total per week |
|---|---|---|---|---|---|---|---|---|---|
| Use Wizso instead of flushing | 6 | 35 | 210 | 10 | 210 | 30 | 63.00 | 720 | **45360.00** |
| Only use half flush button | 6 | 70 | 420 | 33 | 138.6 | 50 | 69.30 | 396 | **27442.80** |
| Turn tap off when brushing teeth | 10 | 14 | 140 | 27 | 37.8 | 80 | 30.24 | 518 | **15676.42** |
| Use appliances on ECO mode | 35 | 2 | 70 | 60 | 42 | 50 | 21.00 | 720 | **15120.00** |
| Turn tap off when washing hands | 2 | 70 | 140 | 33 | 46.2 | 33 | 15.25 | 261 | 3984.69 |
| Dishwasher instead of handwashing | 40 | 7 | 280 | 5 | 14 | 70 | 9.80 | 84 | 823.20 |
| Use washing machine only when full | 20 | 2 | 40 | 19 | 7.6 | 40 | 3.04 | 182 | 554.50 |
| **Seasonal, niche and one-off fixes** | | | | | | | | | |
| Watering garden with water butt | 60 litres | 0.5 | 30 | 60 | 18 | 10 | 1.80 | 144 | 259.20 |
| Trigger head on hose | 60 litres | 0.5 | 30 | 49 | 14.7 | 50 | 7.35 | 588 | 4321.80 |
| Fix leaky loo | 400 litres | 0.01 | 4 | 23 | 0.92 | 90 | 0.83 | 497 | 411.35 |
| Fix dripping tap | 20 litres | 0.01 | 0.2 | 27 | 0.054 | 90 | 0.05 | 583 | 28.34 |

## Evidence Review

We then worked with Kantar Public to undertake a rapid evidence review. We reviewed behavioural interventions designed to reduce water or energy use in households. It identified 30 different intervention types, which were grouped into 11 categories and ordered by strength of evidence.

Figure 3: Pertinent findings from the rapid evidence review.

**Pertinent findings:**

**High potential for savings**

Sharing usage data with customers
(17% reduction in one study where information via smart meters)

Anthropomorphising water
(21% reduction in one case study)

Pro-social messages
(51 l/p/d reduction in one study)

One call to action has best impact
(evidenced in other sectors repeatedly)

**Some potential for savings**

Information and awareness
(4.14 l/h/d reduction)

Social comparisons
(1.3% to 5.1% reduction)

Normative comparisons
(38 l/p/d – roughly 5% reduction)

Incentives
(4.14 litres per day saving in Thames scheme)

**Ineffective**

Gamification
No robust evidence to support

Goal setting and planning
Only worked in conjunction with other motivational interventions

From the totality of the analyses we'd done, it became compelling to have a multi-pronged approach. A combination of highly tailored and targeted comms to particularly high use

groups, combined with an overarching comms campaign which focussed on one clear call to action.

Figure 4: Proposed strategy following rapid evidence review and initial analysis.


Our idea for the 'one simple switch' was 'Choose Eco' encouraging residents to choose the eco-mode on washing machines and dishwashers. This is a relatively low friction switch with large savings and a simple message.

It had an unambiguous call-to-action, applied to all residents, and allowed for more complex messaging as secondary copy.

We researched the white-goods models which each development included as standard, then using Energy Saving Trust and Waterwise data we calculated a potential saving of ~10 litres per person, per day.

Affinity Water's Demand Management team was concurrently running a large scale qualitative and quantative study with Kantar exploring in detail the propensity to change behaviours and the benefits of each water-saving action. We decided to wait until this came out to inform which action, we should ask customers to change, or to validate the 'Choose Eco' route.

## What the research told us

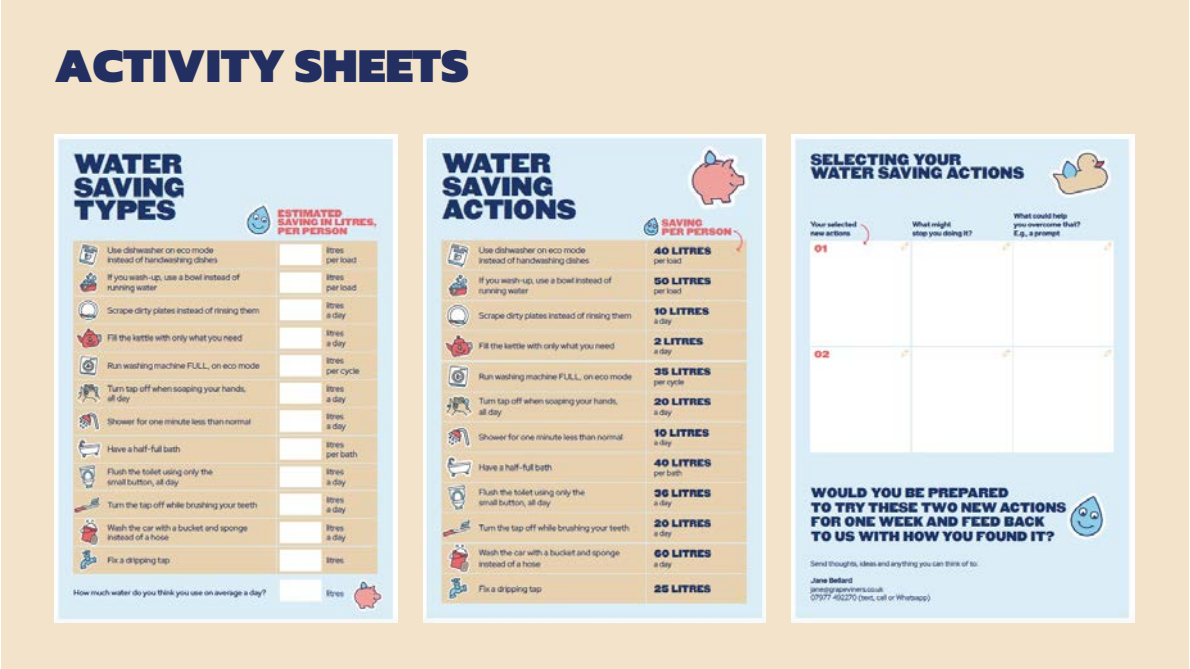
The research belonging to Affinity Water, told us that there was no single action which was suitably universal as to allow all customers to engage with the campaign. It was felt that we

should talk to the residents of Bidwell West and work out how we make this personal enough to them, whilst broad enough to be a blueprint. We also wanted to understand their thoughts on the best actions to take.

We did further ideation on how we could roll out something more universal and took several pieces of stimulus into research. We met 11 residents (6 men, 5 women) on 16 January 2023 in a rugby clubhouse very near the development for two hours. Each attendee was rewarded with a £100 voucher for the retailer partner of their choosing. We picked 4 people with above average PCC (160-177), 3 people with average PCC (130-147) and 4 with below average PCC (56-94).

Our group had 3 people living with just a partner, 7 with children at home and 1 living with her son and 2 grandchildren.

Figure 5: Activity sheets used at the focus group with Bidwell West residents.




We asked residents to guess how much water each action saved on the first sheet shown above. We then spoke about why they moved to Bidwell West, what attracted them, how do they find living there as an icebreaker.

Then we broke into two groups, and discussed usage and attitudes to water, and what would motivate them to save water. We then revealed the correct savings from the activity sheet and discussed their responses. We also told them their own PCC and discussed their reactions.

We then did an exercise where they picked two actions, they thought they could do on an ongoing basis, and what would potentially be a barrier to that, then how they could overcome that barrier. We shared ideas as a group, then discussed and built on the ideas.

Finally, we explained the nature of the Water Neutrality Blueprint and what they were due to be part of. We showed a few creative routes to gather feedback and discussed which of the water-saving actions they think we should focus on.

## The outcome was very clear. They wanted...

- it to feel very **local** and relevant to them.
- to **select their own** water-saving action, not have one dictated.
- to be educated, they like the activity sheet showing them all the savings stats.
- to **understand how much they were using** to add context.
- it to be **community-led** and **personalised.**

## Interesting findings from focus group with residents:

### Response to usage data

- Everyone was shocked at how much they used except one – our lowest user (56 PCC), they all thought they were using much lower than reality.
- They were unanimously surprised how much could be saved by each small action.
- Many were shocked to hear the South-East has lower rainfall than Melbourne and East Sudan, especially among ethnic minority participants.

### Motivations

- Their main motivations to save water were dislike of waste and to save money (unanimously).
- They were only motivated by the environmental impact when we explained the link between water use and the health of local waterways. Then it became the most important factor for half of the group.
- The idea of damaging local waterways (which some couldn't name or reference) really upset them.
- They all wanted to know 'how will it affect me' if we use too much water.
- They were happy to take a 'scary' message if it's followed by easy ways they can help, but it must be relevant to them locally.
- They were glad to be given the full truth about water scarcity in the short, medium, and long term, so they could see why water saving is important.
- They did not take any responsibility for the water stress put on networks from growth in new housing, they saw that as totally the government to blame for deciding to build the new houses, rather than being on them for buying one.

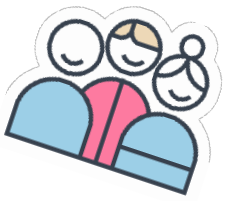
### Communication choices

- Open to all forms of communication.
- Overwhelming desire for face-to-face events for the community.
- Happy to be texted with prompts every 2-3 weeks.
- Happy to have ads targeted at them.

- Appetite was strong for ‘grass roots’ approach.
- All happy to help spread the word and remain advocates of the process.
- Liked the idea of having a person to contact via WhatsApp.

## Post-research objectives we set ourselves:

1. Build a community legacy.
2. Give tailored support.
3. Create a path to future change.
4. Be meaningfully educational.
5. Keep them accountable for their pledge.



# THE FINAL PLAN

Figure 6: Final strategy post-research


Figure 7: How we engaged with residents about water-saving

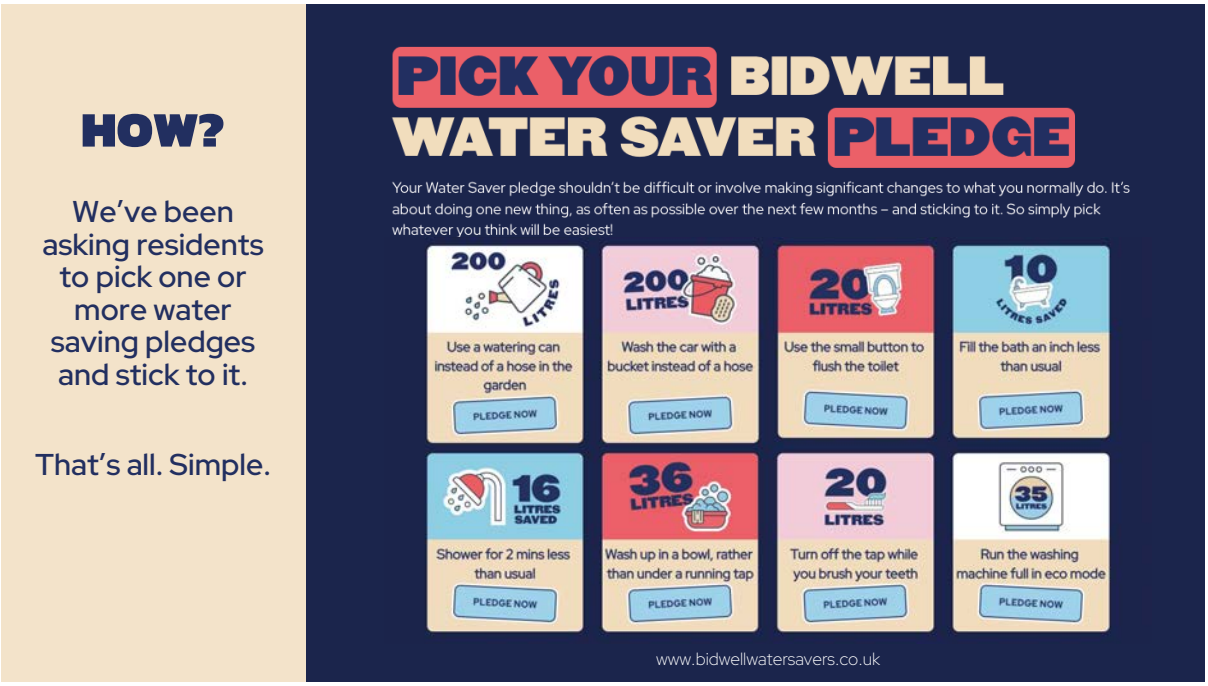


Figure 8: Campaign plan overview.

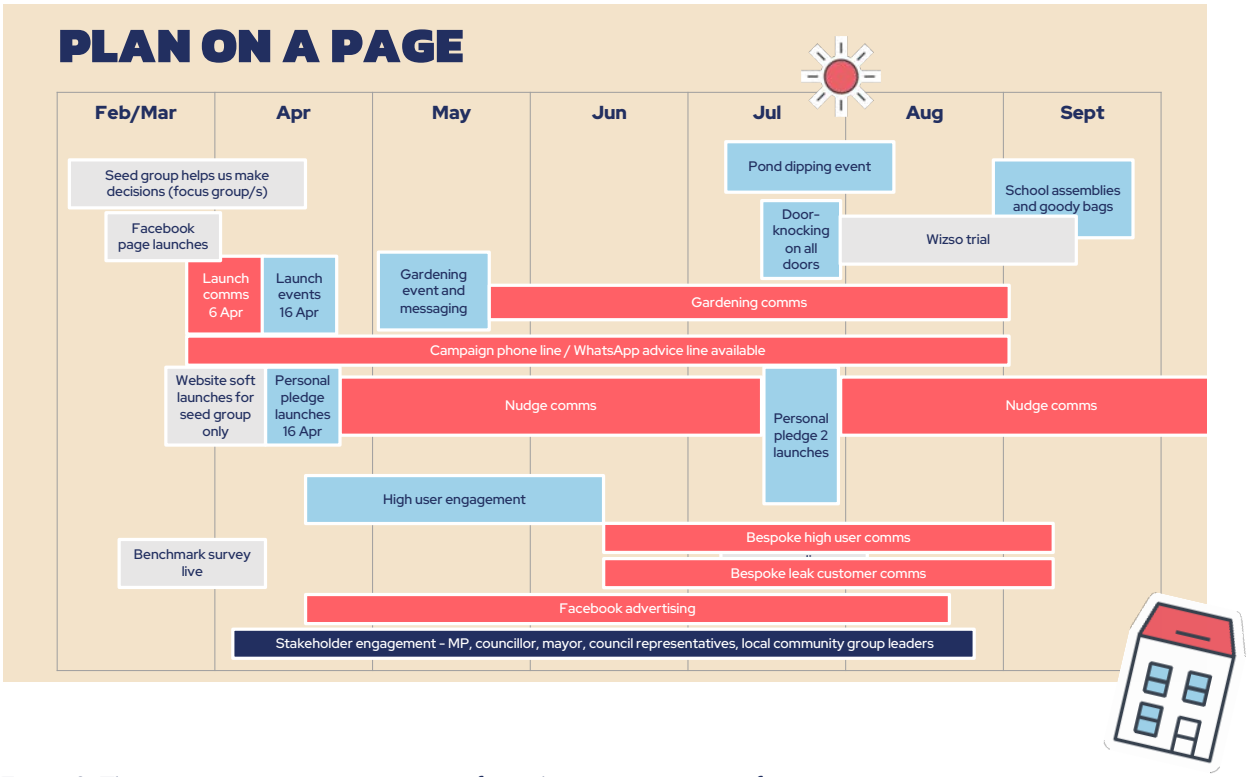
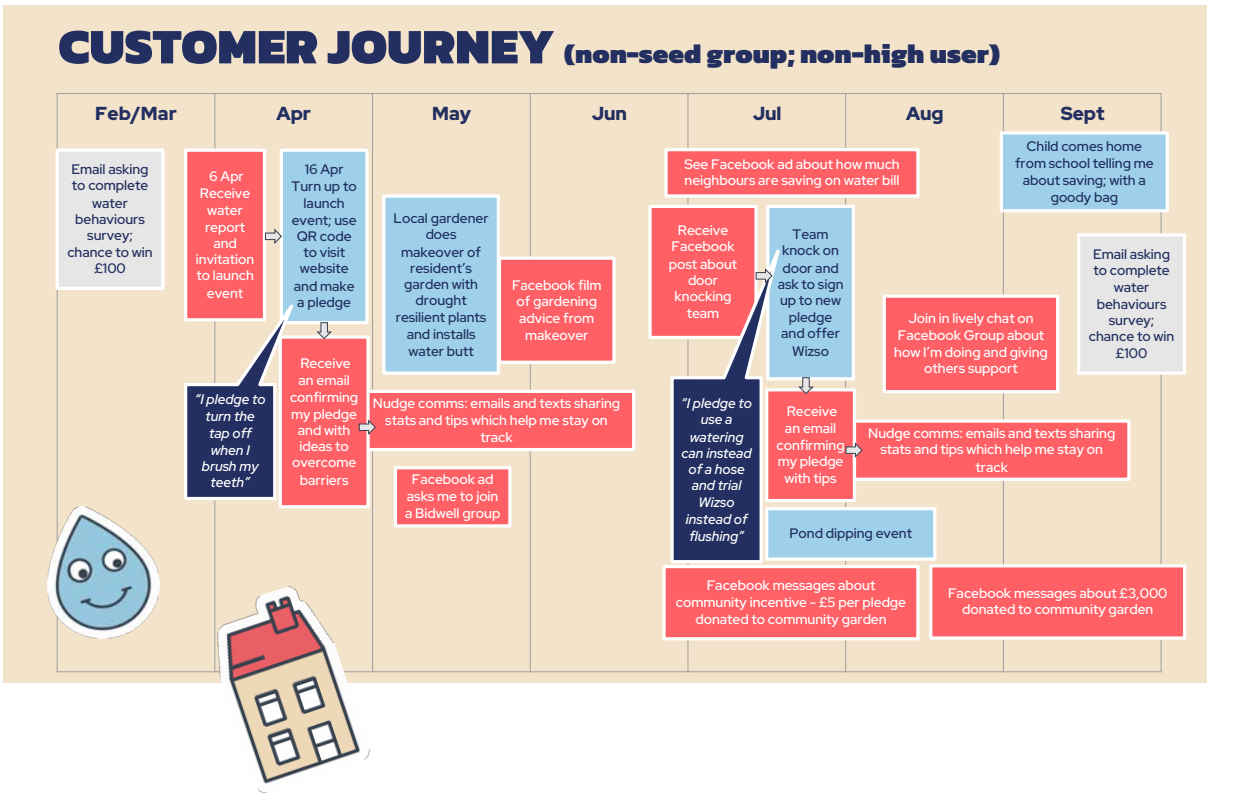



Figure 9: The communications opportunities from the customer point of view.



## Things we wanted to do but data and digital capabilities weren't in place to facilitate:

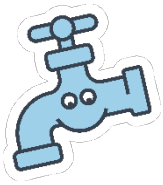
- Targeted comms to high summer users (data set didn't stretch back far enough for many customers, an inevitable issue with new developments).
- League tables of usage per development/street.
- Monthly emailed newsletters about the campaign and savings.
- Leak detection content – couldn't get customers with leaks to engage.
- Analysis of usage patterns per property, to help make tailored water-saving recommendations.
- Giveaway physical devices for the home.

## Ways to overcome this for site 3:

We will have smart metered data, so that alone will fix many of these issues, assuming we have software which can help us to analyse the data and turn it into customer communications.

The water provider for the site would need to have an eCRM system capable of sending HTML emails and the permission from their customers to contact them for water-saving campaigns.

We'd have engaged leak and high users sooner, but the data collection and configuration were extremely manual and time-consuming for IWNL. Smart meters will help with this.



# ACTIVATION – THE CAMPAIGN

## Website and email nudges

To track intent to save water and provide a hub for all communications, we built a campaign specific website – www.BidwellWaterSavers.co.uk. Ordinarily this may be built into the water company's own website, and branded accordingly, however there is a simplicity to a campaign microsite which allows for a clean, quick journey which we chose for this trial.

We soft-launched our website to our focus group applicants, which helped us iron out final bugs. It was met with a positive reception in the soft launch and full launch at the event.

The customer journey is to pick a pledge immediately, then fill in your details. Completion of the form triggered a series of emails containing nudges, statistics, and ways of contextualising the savings to motivate them to continue and share with other members of the household.

Figure 10: www.Bidwellwatersavers.co.uk web pages.

Figure 11: Emails send as part of pledging customer journey (blue outline), plus email reminder to non-pledgers


## Website and email nudges learnings:

- We recommend for future iterations making it possible to opt-in to several pledges without having to sign up again. Many customers told us during the door-knocking that they were happy to take more than one pledge but didn't want to do more admin.
- The complexity of having more than one pledge comes in the nudge emails, so more investment would be needed to facilitate multi-pledge nudge emails. It is possible, just complex, and budget needs to be attributed accordingly.
- The ideal scenario is for the campaign to be continued over 3-5 years; this has been evidenced by SOS: Save Our Streams. However, this was a trial which is not being continued by the NAV partner due to lack of incentive in the current market. When policy makers are considering incentivising water companies and NAVs to create water neutral developments, there should be a focus on longevity rather than a short (under 2 years) campaign.
- If in future the email newsletter was also not an available option, we recommend plugging the gap with extra emails in our series.

# Launch Mailer with Water Usage Report

To introduce the campaign, the concept of water-neutrality and invite people to our launch event, we sent an introductory letter or email (according to expressed preference) including details of their water use. We contextualised their water used by equating it to bathtubs. We received a lot of feedback at the launch event that this had been powerful, even people with low PCC were shocked.

Figure 12: Letter sent to all residents as the first piece of campaign communication – 'launch mailer'.


## Launch mailer learnings:

- Ensure HTML email system in place to make email as compelling as letters
- Starting with a more detailed explanation and how it is relevant to them as an individual definitely warned people up ahead of the launch, contributing to such high launch sign up (15%)

# Launch Event

We wanted to create a personal connection and therefore accountability among the community, as well as garner sign ups and intent through our launch event. We teamed up with the Bidwell West Community Association who were already planning an Easter Egg Hunt event. We joined forces and presented a united front to the event. We held it in the main square next to the newly opened Esquires coffee shop.

We worked closely with the owners of Esquires and the Community Association throughout, which strengthened the community liaison aspect of the campaign. We offered a free ice-cream or muffin (including dietary requirement options) to everyone who took a pledge. Their confirmation email was the mechanic to claim.

## Launch event learnings:

- Joining an existing event removed the need to spend time and budget trying to drive footfall to the event.
- Because the traffic to the event was driven by an Easter Egg Hunt, all attendees came to collect a map where we were able to suggest they take a pledge and get their free muffin or ice cream when they returned. This worked well, as people were prepared for it and congregated to talk after the hunt.
- Many people cited having read the launch mailer and could tell us how many bathtubs they were using.
- The incentive helped to break the ice as a conversation starter, and really delighted residents.
- Having the event on-site and next to the coffee shop created a real sense of community spirit in an emerging development.

Figure 13: Photos of launch event

# Social Media

Social media was an important channel for us, particularly because the Bidwell West Community Association (BWCA) had a Facebook Group and Page with a large percentage of the development's residents already on it.

Initially we'd planned to drive people to a group specifically for the campaign, and although we set one up, it became a better use of resources and budget to post content on the BWCA page and group instead. We used £6,893.58 in total over five months to boost content/ads to people with Bidwell West postcodes. Many customers reported having heard of the campaign through social media when we did the door-knocking activity in July.

We used the content we collected on launch day where residents shared their pledge and their own water saving ideas on video at launch. We also shared videos of our 'Water Saving Expert, Jane Bellard, talking about what the project, is trying to achieve. All footage was taken on site, so it was clearly relevant to the audience.

Figure 14: Examples of social media posts from the campaign.


Having a social media content creator, Keziah Turner, on the Grapeviners team gave us regular, engaging content. We used a photographer/videographer who lived in Bidwell West, which meant he not only knew the site, but also acted as an ambassador for the project on the ground. It became a passion project for him as well as creating strong content. It also added to the sense of community we were establishing.

Figure 15: Screenshots from social media videos of residents sharing their water-saving tips at the launch event.


When we had new ideas for activity, or needed the community's participation, we were able to use the PWCA Facebook Group to ask questions or garner interest. Good examples of this were when we asked who would be interested in a water-butt bulk discount (over 100 responses saying yes), asked for volunteers to have a drought-resilient garden planted or when looking for survey respondents to help us measure the campaign's impact.

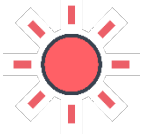
## Social media learnings:

- Featuring residents in the content led to higher engagement.
- Using a local photographer/videographer helped get inside knowledge and spread word-of-mouth throughout the whole project
- Having a launch event really helped to get lots of content, particularly with residents
- Having the Bidwell West Community Association social groups/pages already set up allowed us to communicate for free and regularly. We built a strong relationship with this team, started by speaking at their AGM, and it played a large part in the success of both the events and communications. If you are setting up a campaign where this does not exist, we would strongly recommend starting one as part of the community element of the campaign, also providing a legacy.

# Gardening

A commonality for all new build houses (and ground floor flats) is a new, often just grassed over garden. The soil quality is not usually established and as we found when talking to residents – for many this was their first garden.

We also know that planting drought resilient, native plants can avoid future watering. So, encouraging and showing how to do that felt like an important investment for future water use. Although its savings are not reflected in the project's lifespan, we want to create long term changes to attitudes and behaviours.

