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Benefits of private water supply grants

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Abbreviations

DWD	Drinking Water Directive
DWQR	Drinking Water Quality Regulator
LA	Local Authority
PoE	Point of Entry (when the water supply treatment occurs as the raw water enters the property)
PoU	Point of Use (when the water supply treatment occurs at the point of using the water e.g. tap)
PWS	Private Water Supply
SG	Scottish Government

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The James Hutton Institute

The Scottish Government

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Executive Summary

Key findings

- No overall improvement to water quality in Private Water Supplies was shown from the method developed. Although effective at some specific properties where a point of entry or point of use treatment was applied, improvement in national compliance with the Drinking Water Directive has not been achieved. However, a lack of suitable data and information before and after grant award makes an assessment of improvement in water quality challenging. Much can be done to improve this.

- The data indicate that treatment at source, e.g. within the wider catchment area, rather than the current piecemeal approach at point of use, may be more cost-effective.

- When known about and applied for, private water supply (PWS) grants were valued by PWS users and Local Authorities attempting to implement the grants. Survey respondents were mostly satisfied with the grant process, and reported a range of benefits from using the scheme to improve their water supplies.

- Potential issues with the grant scheme include:
    - low awareness of PWS quality risks
    - difficulties in finding out about the grant
    - barriers to collaborative grant applications
    - lack of knowledge about what to do and how to maintain the PWS system
    - while the grant amount is sufficient for bacterial treatment at point of use, it does not cover more complex and expensive supply or storage solutions

- Overall, the issues are less about the grant process itself and more about the overall approach to resolving PWS problems. Despite no overall improvement to water quality in Private Water Supplies in Scotland during the lifetime of the grant scheme, half of the cases we examined showed increase in compliance at the level of supply. Where the change is negative, it is not yet known whether this is:

    - a matter of maintenance, land use, or an artefact of the method linking tests on different properties with the grant per supply
    - due to non-improvement of source water or other properties providing compliance samples
    - because the treatment did not solve the water quality problems in the long-term

Introduction

Private water supplies provide ~3% of the Scottish population with their main source of drinking water. Many more people encounter private supplies when they visit rural parts of Scotland, although private drinking water supplies can be found in urban settings. The quality of these supplies is variable, many have adequate treatment and are well managed, but others present a risk to health due to the quality of the raw water and inadequate, absent, or poorly maintained treatment.

Since the implementation of the Private Water Supplies (Scotland) Regulations 2006, the Scottish Government has spent almost £8 million on grants to help with the costs of improving private water supplied through applying appropriate treatment in properties using at risk PWS.

Research aims and objectives

The aim was to assess the grant scheme's performance between 2006 and 2013 by investigating its effectiveness in improving PWS drinking water quality in Scotland, and identifying reasons for the results from the perspective of PWS users and Local Authorities implementing the scheme.

The objectives were to:

- Develop a method, using available data, to assess whether the grant scheme has helped to improve private water supply quality.
- Apply the proposed method and present results of the evaluation.
- Make recommendations on how the quality of private water supplies could be improved, including any changes to the grant scheme, or alternative approaches.

This involved a workshop with Local Authority representatives to agree the method, an analysis of Scottish Government data, a survey of PWS users, and interviews with a small number of survey respondents and Local Authority officers responsible for administering the grant scheme.

Recommendations

The evidence does not suggest many problems with the grant scheme per se, although this may reflect the views of a limited sample size. There are some recommendations for improvement, but the wider problem for improving PWS water quality nationally is that the grant scheme supports only piecemeal interventions at the point of use. The scheme does not provide incentives for individuals to collaborate to tackle water quality and water supply issues at source. In brief, we recommend:

- **Improving current processes** for registration of properties; investigating persistent DWD failures; PWS information provision; risk assessments; and data recording
- **Extending the grant** to connection to the mains; allowing the grants to cover a percentage of overall cost of improvements to PWS; requiring or encouraging collaborative grant applications; improving maintenance of PWS, including developing a Trusted Trader Scheme for contractors
- **Further research** on supplies and sources; perceptions of PWS and grants; incentives for social and tied housing; barriers to collaborative applications and methodologies for registering properties on PWS