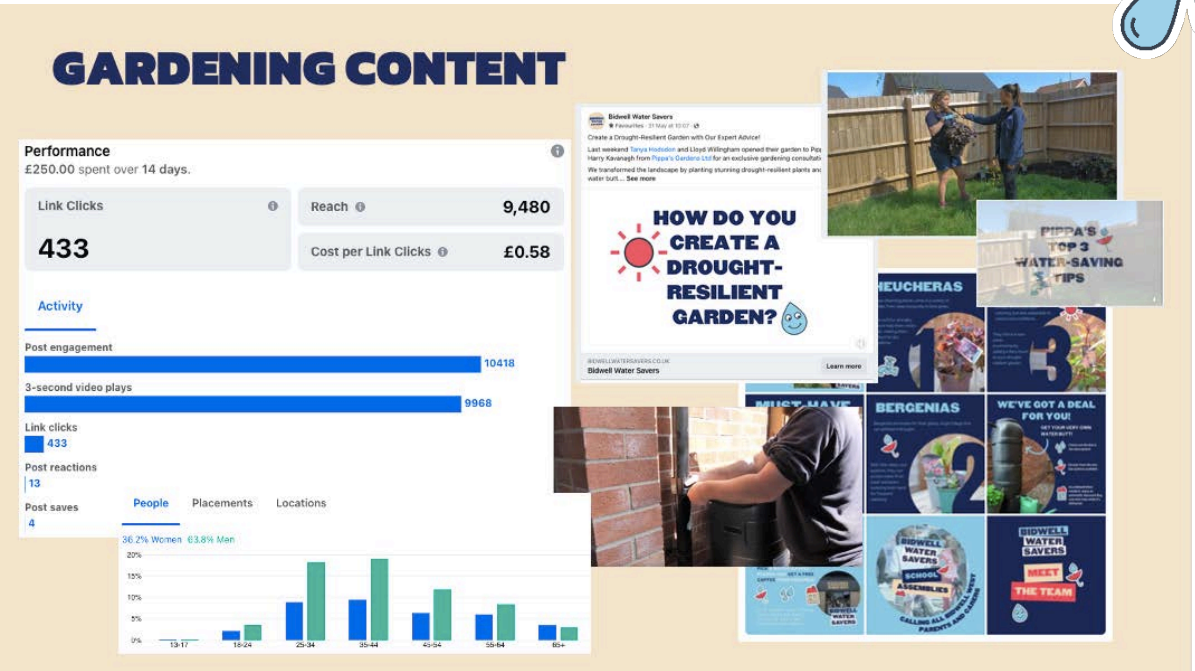


So, we asked on the Bidwell West Community Association for volunteers to have their garden planted with drought-resilient plants and for a water-butt to be installed. All of which would be done with resident mother and son landscapers - Harry and Pippa from Pippa's gardens and filmed for social media content. We also put £250 paid social media spend behind boosting the posts to residents over a two-week period in May/June.

During face-to-face activity in July, we had a lot of positive comments from residents about the gardening content, as they all face to same issues with soil quality, size of garden and not wanting a high-maintenance garden they have to water regularly.

As mentioned, we used the Community Association Facebook Group to ask who would be interested in us trying to organise a bulk discount for water butts, for residents. We had over 100 people reply to say they would be interested. We investigated a bulk order, or discounting and due to the cost of logistics, especially money collection and delivery of such a voluminous product, it was much simpler to negotiate a discount on their they have, which they also subsidise. However, it is not possible to trace exactly how behalf. In the end, Affinity Water's SOS Save Our Streams team agreed to us using the same discount many people took up the offer.

Figure 16: Examples of content about gardening and statistics from social media posts.




## Gardening content learnings

- We had considered doing an event where we sold drought resilient plants and water butts, but we prioritised budget on content which more people could access. This type of event on site is something we would recommend in Spring, with a local gardener on hand to offer advice and a delivery service around the development.
- Both the camera operator/editor and the gardener are Bidwell West residents, we built a strong relationship with both, and it really helped us develop stronger word-of-mouth for the project and added to the relevance for viewers. It also allowed us to call in help at the last minute for the pond dipping event when we needed a favour.
- Showing how to install a water butt allowed us to re-contact all the interested people on the Facebook post and show them the content.
- It feels like this is valuable every year from the first spring people move into a new development until a year or two after it is completed. This is relevant to almost all residents, and if we can encourage drought-resilient planting and water-butt use, we can help flatten the future summer peaks without needing ongoing behaviour change encouragement. It also helps garden owners save time and money watering the plants regularly or annually bedding in new plants.
- When pushing gardening activity, it is important to remember it may produce a short-term spike in water use while people bed in their plants. Thankfully, this typically in Spring when water levels are sufficient to support it.

# Pond Dipping Event

Something learned by the Grapeviners team during their research for SOS: Save Our Streams, was that making the link between local waterways and the water in your home is vital for long term water-saving behaviour change. It is needed to instil the 'why should I' response any time there is the opportunity to save water.

As such, we hosted a pond-dipping event in conjunction with the University of Hertfordshire to teach residents about the eco-system that exists in Bidwell West. With the help of Lewis Stockwell, Principal Lecturer for Postgraduate Programmes in Outdoor Environmental Education, and some of his postgraduates, 62 residents spent an hour discovering what wildlife lives in the Ouzel Brook.

We even had a couple of groups of tweens and teens returning for a second session claiming it was "better than spending the afternoon on screens", much to the team's delight.

Figure 17: Social 'poster' for pond dipping event.

**BIDWELL WEST "EXPLORE YOUR HABITAT" EVENT 16 JULY**


- Eventbrite page for residents to book a slot
- Family and adult only sessions
- Domino's Pizza and Esquires Coffee Shop provided food deals throughout the day
- Water-saving chat with all participants of each session to embed link to water usage at home
- Stickers, colouring sheets and reward charts given out to kids
- Rock painting activity available too

We teamed up with Domino's and Esquires coffee shop on-site to offer free coffees, cakes and £1 pizzas to participants which was extremely well received. The Bidwell West Community Association helped with the bookings and promotion of the event and set up a stall on the day and co-hosted with us. They also helpfully provided gazebos and extra staff and encouraged residents to help with litter picking after the event.

Figure 18: Photos from the pond dipping event.


## Pond dipping event learnings

- This event had real traction with the people who took part. Every person who took part was actively engaged in finding and identifying the wildlife in their tray and took delight in discovering it was a healthy eco-system there.
- They also then took real interest in what we told them about the link between saving water in their homes and the health of local streams and rivers.
- All participants had either taken a pledge before or during the event, with many pledging to do more than just one after the event.
- To be inclusive and pitch the sessions at the right level we ran adults only and family sessions, but only the family sessions had bookings.
- Originally, we had 30-minute sessions planned, but because the adult only sessions were available, each group ran to an hour instead, which worked out well as most children did not want to leave. We let others join later sessions too where there was space, to allow them to enjoy as much time as possible engaging with nature.
- The Ouzel Brook is very central in the site, and en-route to the café for many. So, we got a couple of 'walk-in' bookings, however the weather was extremely windy and not warm, so footfall was lower than usual. We had considered another site, but this felt better for its centrality which proved worthwhile.

- The free coffees, cakes and £1 pizzas were extremely well received, and cost little. Although they were not strictly necessary, they delighted our residents and given the weather, helped keep spirits high.
- Working with the University of Hertfordshire was crucial to the success of the event. One of the post-graduates is a resident and helped make the introduction, this had come through meeting our Water Saving Expert, Jane Bellard, at the AGM pre-campaign. The networking and community liaison groundwork proved invaluable, with the university team helping and providing all the materials for free.

- The knowledge and enthusiasm brought by Lewis' team was infectious, and really engaged the participants. They also had all the relevant equipment, risk assessments and insurances, which were vital to creating a safe event.
- Working with the Community Association also gave us volunteers to help on the day, help promoting the day and administering the ticketing through Eventbrite. All of which was free of charge. This really demonstrates the power of genuine engagement with residents.

# Community Incentive

In the objectives we had set ourselves following the research phase, we wanted to create a genuine legacy to this community, beyond just behaviour change. So, we engaged the community association to discuss what we could do to help them.

They had managed to negotiate land to build a community garden on, however, they needed professional help to clear the space and get it ready for planting by the residents. We agreed to donate £5 per pledge taken during July (up to £3,000) to help with this endeavour and leave a legacy.

During July we also released two new pledges - washing your car with a bucket instead of hose and watering the garden with a can instead of a hose. We also ran the pond dipping and door-knocking activity during July, all of which helped drive new pledges.

The Community Association wanted to help us to gather more pledges, so they offered for their members to send out messages on the private WhatsApp groups for each development within Bidwell West. This is a communications channel we would not normally have access to, so it was valuable to us. Although the tracking link we used did not yield any direct pledges, it may have warmed people up to pledging when our door knockers arrived though.

In the end, we decided to round-up the donation to £2,000 which was very well received.

Figure 19: Social media post about the donation.

## Community incentive learnings

- When we did the door knocking, the fact that we would donate £5 to their community garden was extremely compelling to a lot of customers. Feedback was that they liked how relevant that felt, and they liked that we had taken the time to find out what they were planning and raising money for and linked it to that.
- Having the opportunity for a third-party, trusted neighbour of our audience to send a WhatsApp message into groups for each development felt valuable and personal. We would not have had that without the incentive being mutually beneficial.

- When this programme is re-run for site 3 and beyond, we should consider picking a similar cause and fundraising for it throughout. It was compelling for pledge-takers and could have been used from the start.

# Door Knocking

We made the conscious choice not to pre-allocate all the budget upfront, to allow us to be agile and test new things as they arose, including the community incentive, door knocking and Wizso trial.

Once we had past the launch phase, we knew we wanted to encourage pledges in a second wave of activity, and it became clear that there is an opportunity to test the effect of door-knocking. It is a tried and tested sales technique, but a little outdated.


However, with the proximity of the properties, and the fact that we were not asking people to buy anything we thought it had good potential.

It also presented us with the opportunity for understanding how many people had heard about the campaign, their verbatim responses to it and the perception of it. We worked with Zest to get the ideal team together, Thomas and Saeefa, a couple living in Houghton Regis who both had lots of relevant experience. They certainly brought energy and enthusiasm to the residents and got many people pledging.

Figure 20: Photos taken by our door-knocking team during activity.


## Door knocking results:

- Successfully engaged with 335 (out of 840) customers who answered doors
    - Only 23 people answered their door and did not want to get involved
- Of the 335 who answered and engaged, 201 signed up to a water saving pledge (23.9% of all houses, 60% of those who answered the door)
    - Of these only 36 had already taken a pledge (therefore a high proportion of the households were new pledgers)
    - Only one of our 36 second-time pledgers said they were not keeping up with their original pledge (shorter showers)
- On average, our team knocked on 13 doors an hour, 105 per day x 8 days (2 people)

## Door knocking learnings:

- It was an extremely worthwhile piece of activity, not only did it roughly double the number of pledges, but it gave us the chance to speak face-to-face with the community.
- Offering a £5 donation to the community association's community garden project for every water-saving pledge taken was well received and helped tip people into pledging.
- We had unanimous feedback that the donation to a local cause they all benefited from was positive and 209 people took the Wizso tablets, all very intrigued by an innovation. This eased the value exchange in asking for a pledge and we'd repeat in future.
- One important barrier we overcame was the distrust door knocking can come with, by sharing a photo and the names of our door knockers on the community Facebook group and page, plus via email. It meant our team was welcomed rather than feared.

We had strong sign-up results of those who opened the door (41% answered the door, of which over 90% were interested, and 60% took a pledge there and then).

- In talking to the community face-to-face again, we understood that many wanted to take every pledge, not just one. This was possible, but the customer journey is clunky to register the intent (they would have to sign up 6 times), so we can make that much simpler for customers in future with a more complex e-CRM set-up and improved website functionality.
- We were able to assess how many people had really understood the campaign from their responses, and having spoken to 358 people in 8 days, we had a lot of rich feedback. Those we interacted with early in the campaign who pledged at launch had followed it closely and all-but-one person claimed to be keeping up their pledge.
- However, those who did not hear about it then are less likely to have picked up the message since. We would recommend doing two rounds of door-knocking in future. One closer to the start of the campaign.

# Wizso Trial

Wizso is a new product, just entering the open market which is designed to save flushes by neutralising the colour and smell in the toilet bowl after using the toilet. It currently comes in a plastic packet, like a Smint mints package, releasing one tablet at a time. Users can use a Wizso tablet instead of flushing, for several flushes in a row.

We considered having this as one of our main pledges, but we wanted to concentrate on actions that don't cost the user money and can be done by almost anyone. It also presented a logistical issue getting packs to customers taking the pledge.

However, we could see the large savings potential of Wizso, so we decided to use the opportunity of knocking on every door to distribute them to willing participants.

## Wizso trial learnings

- 209 customers accepted the Wizso trial (of 355 who were asked)
- Many customers pointed out the irony of an environmental campaign handing out plastic packaging, this has been fed back to the Wizso manufacturers and they are already working on an alternative.
- Every pledge-taker in from the door-knocking (plus 8 non-pledge takers) took Wizso. The predictive model showed the impact of taking a pledge + Wizso + doorstep conversation saved 51.1 litres, vs 15.7 litres per household per day for those who just took a pledge.
- We know from a recent Affinity Water trial of Wizso that it can offer great savings, so we would strongly recommend including it in site 3 in a more controlled trial to test the direct result of offering it, including finding out who had used it, not just taken it. For site 3, it may be worth isolating a street or area of the development to exclusively trial this to get more robust data on its exact savings.
- Wizso is genuinely an innovation which could drive long term savings.
- Handing it out as part of the door knocking really worked. It was viewed as an added-value freebie by a lot of people, not another ask.

# High User Letters

Part of our strategy was to specifically target the highest users on the site, and through personal comms, with their own usage included, encourage them to lower their usage.

We picked the top 10 high users and analysed their usage individually. We wrote a personalised letter with a handwritten envelope to them offering them some insight, a chart with their usage vs. high (75th percentile), average (50th) and efficient (25th) similar sized households and the chance to have a personal call or visit from our Water Saving Expert.

The tone of the letters needed to be right, non-judgemental, factual but also personalised. The level of time spent on the analysis and letters was significantly higher than other residents received.

However, not one person replied to the letters. Most likely because it feels uncomfortable to be called out for their high use. However, it may have had an impact on usage. This is a hard to reach and change group and was always going to need to be a challenge.

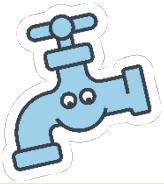


Figure 21: Example high-user letter.

BIDWELL WATER SAVERS

[redacted]

**Did you know...you're one of the top 20 highest water users in Bidwell West?**

***Your household of five is currently using 893 litres of water a day.***

***Similar properties in Bidwell West use 304 litres a day***



**Book your personalised water-saving visit today.**

As a water-saving expert, I would like to offer you a personal visit at a time to suit you. Please **drop me a WhatsApp message** at 07551 261880 or an email to jane@bidwellwatersavers.co.uk and we can arrange a time.

I'll talk through your water use and offer ideas for lowering consumption and cutting bills, including fitting free water-saving gadgets if we think it'll help. We'll also check for leaks and send a plumber if necessary – all absolutely free.

The appointment will last about 30 minutes, and all I ask is that everyone is at home when we're there.

**As one of the top 20 highest water users in Bidwell West, you have the biggest opportunity to make a difference in achieving water neutrality.**

Thank you for reading, and I look forward to helping you save water in any way I can.

**Jane Bellard**
**Water-Saving Expert**
**Bidwell Water Savers**

Hi [redacted]

You've probably heard by now that Bidwell West has been chosen for a world first – a unique experiment called Bidwell Water Savers. If we work together, can we reduce water use so much that we make Bidwell West 'water neutral'.

In plain English, this means Bidwell West won't be taking any extra water from local reserves than before it was built.

As part of our work, we've been looking at everyone's water meter readings. Yours are considerably higher than we'd expect, based on how many people we believe live in your home. This could have one (or more) of three causes.

**1. Are our occupancy records correct?**
Our records show you have **five people living at the property**. If this isn't correct, **please drop us a WhatsApp message on 07551 261880** or an email to jane@bidwellwatersavers.co.uk. We'll adjust our records and you can probably put this letter in your recycling.
However, you might still be a higher-use home, even after we update our records. We'll let you know when you get in touch.

**2. Do you have a hidden leak?**
Very high meter readings are sometimes due to an unidentified leak. Common causes are leaky toilets, dripping taps or faulty pipework. Quite often, these are easy things to fix. Best of all, if a straightforward leak is the culprit, we'll send round a plumber to fix it – free of charge. The most common sign of a leak is consistent water use in the house overnight when many people are asleep and not using water. In your case, **there isn't much water being used overnight so there doesn't seem to be a leak.**

**3. Are you simply a higher-use household?**
It appears as though **your household just uses a significant amount of water**, but we're here to he

When it comes to saving water, baths and showers tend to be the first things we look at. Baths alone consume around 100 litres of water, and long showers can use even more, so switching to shorter showers is key. Another significant contributor to water usage is dishwashing. If you wash dishes by hand, it's crucial to fill a bowl with water instead of letting the tap run continuously. Also, during this hot and dry time of year, many people may also be using a lot of water outdoors for gardening. If this is the case, you can save water by watering the plants with a watering can instead of a hose pipe.

Lower consumption means lower bills, and not just water bills. For example, if the culprit is unusually long showers, shorter showers mean less money spent heating water – so you'll see big savings on your energy bill.

## High users letters learnings:

- Without accurate occupancy data we can't tell for certain that the high users aren't just high occupancy houses. Having an up-to-date occupancy survey of the site before the campaign would be ideal but is understandably not a priority. We would recommend it for site 3.
- We could have asked the water company to contact the customer to follow up on the letters. One complication of running the campaign separately to the water company is data protection and sharing, making it hard for the campaign team to make direct contact with the customers. This would be simpler outside of a test environment. For site 3 where we can also use technology, it feels like the best foot in the door for high use customers. Behaviour change is a hard place to start the conversation, however something like a flow restrictor with the attached savings spelled out might be more compelling.

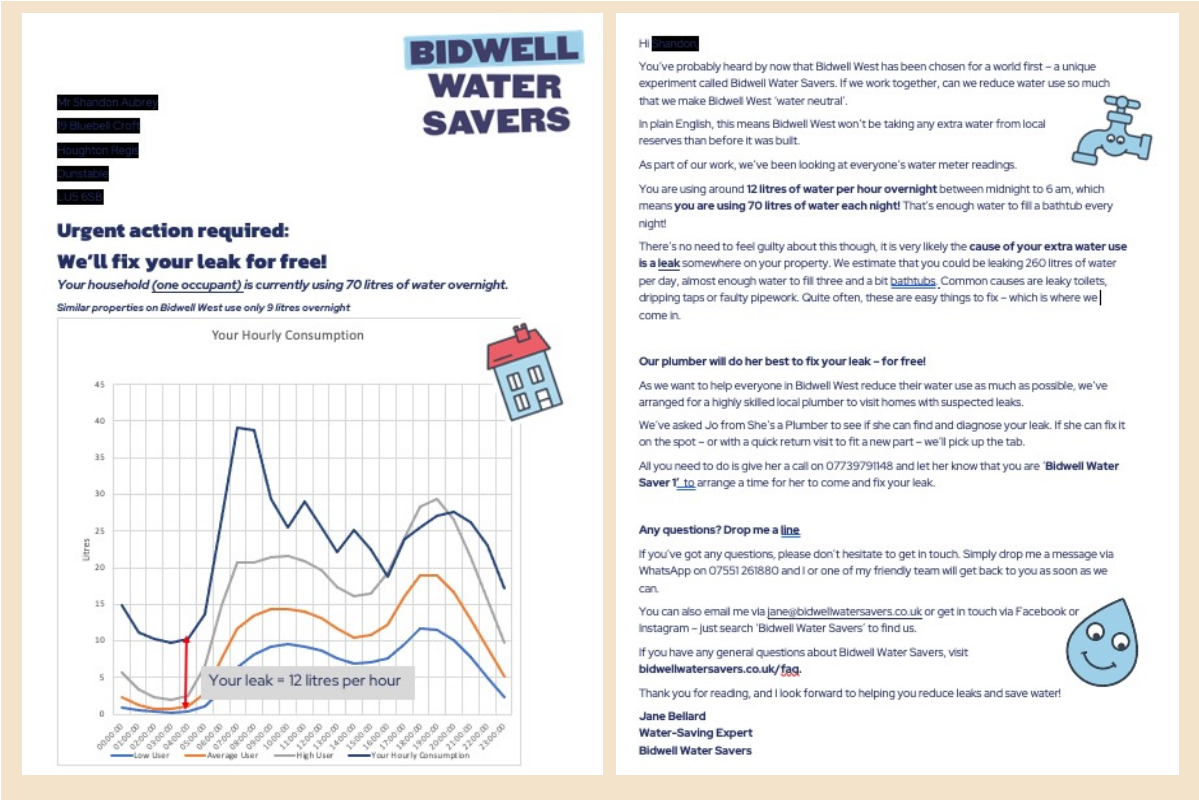
- Having to analyse the data manually wasn't scalable, nor was doing it from a manual meter read. This is only an intervention possible on a small scale or with smart meters and the necessary software to analyse the data.
- 'Interviewee 11' from the evaluation interviews conducted by PHD student Harry Nicklin for this campaign was a recipient of a high use letter. He lives in a family of eight and stated that he felt "more shocked than guilty" when he received the letter, but considered the reason to be that there were several babies who were bathed regularly.

# Leaks Letters

Similarly, to the high users group, we wanted to let customers who have a leak know and offer to send a plumber to fix it for free. We identified eight customers with leaks, sent a personalised letter showing their use and explaining that overnight flow indicated a leak.

The letter was clear and simple, explaining the water being used plus the contact details of a very local female plumber 'She's a Plumber' to help fix it. Yet we still only had one person contact her and get their toilet fixed.

Figure 22: Example letter to customer with identified leak.




## Leaks letters learnings

- We took the meter readings in Jan-April which identified the leaks, but we could not do the analysis and send the letters until July, so some leaks may have been repaired in the meantime.
- We are interested in testing a different approach for site 3, hiring a plumber for one day and telling customers we will pop in and try to fix their leak that day. One time offer, take it or leave it. We would like to test the urgency and the convenience of knocking on the door and not having to plan. We would warn them we are coming on email and text, with a personalized message about it and the savings they could get.
- We could have followed-up either with more emails or letters, or even a phone call or doorstep visit to have secured stronger uptake.

# Stakeholder Toolkit

We engaged stakeholders as part of the steering group – Central Bedfordshire Council in particular. Our contact helped us disseminate a stakeholder toolkit to the relevant people.

Or launch event happened during purdah so unfortunately MPs couldn't attend. We also invited locally stakeholders and dignitaries to all the other events, but to no response.

This is not an area we invested heavily in and is certainly an area we could have concentrated more time and effort to, but diverting it to water-saving behaviour change felt a better use of budget for this element of the campaign.

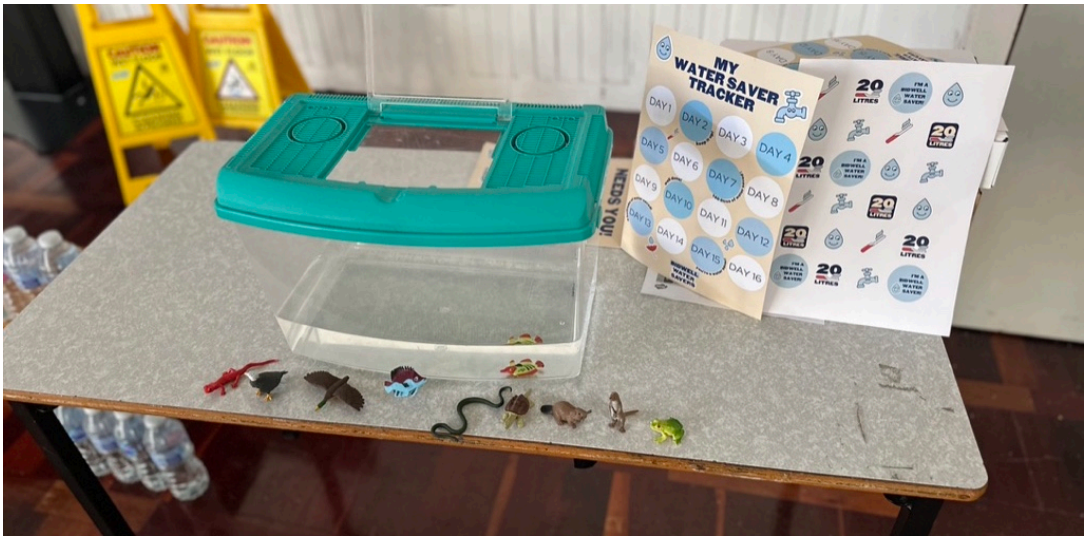
# School Assemblies

We engaged with the three schools which Bidwell West children fell into the catchment for, one did not respond and two were keen. Due to logistics on the school's side, both asked to be September (just after the campaign ended), and only one ended up going ahead.

We did two assemblies at Houghton Regis Primary School – one for the juniors, the other for the infants – approximately 350 people in total. Every child in attendance that day saw the assembly. It had high engagement from the children and teachers.

We started with the session by asking who had been to a river or stream before? We asked which animals they had seen there, and as they named them, we dropped toy versions of them into a fish tank to show all the animals enjoying the water.

Figure 23: School assembly set up.



We then made the link between the water in our rivers and our homes. We laid out 50 half litre bottles of water on a school bench, and asked the children to put their hands in the air if they thought turning the tap off when they brushed their teeth would save more than 5 bottles worth, then 10 and so on. Only a few children guessed right and there was evident shock on their faces, especially when reminded that the wasted water affects the animals in the river.

We then repeated the exercise with using the single flush button, and even the adults were shocked. When asked who was going to use one button and turn the tap off when brushing their teeth every hand went up.

We had created a sticker sheet to hand out to every pupil to help them remember and embed the habit at home. In one session we had some time leftover, so the children suggested other ways they could save water at home, and we told them how many litr[illegible]ach of their suggestions would save.

Figure 24: Water bottles used to demonstrate savings at school assemblies.

## School Assemblies Learnings:

- Engaging earlier in the school year and booking the date well in advance helps ensure it happens, although we were rescheduled several times by both schools.
- Having an interactive session with questions they can all answer keeps energy and attention up.
- The water bottles used to show water usage was powerful and shocked the group.
- Having a guessing game where they could keep their hand in the air to guess quantities of water was an effective way to engage all the children at once.
- Larger water companies often have a school's programme in place, that would be ideal as relationships and working practises are already established. For NAVs or water companies with an education programme, they may require specialist help.
- Because we were interested in targeting only Bidwell West children, there was a lot of 'wastage' in this approach. However, in the new school being built next year on-site, it makes sense to try to book in several sessions a year to build strong advocates for the behaviours.

# TOP LINE RESULTS

There is an in-depth methodology written up in the measurement section for those with an interest in the detail of the analysis. We have concentrated on making this section clear and understandable.

## Key success indicators

Did we create a water-neutral housing development on a NAV site?

**Yes (in fact, it's water-positive)**

What is the average saving per household on the Bidwell West site, per day post-campaign?

**24.9 litres**

What is the post-campaign average PCC for Bidwell West?

**105 litres per person, per day (vs. mean PCC on site of 152.7 one year prior)**

How much water are pledge-taking households saving per day?

**32.9 litres per household, per day**

**(51.1 litres for those who took pledge via door knocking + also trialled Wizso)**

How much water are non-pledge-taking households saving per day?

**22.8 litres per household, per day**

How many pledges were taken (engaged households)?

**382 pledges** – 42% of **908 occupied properties in April 2023**

# Evaluation Framework

Using Kantar Public's established Evaluation Framework, here is the full campaign evaluation:

| Inputs | Outputs | Outtakes | Outcomes | Impact |
|---|---|---|---|---|
| £3,031.98 primary research<br><br>£11,720.76 events<br><br>£15,138.00 website and eCRM<br><br>£6,893.58 social ads<br><br>£1,200 Wizso tablets<br><br>£6,890 door knocking<br><br>£3,240 community incentives<br><br>£246 schools materials<br><br>£15,776.40 copywriting, design and printing<br><br>£67,810.74 project management and community liaison<br><br>£32,344.40 evaluation | 468 people attended launch event<br><br>68 people attended pond dipping event<br><br>2,286,500 social ad impressions<br><br>1,362 Facebook and Instagram page visits<br><br>40,700 organic social reach<br><br>2,698 engagements on social content (likes, comments, shares, reactions)<br><br>382 pledges taken<br><br>1,991 website visits<br><br>1,500 unique visitors to the website<br><br>4,900 website page views | 96% of residents surveyed had heard of Bidwell Water Savers.<br><br>3 out of 4 residents surveyed stated the campaign changed their behaviour.<br><br>73% of respondents remember hearing about the campaign via email.<br><br>39% remember seeing the campaign on social media.<br><br>28% recall receiving a letter or leaflet from BWS.<br><br>19% heard about the campaign through events; 18% from Esquires Coffee Shop; 15% through word-of-mouth; 15% through the Community Association<br><br>*"I think it's definitely we've made significant changes that I think will stick with us now." Female resident, living with husband and two children.* | 55% of pledge-taking households showed savings, at an average of 32.9 litres per household, per day.<br><br>44% of non-pledge taking households saved water, on average 22.8 litres per household, per day.<br><br>*"I don't think it's ever been spoken about as much as it has been on this estate, so probably not ever as conscious about it as I am now." Female resident, living with husband and two children.*<br><br>*"I can actually have quite a big impact when making some relatively small changes." Female resident, lives alone.* | Through the reduction in water-use from behaviour change (driven by Bidwell Water Savers) and off-setting in local business properties, Bidwell West is now water positive.<br><br>**It is the world's first water positive NAV site.**<br><br>Across the whole Bidwell West site, on average each household is saving 24.9 litres per day (vs. expected use).<br><br>The average PCC on the Bidwell West site post-campaign is 105 litres.<br><br>246,836 litres per day are being offset, delivering a water-positive result. |

*Details of each 'output' metric shown in Appendix IV*

# SUMMARY OF QUALITITIVE INTERVIEWS

This section includes verbatim quotes from 11 residents interviewed post-campaign, a combination of pledge-takers and non-pledge-takers, differing household make up and attitudes towards water companies and water-saving.

Fulsome write-ups of each interview can be found in appendix V.

**Many interviewees now have a water-positive attitude.**

Interviewee 8 (female living alone) said "*Living with a family the water use was kind of lost into 'this is what the family uses', so no one person is really owning those numbers. Strangely I'm more conscious of my water use since living alone. Now I turn off the tap when brushing my teeth whereas previously I never would have even thought of doing that. I can actually have quite a big impact when making some relatively small changes."*

Interviewee 2 (female living with husband) shared her thoughts, *"Because we live in a modern country and other countries where they get water easily, it feels like we have an unlimited supply so we really need to be more conscious."*

Interviewee 3 (male living with wife and children) reports that behaviour change was difficult at first because it was breaking habits he'd had since he was a child. Over time with repetition the change has become easier, especially as he is usually the only one responsible for washing dishes. "*Before, I wouldn't have cared if the tap tuns for too long. I used to just leave the tap running and wash up that way, but now my wife also bullied it into me that I will fill the bowl up and wash up, and then maybe I'll rinse a little bit, but nowhere near as bad as what I was. And I'm very conscious when using the kettle, I only fill it up with what I need."*

Interviewee 9 (male, family of 3) thought positively about the campaign, had a door-knock and fliers, and appreciated the physical aspect of the campaign. "*It should help raise awareness about the importance of conservation of water and also it's important to encourage people to adopt more conscious water use habits*."

*"[I] liked making sure that you know the tap's off when you brush your teeth 'cause it's something to change quite quickly. I'm sure I did it before but not as regularly, not as much. Not as consciously and now I do that every time"* Interviewee 2 (female living with husband) said.

## Outdoor usage was a non-negotiable for some parents.

Interviewee 6 (female living with husband and two children) wouldn't be willing to reduce outdoor water use because she values, and put a lot of money into, having a nice garden where her children can play. She doesn't want to restrict her children from playing outdoors. *"I do water my plants and water my grass maybe more than I should, but that's not something that I'm willing to sacrifice for the amount of money that I've put into my garden."*

Similarly, Interviewee 7 (male living with two children, wife and her brother) said he wouldn't be willing to reduce water use for the children's swimming pools, stating that it is *"Important for kids to spend time outside and enjoy the summers even if it increases water use".*

## Pledge to use eco-mode has been an easy switch.

*"I changed timing of doing washing to overnight to accommodate longer eco-mode setting, shared responsibilities with wife, behaviour was very easy to change and sustained. Previously was not using eco-mode so this was the biggest change"* said interviewee 1 (male living with wife and children).

*"Very consciously started using the eco mode on the washing machine. I think I never used it before because I thought that because it was such a long cycle, it would automatically be using more of everything"* said interviewee 4 (female living with husband and two children). She feels like behaviour has changed, now she *"Wouldn't even think of washing her clothes and not use eco-settings."*

## Bathing 'me time' is too important to some, however bath-pledgers managed it.

Interviewee 3 (male living with wife and children) told us: *"I don't think I'll ever be able to change that, I love my bath too much. I'll never change that habit, I don't think you could pay be to do that – my bath is my escape, it can be quite stressful coming home, so it's my escape where I know I won't be bothered by the wife or kids.*
*"Maybe if I had a fancy walk-in shower, but I don't. You know, I think you can't take my bath time from me, I'll go to war for my bathtub. I am away from everything to do my own little thing. When I decide to have a bath, you ain't taking me out of it."*

Interviewee 5 (female living with husband and two kids) said *"I prefer a bath over a shower, it's my time to sort of escape which is something I need."*

Similarly, interviewee 8 (female living alone) "*Wouldn't let my bath be taken away, that's time to relax, find indulgence.*"

However, some people took up that pledge and managed it. Interviewee 11 (male living in a family of 8) said he likes to take long baths and relax, he used to fill water to the brim but now does not. He said he did not notice or pay attention to water use at all prior to the campaign, would only think about bills.

Interviewee 2 (female living with husband) said *"I followed the advice from the water company. They sent out regular emails about how to save water. And that was one of them, making sure that your bath is like at least 1/3 less than normal and then you would save so much water. I definitely use less in my bath time now than I did before and it is something I've kept to."*

## Two minutes less in the shower was tough but doable.

Interviewee 4 (female living with husband and two children) who took the showering for two minutes less pledge, found reducing shower time tougher than the eco-mode switch. She said it is because she showers in the mornings and already takes rushed showers, but they are trying to keep it in their minds when they shower.

*"The showering one is quite a challenge, but I do try really consciously."*

Interviewee 3 (male living with wife and children) said *"Shower, using the kettle, and when I wash up are the three things that I do certainly try and keep an eye on what I'm doing sort of using my water. If I'm showering, I will try my best to make it so I'm in there for no longer than four minutes. I've got a family that's only getting bigger, so I want to make sure that they're educated as well."*

## Wizso worked best at night for one couple.

Interviewee 10 (female living with wife) pledged during the door-knocking activity and took Wizso tablets to try. She said they use it to save flushing through the night and that worked well.

## Events and face-to-face had positive impact.

Interviewee 4 (female living with husband and two children) attended the pond-dipping event with her daughter and reflected "*The fact that she could kind of do it herself and learn about and the importance of water and keeping it clean and, you know, looking at all the bugs that everyone had found as well, she just loved it.*"

Her daughter was given stickers for turning the tap of when brushing teeth and she's become more conscious and talked to her sister about it. *"I mean it's definitely made us all think as a family about water saving…especially with bills rising.*

*"I think the events have been brilliant, it gets the whole community together. I know the kids loved it and I've never lived in an area that has had so much going on in the community."*

She commented that she liked the in-person events, being able to speak to water savers and interact with people about the campaign and pledge. *"I think it's definitely we've made significant changes that I think will stick with us now."*

Interviewee 6 (female living with husband and two children) told us *"It was good to have them out in the community so that people could go up to them face to face"*

*"I'm always happy for new information as long as I don't feel like I'm being bombarded with information…The odd email or these events where you can go and talk to somebody, I think they're good ways of getting the information out without feeling overwhelmed."*

Interviewee 3 (male living with wife and children) said he would like more similar events, especially as a first-time homeowner he feels many people could use help learning how to reduce waste and minimise bills. He was happy with personal door-to-door visits if the goal is to save money, not to sell him something.

He also said *"It did help talking to someone about it, I never really knew like how bad I was with water, it certainly make me a bit more conscious and aware of my water usage…It was actually quite nice to have someone not necessarily from Affinity Water that can guide you and give you a bit of advice and just a bit of information that will open your maybe you didn't know before and for me that's certainly helped."*

Interviewee 10 (female living with wife) said she was happy with the campaign and appreciated the community aspect.

*"I think having events in the community is really good, makes it feel more personal to us…And having the people that came to knock on our door was helpful as well since we couldn't make it to the event."*

**The campaign drove word-of-mouth in the community.**

*"I don't think it's ever been spoken about as much as it has been on this estate, so probably not ever as conscious about it as I am now",* Interviewee 4 (female living with husband and two children).

Interviewee 7 (male living with two children, wife and her brother) said they especially liked the community aspect of the campaign, interacting with neighbours and sharing ideas.

Interviewee 11 (male, family of eight) told us, *"Maybe not each pledge was successful, but through word of mouth it has been successful at raising awareness among whole community."*

**Response to the 'choosing your own pledge' concept was largely positive.**

Interviewee 3 (male living with wife and children) said *"Initially I found it funny because I've never pledged to do anything, so I was like I'm not pledging anything. But it was actually quite a smart thing to do and helped me understand better to have it in black and white in front of you to show you how pledging to change a couple of things does make a difference. It was nice to see how much water I could save with some actions, and the impact this could have on my bills.*


*"It was quite interesting that actually changing something so simple like a silly habit of keeping the tap running that I have got and knowing it works in my favour quite a lot."*

Interviewee 4 (female living with husband and two children) liked the act of giving a pledge and feels it was valuable to have a list of options to choose from, and was not sure if she would have been able to make up her own pledge from scratch.

*"I think giving people choice gives them ownership. And when you have the ownership, you're more likely to do it. If you're just being told what to do then people are less likely to do it because people don't like being told to do stuff"*


Similarly, interviewee 7 (male living with two children, wife and her brother) said *"I quite like the pledge idea because it gave me ideas that I never heard about before or never thought about."*

*"My kids loved it, particularly getting a cupcake and an ice cream when they made a pledge. It's great to engage the younger people as well."*

Conversely, interviewee 8 (female living alone), who heard about the campaign on Facebook, thinks that being asked to make a pledge seems a slightly strange approach, she doesn't like public declarations and finds that managing water use is a personal, private choice. *"Pledging is not something that makes me any more or less likely to undertake it… it's more about an achievement rather than a statement of intent."* She would like a reward for pledging, but it does not have to be monetary.

Interviewee 9 (male, family of 3) likes the idea of taking a pledge but wants more follow up reminders to make sure people are sticking to the pledge. He felt that the pledge had a

short-term impact when it was fresh in their mind, but installing the light timer showerhead had more of an impact than making the pledge did.

## Motivation for saving varied.

Non-pledge-taker, interviewee 5 (female living with husband and kids), commented *"I think the only reason why I would be willing to join in any campaign was if there's an incentive to me."*

However, when we explained the campaign and the rationale, her response was *"That's the main thing, making people more aware…because it is important that we all make changes into our lives to make it better for the future… I just think it's just making more people aware of what you can do to make that change, because I think more people would be happy to help, but they just don't know what to do."*

Interviewee 7 (male living with two children, wife and her brother) said his motivation was to save water is for his kids, making sure they have a bright and secure future.

Interviewee 3 (male living with wife and children) said *"Usually I wouldn't care about this type of stuff, but ever since I've become a homeowner and I've had my own family, it's quite important. And it's stuff you don't get taught in school, would never be aware of, so it's quite nice to have these little campaigns going on. And since some of us are first time new homeowners, we don't know if we are overdoing it or something like that so it is really helpful to know."*

## When asked if they'd value a smart meter, most wanted it.

*"I would like to know in laymans terms, the costs, where we use water, how we compare to other months and last year, and the impacts of specific actions, like using the small toilet flush, on the units use and costs…if people could see they could, they could save at least like £50 and if that was by just turning the shower off 2 minutes earlier, people are gonna do that, especially in the crisis we're in"* said Interviewee 5 (female living with husband and two kids).

Interviewee 7 (male living with two children, wife and her brother) has a smart energy meter but doesn't use it. He doesn't feel like he needs to because he has a good idea of his energy use already, same with water use. *"I'd like to think that we try and use as minimal as we can…I could probably work it out how much, but well, I can't be bothered.*

*"If you need to use something, you need to use something…I don't know what having a smart water meter would achieve, it'd probably just give me a heart attack about how much the water is costing."*

Interviewee 10 (female living with wife) has a smart meter for energy and would like the same for water, finds it would be more useful for high using households to see how specific actions like using eco wash can save water and money.

Interviewee 2 (female living with husband) said *"I'd like to know, like if I save if I've done this like how much water have I saved overall and like how that affects the environment out of curiosity because I kind of want to know, you know the carbon footprint, how my changes can help my carbon footprint and the overall changes if the whole community saved more water.*

*"Not necessarily breakdown for each appliance, I can kind of know by the day on what's the water usage by what where that water is coming from, and it just helps to know your overall monthly usage and pinpoint slightly where the higher usages are. More data is useful, it helps you change your behaviours."*

## We asked for ideas and suggestions...

Interviewee 3 (male living with wife and children) said "*We all love freebies or little cheeky rewards. If we are gonna do pledges, I'd love to have that tracked and at some point get rewarded for keeping the pledge. That's what motivates most people, acknowledgement, and praise for acting good and doing something new you wouldn't usually do."*

Interviewee 8 (female living alone) would like a neighbourhood comparison to similar profiles, and to see what water use reductions could mean for the whole community if everyone took part.

Interviewee 10 (female living with wife) felt that the water savers campaign had a noticeable impact. She found out about it through the Facebook group. "*I remember a post about how to fix a leaky toilet, which I thought was really useful...This is our first time having to do maintenance around the house so it would be good to see more tips like that to make sure you're not wasting any water when something goes wrong with your plumbing."*

## Summary

The interviews were largely positive about the campaign, pledges and their own behaviour changes. It was clear certain bathing behaviours and outdoor water use for kids were too high a sacrifice for some, but not all.

We knew when we created Bidwell Water Savers that no one behaviour was going to be the answer. However, giving residents ownership to choose one that they can achieve, seems to have resonated and driven action.

# DETAILED ANALYSIS OF ACTUAL WATER-SAVINGS

Author: Shorif Islam, Data Scientist, Affinity Water

## Overview

The purpose of this project is primarily to understand the impact of the Bidwell Water Savers campaign on encouraging customers in the NAV site at Bidwell West, a new housing development to reduce their water consumption and achieve water neutrality.

To accomplish this, some of the latest artificial intelligence (AI) modelling techniques are utilised to build a predictive model to predict the expected consumption of customers if the campaign did not occur, then the difference between the actual and expected is considered to be the impact of the campaign.

Furthermore, a control site, Bishop Stortford was provided, however due to the uncertainty of whether this control site is a suitable comparison to Bidwell, further analysis is carried via statistical methods to ensure both the test and control sites are comparable and where this is not the case, suitable adjustments to the control group will be made.

This adjustment of the control group is facilitated by undertaking a bespoke segmentation of customers based on their usage trends utilising AI clustering algorithms, then utilising this information to select the most comparable customers in the control group that are most representative of the relevant test group subset in Bidwell.

## Requirements Summary

A summary of the key requirements of the project are outlined below:

1. Assessing suitability of control group and adjusting where necessary based on usage.
2. Building predictive model for the test group, facilitate comparison of expected vs actual consumption.
3. Deep dive analysis:

a) Water use of pledge taking households vs expected use compared with non-pledge taking households.
b) Difference in expected water consumption pre and post pledge – did the difference wain over time?
c) Were some pledges more effective than others?
d) Wizso trial (almost the exact group who took pledges in mid-July) consumption savings.
e) Using the close-out survey data, it would be ideal to match the claimed data to their real data and see whether they tell the same story. We may be able to see a difference in water use from those who saw the campaign and didn't pledge. If we have sufficient data to create segments that would be very interesting e.g. saw information but didn't pledge, took action but didn't officially sign up etc.
f) Comparison of water use of people who didn't officially sign up still went down because of this community initiative.
g) Was there a tipping point where we saw a trend in water reduction vs. expectations?

# Data Sources

The key data sources utilized for this analysis include:

- Bidwell and Bishop Stortford consumption data
- Pledge data
- Publicly available holiday data
- Weather data (Visual Crossing)

# Data Preparation

The table below shows a summary of the key data cleansing transformations carried out prior to modelling the data, (green indicating it is carried out and yellow indicating not relevant):

| Data Transformation | Clustering Algorithm | Predictive Deep Learning Models |
|---|---|---|
| Removing duplication in the data, ensuring single consumption value for a single meter serial per date and time. | | |
| Removing outliers where consumption in a 30 minute period is over 500 litres. | | |

| | | |
|---|---|---|
| Removing any periods with a negative consumption. | | |
| Utilising only pre campaign data | | |
| Sufficient property consumption history - Minimum of 8 months prior to April 2023 and 1 month post campaign data. | | |
| Daily outliers above 3000 litres in a single day replaced. | | |
| Missing days were identified for each property and set to 0 | | |
| Customers with an extended period of low consumption are removed. | | |
| An anomaly detection model called the Median Absolute Deviation (MAD) was utilised to find local property level outliers. | | |

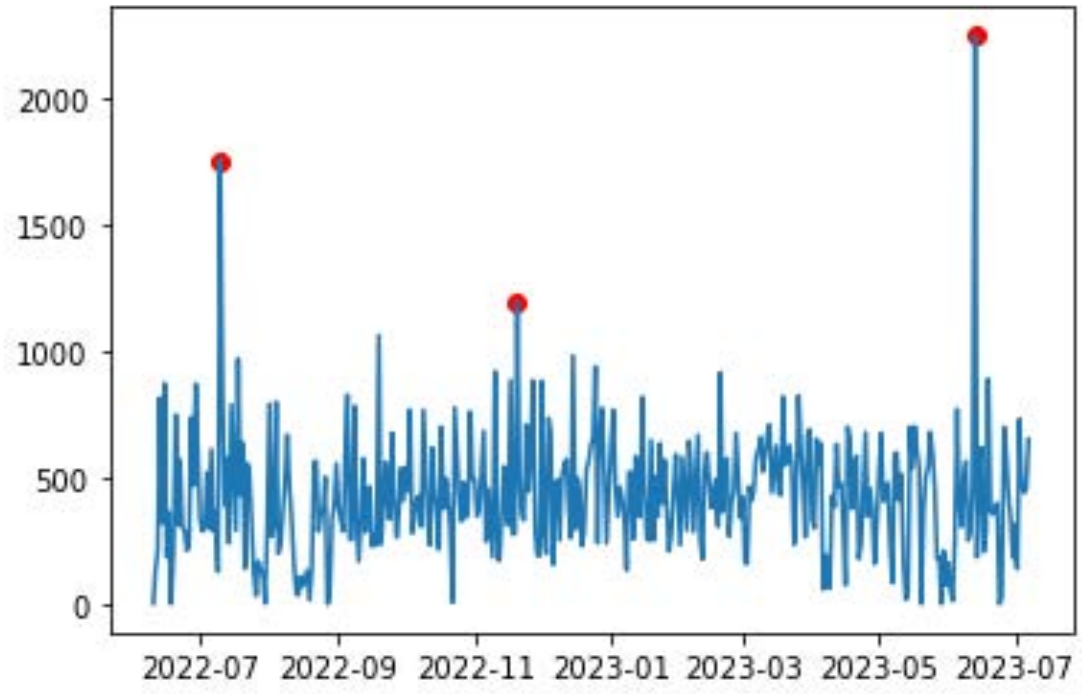



*Figure 1: Daily consumption (litres) of a single property by time (Anomalies detected by MAD algorithm are shown in red)*

# Suitability of Control Group Assessment

## Methodology

The segmentation of customers based on usage trends was carried out to identify distinct groups of customers that can then be used for the adjustment of the Bishop Stortford control group and facilitate the fairer comparison between the control and test groups at the Bidwell site. An unsupervised machine learning model is utilised to discover the hidden patterns in the data to capture and group together similar cohorts of customers.

Further analysis is carried out to identify the distinct characteristics of groups found, the segments generated by the algorithm with their descriptions are shown below (Please note Cluster 0 has been omitted due to its small sample size):

| | **Cluster Description** |
|---|---|
| Low Occupancy, Low Summer Consumption Households (Cluster 1) | These customers appear to consistently have low consumption across most metrics, which could indicate low occupancy households. As the average daily household consumption is nearly 150 litres per day per person, these are likely single person households. |
| Stay at Home Households (Cluster 2) | This group has the highest night-time (hours 0 to 6) average daily usage after cluster 3. They also generally have a consistent usage throughout the day (about 80 - 90 litres morning, afternoon, and evening), which could indicate home workers, unemployed, elderly retired etc. |
| High Occupancy, High Usage Households (Cluster 3) | This group appears to be high users as they consistently appear to have the highest consumption. This may indicate high occupancy households, families with children etc. This is further supported by the average public holiday consumption for these households to be higher than their non-public holiday consumption, i.e. where children/workers may more likely be at home. |
| Day Time Absent Households (Cluster 4) | These customers generally see a decrease in consumption during the afternoon, and then an increase in the evening, which could indicate that they are have members of the household that may go out to work during the day. |
| Low Occupancy, High Users (Cluster 5) | These customers may be low occupancy households but with high usage, as their usage is slightly higher than cluster 1, they also may have more occurrences of short interval high water usage e.g. max 30-minute consumption seems to vary the greatest between 250 to 430 litres on average per day. |

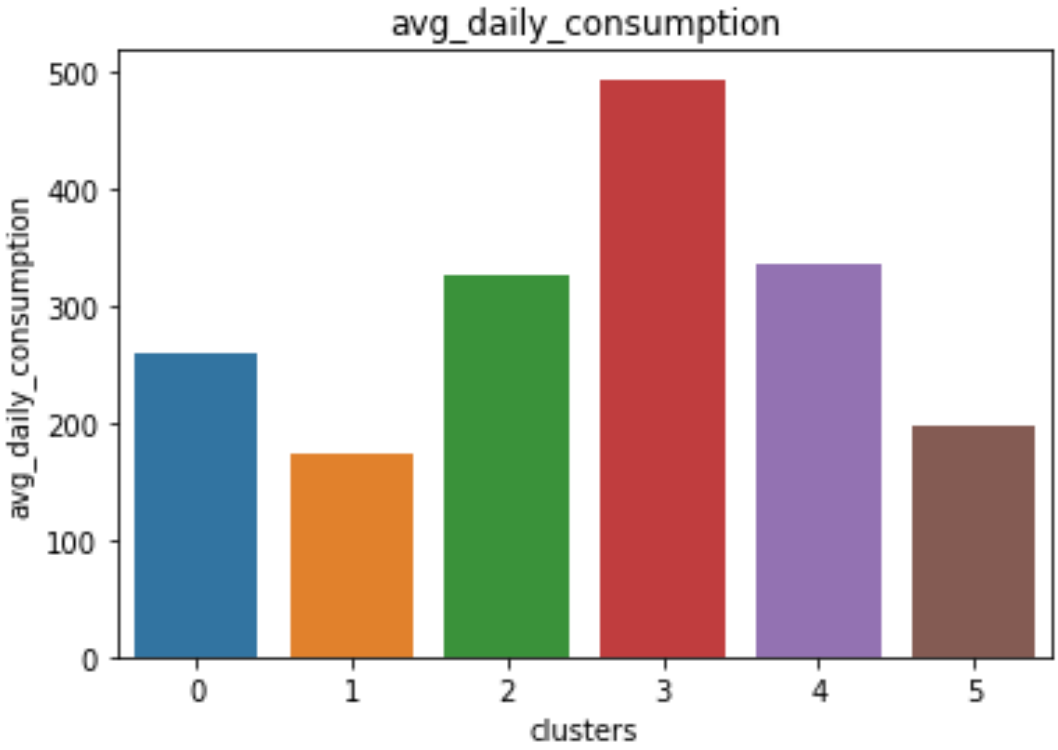



*Figure 2: Average Daily Consumption by Segment identified by the Clustering Algorithm*

## Balance Tests and Relevant Control Groups

The table below shows the results of the balance tests at different levels of comparison, both the test and control groups are considered balanced in terms of water consumption when there is no statistically significant difference between their consumption, i.e. the p value must be above 0.05.

Where the control group was not found to be balanced initially, a new curated group was selected from the overall control group with the aid of the clusters identified by the clustering algorithm to ensure a representative control is created.

| Segment | Test Group Size | Control Group Control Size | Is Curated Control Group Used? | Balance Test Result p value (Significance level 0.05) |
|---|---|---|---|---|
| Overall site level for all customers in the test group vs control | 843 | 443 | No | 0.63 |
| All Pledge taking customers in the test group vs control | 216 | 215 | Yes | 0.67 |

| | | | | |
|---|---|---|---|---|
| All Non Pledge taking customers in the test group vs control | 627 | 443 | No | 0.58 |
| Pledge - Wash up in a bowl | 18 | 18 | Yes | 0.45 |
| Pledge - Washing machine eco mode | 24 | 24 | Yes | 0.54 |
| Pledge - Fill the bath less | 7 | 7 | Yes | 0.699 |
| Pledge - Shower for less time | 16 | 16 | Yes | 0.60 |
| Pledge - Low flush button when flushing toilet | 19 | 19 | Yes | 0.48 |
| Pledge - Turn tap off when brushing teeth | 26 | 26 | Yes | 0.77 |
| Pledge - Watering Can | 64 | 64 | Yes | 0.55 |
| Pledge - Wash car with bucket | 18 | 18 | Yes | 0.78 |
| Wizso Trial | 120 | 117 | Yes | 0.98 |

An example of how a new curated control group utilizing the segments found from the clustering algorithm for the pledge taking customers is shown in the table below:

| **Segment No.** | **Segment Name** | **Bidwell pledge takers** | **Bishop Stortford Curated Control** |
|---|---|---|---|
| 0 | Undefined (Small sample size) | 6 | 6 |
| 1 | Low Occupancy, Low Summer Consumption Households | 80 | 82 |
| 2 | Stay at Home Households | 12 | 12 |
| 3 | High Occupancy, High Usage Households | 40 | 38 |
| 4 | Day Time Absent Households | 67 | 67 |
| 5 | Low Occupancy, High Users | 11 | 10 |
| **Total** | | **216** | **215** |

# Predictive Model for Expected Consumption

## Methodology

In order to understand the impact of the Bidwell Water Savers campaign and to determine whether or not customers in the Bidwell site saved water via the adjustment of their water use behaviour, state of the art artificial intelligence (AI) deep learning models were developed to learn the water use behaviour of customers prior to the campaign.