Key words: Private Water Supplies; Water Quality; Water Quantity; Rural; Risk

1.0 INTRODUCTION

Private water supplies (PWS) provide ~3% of the Scottish population with their main source of drinking water. Many more people encounter private supplies when they stay in holiday accommodation and visit the more remote parts of Scotland, although PWS can be found in urban areas. The quality of these supplies is variable; many have adequate treatment and are well managed, but others present a risk to health due to the quality of the raw water and inadequate, or absent, treatment. For many communities relying on water supplies outwith the public distribution network it may be difficult to afford the capital costs required for improvement.

In Scotland, supplies that are not provided by the public water supply network are referred to as **private water supplies** (PWS). The Drinking Water Directive[1] (DWD) sets monitoring and quality measures for drinking water standards in the European Union (EU) in line with World Health Organisation guidelines for drinking water quality (WHO, 2004). In Scotland, the DWD is implemented by the 2006 Private Water Supplies (Scotland) Regulations (the 'PWS Regulations').

There are two types of PWS: **Type A** supplies provide 10 or more cubic metres of water a day (or supply 50 or more people), or to commercial or public activities, irrespective of volume; **Type B** supplies provide water for up to 50 people in a domestic situation. Type A supplies must comply with DWD standards; for Type B supplies a smaller number of domestic standards has been set with the principal aim of health protection.

The PWS Regulations require Scottish local authorities (LAs) to monitor, carry out risk assessments, and enforce the legislation to ensure compliance with drinking water quality standards and protection of public health. The DWQR has a general function of supervising the enforcement by LAs of their general water quality duties, an independent role in verifying compliance with the PWS Regulations, and also reports to the European Commission on compliance with DWD.

LAs are required to maintain a register of every private water supply to premises in its area. The PWS Regulations require LAs to perform check and audit monitoring in specified frequencies (depending on water volume per supply) and complete risk assessments on an annual basis in all Type A supplies to ensure compliance with water quality standards.

The PWS Regulations also give discretionary powers to LAs to support owners and users of Type B supplies to monitor and perform risk assessments upon request. Results of monitoring and risk assessments inform what needs to be done to align a supply's water quality with the statutory and health requirements. LAs have powers to require improvements; it is an offence to fail to comply with an 'improvement notice'. The capital costs of the works needed for improvement and compliance are borne by the owners and users of PWS.

[1] Council Directive 98/83/EC

In 2013 there were 20,193 registered PWS in Scotland, 2,330 Type A and 17,863 Type B (DWQR, 2014[2]). This figure shows that around 164,000 people (3% of Scotland's population) live or work in premises that rely daily on a PWS. However, it is difficult to specify the total number of properties (business and domestic) served by PWS supplies, given that many supplies serve more than one property, and an unknown number of supplies or properties remain unregistered.

Currently, many PWS suffer from inadequate treatment and poor or variable water quality (DWQR, 2014). Compliance with the drinking water quality standards is often much lower for PWS than for Scottish Water's public supplies; it is also much lower for Type B than for Type A supplies (DWQR, 2014). Year on year comparisons are hard to make, especially with the smaller Type B supplies which are not required to be sampled consistently every year. However, it is possible to estimate compliance on the basis of the total number of tests failing to reach the standards set for each water quality parameter. For example, compliance with the coliform standard is up to 75% for Type A supplies and only 59% for Type B supplies (DWQR, 2014). When all parameters for which data were available are taken into account, overall compliance reaches 94.5% for Type A supplies and 89% for Type B supplies (DWQR, 2014).

1.1 Private Water Supply Grant Scheme in Scotland

The Scottish Government (SG) is committed through the PWS Grant Regulations to provide financial assistance with the cost of improvement work, with a non-means tested grant of up to £800 per property served by a PWS.