They consider factors such as weather, time of week (weekend vs weekday), public holidays and other known time varying factors and then subsequently using these models to predict the customers expected consumption during the campaign period, effectively simulating the scenario of the water saving campaign not taking place.

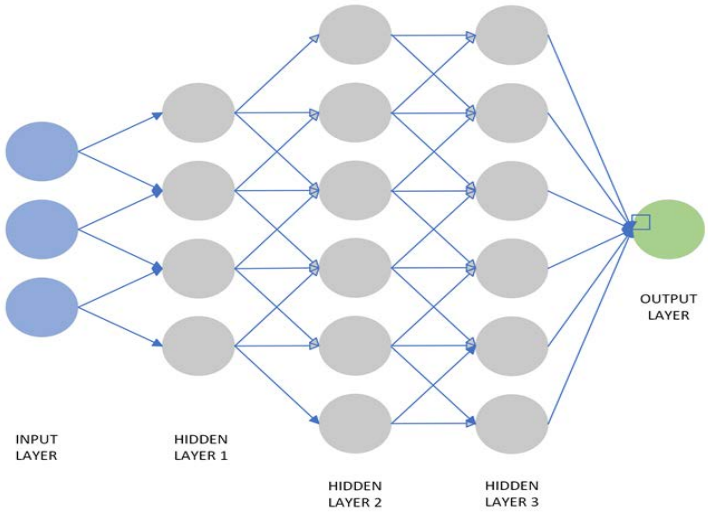
The average difference between the predicted expected consumption and the actual consumption of customers during the campaign will identify whether individual customers have made water savings, how much have they saved and approximately when they made those savings.

Please note, this analysis is a bottom up approach to predict expected consumption at a household level on a daily time interval.

## Deep Learning Artificial Neural Networks

Deep learning models have been selected for addressing this challenge of predicting expected household water consumption because of its unparalleled ability to discover intricate patterns and discover complex relationships in temporal data.

Deep learning models are a type of artificial intelligence that have been inspired by the human brain's neural networks, these models usually contain multiple layers of interconnected nodes (at least 2 for deep networks), which enables them to learn from the various features of the input data. See figure below for a typical representation of a deep learning network.




Not all properties are eligible for modelling due to a lack of historical data for each property, especially the given fact that this is a new housing development, the table shows various exclusion criteria applied, and the number of properties remaining for modelling as well as how many of these customers took a pledge.

| Criteria Applied | Bidwell Properties |
|---|---|
| Total initial properties available in Bidwell | 956 |
| Total no. of properties with sufficient meter read history | 462 |
| Total no. of properties with sufficient meter read history and removing customers with extended period of low consumption | 433 |
| **Total no. of properties eligible for modelling** | **433** |

| Description | Bidwell Pledge Customers |
|---|---|
| Total no. of properties who have pledged | 318 |
| Total no. of properties who have pledged with a known meter serial | 300 |
| **Total no. of properties who have pledged suitable for modelling** | **113** |

A summary of the input features of the models can be shown below:

| Feature |
|---|
| Consumption (l) |
| Wind speed |
| Temperature |
| Feels like |
| Humidity |
| Dew |
| Visibility |
| UV index |
| Precipitation |
| Is public holiday |
| Is school holiday |
| Is weekend |
| Day |
| Month |
| 30 day rolling statistics |
| 14 day rolling statistics |
| 10 day rolling statistics |
| 7 day rolling statistics |
| 3 day rolling statistics |

## Model Performance

Deep learning models can take a significant amount of time to train and optimise to ensure they are making accurate predictions, below shows predictions of 2 models, the first with very little optimisation and the second showing the predictions after the model was further refined and optimised, please note the charts below show predictions on data the model has not 'seen' thus does not know what the data actually looks like in this period.

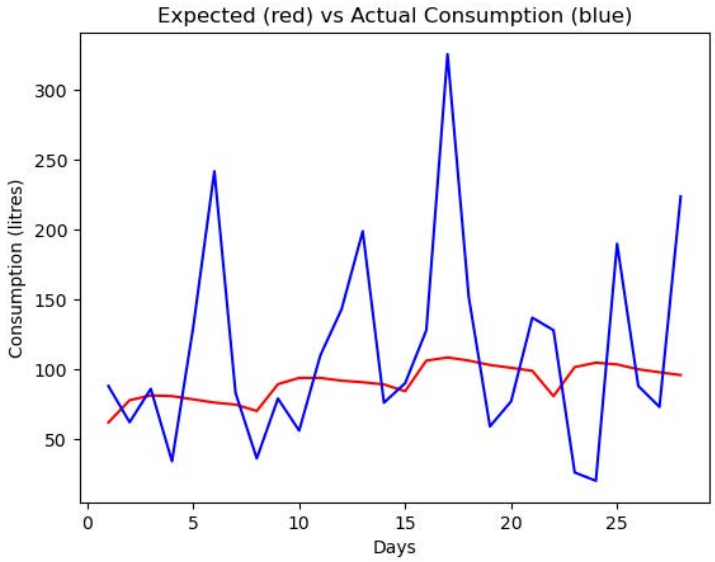



*Figure 3: Sub-optimal deep learning predictions vs actual*

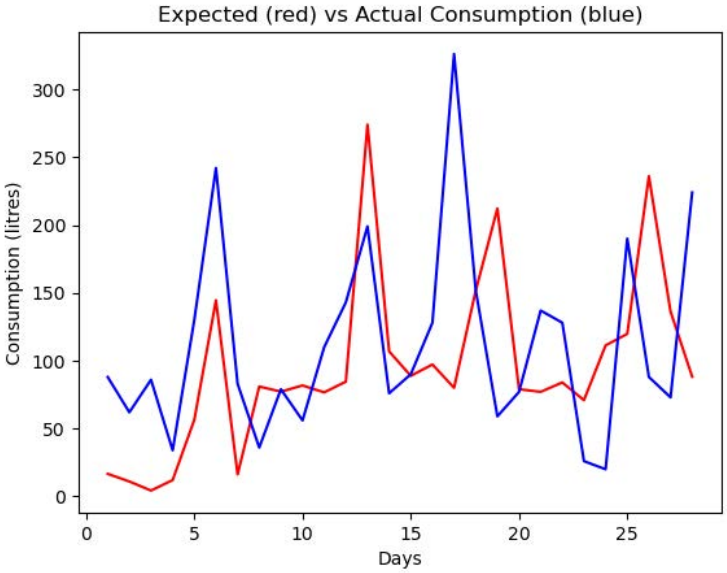



*Figure 4: Further optimised deep learning model*

# SAVINGS ANALYSIS & RESULTS

## Methodology

To calculate the impact of the Bidwell Water Savers campaign, two main methods have been employed:

1. Calculating any savings at an individual property level comparing the properties' actual consumption to their expected consumption during the relevant campaign period.
2. Calculating savings of the relevant cohort of customers at Bidwell West by comparing them to the relevant comparable control group subset at Bishop Stortford.

Savings have then been calculated for the following main segments:

1. Pledge taking households
2. Non-pledge taking households
3. Different pledge groups
4. Wizso trial customers
5. Close out survey
6. Overall site level

The savings for households who have taken a pledge have then been determined by comparing the predicted to the expected consumption of these customers post their earliest known pledge date. This is assuming these customers made the most significant changes in behaviour after making their pledge.

As for households who have not taken a pledge, the comparison between expected and actual consumption was carried out for consumption data from the start of the Bidwell Water Savers campaign on the 8th of April 2023.

# Savings

The colour key for the savings results tables is shown below:

| | |
|---|---|
| | Predictive Model Results |
| | Statistical Test Results using non parametric Mann–Whitney Test |

The statistical significance levels are shown below for the statistical test:

| | |
|---|---|
| * | 30% significance level |
| ** | 20% significance level |
| ** * | 10% significance level |
| ** ** | 5% significance level |

The higher the significance level, the more confident we are that this is a real reduction in consumption as opposed to this reduction being explained by random chance.

The table below shows the estimated savings of 3 of the main segments of households:

| Analysis Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings via Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings via Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Water use of pledge taking households | 105 | 58 | 55% | 32.9 | 174 | 205 | 9.25** |
| Water use of Non-pledge taking households | 320 | 141 | 44% | 22.8 | 994 | 446 | 7.25** |

The table below shows the estimated savings of different types of pledge the households had taken:

| Pledge Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Wash up in a bowl | 10 | 6 | 60% | 19.4 | 18 | 17 | 30.5** |
| Washing machine eco mode | 12 | 6 | 50% | 36.1 | 19 | 18 | 39.5* |
| Fill the bath less | 6 | 1 | 17% | 5.0 | 6 | 6 | 171.5* |
| Shower for less time | 9 | 5 | 56% | 33.8 | 18 | 14 | 80.5** |
| Low flush button when flushing toilet | 12 | 8 | 67% | 40.97 | 20 | 17 | 113.25** ** |
| Turn tap off when brushing teeth | 16 | 9 | 56% | 15.7 | 26 | 24 | 63.25* |
| Watering Can | 29 | 17 | 59% | 69 | 53 | 55 | 26.5* |
| Wash car with bucket | 11 | 6 | 55% | 37.8 | 13 | 16 | 2 |

The table below shows the savings estimated from the Wizso trials, however it is difficult to determine the actual impact of this trial because all of these customers took a pledge and it is unclear how to separate out the savings.

| Pledge Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Wizso + Pledge | 59 | 35 | 59% | 51.1 | 99 | 122 | 7 |
| Pledge only | 46 | 23 | 50% | 15.7 | 85 | 89 | 43** ** |

The below shows savings estimated for cohorts from the close out survey:

| Analysis Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings via Expected Consumption (Average Litres Per Property Per Day) |
|---|---|---|---|---|
| Household took action not officially pledged | 8 | 5 | 63% | 47.0 |
| Households somewhat conscious of campaign | 10 | 6 | 60% | 40.7 |
| Households most conscious of campaign | 12 | 6 | 50% | 32.5 |
| Washing machine eco mode | 15 | 6 | 40% | 30.8 |
| Turn tap off when brushing teeth | 14 | 5 | 36% | 20.8 |
| Wash up in a bowl | 10 | 5 | 50% | 20.8 |
| Shower for less time | 15 | 8 | 53% | 33.9 |
| Low flush button when flushing toilet | 12 | 5 | 42% | 20.8 |
| Wash car with bucket | 8 | 5 | 63% | 47 |
| Fill the bath less | 12 | 5 | 42% | 47 |
| Watering Can | 8 | 4 | 50% | 33.9 |

The chart below shows the overall savings at a site level by month:

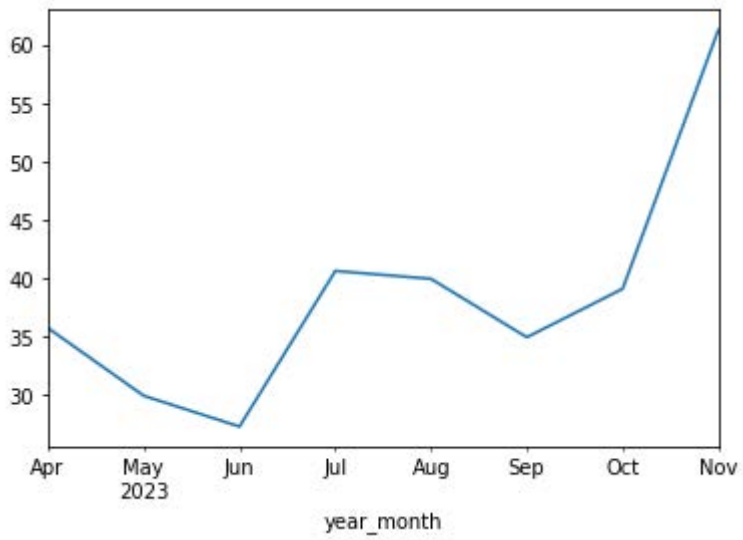



*Figure 5: Savings in average litres per property per day*

The number of properties estimated to be saving water based on their expected usage, this is the underlying data for the chart above.

| Month | Total Properties | Number of Properties Saving | % |
|---|---|---|---|
| 2023-04 | 433 | 209 | 48% |
| 2023-05 | 405 | 180 | 44% |
| 2023-06 | 398 | 160 | 40% |
| 2023-07 | 385 | 212 | 55% |
| 2023-08 | 382 | 198 | 52% |
| 2023-09 | 245 | 88 | 36% |
| 2023-10 | 124 | 54 | 44% |
| 2023-11 | 25 | 18 | 72% |

The overall site level savings across the full campaign period is shown below:

| Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Overall all properties site level | 433 | 197 | 45% | 24.9 | 745 | 446 | 11.75** |

The level at which customers are not saving water according to the expected consumption model is shown below:

| Description | Total Modelled Households with non zero actual consumption | Number of Households with Non Savings | Proportion of Customers with Non Savings | Non Savings vs Expected Consumption (Average Litres Per Property Per Day) |
|---|---|---|---|---|
| Overall all properties site level | 433 | 236 | 55% | -32.7 |

# PCC DURING CAMPAIGN PERIOD

The per capita consumption (PCC) was estimated for the whole Bidwell site during the campaign period, April 2023 to August 2023.

The data utilised for calculating this was cleaned to remove pre move in consumption, removing duplication, and removing extreme consumption outliers.

The PCC was then calculated utilising 2 methods, both methods calculated per household consumption (PHC) initially then calculating PCC using:

1. Dividing by the average occupancy factor: 2.48
2. For customers with known occupancy, dividing by their actual occupancy.

The second method utilises the following data sources for occupancy, ordered by preference:

- Occupancy reported in the close out survey.
- Occupancy reported when pledge taken.
- Occupancy according to CACI Acorn.
- Occupancy according to IWNL (Note this was taken as the last preference as IWNL were unsure of the accuracy of this data).

The median PHC/PCC was calculated to ensure it is more robust to extreme outliers.

The results of the PHC/PCC analysis is shown in the table below:

| Method | Households | Per Household Consumption (PHC) | Per Capita Consumption (PCC) |
|---|---|---|---|
| Occupancy factor 2.48 | 814 | 261 | 105.2 |
| Actual Known Occupancy | 217 | 286 | 107.0 |

# APPENDICES

# APPENDIX I: CUSTOMER USAGE BEHAVIOUR SEGMENTATION

## (CLUSTERING MODEL)

## Overview

The purpose of carrying out a segmentation of customers based on usage trends is to identify distinct groups of customers that can then used for the adjustment of the Bishop Stortford control group and facilitate the fairer comparison between the control and test groups at the Bidwell site.

A unsupervised machine learning model is utilised to discover the hidden patterns in the data to capture and group together similar cohorts of customers.

## Model Training

## Data Preparation

### Data Sources

- Bidwell and Bishop Stortford consumption data
- Publicly available holiday data

### Data Transformations

The below lists the key data transformations in order to prepare it for modelling:

- Combine both test and control group consumption data
- Removing duplication in the data, ensuring single consumption value for a single meter serial per date and time.
- Removing outliers in consumption data, arbitrarily setting maximum permissible consumption in a 30 minute period to be 500 litres, as very few activities could consume more than this amount of water within this period.
- Removing any periods with a negative consumption.
- Utilising only pre campaign data i.e. consumption data prior to April 2023 is considered, this is to ensure post campaign behaviour change in the Bidwell site does not influence the clustering of customers in both the Bidwell and Bishop Stortford sites.
- Data is resampled at 30 minute increments, in order to facilitate easier calculations.
- Any missing values are filled with zero.

- A standard scaler has been used to scale the features.
- Data is aggregated to a property level, where each row in the dataset is a single property.

# Feature Engineering

## Model Features

The following lists the features used to train the machine learning models, please note each row in the data represents a single property:

| Feature | Description |
|---|---|
| Average Daily Consumption (avg_daily_consumption) | The median average daily consumption of the customer. |
| Average Weekday Consumption (average_weekday_consumption) | The median average daily consumption of the customer during the weekdays. |
| Weekend Average Daily Consumption (weekend_avg_daily_consumption) | The median average daily consumption of the customer during the weekends. |
| Night Average Daily Consumption (night_avg_daily_consumption) | The median average daily night time consumption of the customer between the hours of 12am to 6am. |
| Morning Average Daily Consumption (morning_avg_daily_consumption) | The median average daily morning consumption of the customer between the hours of 6am to 12pm. |
| Afternoon Average Daily Consumption (afternoon_avg_daily_consumption) | The median average daily afternoon consumption of the customer between the hours of 12pm and 6pm. |
| Evening Average Daily Consumption (evening_avg_daily_consumption) | The median average daily afternoon consumption of the customer between the hours of 6pm and 12am. |

| | |
|---|---|
| Minimum Daily Consumption (min_daily_consumption) | The minimum average daily consumption of the customer. |
| Maximum Daily Consumption (max_daily_consumption) | The maximum average daily consumption of the customer. |
| Minimum 30 Minute Consumption (min_30min_consumption) | The minimum 30 minute consumption. |
| Maximum 30 Minute Consumption (max_30min_consumption) | The maximum 30 minute consumption. |
| Winter Daily Consumption (winter_daily_consumption) | The median average daily afternoon consumption of the customer during the winter period. |
| Spring Daily Consumption (spring_daily_consumption) | The median average daily afternoon consumption of the customer during the spring period. |
| Summer Daily Consumption (summer_daily_consumption) | The median average daily afternoon consumption of the customer during the summer period. |
| Autumn Daily Consumption (autumn_daily_consumption) | The median average daily afternoon consumption of the customer during the autumn period. |
| Average Daily Public Holiday Consumption (avg_daily_public_holiday_consumption) | The median average daily public holiday consumption of the customer. |
| Average Daily School Holiday Consumption (avg_daily_school_holiday_consumption) | The median average daily school holiday consumption of the customer. |
| Average Daily Non Public Holiday Consumption (avg_daily_non_public_holiday_consumption) | The median average daily NON public holiday consumption of the customer. |
| Average Daily Non School Holiday Consumption (avg_daily_non_school_holiday_consumption) | The median average daily NON school holiday consumption of the customer. |

| | |
|---|---|
| Average Standard Deviation Daily Consumption (avg_std_daily_consumption) | The average standard deviation of the daily consumption of each customer. |
| Average Daily Minimum Night Flow (avg_daily_min_night_flow) | The average minimum night flow of the daily consumption of each customer. |

# Modelling

## Selected Model & Evaluation

There were four clustering algorithms utilized in order to segment and discover distinct customer groups in the data based on their usage behaviour:

1. K Means (Evaluated using the Silhouette Score)
2. Agglomerative Clustering (Evaluated using the Davies Bouldin Score)
3. Gaussian Mixture (Evaluated using the Silhouette Score)
4. DB Scan (Evaluated using the Silhouette Score)

The algorithms were trained to detect up to (k=10) 10 clusters or customers segments, the number of segments by the relevant evaluation score charts are shown below (Figure 6):

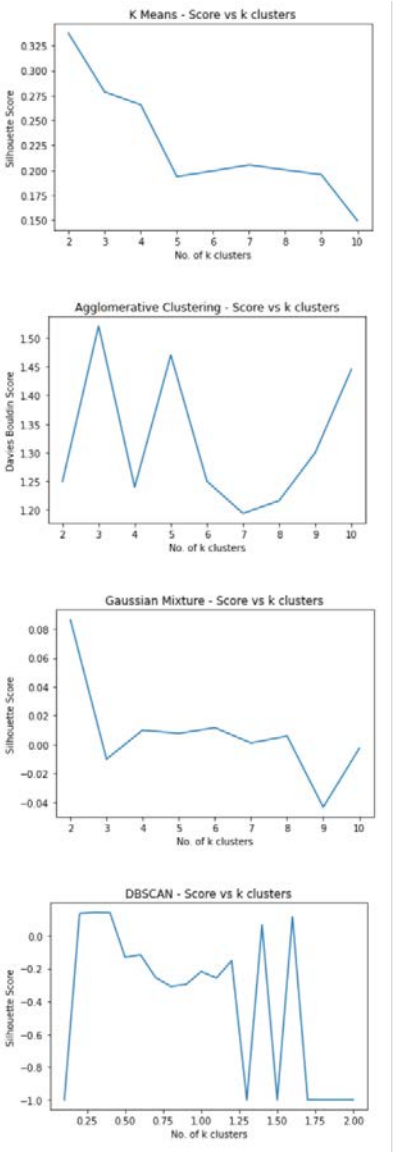



*Figure 6*

The Agglomerate Clustering model along with 6 clusters (k=6) was chosen as this appeared to have the best distribution of customers per cluster across both sites and also has one of the lowest Davies Bouldin Score indicating a higher quality clustering of the customers. See figure 7 and 8.

| cluster | meter_serial |
|---|---|
| 0 | 23 |
| 1 | 588 |
| 2 | 78 |
| 3 | 163 |
| 4 | 415 |
| 5 | 80 |

*Figure 7*

| site | cluster | meter_serial |
|---|---|---|
| Bidwell | 0 | 17 |
| Bidwell | 1 | 391 |
| Bidwell | 2 | 53 |
| Bidwell | 3 | 124 |
| Bidwell | 4 | 257 |
| Bidwell | 5 | 44 |
| Bishop Stortford | 0 | 6 |
| Bishop Stortford | 1 | 197 |
| Bishop Stortford | 2 | 25 |
| Bishop Stortford | 3 | 39 |
| Bishop Stortford | 4 | 158 |
| Bishop Stortford | 5 | 36 |

*Figure 8*

# Model Application

# Model Cluster Descriptions and Analysis

Further analysis was carried out to determine the characteristics of the clusters and give them meaningful descriptions. Please note as Cluster 0 has a very low number of customers, further analysis may not be completely reliable for this group:

| Cluster Name | Cluster Description | Supporting Figures |
|---|---|---|
| Low Occupancy, Low Summer Consumption Households (Cluster 1) | These customers appear to consistently have low consumption across most metrics, which could indicate low occupancy households. As the average daily household consumption is nearly 150 litres per day per person, these are likely single person households. | Figure 9 |
| Stay at Home Households (Cluster 2) | This group has the highest night time (hours 0 to 6) average daily usage after cluster 3. They also generally have a consistent usage throughout the day (about 80 - 90 litres morning, afternoon and evening), which could indicate home workers, unemployed, elderly retired etc. | Figures 10 to 13 |
| High Occupancy, High Usage Households (Cluster 3) | This group appears to be high users as they consistently appear to have the highest consumption. This may indicate high occupancy households, families with children etc. This is further supported by the average public holiday consumption for these households to be higher than their non public holiday consumption, i.e. where children/workers may more likely be at home. | Figure 9, Figure 14, Figure 15 |
| Day Time Absent Households (Cluster 4) | These customers generally see a decrease in consumption during the afternoon, and then an increases in the evening, which could indicate that they are have members of the household that may go out to work during the day. | Figure 11, 12 and 13 |
| Low Occupancy, High Users (Cluster 5) | These customers may be low occupancy households but with high usage, as their usage is slightly higher than cluster 1, they also may have more occurrences of short interval high water usage e.g. max 30 minute consumption seems to vary the greatest between 250 to 430 litres on average per day. | Figure 9, Figure 16 |

The following shows supporting figures for the analysis in the table above:

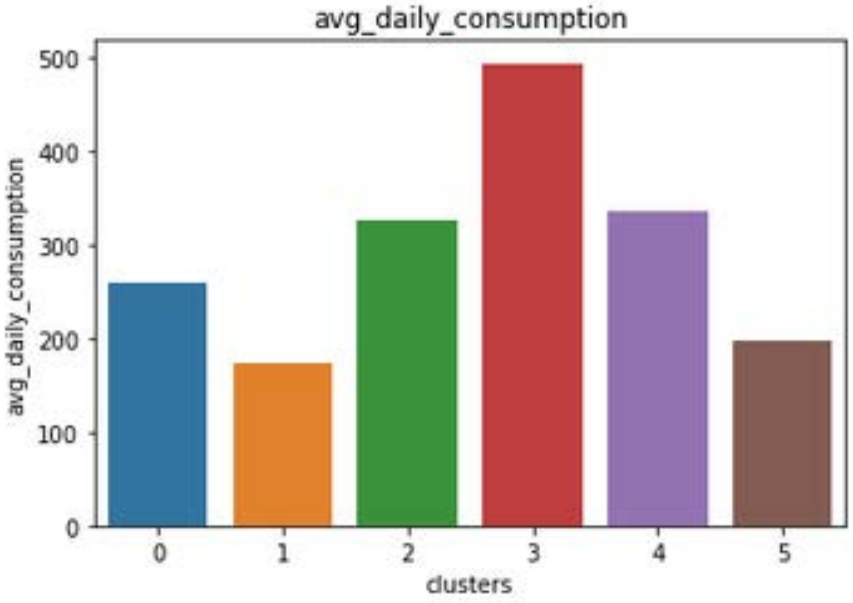



*Figure 9: Average Daily Consumption by Cluster*

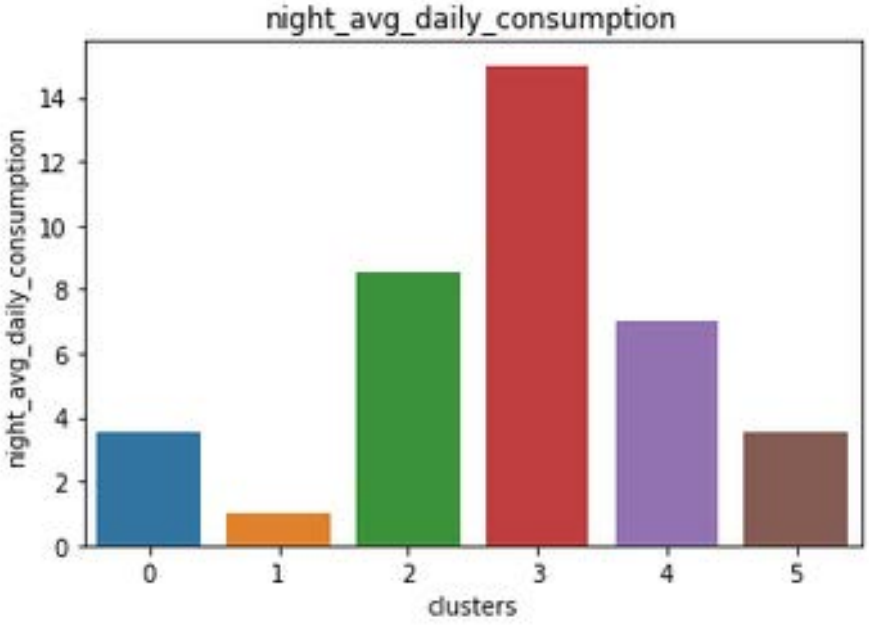



*Figure 10: Average Daily Night Time Consumption by Cluster*

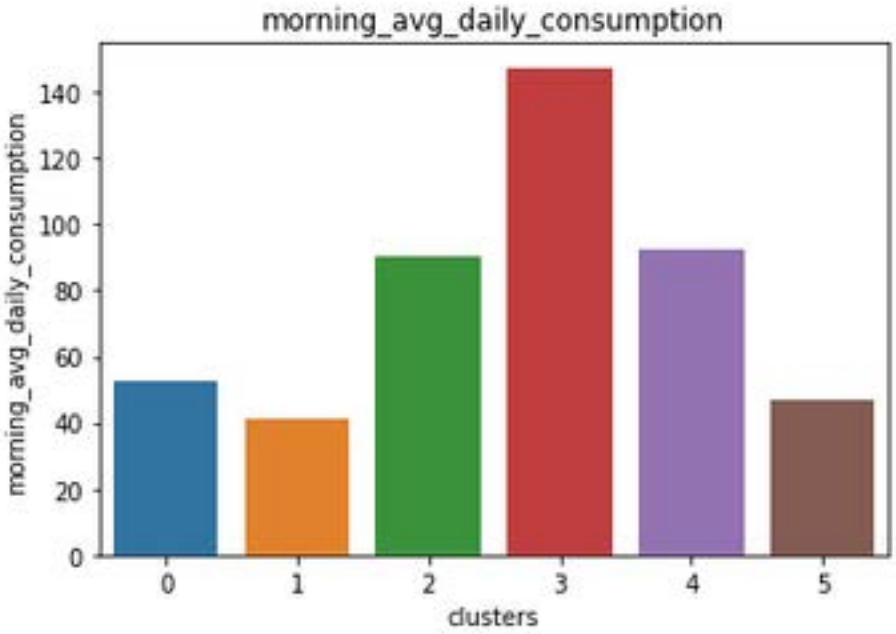



*Figure 11: Average Daily Morning Time Consumption by Cluster*

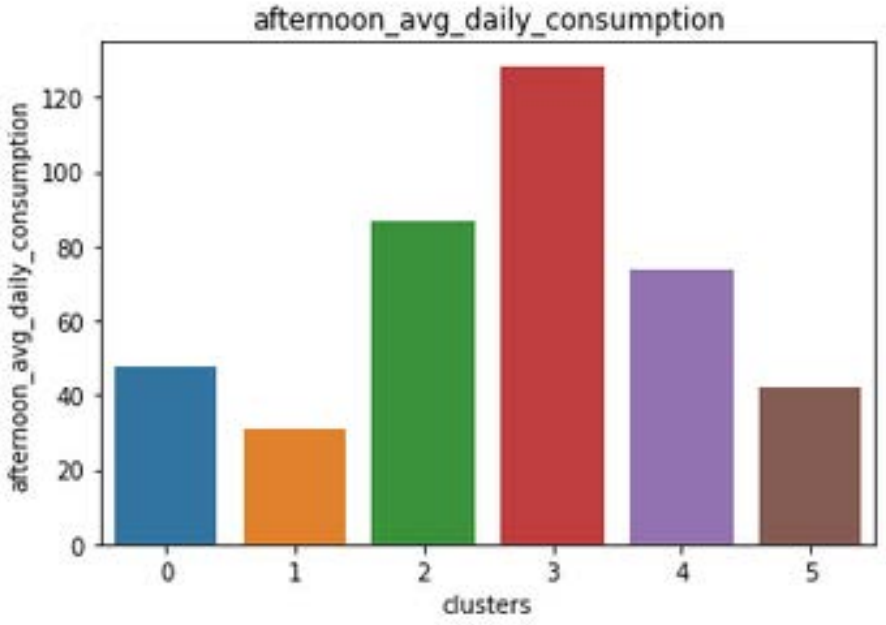



*Figure 12: Average Daily Afternoon Time Consumption by Cluster*

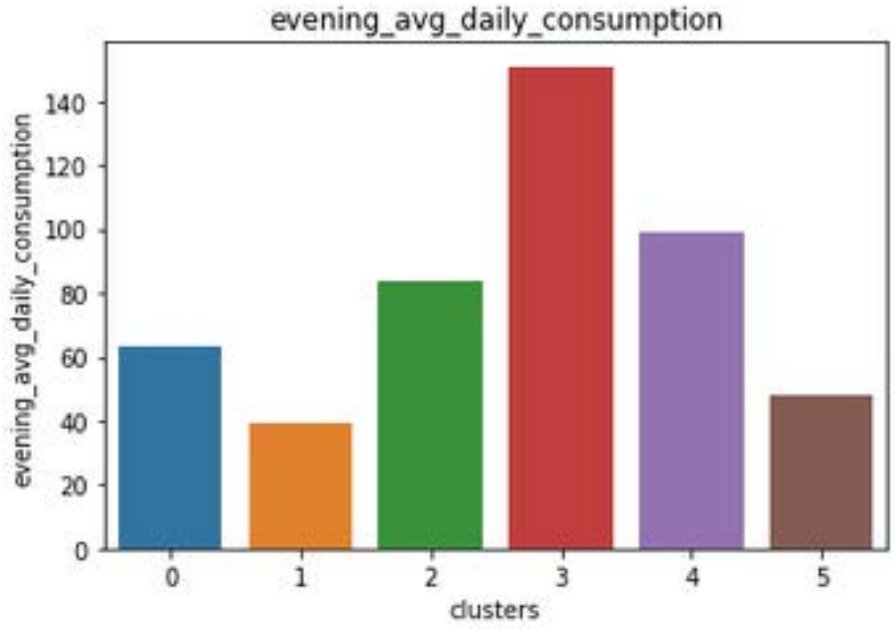



*Figure 13: Average Daily Evening Time Consumption by Cluster*

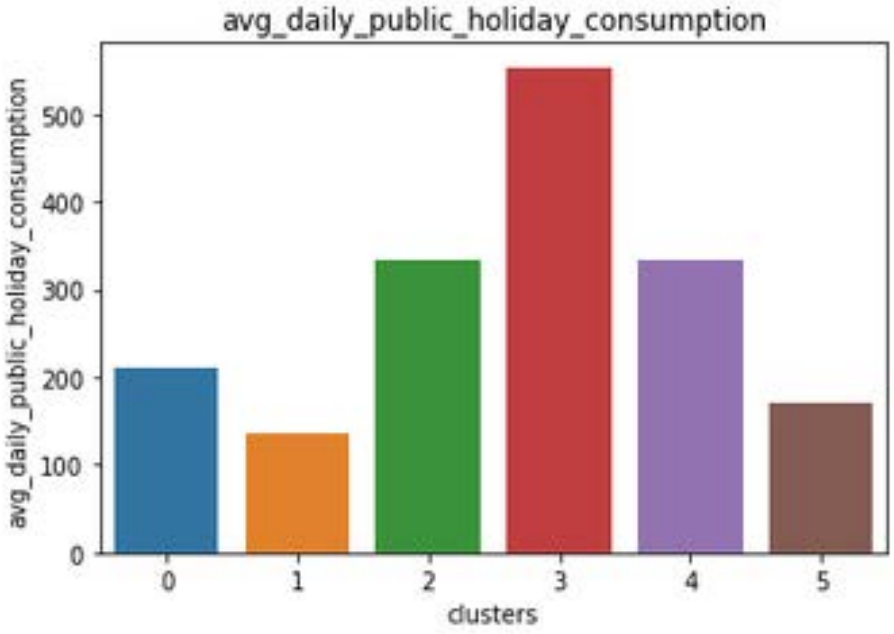



*Figure 14: Average Daily Public Holiday Consumption*

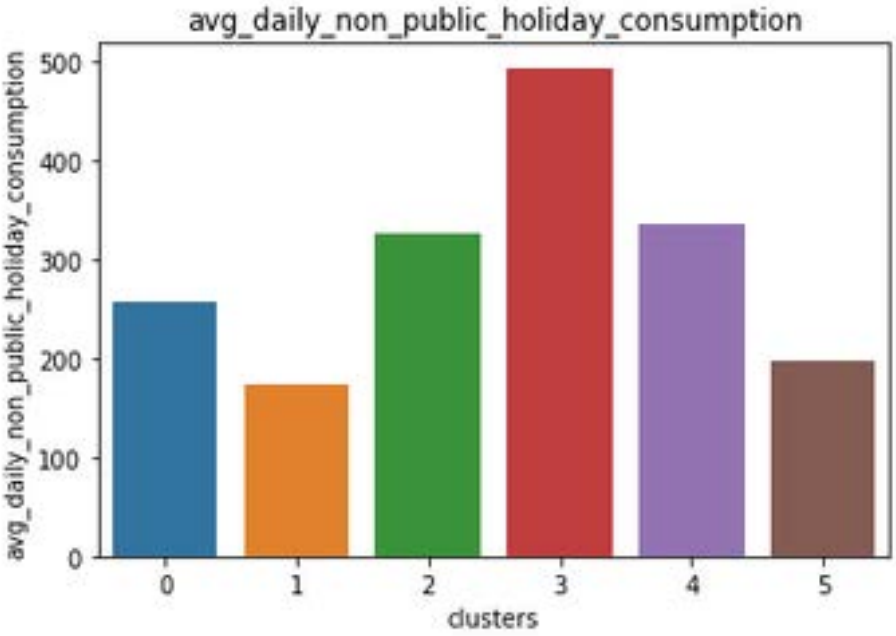



*Figure 15: Average Daily NON public Holiday Consumption*

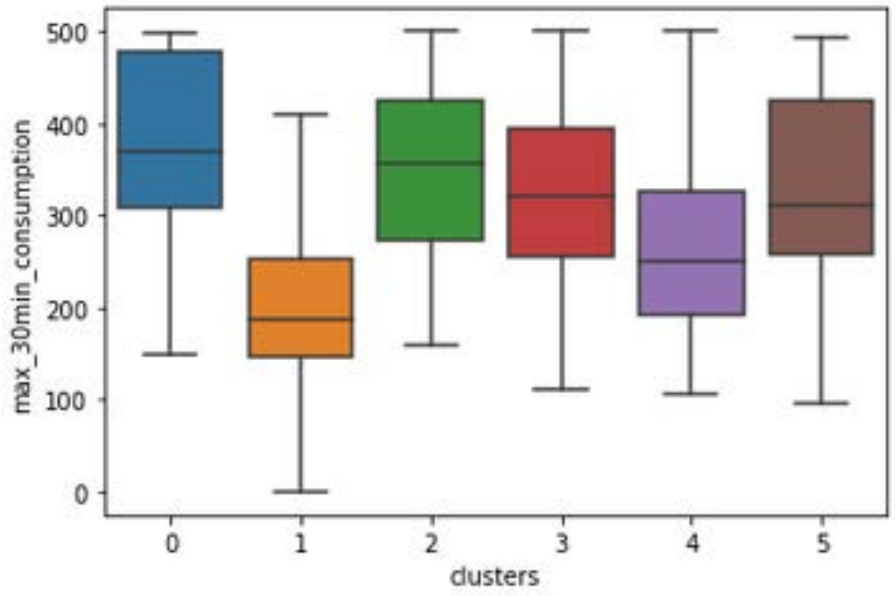



*Figure 16: Maximum 30 Minute Consumption Boxplots by Cluster*

# APPENDIX II: DAILY EXPECTED CONSUMPTION MODELS

## Overview

In order to understand the impact of the Bidwell Water Savers campaign and to determine whether or not customers in the Bidwell site saved water via the adjustment of their water use behaviour, state of the art artificial intelligence (AI) deep learning models were developed to learn the water use behaviour of customers prior to the campaign, taking into account factors such as weather, time of week (weekend vs weekday), public holidays and other known time varying factors and then subsequently use these models to predict the customers expected consumption during the campaign period, effectively simulating the scenario of the water saving campaign not taking place. The average difference between the predicted expected consumption and the actual consumption of customers during the campaign will identify whether or not individual customers have made water savings, how much have they saved and approximately when they made those savings.

## Model Training

## Data Preparation

### Data Sources

- Bidwell and Bishop Stortford consumption data
- Publicly available holiday data
- Weather data (Visual Crossing)

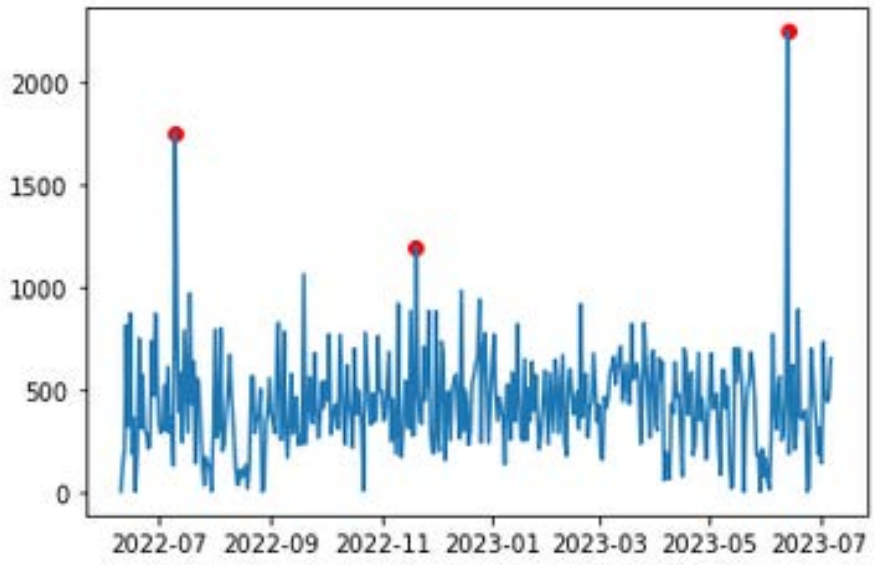
### Data Transformations

The below lists the key data transformations in order to prepare it for modelling:

- AI models typically require sufficient historical data for the model to learn previous patterns hidden within the data so that it can make satisfactory predictions. In order to facilitate this, properties with sufficient historical data can be modelled only. Ideally in time series modelling where annual seasonality is a key influencer, a years worth of data is prefered, however we have tried to relax this requirement sacrificing some predictive power in order to retain as many properties as possible for modelling.
- Sufficient property consumption has been somewhat arbitrarily defined as properties with a minimum history of 8 months prior to April 2023 i.e. start of the

water saving campaign, and at least one month of post campaign data from the start of the campaign.

- Pre move in consumption is removed.
- Duplicate records in the data have been removed, e.g. where there is more than one consumption read for the same customer at the exact same date and time.
- Negative consumption occurrences has been set to zero.
- The consumption has been aggregated to a daily level.
- Initial basic outlier detection is applied where any consumption above 3000 litres in a single day is identified and replaced with the average daily property consumption.
- Missing days were identified for each customer, and consumption was set to 0 in these days for each customer. Please note there was usually a large spike in consumption just after the missing days indicating that the meter may have failed to make a reading for a specific period however recovered and took the reading for whole missing period, so a more accurate way to deal with this may be possible, however this method has been used due to time limitations.
- Any leading 0 consumption days in the meter history of each customer has been removed.
- Utilising only pre campaign data i.e. consumption data prior to April 2023 is considered for training.
- Customers with an extended period of low consumption are removed. This is defined as customers with 3 or more months where the consumption is less than 500 litres in a single month, in their consumption history. These customers are removed because it is very difficult to model customer consumption if they have large gaps in their consumption history.
- An anomaly detection model called the Median Absolute Deviation (MAD) was utilised for it's speed and simplicity in use, in order to identify anomalous consumption values for individual properties. This algorithm identifies outliers by identifying data points that differ significantly to their median consumption. An example of the application of this algorithm on one property is shown below:




- Anomalies are replaced by the consumption value 7 days ago.
- Any remaining missing values are filled by the property's median consumption.
- Relevant features for training the machine learning models (please see feature engineering section)
- The impact of exclusions carried out on the overall no. of properties that can be modelled is summarized in the table below:

| Criteria Applied | Bidwell Properties |
|---|---|
| Total initial properties available in Bidwell | 956 |
| Total no. of properties with sufficient meter read history | 462 |
| Total no. of properties with sufficient meter read history and removing customers with extended period of low consumption | 433 |
| Total no. of properties eligible for modelling | 433 |

- A further check was carried on the properties eligible for modelling for the no. of customers who have taken a pledge in Bidwell:

| Description | Bidwell Pledge Customers |
|---|---|
| Total no. of properties who have pledged | 318 |
| Total no. of properties who have pledged with a known meter serial | 300 |
| Total no. of properties who have pledged suitable for modelling | 113 |

### Deep Learning Specific Data Transformations

The preferred modelling approach taken was to utilise deep learning models, chosen for their state of the art skill in time series modelling as attested to by the latest research. As such further data transformations are required in order for the data to be trained utilising these models:

- These models only accept 3D tensors of the shape [samples, timesteps, features], data was converted to match this requirement.
- Each sample contained 7 days as the timesteps.
- The model was trained to predict the next 7 days as output for each input sample.
- The last 56 days consumption prior to the campaign for each property was taken as the test set, in order to test the model on unseen data.
- The consumption data prior (with exceptions mentioned previously) to that for each property was taken to train the models.
- Each property consumption data was fitted with it's own deep learning model, to ensure the model learned the idiosyncrasies of that particular household.
- The final datasets feeding the model were also normalized using a min/max scaler prior to training.

## Feature Engineering

### Model Features

The following lists the features used to train the deep learning models, the model utilises 60 features:

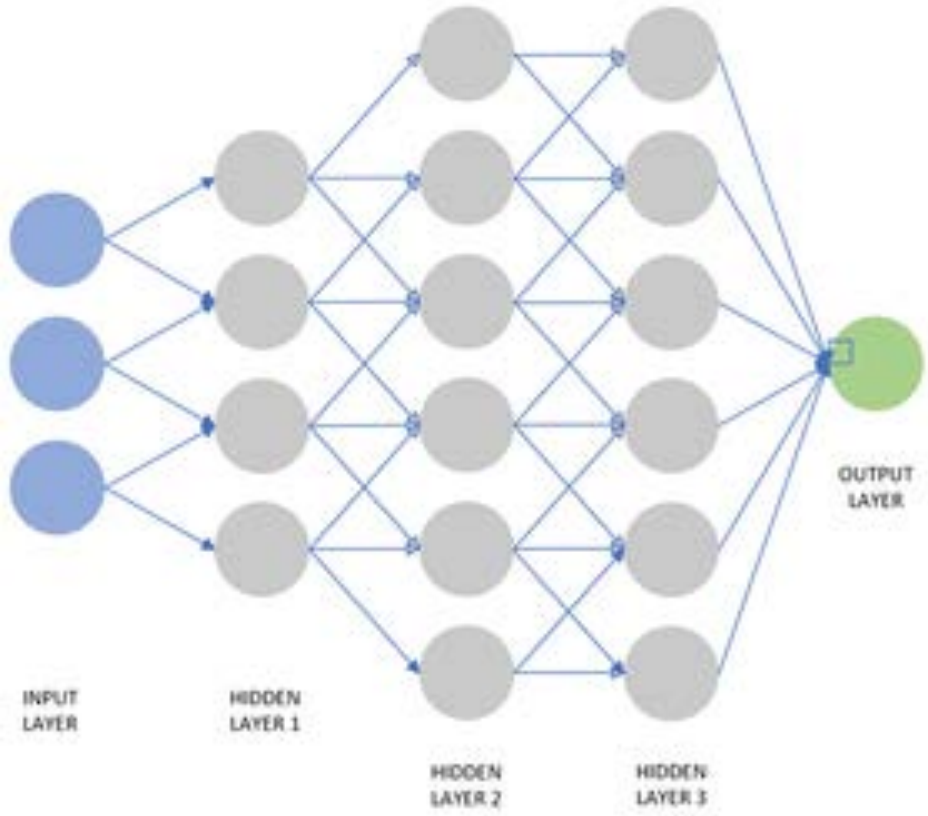
| Feature | Description |
|---|---|
| Consumption (l) | Daily property consumption |
| Wind speed | Three weather features, including the minimum, maximum and mean |
| Temperature | Three weather features, including the minimum, maximum and mean |
| Feels like | Three weather features, including the minimum, maximum and mean |
| Humidity | Three weather features, including the minimum, maximum and mean |
| Dew | Three weather features, including the minimum, maximum and mean |

| | |
|---|---|
| Visibility | Three weather features, including the minimum, maximum and mean |
| UV index | Three weather features, including the minimum, maximum and mean |
| Precipitation | Three weather features, including the minimum, maximum and mean |
| Is public holiday | Binary feature indicating whether or not the day is a public holiday |
| Is school holiday | Binary feature indicating whether or not the day is a school holiday |
| Is weekend | Binary feature indicating whether or not the day is a weekend |
| Day | 6 binary features indicating the day of the week, note last day is excluded as it is redundant. |
| Month | 11 binary features indicating the month of the year, note last month is excluded as it is redundant. |
| 30 day rolling statistics | 3 features representing the 30 day rolling daily consumption mean, standard deviation and median. |
| 14 day rolling statistics | 3 features representing the 14 day rolling daily consumption mean, standard deviation and median. |
| 10 day rolling statistics | 3 features representing the 10 day rolling daily consumption mean, standard deviation and median. |
| 7 day rolling statistics | 3 features representing the 7 day rolling daily consumption mean, standard deviation and median. |
| 3 day rolling statistics | 3 features representing the 3 day rolling daily consumption mean, standard deviation and median. |

# Modelling

## Selected Model

Deep learning models have been selected for addressing this challenge of predicting expected household water consumption because of it's unparalleled ability to discover intricate patterns and discover complex relationships in temporal data. Deep learning models are a type of artificial intelligence that have been inspired by the human brain's neural networks, these models usually contain multiple layers of interconnected nodes (at least 2), which enables them to learn from the various features of the input data. See figure below for a typical representation of a deep learning network.




For our purposes we will be utilising specific types of deep learning models optimised for solving time series problems, which are Convolutional Neural Network (CNNs) and Long Short-Term Memory (LSTM) networks.

## Prediction (Target Variable)

The target variables is a sequence of the next 7 days of daily consumption.

The 7-day predictions will be merged to the relevant feature dataset to predict the next 7 days in an iterative fashion until it covers the period of time required for analysis purposes., i.e. predictions will cover the campaign period between April 2023 to August 2023.

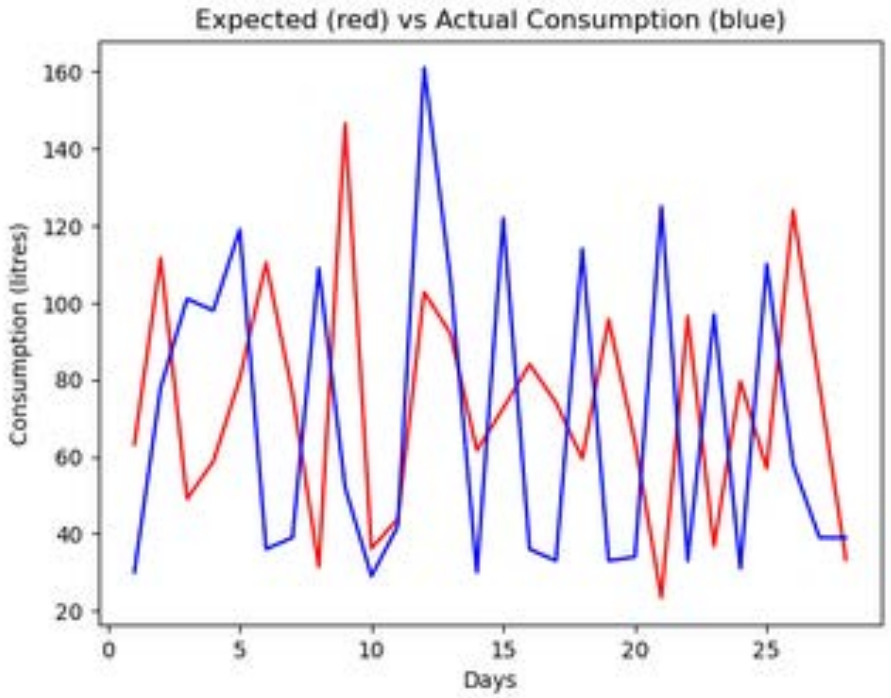
# Evaluation

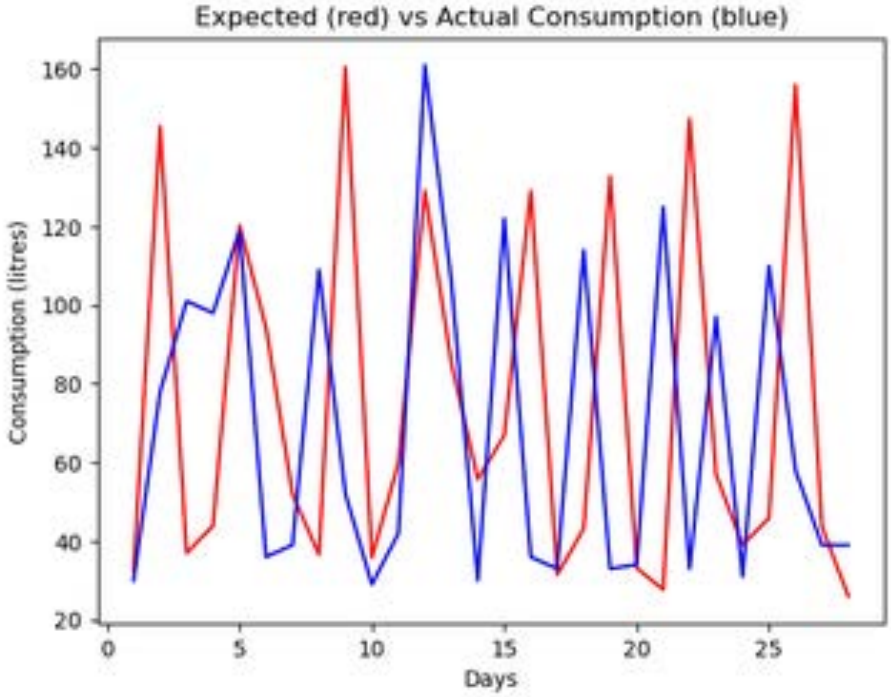
A number of deep learning models with various architectures were built and evaluated, three of these models are shown in the table below with the evaluation scores:

| Model No. | Model Architecture | Median RMSE | Mean RMSE | Standard Deviation RMSE |
|---|---|---|---|---|
| 1 | Multivariate CNN-LSTM Encoder Decoder Model | 130.6 | 147.8 | 83.0 |
| 2 | Multivariate Deep Convolutional Neural Network (3 layers) | 124.1 | 143.3 | 79.8 |
| 3 | Multivariate Encoder Decoder Model | 178 | 208.9 | 117.2 |

The RMSE is the root mean squared error of the model, this metric measures how far away on average the predictions are from the actual true values, a lower RMSE generally indicates a better performing model. Although from the above the second model appears to perform the best on this metric, a further verification step was carried out by inspecting the predictions visually in order to assess how well the predictions appeared to match the actual consumption.