The basic grant scheme is available for both Type A and B water supplies under at least one of the following circumstances:

- The LA has served the user or owner of a PWS with an 'improvement notice'
- The supply has received a risk assessment completed by the LA showing the need to improve the supply or its maintenance
- Monitoring has indicated a departure from the required water quality standards

The PWS Grant Regulations require that LAs notify the applicant:

- Whether and why the application is approved or refused
- Of the approved works and approved expenditure
- The amount of grant intended

In addition, the grant is to be paid only when the LA is satisfied that the improvements have been satisfactorily completed. There is no statutory requirement for recording to what extent the grant has improved compliance of a PWS with drinking water quality standards in the long term. Therefore, there is a need to quantify the contribution of the grant scheme to improving compliance with DWD on a year-by-year basis, and to the water quality of a PWS in the long term.

[2] http://www.dwqr.org.uk/information/annual-report

However, identifying what needs to be done to monitor the grant scheme and assess its effectiveness is not easy to do given current reporting arrangements.

A key issue is that LAs return data to SG for the purposes of illustrating compliance with the DWD, and the unit of reporting is the private water supply. However, grants are awarded to individual property owners so the unit of analysis for grants is the property. Users or owners of PWS are obliged to provide information to LAs on the characteristics of their supply, and the details of the work required to improve water quality in their application for a grant. Apart from the amount of grant awarded per supply, and despite the fact that the grant is awarded once monitoring shows that the improvements required are in place, it is not known whether the grant has contributed to increasing compliance of a particular PWS with water quality standards.

Unless the grant is used to treat water quality problems at source, or there is only one property on the PWS, a supply may continue to have water quality problems once a grant has been provided to a property, as it may be that sampling from non-improved properties on the supply is contributing to non-compliance.

1.2 Purpose of the Research

This report assesses the grant scheme's performance from 2006 until 2013, investigating its effectiveness in improving PWS drinking water quality in Scotland; and identifying reasons for these results from the perspective of PWS users and Local Authority officers administering the grant scheme.

The aims of the project were to:

- Develop a method using **available** data to assess the benefits of the grant scheme to improving private water supply quality since its inception in 2006.
- Apply the proposed method and present results of the evaluation.
- Make recommendations on how the quality of private water supplies could be improved, including any changes to the grant scheme, or alternative approaches.

Project deliverables were:

- A stakeholder workshop to finalise the method
- A proposed method to assess the benefits of the grant
- A report on the findings and non-technical summary including recommendations
- Presentation to PWS subgroup if requested by the SG

1.3 Research methods

The final methodology was informed by insights from participants at a workshop held on 7th July 2014 involving representatives from the Scottish Government and five local authorities (ranging from those with several thousand PWS within their administrative area to those with very few), and a meeting with SG held on 11th September 2014. The method comprises three aspects:

1. Effectiveness analysis (in terms of achieving compliance with drinking water quality standards) of existing PWS data from Scottish Government
2. Primary data analysis on survey and interview responses
3. Combined insights from (1) effectiveness analysis and (2) stakeholder analysis

See Annex 1 for full details of the research methods.

2.0 Research findings

Overall, the interview results support the questionnaire findings that there is potentially a problem with awareness of PWS quality risks; there are issues about finding out about the grant; there are barriers to collaborative applications; and there is a lack of knowledge about what to do and how to maintain the PWS system. The grant amount is sufficient for bacterial treatment at point of use but more problematic for expensive supply or storage solutions. Generally, however, these issues are less about the grant and more about the PWS system in general.

Findings from the stakeholder perception work suggest that the grants, when known about and applied for, were valued by PWS users and were seen as providing an important 'carrot' to help business and domestic PWS users meet the DWD standards. However, the effectiveness analysis was not able to show that the grants had led to an increase in compliance at the unit of the water supply. The grants *may* have been effective at the specific property, but overall compliance has not been achieved. This may be due to issues in data recording; issues with maintenance of the treatment system; non-improvement of source water or other properties tested for compliance with the DWD standards; or the fact that the treatment did not solve the water quality problems long-term.