Below shows the predictions vs actual consumption for the same property, the first chart shows this using model number 2, and the second chart shows the same for model number 1:

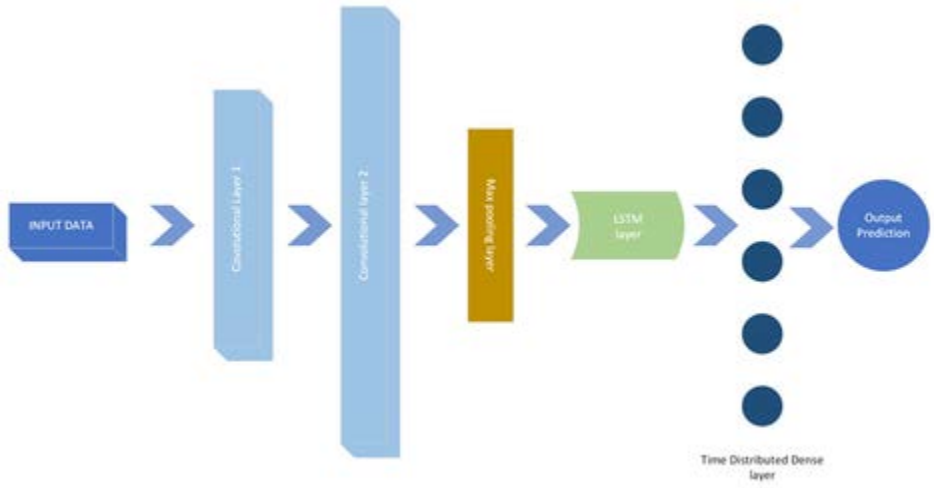



As you can see, although the RMSE tends to be better for model 2, the predictions do not look visually as accurate as model number 1, as model 1 appears to predict peaks in consumption more robustly, albeit with with either a lag or lead of the predicted peaks and troughs out by roughly a day in this case.

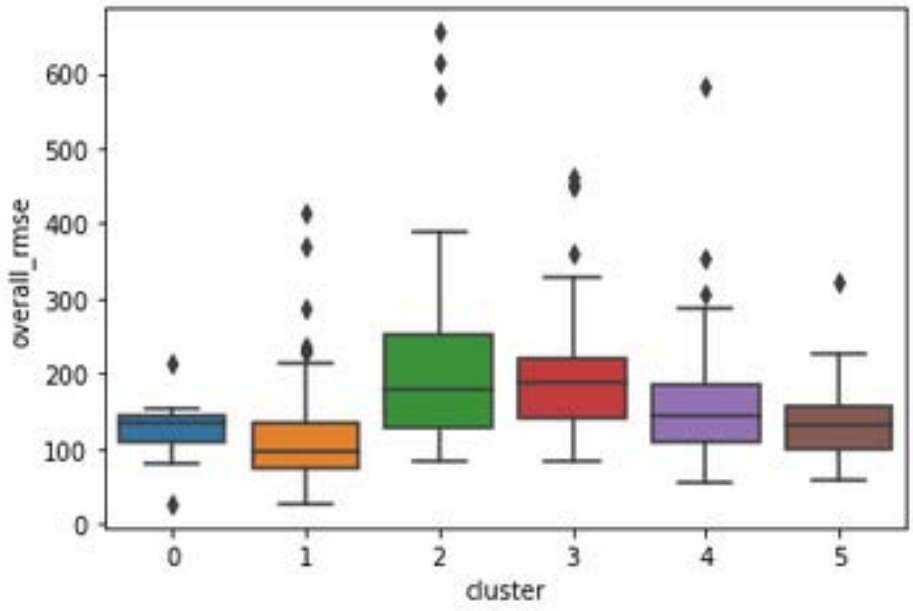
# Model Selection

The model selected based on both a good RMSE performance and further visual verification was Model 1. A visual representation of the technical neural network architecture is shown below:




The median RMSE seems to be quite high, however this can be explained by the following factors:

- Predicting peak usage on the exact days that this occurs every week, is difficult due to the variability in habits and schedules, e.g. a person may vary when they decide to do their weekly wash using their washing machine.
- The RMSE is the median for all types of households, and RMSE is typically lower for households that utilise less water, below shows RMSE boxplots by cluster identified by the clustering algorithm:




- As this is a new housing development, there is a lack of historical data available for training the models, as such the data utilised for the testing the data was also very limited, this can also contribute to the high RMSE seen.
- As mentioned previously RMSE is not the sole way to evaluate a model, visual inspection is also required to validate the predictions.

To mitigate for this in the savings calculations the average daily consumption between the expected and actual were compared in the relevant time interval, rather than comparing the expected and actual by individual same days.

# APPENDIX III: BALANCE TESTING FOR ASSESSING CONTROL GROUP

## Overview

The first key requirement of the project is to assess the validity of the selected control group Bishop Stortford as a fair comparison to the test site Bidwell, and to make further adjustments to the control group where necessary if it initially does not meet that criteria.

## Balance Tests

In order to evaluate the control group, statistical balance testing is carried out to determine whether or not there is a statistically significant difference between the consumption at both sites. This is carried for various test site grouping including:

1. Overall site level for all customers in the test group vs control
2. All Pledge taking customers in the test group vs control
3. All Non Pledge taking customers in the test group vs control
4. All Pledge sub types vs control
5. All Wizso trial customers in the test group vs control

If the test site grouping fails the balance test and their consumption is statistically significantly different from the control site then via the utilisation of the customer segments identified by the clustering algorithm, a new control group is selected by choosing customers from the control group that most closely resemble the test group in question, finally another balance test is carried out to confirm that there is no statistically significant difference between the test and curated control groups.

## Data Preparation

### Data Transformations

The below lists the key data transformations in order to prepare it for modelling:

- Combine both test and control group consumption data
- Removing duplication in the data, ensuring single consumption value for a single meter serial per date and time.
- Removing outliers in consumption data, arbitrarily setting maximum permissible consumption in a 30 minute period to be 500 litres, as very few activities could consume more than this amount of water within this period.
- Removing any periods with a negative consumption.

- Utilising only 6 months of pre campaign consumption data from the period of October 2022 to March 2023, as including more data prior to this seemed to decrease the sample sizes.
- Aggregating the data to a median consumption value per customer in this period

Any customers with 0 median consumption were removed.

# Balance Tests and Curated Control Groups

The consumption distributions were first checked in order to see if they met the requirements for a normal distribution, then either a parametric or non-parametric test was carried out for the balance test to check whether or not there was a statistically significant difference between the test and control groups. A curated control group was then created if required.

# Overall site level for all customers in the test group vs control

The results of the balance test showed that overall there is no statistically significant different when comparing the overall test group site customers to the control group as indicated by the results of both the t test and non-parametric Mann Whitney test (significance level 5%), the former of which should be relied on as the Q-Q plots seemed to indicate the absence of a strong normal distribution.

Sample sizes and summary statistics:

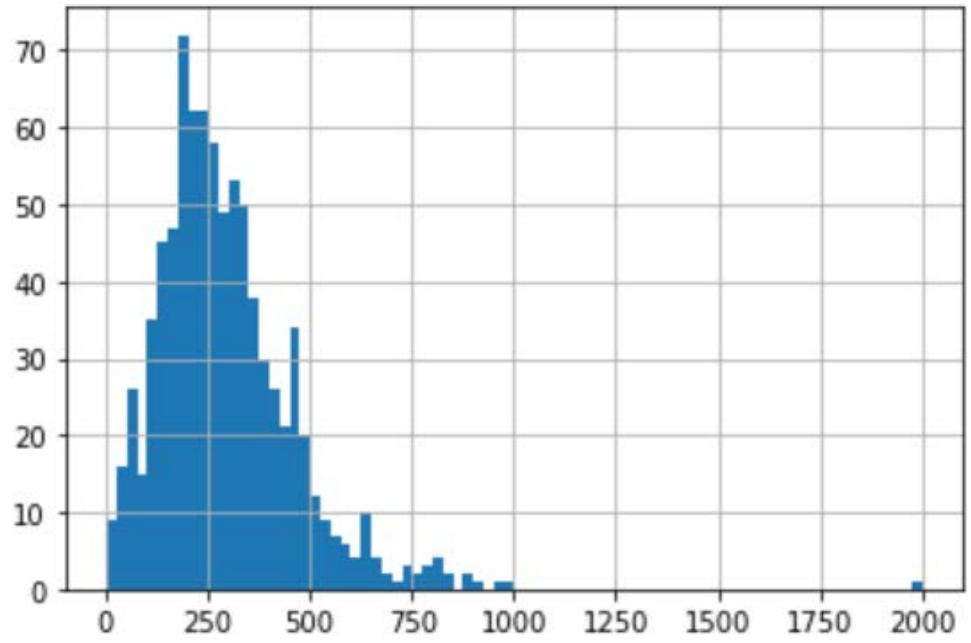
| Site | Sample Size (After Relevant Transformations) | Mean Consumption (Litres Per Property Per Day) | Standard Deviation Consumption (Litres Per Property Per Day) | Median Consumption (Litres Per Property Per Day) |
|---|---|---|---|---|
| Bidwell | 843 | 292.7 | 170.6 | 261 |
| Bishop Stortford | 443 | 278.3 | 138.1 | 265.5 |

Statistical Testing Results:

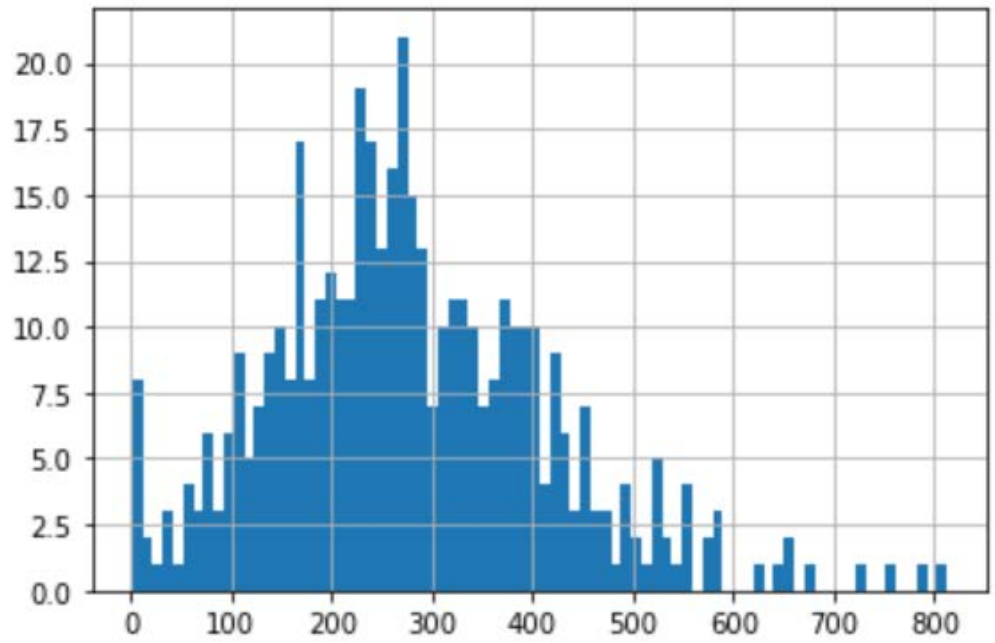
| Statistical Test | Statistic (T statistic) | P-value |
|---|---|---|
| Independent T Test | 1.53 | 0.13 |
| Mann Whitney | 189777.5 | 0.63 |

Histograms and Q-Q Plots for Normality:

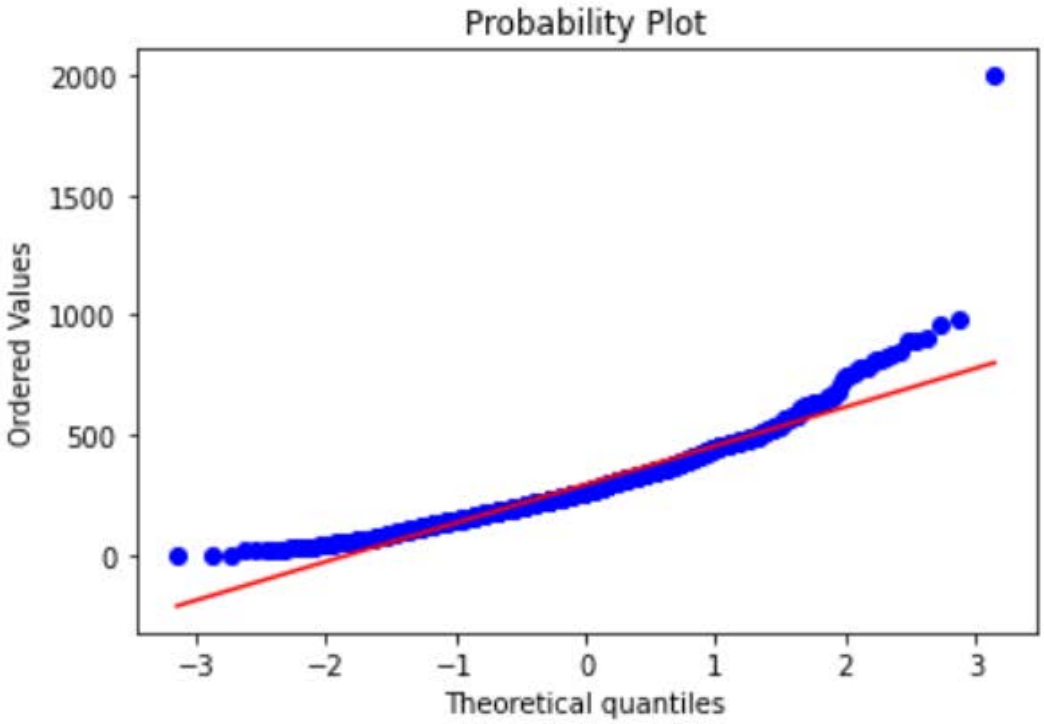
Bidwell histogram



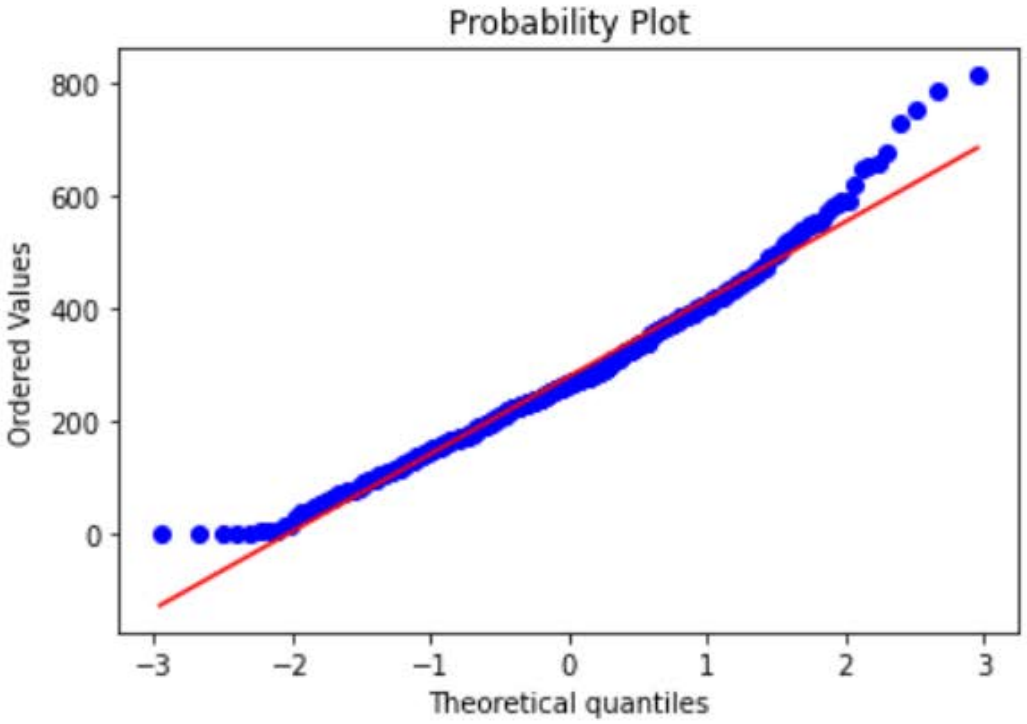

Bishop Stortford



Bidwell Q-Q plot




Bishop Stortford Q-Q plot



# Pledge Test vs Curated Control Groups

The customers who have taken a pledge and have qualified for comparison against the control are 216 customers. When compared against the 443 customers in the control site, the balance test shows there is a statistically significant difference between their consumption (significance level=0.5):

| Statistical Test | Statistic (T statistic) | P-value |
|---|---|---|
| Independent T Test | 3.01 | 0.003 |
| Mann Whitney | 53635.5 | 0.011 |

A new control group was curated for the test group site utilising segments identified by the clustering algorithm, ensuring the new control group contained a similar distribution of consumers as present in the test group, then another balance test is carried out to ensure the consumption of both the test group in question and the new curated control group are comparable, the results of which are below:

| Site | Sample Size (After Relevant Transformations) | Mean Consumption (Litres Per Property Per Day) | Standard Deviation Consumption (Litres Per Property Per Day) | Median Consumption (Litres Per Property Per Day) |
|---|---|---|---|---|
| Bidwell | 216 | 317.6 | 188.3 | 290.3 |
| Curated Bishop Stortford for Pledge Customers | 215 | 306.5 | 154.1 | 279.0 |

| Statistical Test | Statistic (T statistic) | P-value |
|---|---|---|
| Independent T Test | 0.67 | 0.51 |
| Mann Whitney | 23771.0 | 0.67 |

A breakdown of the sample sizes in the Bidwell and new curated control group from Bishop Stortford by the segments derived from the clustering algorithm is shown below:

| Segment No. | Segment Name | Bidwell pledge takers | Bishop Stortford Curated Control |
|---|---|---|---|
| 0 | Undefined (Small sample size) | 6 | 6 |
| 1 | Low Occupancy, Low Summer Consumption Households | 80 | 82 |
| 2 | Stay at Home Households | 12 | 12 |
| 3 | High Occupancy, High Usage Households | 40 | 38 |
| 4 | Day Time Absent Households | 67 | 67 |
| 5 | Low Occupancy, High Users | 11 | 10 |
| Total | | 216 | 215 |

## Non-Pledge Test vs Curated Control Groups

The customers who have not taken a pledge and have qualified for comparison against the control are 627 customers. When compared against the 443 customers in the control site, the balance test shows there is no statistically significant difference between their consumption (significance level=0.05), hence no further curated control group is required:

| Statistical Test | Statistic (T statistic) | P-value |
|---|---|---|
| Independent T Test | 0.62 | 0.54 |
| Mann Whitney | 136142.0 | 0.58 |

# Pledge Sub Types Test vs Curated Control Groups

When comparing customers who have taken a specific pledge to the control group, on all occasions the balance test failed hence further control groups needed to be created so fair comparison can be made, the new curated control groups were created by utilising the segments from the clustering algorithm:

| Pledge Taken | Bidwell Test Sample Size | Bishop Stortford Curated Control Group Size | Balance Test Result (p value, significance level 0.05, via Mann Whitney) |
|---|---|---|---|
| Wash up in a bowl | 18 | 18 | 0.45 |
| Washing machine eco mode | 24 | 24 | 0.54 |
| Fill the bath less | 7 | 7 | 0.699 |
| Shower for less time | 16 | 16 | 0.60 |
| Low flush button when flushing toilet | 19 | 19 | 0.48 |
| Turn tap off when brushing teeth | 26 | 26 | 0.77 |
| Watering Can | 64 | 64 | 0.55 |
| Wash car with bucket | 18 | 18 | 0.78 |

Please note customers who had taken multiple pledges had been excluded from this analysis as it is very difficult to ascertain which pledge had the most impact for these customers.

# Wizso Trial Test vs Curated Control Groups

Customers taking a pledge between the 13th of July to 21st of July, were regarded as customers on the Wizso Trial.

When comparing customers who have taken part in the Wizso trial to the control group, the balance test failed hence a new control group needed to be created so

fair comparison can be made, this was created by utilising the segments from the clustering algorithm:

| Site | Sample Size (After Relevant Transformations) | Mean Consumption (Litres Per Property Per Day) | Standard Deviation Consumption (Litres Per Property Per Day) | Median Consumption (Litres Per Property Per Day) |
|---|---|---|---|---|
| Bidwell | 120 | 332.6 | 159.9 | 304.75 |
| Curated Bishop Stortford for Wizso Trial | 117 | 333.8 | 153.3 | 311.0 |

| Statistical Test | Statistic (T statistic) | P-value |
|---|---|---|
| Independent T Test | -0.060 | 0.95 |
| Mann Whitney | 7008.5 | 0.98 |

# APPENDIX IV: SAVINGS ANALYSIS

## Methodology

In order to calculate the impact of the Bidwell Water Savers campaign, two main methods have been employed:

1. Calculating savings at an individual property level comparing the properties actual consumption to their expected consumption during the relevant campaign period.
2. Calculating savings of the relevant cohort of customers at Bidwell by comparing them to the relevant comparable curated subset of the control group at Bishop Stortford.

Savings have then been calculated for the following main segments:

1. Pledge taking Households
2. Non Pledge taking Households
3. Different Pledge Groups
4. Wizso Trial Customers
5. Close out survey
6. Overall site level

## Additional Considerations

### Expected Consumption Model

The following are additional data preparation and technical details pertaining to calculating the savings utilising the predictive model:

- The campaign period expected consumption is calculated for each household, by using the model specific to each property to cycle through this period and predict the expected consumption, utilising the predicted consumption with actual features as input for the next cycle of predictions.
- Please note prior to calculating savings, where the customers actual consumption is zero on a single day, it is assumed the customer was not present at home, hence the predicted expected consumption has also manually been set to zero.
- Where the customer had a zero average actual consumption for the relevant campaign period, they were excluded from the analysis.
- The savings for households who have taken a pledge have been determined by comparing the predicted to the expected consumption of these customers post their earliest known pledge date. This is assuming these

customers made the most significant changes in behaviour after making their pledge.

- As for households who have not taken a pledge, the comparison between expected and actual consumption was carried out for their consumption from the start of the Bidwell Water Savers campaign on the 8th of April 2023.
- The savings for each household was calculated by comparing the overall expected consumption with the actual consumption in the relevant period and taking the average difference in average litres per day for each property.
- The overall savings for the relevant group was then calculated by taking the median litres per day difference of households with a reduction in consumption to obtain a final median average litres per property per day savings figure.
- A similar method was followed to calculate savings month on month during the campaign period.
- Wizso trial customers were considered to be those that had taken a pledge from the 13th of July 2023 to 21st of July 2023.

## Control Group via statistical testing

The following are additional data preparation and technical details pertaining to calculating the savings utilising the control group via traditional statistical methods:

- Households that have not been clustered are not included, these are typically households with no consumption prior to the campaign.
- The underlying distributions of both the control and test groups were examined to identify whether or not these were normal distributions. This was carried out by visually inspecting the Q-Q plot and histograms.
- Due to most cases having a non normal underlying distribution, a non parametric test i.e. the Mann Whitney test was carried out to determine whether or not there was a statistically significant reduction in consumption.
- The actual reduction in consumption was determined by taking the difference of the median consumption of both the test and control group average household consumptions.
- For the analysis of pledges, the earliest pledge of the households was considered.
- Households who have taken a pledge, post pledge consumption was considered for each household.
- Households who had not taken a pledge, consumption considered during the campaign period between April to August is considered.
- The median consumption per household for both the test and control groups in the relevant period and excluding properties with a zero median consumption is prepared prior to carrying out the statistical test.
- In order to ensure a fairer comparison between the test and control group in particular for pledge taking households and the Wizso trial, the control group was provided with simulated pledge dates which are similar to the actual pledge dates by cluster of the test group.
- Wizso trial customers were considered to be those that had taken a pledge from the 13th of July 2023 to 21st of July 2023. Non Wizso customers were considered to be those pledges prior to 13th July 2023.

# Savings

The colour key for the savings results tables is shown below:

| | |
|---|---|
| | Predictive Model Results |
| | Statistical Test Results using non parametric Mann–Whitney Test |

The statistical significance levels are shown below for the statistical test:

| | |
|---|---|
| * | 30% significance level |
| ** | 20% significance level |
| ** * | 10% significance level |
| ** ** | 5% significance level |

The lower the significance level, the more confident we are that this is a real reduction in consumption as opposed to this reduction being explained by random chance.

## Pledge vs Non-Pledge taking Households

The table below shows the estimated savings of 3 of the main segments of households:

| Analysis Description | Total Modelled Households with non-zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings via Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings via Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Water use of pledge taking households | 105 | 58 | 55% | 32.9 | 174 | 205 | 9.25** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water use of Non-pledge taking households | 320 | 141 | 44% | 22.8 | 994 | 446 | 7.25** |

## Different Pledge Groups

The table below shows the estimated savings of different types of pledge the households had taken:

| Pledge Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Wash up in a bowl | 10 | 6 | 60% | 19.4 | 18 | 17 | 30.5** |
| Washing machine eco mode | 12 | 6 | 50% | 36.1 | 19 | 18 | 39.5* |
| Fill the bath less | 6 | 1 | 17% | 5.0 | 6 | 6 | 171.5* |
| Shower for less time | 9 | 5 | 56% | 33.8 | 18 | 14 | 80.5** |
| Low flush button when flushing toilet | 12 | 8 | 67% | 40.97 | 20 | 17 | 113.25*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Turn tap off when brushing teeth | 16 | 9 | 56% | 15.7 | 26 | 24 | 63.25* |
| Watering Can | 29 | 17 | 59% | 69 | 53 | 55 | 26.5* |
| Wash car with bucket | 11 | 6 | 55% | 37.8 | 13 | 16 | 2 |

## Wizso Trial

The table below shows the savings estimated from the Wizso trials; however, it is difficult to determine the actual impact of this trial because all of these customers took a pledge, and it is unclear how to separate out the savings.

| Pledge Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Wizso Trial | 59 | 35 | 59% | 51.1 | 99 | 122 | 7 |
| Non Wizso Trial | 46 | 23 | 50% | 15.7 | 85 | 89 | 43** ** |

## Close out survey

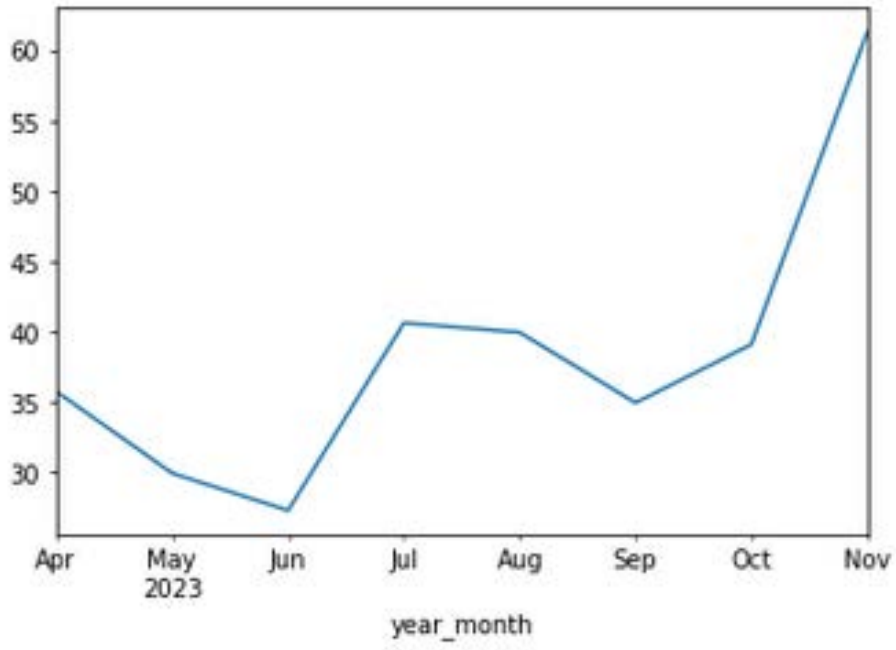
This was an online survey sent to all Bidwell residents to understand their behaviours and attitudes post-campaign.

The below shows savings estimated for cohorts from the close out survey:

| Analysis Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings via Expected Consumption (Average Litres Per Property Per Day) |
|---|---|---|---|---|
| Household took action not officially pledged | 8 | 5 | 63% | 47.0 |
| Households somewhat conscious of campaign | 10 | 6 | 60% | 40.7 |
| Households most conscious of campaign | 12 | 6 | 50% | 32.5 |
| Washing machine eco mode | 15 | 6 | 40% | 30.8 |
| Turn tap off when brushing teeth | 14 | 5 | 36% | 20.8 |
| Wash up in a bowl | 10 | 5 | 50% | 20.8 |
| Shower for less time | 15 | 8 | 53% | 33.9 |
| Low flush button when flushing toilet | 12 | 5 | 42% | 20.8 |
| Wash car with bucket | 8 | 5 | 63% | 47 |
| Fill the bath less | 12 | 5 | 42% | 47 |
| Watering Can | 8 | 4 | 50% | 33.9 |

## Savings month on month

The chart below shows the overall savings at a site level by month:




The number of properties estimated to be saving water based on their expected usage, this is the underlying data for the chart above.

| Month | Total Properties | Number of Properties Saving | % |
|---|---|---|---|
| 2023-04 | 433 | 209 | 48% |
| 2023-05 | 405 | 180 | 44% |
| 2023-06 | 398 | 160 | 40% |
| 2023-07 | 385 | 212 | 55% |
| 2023-08 | 382 | 198 | 52% |
| 2023-09 | 245 | 88 | 36% |
| 2023-10 | 124 | 54 | 44% |
| 2023-11 | 25 | 18 | 72% |

The July spike was due to the increased activity – door knocking/Wizso and pond dipping, plus the introduction of two new pledges.

## Bidwell West site level savings

The overall site level savings across the full campaign period is shown below:

| Description | Total Modelled Households with non zero actual consumption | Number of Households with Savings | Proportion of Customers with Savings | Savings vs Expected Consumption (Average Litres Per Property Per Day) | Bidwell Households (Test Group) | Bishop Stortford Households (Control Group) | Savings vs Control Group (Average Litres Per Property Per Day) |
|---|---|---|---|---|---|---|---|
| Overall all properties site level | 433 | 197 | 45% | 24.9 | 745 | 446 | 11.75** |

## Households not saving according to Expected Consumption Model

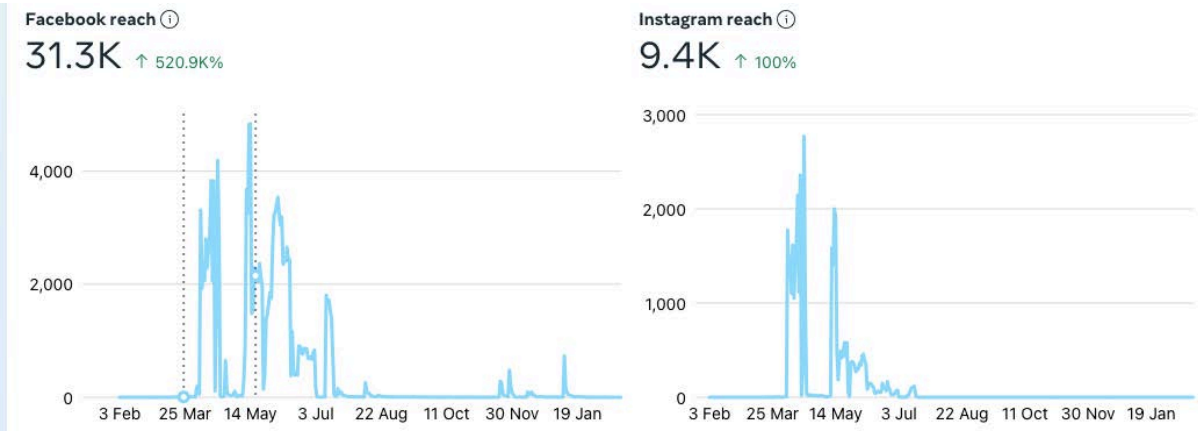
The level at which customers are not saving water according to the expected consumption model is shown below:

| Description | Total Modelled Households with non zero actual consumption | Number of Households with Non Savings | Proportion of Customers with Non Savings | Non Savings vs Expected Consumption (Average Litres Per Property Per Day) |
|---|---|---|---|---|
| Overall all properties site level | 433 | 236 | 55% | -32.7 |

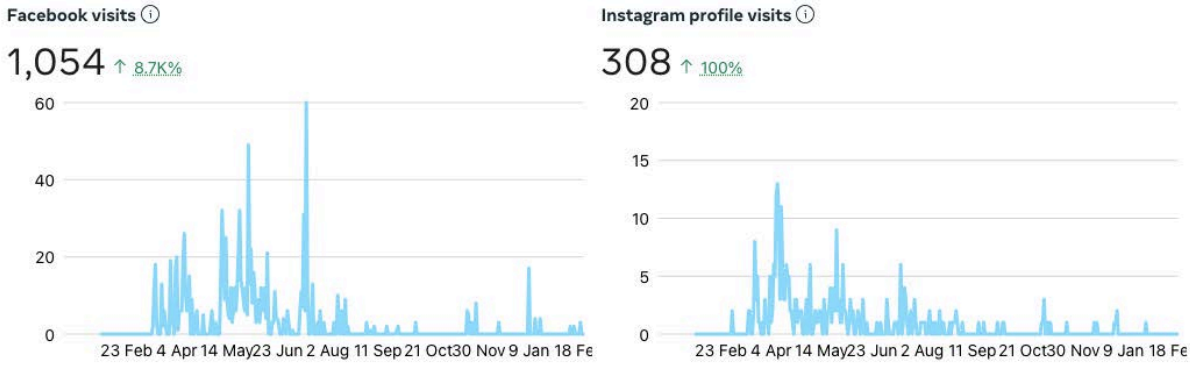
# APPENDIX V

Evaluation Framework supporting statistics and charts.

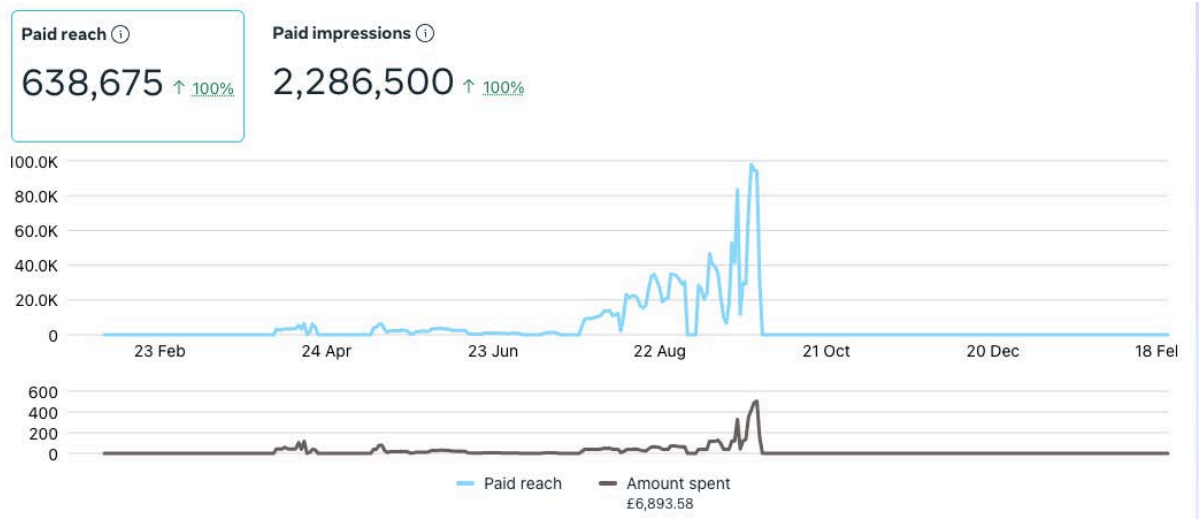
## Organic Reach



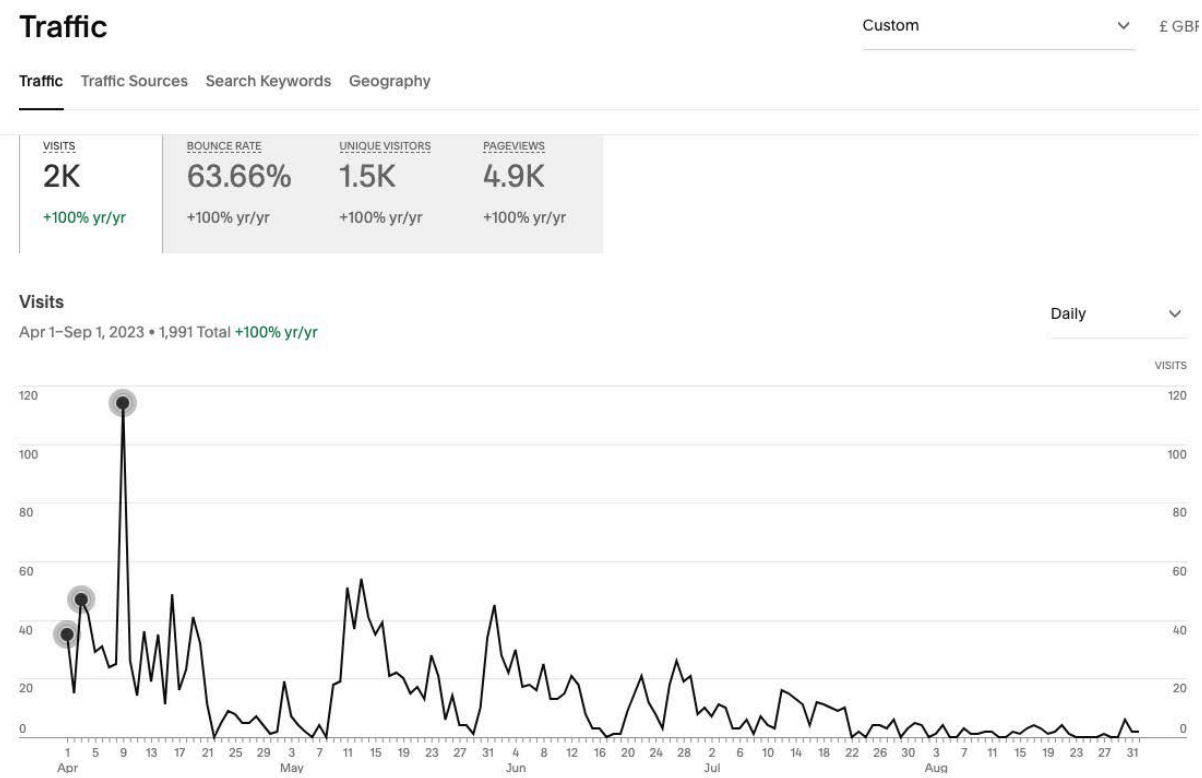

## Page / profile visits



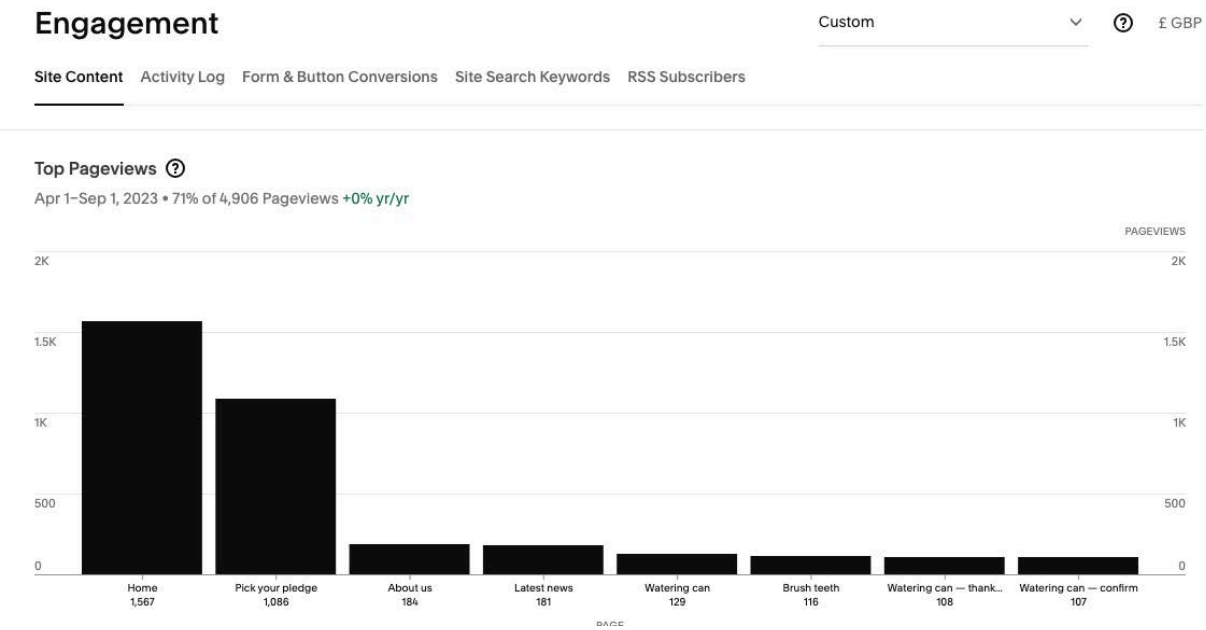
## Paid reach and impressions

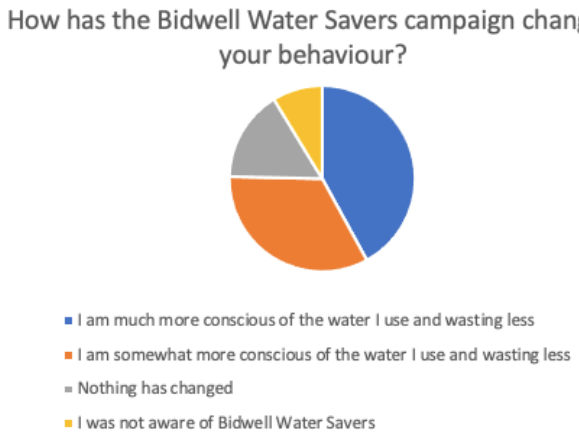


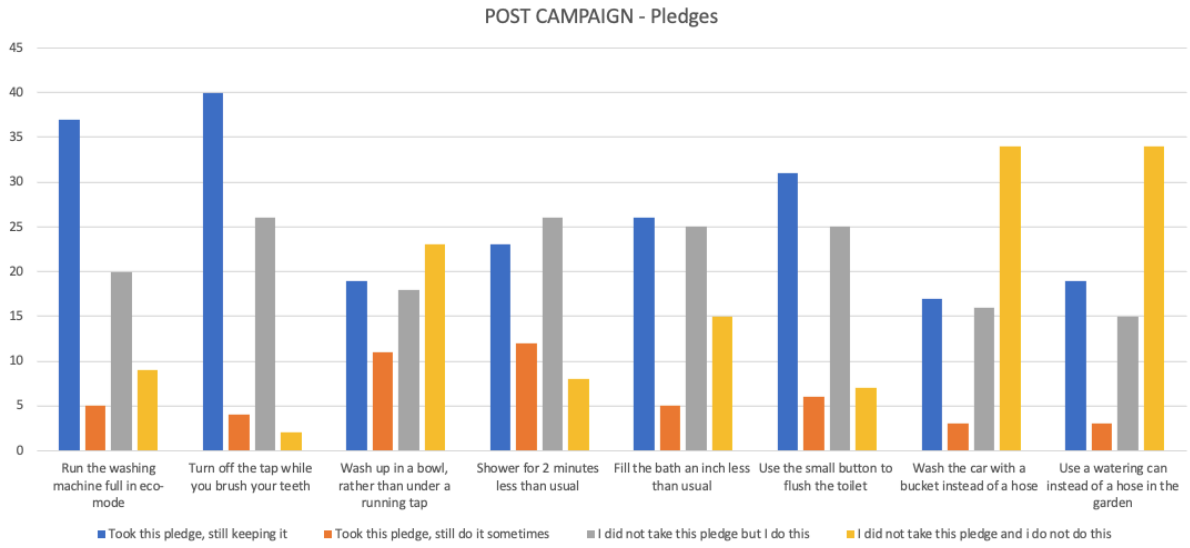

## Website traffic

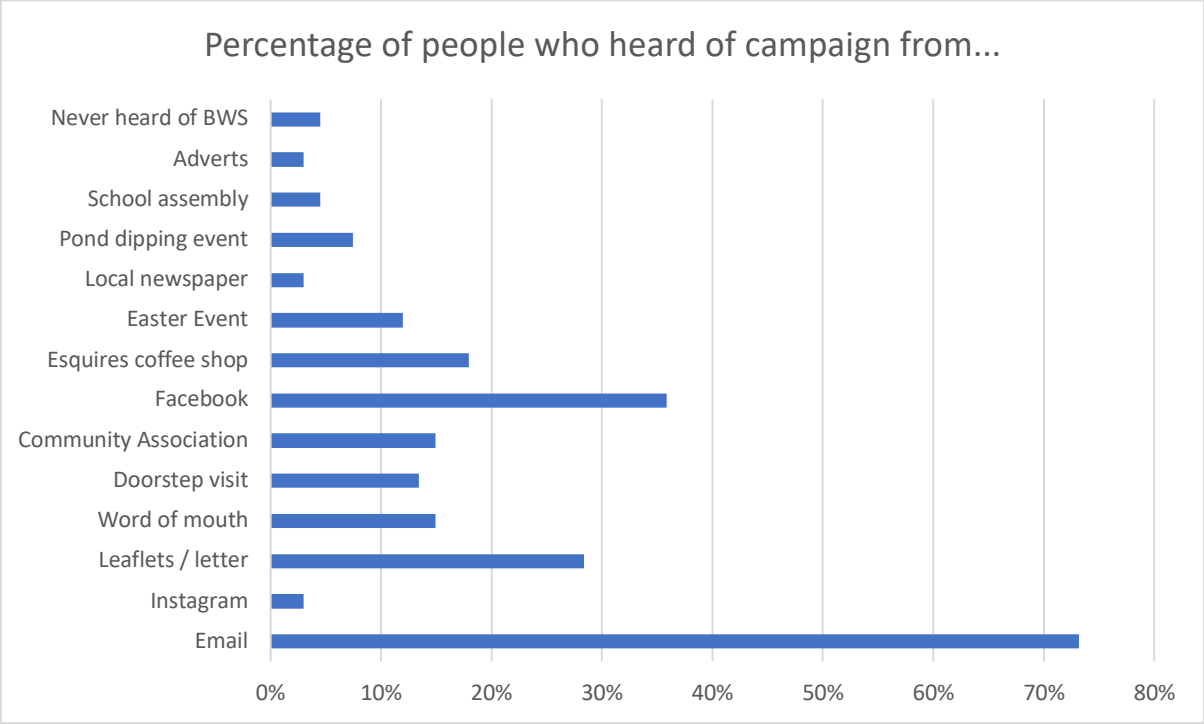


## Breakdown of website visits


POST CAMPAIGN - Pledges
45
40
35
30
25
20
15
10
5
0
Run the washing machine full in eco-mode
Turn off the tap while you brush your teeth
Wash up in a bowl, rather than under a running tap
Shower for 2 minutes less than usual
Fill the bath an inch less than usual
Use the small button to flush the toilet
Wash the car with a bucket instead of a hose
Use a watering can instead of a hose in the garden
Took this pledge, still keeping it
Took this pledge, still do it sometimes
I did not take this pledge but I do this
I did not take this pledge and i do not do this


Percentage of people who heard of campaign from...
Never heard of BWS
Adverts
School assembly
Pond dipping event
Local newspaper
Easter Event
Esquires coffee shop
Facebook
Community Association
Doorstep visit
Word of mouth
Leaflets / letter
Instagram
Email
0%
10%
20%
30%
40%
50%
60%
70%
80%

Where have you heard of the Bidwell Water Savers water saving campaign?

| Media | Percentage of people who heard of campaign from... |
|---|---|
| Email | **73%** |
| Instagram | **3%** |
| Leaflets / letter | **28%** |
| Word of mouth | **15%** |
| Doorstep visit | **13%** |
| Community Association | **15%** |
| Facebook | **36%** |
| Esquires coffee shop | **18%** |
| Easter Event | **12%** |
| Local newspaper | **3%** |
| Pond dipping event | **7%** |
| School assembly | **4%** |
| Adverts | **3%** |
| Never heard of BWS | **4%** |

n = 67

# APPENDIX VI: SUMMARY OF 1:2:1 EVALUATION INTERVIEWS

All interviews took place over video call between Cranfield University PHD student Harry Nicklin and residents of Bidwell West in December 2023 or January 2024. Interviewees were paid £30 each for their time. Most interviews lasted around 30 minutes. Identities have been concealed to protect the interviewees. Write up by Harry Nicklin, recordings are available upon request.