2.1 Awareness of the Private Water Supplies Grant Scheme

Firstly, the findings highlight there may be a problem with whether people actually know they are on a PWS, and if so what type of supply they have (e.g. over a quarter of those on PWS surveyed didn't know whether they were on a type A or type B supply). Answers to further questions also indicated that many were unaware of the responsibilities associated with caring for their own potable water supply. This must impact on their awareness of the grant and whether they are eligible for it.

Secondly, only one third (34%) of all survey respondents were aware that they could obtain a grant to improve their PWS (N=412). Business respondents were more likely than household respondents to be aware of the availability of the grant; almost half of businesses were aware of the grant (46%, n=203), compared to just under a quarter of households (23%, n=209). There were only three areas where more respondents were aware than unaware, Stirling, Angus, and Perth & Kinross.

Most respondents who did proceed with a grant tended to get their information from the local authority in some way, either through a risk assessment or another form of contact, although word-of-mouth was important for 20% of domestic users. These results echo comments from the follow up interviews, where it was the people from commercial properties who heard about the grants from LA officers, whilst other interviewees were proactive and sought information from neighbours, social media, or local contractors. LA officers also reported examples of word-of-mouth prompting further applications by neighbours of grant applicants. However, there were also many anecdotes of neighbours being unwilling to collaborate with supply improvements, even where risk assessments showed the source to be contaminated, so word of mouth awareness raising only works in some instances.

LA officers also noted issues about the need to raise awareness of the grant scheme; a number talked about using the risk assessment process with type A supply properties to promote the grant scheme. Interestingly, some LAs are conducting risk assessments on both Type A (annually) and Type B supplies (once every five years), increasing awareness of the grant scheme that way.

Generally respondents who had obtained the grant thought that they had received enough information; businesses were less satisfied than households with amounts of information received.

Many LA officers, particularly those with large numbers of PWS in their area, talked about trying to raise awareness through placing leaflets and posters in public places, and by occasional mail outs. However, many noted that they had fewer resources than before and therefore were no longer as proactive as they had been in the past. There were many comments about the difficulty of maintaining property owners' knowledge of PWS issues in general, and of the grant scheme in particular, as ownership changed, particularly with second homes. Some officers noted that they did not always know where all the PWS were, or which properties were connected, given there was no legal obligation for PWS owners to register with the LA. This makes their ability to inform properties on Type B supplies very difficult.

2.2 Uptake of the Grant Scheme

The survey illustrated that of those people who were aware of the grant, less than half (45%) had applied for it. The reasons not to apply are given in section 2.3 below. The follow up interviews and LA interviews suggested that some trigger events stimulate residents on type B supplies to undertake a risk assessment, such as the desire for a potability certificate to help sell a property; life-stage events (e.g. new baby, older relative coming to stay); or illness connected to the PWS. Often conversion of a domestic property into self-catering holiday accommodation will reclassify a Type B supply to a type A supply, and trigger a risk assessment for that supply; however, although the results of a risk assessment are sent to all premises on the supply, often only those where the sample was taken will apply for the grant.

What wasn't covered in the questionnaire responses was that accessing the grant allowed the LA to reclaim the initial risk assessment and sampling fees for both Type A and Type B supplies from Scottish Government and therefore the PWS user would not be charged. Whilst there was considerable variability in how these processes worked in each LA, the officers suggested that this cost-recovery seemed to provide an incentive to proceed with a grant as the fees for a risk assessment and sampling could add up to over £600 for a commercial property.

2.3 Lack of uptake of the Grant Scheme

Although 13% of Type A businesses (n=5) had been refused a grant, in general it seems the low uptake of the grant in our sample was due to a combination of lack of awareness, and the perception that their water supply did not need improvement.