**Interviewee 1: (Male, wife and children)**

| ***Question*** | ***Answer*** |
|---|---|
| **Water using appliances and water saving habits?** | Dishwasher and washing machine, makes conscious effort to minimise waste |
| **Awareness of water use?** | Not really aware of volumes, can only estimate time spent in shower or doing dishes |
| **How they heard of water saving campaign?** | Took a pledge at in-person event easter time |
| **Which pledges?** | Using eco-mode and dual flush toilet. Didn't take other pledges because they didn't seem relevant |
| **How did behaviour change?** | Changed timing of doing washing to overnight to accommodate longer eco-mode setting, shared responsibilities with wife, behaviour was very easy to change and sustained. Previously was not using eco-mode so this was the biggest change |
| **Any behaviours they won't change?** | |
| **Feelings about water company?** | Positive – indifferent, feels that he has had engagement compared to previous water company but the bar is low |
| **Water company communication preferences?** | Wants more contact about billing, reminders about the pledges |

| | |
|---|---|
| **Use of water bills?** | Confusion over billing, when they will be charged for their own usage instead of usage estimate |
| **Preference for smart meter data?** | Used for electricity/energy for financial reasons, would have interest in the same for water, no issues with data collected as long as the information is given to the household |

**Interviewee 2: (female, husband, no children)**

| ***Question*** | ***Answer*** | ***Quote*** |
|---|---|---|
| **Water using appliances and water saving habits?** | Dishwasher and washing machines always on eco mode, daily showers by husband kept quick, baths every two days to help muscles relax. Uses minimal water for gardening and growing vegetables in garden | "Using eco for the washing isn't really a problem because it takes so long to dry anyway without a drier"<br><br>"The environmental settings are always quite efficient anyway, and washing and getting rid of all the bacteria that you would need and still saves time and effort compared to washing the dishes under the sink" |
| **Awareness of water use?** | Yes, thinks water use is lower than normal. Important to use efficient appliances with good fire safety ratings<br><br>Believes bath uses less water than shower because no need to leave water running while waiting for it to heat | "I feel conscious that I have to run lots of water to get hot water…I need hot water and it's not gonna happen without running it for a couple minutes"<br><br>"Because we live in a modern country and other countries where they get water easily it feels like we have an unlimited supply so we really need to be more conscious" |

| | | |
|---|---|---|
| **How they heard of water saving campaign?** | Pond dipping event, email communications, social media | |
| **Which pledges?** | Using less water in the bath | |
| **How did behaviour change?** | Still takes frequent bathes as it is an escape and necessary for wellbeing, but uses less water after receiving reminders.<br><br>Persuaded husband to wash clothes less often and spend less time in the shower, but acknowledges that sometimes water needs to be used to keep clothes clean for his job. Also admits that behaviour change would be difficult if she had children | "I followed the advice from the water company. They sent out regular emails about how to save water. And that was one of them, making sure that your bath is like at least 1/3 less than normal and then you would save so much water"<br><br>"I definitely use less in my bath time now than I did before and it is something I've kept to and also liked in making sure that you know taps off when you brush your teeth cause it's something to change quite quickly. I'm sure I did it before but not as regularly, not as much. Not as consciously and now I do that every time" |
| **Any behaviours they won't change?** | Difficult to reduce washing machine use frequency, and need to take frequent baths for wellbeing reasons. But, tries to change behaviour where it is easy, like turning the tap off when brushing teeth and using eco mode for appliances | "I just try to be as conscious as possible but sometimes there are other requirements that come to mind first"<br><br>"With my disability I get quite cold my my joints and my muscles tense up and the only thing that does help is hot water and to help like release the muscles" |
| **Feelings about water company?** | Feels like IWNL are doing a good job with communicating, prefers | "They do communicate quite regularly I probably say but not every month maybe every two |

| | | |
|---|---|---|
| | more personal relationship with a smaller company than larger companies. More motivated to save water if she can feel why it matters to the water company<br><br>Generally, thinks water companies are frustrating when moving into a new house because communication can be slow and there can be issues with metering, but found that communication from IWNL was quick and efficient, so has no complaints | months you get an email from them and they're quite good like that… they do quite a lot with like trying to get involved in the community"<br><br>"I like the fact they're a smaller company just because they seem to be more on board and have more in common. And more work into saving money and also saving the environment"<br><br>"**If you have a negative feeling with the company you will be less likely to engage with them. And if they aren't giving you good or useful information, you will be less likely to follow it"** |
| **Water company communication preferences?** | Would like to know how behaviour change makes an impact on water footprint, carbon footprint, environmental quality, and the impacts if the whole community changed behaviour. Feels that this would motivate people to see the positive impacts and maintain behaviour change<br><br>Prefers email communication – door to knocking feels too personal like they are selling something | "Other companies like Affinity Water, 10S Valley, they're bigger companies and you probably don't feel you have much in common, I guess because they are big but with this network it's slightly smaller and they are more personalized. I guess that they're trying to be involved in the community and trying their hardest to get people on board with saving water. The communication works a little bit better as well"<br><br>"I'd like to know, like if I save if I've done this like how much water have I saved overall and like how that affects at the environment out of curiousity because I kind of |

| | | |
|---|---|---|
| | | want to know, you know the carbon footprint, how my changes can help my carbon footprint and the overall changes if the whole community saved more water" |
| **Use of water bills?** | Water bills stayed steady while other bills and cost of living have increased. Important to keep water bills low for sanity and to save money | "Water bills have stayed quite steady and I want to keep it that way, one less thing to worry about"<br><br>"I'm always conscious about what we spend our money on. And where things go, so even when it comes to cooking, we would reuse all the pasta water in the sauces"<br><br>"The cost of living is so high that you don't want to up your bills in any way possible and which includes not overusing" |
| **Preference for smart meter data?** | Uses app for smart energy meter data, likes using it to find out where most energy is being used. Sometimes learns that energy use/cost is actually lower than she expects but does not use it as an excuse to use more energy. Would want the same for water use, showing how much water each appliance is using<br><br>No issues with data being collected, doesn't see much risk in other parties having her water use information, | "Would like to know if this is what's using the most water, and if that's the most and maybe use that less or change how, like maybe use a different sort of way of doing things"<br><br>"Not necessarily breakdown for each appliance, I can kind of know by the day on what's the water usage by what where that water is coming from and it just helps to know your overall monthly usage and pinpoint slightly where the higher usages are. **More data is useful, it helps you change your behaviours**." |

| | | |
|---|---|---|
| | admits data collection is just a part of the modern world | |

**Interviewee 3: (male, wife, and children)**

Most water use in the house occurs in kitchen sink, taps, washing machine, showers. No dishwasher in house so all dishes washed by hand. "***I used to just leave the tap running and wash up that way, but now my wife also bullied it into me that I will fill the bowl up and wash up***, and then maybe I'll rinse a little bit, but nowhere near as bad as what I was. And I'm very conscious when using the kettle I only fill it up with what I need"

***"Shower, using the kettle, and when I wash up are the three things that I do certainly try and keep an eye on what I'm doing sort of using my water"***

Generally he tries to save water around the house, but depends what he is doing - ***"I'm terrible with my baths. When it comes to my bath, no I won't try to save water, I don't care because that's me time. And I am quite tall so I make sure I am covered*** when it comes to washing up. If I'm showering, I will try my best to make it so I'm in there for no longer than 4 minutes"

Behaviours he won't change?

***"I don't think I'll ever be able to change that, I love my bath too much. I'll never change that habit, I don't think you could pay be to do that – my bath is my escape, it can be quite stressful coming home so it's my escape where I know I won't be bothered by the wife or kids. Maybe if I had a fancy walk-in shower but I don't. You know, I think you can't take my baththime from me, I'll go to war for my bathtub."***

***"I've reduced my baths already, but to take it away, no I'm not having that"***

***"I am away from everything to do my own little thing. When I decide to have a bath, you ain't taking me out of it"***

***"And with washing machine, I didn't know how much it actually uses. So I try not to do so much washing, but with two kids and two working adults it can be quite difficult"***

***"I don't actually like physically, like properly time my shower or use my phone or anything like that, maybe I should but I don't. I just know it's been too long when the water is above my feet, that's when it's time to get out"***

Hadn't really considered that saving water in the shower and kettle was also saving energy, but acknowledges that it does also save energy and he should consider these savings too. "***In my mind I'm just trying to save water but you're now making me think actually I'm quite energy efficient too"***

Motivations to save water are the state of the climate, increasing bills, and the want to educate his children. ***"Every single bill has just skyrocketed, and it seems that water is the only one that stayed...I've got a family that's only getting bigger, so I wanna make sure that they're educated as well"***

Actively trying to keep water bills stable and would be frustrating if water bills rose like his others. "***That's the one bill that we're really focusing on to try and keep stable cause every other one we've tried to do that with, we've lost the battle"***

Thoughts on the campaign: had a conversation with a lady (thinks it was Jane) at the start of the summer, who told him that he could do a better job with washing up, so he's been more conscious since that conversation. He liked having this conversations and feels like this personal touch is often lacking from companies nowadays:"***You're lucky to get through to a bloody robot or just an automatic message***"

***"It did help talking to someone about it, I never really knew like how bad I was with water, it certainly make me a bit more conscious and aware of my water usage...It was actually quite nice to have someone not necessarily from Affinity Water that can guide you and give you a bit of advice and just a bit of information that will open your maybe you didn't know before and for me that's certainly helped."***

He would like more similar events, especially as a first time homeowner he feels many people could use help learning how to reduce waste and minimise bills. Happy with personal door to door visits if the goal is to save money, not to sell him something

Usually communications from water companies only occur when he owes them money, so he is happy to hear more from them about how to save money, rather than only being reached out to when he is being charged for something. ***"Little people, they don't care about us. Even the likes of British Gas, they don't care, they're always gonna make profit and they don't care as long as people are paying each month"***

Heard about the campaign by bumping into representatives at in-person event, might have seen posts on the social media page and bidwell website but doesn't recall

Pledges: not keep the tap running when washing dishes, reducing bathing frequency, which he has done

***"Initially I found it funny because I've never pledged to do anything, so I was like I'm not pledging anything. But it was actually quite a smart thing to do and helped me understand better to have it in black and white in front of you to show you how pledging to change a couple of things does make a difference. It was nice to see how much water I could save with some actions, and the impact this could have on my bills."***

***"it was quite interesting that actually changing something so simple like a silly habit of keeping the tap running that I have got and knowing it works in my favour quite a lot"***

Behaviour change was difficult at first because it was breaking habits he had since he was a kid. Over time with repetition the change becomes easier, especially as he is usually the only one responsible for washing dishes. "***before, I wouldn't have cared if the tap tuns for too long"***

***"It's my bills and the only person that can make that difference is me or the people in my household that I can then educate and teach."***

Would like more information from water company about how much water is used, how to save it, rather than only about billing

***"It would be nice to know a little bit more than just when the bill comes in"***

Electricity could be on smart meter, but not water –"***I don't monitor it in any way shape or form, I probably should really…At the minute I don't fully know what I'm using, but from my understanding from the bills that I'm getting I'm doing alright"***

Would be interested in smart water meter, but is worried he might be constantly watching it, seeing where water is used and it being not good for family relationships or mental health.

"***I might just sit in front oof it, watching and be like, right who used that amount of water. So, I don't know if that would make me better or worse having a smart meter"***

***"And maybe I would learn that I am not using as much water as I thought, so I would act like a little savings bank and use more another time"***

Feelings about data collection: would support, as long as benefits are clear to him and not just for the company to increase profit – ***"If it's for the benefit, a bit of everyone in terms of they doing it to help the customers rather than to help themselves, then I'll be all for it. If it's just data goes for companies to benefit them, I'd be a bit like, yeah, I'm good"***

Preference for data: knowing when most water is used, which appliances, e.g. whether his bathing habit is really a problem. But also has concerns about AI and overreliance on technology, so he's sceptical but all for having the data if it benefits him

Would like rewards or incentives as a motivation for saving water, "***We all love freebies or little cheeky rewards. If we are gonna do pledges, I'd love to have that tracked and at some point get rewarded for keeping the pledge. That's what motivates most people, acknowledgement and praise for acting good and doing something new you wouldn't usually do"***

Impacts of having a home and family: motivates him to care more about saving water, previously he did not care at all. "***usually I wouldn't care about this type of stuff, but ever since I've become a home owner and I've had my own family, it's quite important. And it's stuff you don't get taught in school, would never be aware of, so it's quite nice to have these little campaigns going on. And since some of us are first time new home owners, we don't know if we are overdoing it or something like that so it is really helpful to know"***

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**Interviewee 4: (female, husband, two children)**

Most water use is with washing machine and dishwasher. Found out about the campaign via the in-person events like pond dipping and at the easter egg hunt, which her children loved.

***[Talking about her daughter at the pond dipping event] "the fact that she could kind of do it herself and learn about and the importance of water and keeping it clean and, you know, looking at all the bugs that everyone had found as well, she she just loved it."***

Daughter was given stickers for turning the tap of when brushing teeth and she's become more conscious and talked to her sister about it

***"I mean it's definitely made us all think cause the as a family about water saving...Especially with bills rising and all that"***

Behavioural changes: using eco-mode for washing machine, filling up the bath less

Pledges: eco-mode on washing machine and showering for two minutes less

Eco-mode an easy change to make, reducing shower time tougher because she showers in the mornings and already takes rushed showers, but they are trying to keep it in their minds when they shower

***"Very consciously started using the eco mode on the washing machine. I think I never used it before because I thought that because it was such a long cycle, it would automatically be using more of everything"***

***"The showering one is is quite a challenge, but I do try really consciously"***

Never had previously been asked to take a pledge, and appreciated the email and activities with opportunities to meet the water savers and get free cookie/coffee in person. The reward was a nice touch but she feels it didn't impact her decision to make a pledge. She feels that she's been reminded of the pledges via emails and the stickers and even spoke to her neighbours about it and attended the events together with neighbours.

***"I don't think it's ever been spoken about as much as it has been on this estate, so probably not ever as conscious about it as I am now"***

***"I think the events have been brilliant, it gets the whole community together. I know the kids loved it and I've never lived in an area that has had so much going on in the community"***

She wouldn't mind having some kind of neighbourhood comparison "healthy competition", but would want to be compared with similar families to have realistic comparison of her own water usage.

Doesn't recall much communication from her water company, besides knowing that her bill went down. Would like to know some tips for saving water, the benefits in terms of how much water can be saved – more facts and figures about the impacts on water use/bills of specific behaviours like spending less time in the shower

Doesn't pay much attention to water bills, would like more information about water use via smart meter just like for gas and electricity, so she can see how much running a bath costs. Isn't personally concerned about her data being collected or the use of smart meters but knows it can cause anxiety to watch the bills go up in real time.

***"I've had conversations with other people about it and you know, some people do find it gives them, you know, more anxiety and stuff about just literally watching their bills go up. But, I think it's just a handy way to know how much we're using"***

Saving money and reducing environmental impacts are equally motivating for saving water, conscious of saving money wherever she can with the cost of living climate.

Liked the act of giving a pledge and feels it was valuable to have a list of options to choose from, not sure if she would have been able to make up her own pledge from scratch though. "***I think giving people choice gives them ownership. And when you have the ownership, you're more likely to do it. If you're just being told what to do then people are less likely to do it because people don't like being told to do stuff***"

Liked the in-person events, being able to speak to water savers and interact with people about the campaign and pledge. Feels like behaviour has changed, now she wouldn't even think of washing her clothes and not use eco-settings.

***"I think it's definitely we've made significant changes that I think will stick with us now"***

Would like more information about water use, but careful to get the balance right and not ram things down people's throats which can be offputting

Wasn't aware that using dishwashing is actually more efficient than washing dishes by hand, so was relieved to hear that her habit of using dishwasher to wash her dishes was actually a good thing, especially as she uses the eco-setting since switching her washing machine to eco after the pledge.

**Interviewee 5: (female living with husband, two children)**

Water using appliances: washing machine daily, dishwasher if lot's of dishes (otherwise dishes done by hand), and showers/baths every day or two. Uses eco-settings for dishwasher and washing machine, but doesn't really know the difference in terms of how they work. Eco-setting used because it "it's there and it does what it needs to do, so why not"

Water saving campaign: heard about it and signed up to get a free coffee, but never heard back about the coffee. Saw the water savers in the tent during the easter egg hunt but was too busy to participate. Prefers an incentive to participate, as she does not view the water company very positively.

***"I pledged to use the small button on the flushing a toilet and which is obviously something we do anyway...it was the one that I thought that we could do easily as a family"***

***"my children don't ever flush the toilet anyway, so they're probably doing a pledge without realizing"***

***"I think the only reason why I would be willing to join in any campaign was if there's an incentive to me"***

Believe water use is comparatively low, already taking steps that save water like avoiding keeping taps running, daughters are young enough to share a bath, using bucket instead of running water when washing hair. Admits having long hair is a reason to have longer showers compared to her husband, usually showers for 15-20 minutes. Doesn't know which is more water efficient between a shower and bath

***"I don't think our water intake is too high comparison to maybe some others"***

***"I think we're quite water conscious anyway and so making a pledge is not gonna really make us change our habits, However, I think it's a really good recognition for people like ourselves and other people that there could be something else you could do to make that change in your lifestyle and maybe just making a pledge, it's allowing people just to see what options there are"***

*"Just reusing the water that's in the bath to fill a bucket and wash her hair…It's how I was brought up"*

***"I prefer a bath over a shower, it's my time to sort of escape which is something I need"***

*"I can't stand washing dishes with a bowl in the sink…I think it's really unhygienic to keep washing with a dirty bowl in the sink and I feel it's a really English thing to do"*

*"If you lift it up it's usually moldy…so yeah I wouldn't want that kind of thing in my sink"*

Doesn't really understand water (or any utility) bills, doesn't really understand the units. Also, bills don't really matter when there's a sickness or any outside circumstances which necessitate cleaning and high water use, or higher water use as families grow or as it becomes summer. "***there's always gonna be, I think lifestyle impacts that could make you use something more in a short time***"

***"I would like to know in laymans terms, the costs, where we use water, how we compare to other months and last year, and the impacts of specific actions, like using the small toilet flush, on the units use and costs…if people could see they could, they could save at least like £50 and if that was by just turning the shower off 2 minutes earlier, people are gonna do that, especially in the crisis we're in."***

Has a grievance because water utility came to change water meter in front garden without notification, and never responded to her emails asking what the visit was for. Feels like this impacts her view towards the water company and willingness to interact with their campaigns. "***It's just common courtesy. If you're gonna come into my front garden and do something, you should come and knock on my door just to let me know…I was just not happy that they hadn't made me aware"***

***"They are like all the other companies, not very good with communication unless they want your money"***

***"I can control what my children wear, when they reuse their clothes. But I can't control my husband"***

Misses having smart energy meter, finds it useful to have this data for control of spending. Would be happy to have smart meter installed, as long as her bills do not increase, but would need an incentive to accept anything from the water company because of prior grievance

with their lack of communication to her. "***Why should I help them collect the information when they've not even bothered to come back to me***"

Overall she appreciates the campaign and understands how important it is to raise awareness of not only water conservation issues, but also solutions and open people's eyes of the opportunities available for them to reduce water use and make a difference

"***that's the main thing making people more aware…because it is important that we all make changes into our lives to make it better for the future…I just think it's just making more people aware of what you can do to make that change, because I think more people would be happy to help, but they just don't know what to do.***"

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**Interviewee 6 (female, husband and 2 children)**

- Gets her children to time showers using their phones because transition from taking baths to showers led the children taking excessively long showers
- rainwater collection for gardening, water bill is expensive so putting a conscious effort into saving water but admits sometimes there is nothing they can do to save water
- Prefers to wash dishes by hand so chose not to purchase dishwasher
- Saw campaign on facebook and easter egg hunt. No pledges because already did the behaviours, kids were distracted by easter egg hunt so she found it difficult to fully engage with the water savers at the focus for the day was kids easter egg hunt.

***"It was an Easter egg hunt, so it was very difficult to try and talk to them and listen to what they had to say and sign up to anything when all my children wanted to do was the other activity that was available"***

- Felt that campaign could have been more accessible for people who don't work the usual Monday-Friday shifts
- Would like more reminders about pricing if water price varies during the day and she can save money by using water during off-peak hours, would be happy to hear more about ways to save water, more engagement from water company, for example she would like to know roughly how much each appliance is costing her and when she is using water the most

- Wouldn't be willing to reduce outdoor water use for summer garden because she values and put a lot of money into having a nice garden where kids can play, doesn't want to restrict her kids from playing outdoors

*"**I do water my plants and water my grass maybe more than I should, but that's not something that I'm willing to sacrifice for the amount of money that I've put into my garden**"*

*Thoughts about pledging*

***"it was good to have them out in the community so that people could go up to them face to face"***

***"I didn't pledge at the time, but purely because I had my children with me and they were excited to do the Easter egg hunt, but I did have a look at it and we kind of use water quite sustainably anyway, so I didn't actually sign up to anything"***

*Communication preferences:*

***"I'm always happy for new information as long as I don't feel like I'm being bombarded with information…The odd email or these events where you can go and talk to somebody, I think they're good ways of getting the information out without feeling overwhelmed"***

***"every now and then maybe an email says, you know, just a reminder of ways to save water, you know, reminding you to turn your taps off, obviously not every week maybe once every one or two of months"***

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**Interviewee 7 (male, wife and 2 children and wife's brother moved in short-term)**

Thinks washing machine and dishwasher use the most water, times their use late at night to save money on energy. Motivation to save water is for his kids, making sure they have a bright and secure future

Has smart energy meter but doesn't use, it doesn't feel like he needs to because he has a good idea of his energy use already, same with water use: ***""I'd like to think that we try and use as minimal as we can…I could probably work it out how much, but well, I I can't be bothered"***

Doesn't think there's much else he could do to save water, so doesn't see much use in more data but also has no concerns about it because he has nothing to hide: "***If you need to use something, you need to use something…I don't know what having a smart water meter would achieve, it'd probably just give me a heart attack about how much the water is costing"***

- Found out about campaign via door knocking, coffeeshop appearances, and facebook posts. Liked pledge idea as it gave him ideas for how to save water, for example moved shower gels and shampoo into the shower rather than outside the shower, using plugs to save water in the shower

***"I quite like the pledge idea because it gave me ideas that I never heard about before or never thought about"***

- Especially liked the community aspect of the campaign, interacting with neighbours and sharing ideas
- ***"My kids loved it, particularly getting a cupcake and an ice cream when they made a pledge. It's great to engage the younger people as well"***
- Wouldn't be willing to reduce water use for kids swimming pools, important for kids to spend time outside and enjoy the summers even if it increases water use
- Doesn't pay attention to water bills, just pays direct debit

***"I do like finding an engineering solutions to problems, but it all starts with behavioural, there's no point in fighting with an engineering solution if the behaviour is not gonna be there"***

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**Interviewee 8 (female, lives alone)**

Lives alone, does not use dishwasher. More conscious of water usage now because she can see the direct impact of it as she lives alone, can't blame it on somebody else.

"***Living with a family the water use was kind of lost into this is what the family uses, so no one person is really owning those numbers. Strangely I'm more conscious of my water use since living alone. Now I turn off the tap when brushing my teeth whereas previously I never would have even thought of doing that"***

***"I can actually have quite a big impact when making some relatively small changes"***

- Heard about the campaign on facebook. Thinks that being asked to make a pledge seems a slightly strange approach, doesn't like public declarations, finds that managing water use is a personal private choice "***pledging is not something that makes me any more or less likely to undertake it... it's more about an achievement rather than a statement of intent.***"

- Would like a reward for pledging, doesn't have to be monetary
- Would like neighbourhood comparison to similar profiles, and to see what water use reductions could mean for the whole community if everyone took part
- Doesn't like privately owned aspect of water companies, so doesn't really trust their intentions when profit for shareholders is the prime motivator for their decisions ***"It doesn't make me not wish to participate in their campaigns, but it certainly clouds my view"***
- Would like less defensively toned communications about challenges/infrastructure being outdated – water companies need to fight back the negative media attention and show how they are acting to save water and they aren't the only ones to blame

***"It's very easy to hide behind the rationale, well they're losing more in the water leaks than I could ever use in a lifetime, but we can't use that rationale here…I think we should all own the problem and water companies have difficulty getting the message across"***

- Wouldn't let her bath be taken away, that's time to unwind, relax, find indulgence
- Interested in knowing more about her volume of water use, not just the water bills because she is curious and "***Finds it quite fascinating***"
- Doesn't feel she needs more communication from water companies, if she wants information she seeks it herself on the website "***If I got more, it would just end up in the junk mail***"

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**Interviewee 9 (male, family of 3)**

- Prevents taps from running and collects rainwater to reduce water use – reuses rainwater for washing car "***if there is a shortage of water from inside the building and due to the fact that you have the rain water, you can go a long way for example if you want to do some laundry or water the garden"***
- Thought positively about the campaign, had a door knock and fliers and appreciated the physical aspect of the campaign. "***It should help raise awareness about the importance of conservation of water and also it's important to encourage people to adopt more conscious water use habits*** "
- Didn't take a pledge because was busy running off for work, but interested in the idea
- Thinks best ways to save water are also to save time in the shower, washing dishes
- Doesn't really think about how much he is paying for water or the bills, "***I have a basic idea about conserving water so I just pay and forget about it. I know***

***very well I'm not overusing the water since I'm conscious about using the water without wasting it***"

- Happy with the water company and feels communication is adequate, if anything would just want to hear when things are changing like water supply and price

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**Interviewee 10 (female, living just with wife)**

- Very conscious about saving water, already taking many steps like having a water butt, saving water in the shower with showerhead with light display as timer. Previously heard from Affinity that they are using half the amount that is expected, can't remember when but thinks it was in annual statement. "***We were quite impressed with ourselves, we weren't really making a conscious effort to save more water than we were previously, we just know it is generally a good thing to not waste water so we just do it without thinking"***
- Felt that the water savers campaign had a noticeable impact, found out about it through the Facebook group but did not know it was run by Affinity
- Happy with level of communication from Bidwell Water Savers online, recommends more in the post for people who don't check online
- Didn't attend the in-person events, just had a door knock to give them Wizso and pledged online
    - Using Wizso mostly to avoid flushing at night
    - Pledged to shower for 2 minutes less, felt that most of the other pledges were behaviours they were already doing, like keeping the tap from running

***"it would just not occur to me to leave the tap running for like any length of time, it would just feel wrong to me to do that."***

- Likes the idea of taking a pledge, but wants more follow up reminders to make sure people are sticking to the pledge
- Felt that the pledge had a short term impact when it was fresh in their mind, but installing the light timer showerhead had more of an impact than making the pledge did
- Doesn't really know whether she is charged flat rate, doesn't really pay attention to water bills as they remain stable compared to other utilities
- Has a smart meter for energy and would like the same for water, finds it would be more useful for high using households to see how specific actions like using eco wash can save water and money

- Feels that they are doing everything they can to save water "***I can't think of much else that we could be doing to save more water"***
- Likes to hear tips from the water company about how to fix leaks, save water around the house, as they are first time homeowners and it's the first time doing household maintenance "***I remember a post about how to fix a leaky toilet, which I thought was really useful…This is our first time having to do maintenance around the house so it would be good to see more tips like that to make sure you're not wasting any water when something goes wrong with your plumbing"***
- Overall happy with the campaign and appreciate the community aspect

"***I think having events in the community is really good, makes it feel more personal to us…And having the people that came to knock on our door was helpful as well since we couldn't make it to the event***"

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**Interviewee 11 (male, family of 8)**

- Lived in bidwell for 11 years, says a lot has been going on in the community about saving water last year. A lot of people have been cooperating. He's happy living there, doesn't see himself leaving the family – lives with 8 in his house
- Kitchen and bathroom water uses are the biggest, sometimes children consume water a lot.
- Previously didn't know that they were using a lot of water use, didn't have the consciousness to preserve water, but now thinks about it because of the campaign
- Found about the campaign through door to door knocking, thought it was a beneficial initiative. They told why to save water, why changing is important, and asked them to take a pledge
- Pledged to use a bucket instead of hose to wash the car, using a bowl when washing dishes, reducing shower time – wishes all families would do a pledge
- He likes to take long baths and relax, used to fill water to the brim but now does not
- Has been told that they are saving water after the pledges
- Because big family are all in the kitchen at the same time, they might leave tap running for a while and they need to be more conscious

- Didn't notice or pay attention to water use at all prior to the campaign, would only think about bills
- Behaviour change is hard: with new initiatives it takes time to adapt and build new habits for continuous practices. Might not be using water to satisfaction but need to adapt and it's good to know how it benefits bills
- Need to be more conscious when using water, energy, people need to know why to put effort to changing habits
- Maybe not each pledge was successful, but through word of mouth it has been successful at raising awareness among whole community
- Water is a universal resource and there is a need to conserve
- Received email about excess water use in water bill – was more shocked than guilty, there were some babies so it was hard to reduce water use, they get dirty
- He would like updates about what can be used to efficiently use water, tips and devices for saving water – would like a subsidised price
- Isn't distrustful of water company and doesn't really care, cares more about general society wellbeing – there should be oversight to make sure water companies aren't exploiting people.
- Campaign should remain constant, otherwise people will forget and return to original activities if it just a one time thing
- Would like more interactive events in common areas where people will participate, social media for spreading awareness, door to door knocking is tedious but can be helpful