The main reason (given by around two fifths) was that their water supply does not need improving. This was consistent across households and businesses, and Type A and Type B supplies. Where the uptake of the grant was triggered by a risk assessment illustrating the need for treatment, a number of people commented that they were surprised as 'they had never been ill' from the water supply (even when the supply tested positive for e-coli). LA interviews reiterated a prevalence of assumptions that PWS were free from contamination, despite the widespread incidence of pathogens in most LA areas, something also reflected in the effectiveness analysis (see section 2.5 below). There seemed to be a failure to connect any health problems to their water supply. This suggests that few people were likely to seek out water quality improvements without some kind of trigger event or enforcement actions by the LA. Both survey follow –up and LA interviewees worried

that without regular tests, many domestic PWS users could be at risk from contaminated PWS without knowing it.

Other reasons given for not applying for the grant were that respondents did not want the bother of applying; that they are a tenant, or were ineligible; that they did not have time to apply; issues with cost; or that they were concerned about the impact on the taste of their water. From the survey sample, households were more likely to state because they were tenants they had not applied for the grant. Households were more likely than businesses to state they were not eligible for the grant, and businesses were more likely than households to have not had time to apply.

LA officers also highlighted problems with perceptions that treatment would alter the taste of their water. A few survey respondents did report problems with changed taste following treatment. Some LA officers felt that property owners' perceptions that they might become liable for costly and expensive treatment with ongoing maintenance requirements was putting people off getting a risk assessment at all. LA officers also talked about owners resenting having to pay for what they perceive as 'free water'.

LA officers were consistent in explaining that eligibility is defined in the PWS regulations. However, there were some variations in the discussions that followed, including whether grants could be given to new builds; whether a grant could be given for an empty property; and whether it could be given when connection to the mains was an option. Publicly owned property is excluded from the grant scheme. Whilst the public sector have to meet the same standards as any other relevant person, it is possible that the lack of grant aid in an age of austerity might delay expensive improvements, yet social housing may contain some of the most vulnerable populations who need protection from contaminated water.

Notices to act on risk assessment results for Type A supplies can be enforced but our interviews suggest that the decision of whether to act on Type B or not seems to be voluntary and left up to the PWS user in many cases. However, the regulations clearly state that if there is a public health risk then LAs should enforce the risk assessment, and notify all other users of the PWS of potential risks to their health.

2.4 Water Quality Issues

Table 1 below illustrates the water quality problems that respondents sought to fix using the grants. From this information; and the data from the follow-up and LA interviews, it is clear that many PWS have multiple water quality and water quantity pressures. The problems to be resolved by the grant were often multi-factor e.g. colour, bacterial/pathogen contamination, and supply issues simultaneously. Different water quality issues require different treatments, and some water quality issues such as pathogens, make more sense to treat at source than at point of use,

Table 1: Problem the grant addressed according to respondent type (n=50)

Problems the grant aimed to address	Household	Business
Bacteria/pathogen contamination	35%	33%
Chemicals (e.g. pesticides, lead, aluminium, nitrate)	30%	23%
Turbidity/sediment	30%	23%
Colour	20%	10%
pH (acidity/alkalinity)	15%	13%
Taste/odour	5%	10%
Inadequate supply pressure	10%	7%
Inadequate supply in drought	10%	3%
Other [3]	5%	10%
Don't know	25%	27%
Base	**20**	**30**

LA officers reported that there were water quality issues with both surface water and ground water supplies, and the most prevalent issue across all 13 LAs was bacterial and pathogen contamination from land use, followed by colour, pH, and metal and chemical contamination. Pathogen and bacterial contamination can be treated at point of entry or point of use, but many LA officers, and follow-up interviewees pointed to the need to take account of how multiple pressures interacted, such that pH and colour reduced the effectiveness of UV and filter treatments. This may explain some of the findings reported in section 2.5 below. Some LA officers commented that the new parameter of 6.5 for pH was difficult to achieve in areas with acidic underlying rock without pH correction, which is prohibited in some food and drink sectors.

A number of LA officers commented on the importance of having robust sampling procedures to capture the main issues associated with PWS, such as varying the seasons in which samples are taken. In many cases, the timing and location of the sampling was partially dictated by the needs of the processing laboratories and their collection hours, as samples for pathogens must be processed within 24 hours of collection.

[3] Other problems mentioned by 15% of respondents included: Replace/remove old/lead pipes (mentioned by 3 respondents); New water source for the animals and for new property (1); Reliability of water supply (1)

2.5 Implementation of the Grant Scheme

2.5.1 Spending on the Grant Scheme

Table 2 shows the total number of supplies granted financial support in each local authority in relation to the total number of supplies.

Table 2: Total number of Type A-PWS in the selected 13 local authorities

Local authority	Total no. of supplies^	No. of Type A Supplies	No of Type A supplies awarded a grant	No of Type B supplies	No of Type B supplies awarded a grant
Aberdeenshire	7810	206	51	7,604	576
Angus	429	42	40	387	28
Argyll and Bute	1844	432	264	1,412	327
East Ayrshire	196	15	13	181	98
Fife	328	35	31	293	65
Highland	2347	685	344	1,661	198
Midlothian	65	4	3	61	15
Moray*	799	94	153	703	374
Perth and Kinross	1521	262	148	1252	123
Scottish Borders	1424	152	51	1,271	116
South Ayrshire	231	22	17	208	44
South Lanarkshire	302	25	7	277	12
Stirling	434	62	48	371	76

Data Source: DWQR, 2014. ^Including supplies exempt from monitoring. *In Moray supplies with the same supply codes have been recorded with different number of properties within and between reporting and financial years, leading to strange results.

The data in table 2 generally support the LA officer interview data whereby most local authorities reported Type A applications falling as the majority of these have been given a grant already, although there are still some LAs with about half of Type A supplies without any grant (these may, of course, be in process). However many LA officers noted that numbers of applications, particularly of Type Bs increased after a publicity drive and, in some areas, it is now mainly Type B that make up grant applications. However, given that many point of use (PoU) units do not last indefinitely, many Type A supplies will need new units in years to come. Again, we reiterate that whilst the data on Type A supplies are fairly robust, there is much less certainty about the total number of Type B

supplies or the domestic properties using type A or type B supplies. Given the dynamic nature of some rural areas, with new properties being built and others moving onto mains water, it is difficult to maintain a true picture of how many supplies remain to be improved using the grant scheme.

Figures 1a and 1b below show the amount of grant given in Type B and Type A supplies in each of the 13 selected LAs respectively, in comparison with the spend in the remainder of LAs. Overall, over £7.5 million has been spent on grants to improve PWS since the PWS regulations were introduced. LAs with a large number of Type A and B supplies are, in general, granting the greatest amount of financial support; notable examples include Highland, Argyll and Bute, and Perth & Kinross (Figure 1a; Figure 1b; Table 2). On the other hand, Scottish Borders shows a lower grant record in terms of both number of supplies (Table 2) and spend (Figure 1a; Figure 1b). In parallel, LAs with a relatively lower number of Type A supplies, such as Angus, East Ayrshire, and Fife (Figure 1b, Table 2) show lower amounts of grant spend per year but have supported improvements in the vast majority of existing supplies. By contrast, and regardless of amounts spent, only a relatively small proportion of Type B supplies have been supported by the grant (Figure 1a, Table 2); this could be attributed to the much larger number of Type B supplies.

A great variation in the spend per LA over the years is also observed. The 13 LAs selected for this analysis have been consistently awarding a large amount of grant support for improvements in Type B supplies (Fig. 1a). Five of them spent the largest amounts of all LAs in Scotland. These are Argyll and Bute in 2007; Moray in 2008; Aberdeenshire in 2009 and 2011; Perth & Kinross in 2010; and Highland in 2012. For Type A supplies, Argyll and Bute awarded the highest amounts of grant support in 2008, 2009, 2010 and 2013 (not shown); Highland provided the highest amounts of grant support in 2007 and 2012 (Fig. 1b). Conversely, although Aberdeenshire has 206 supplies, it spent a relatively smaller amount of money, which ranged from £1,593 in 2010 to £30,373 in 2013 (not shown). These data relate to data returns per calendar year.

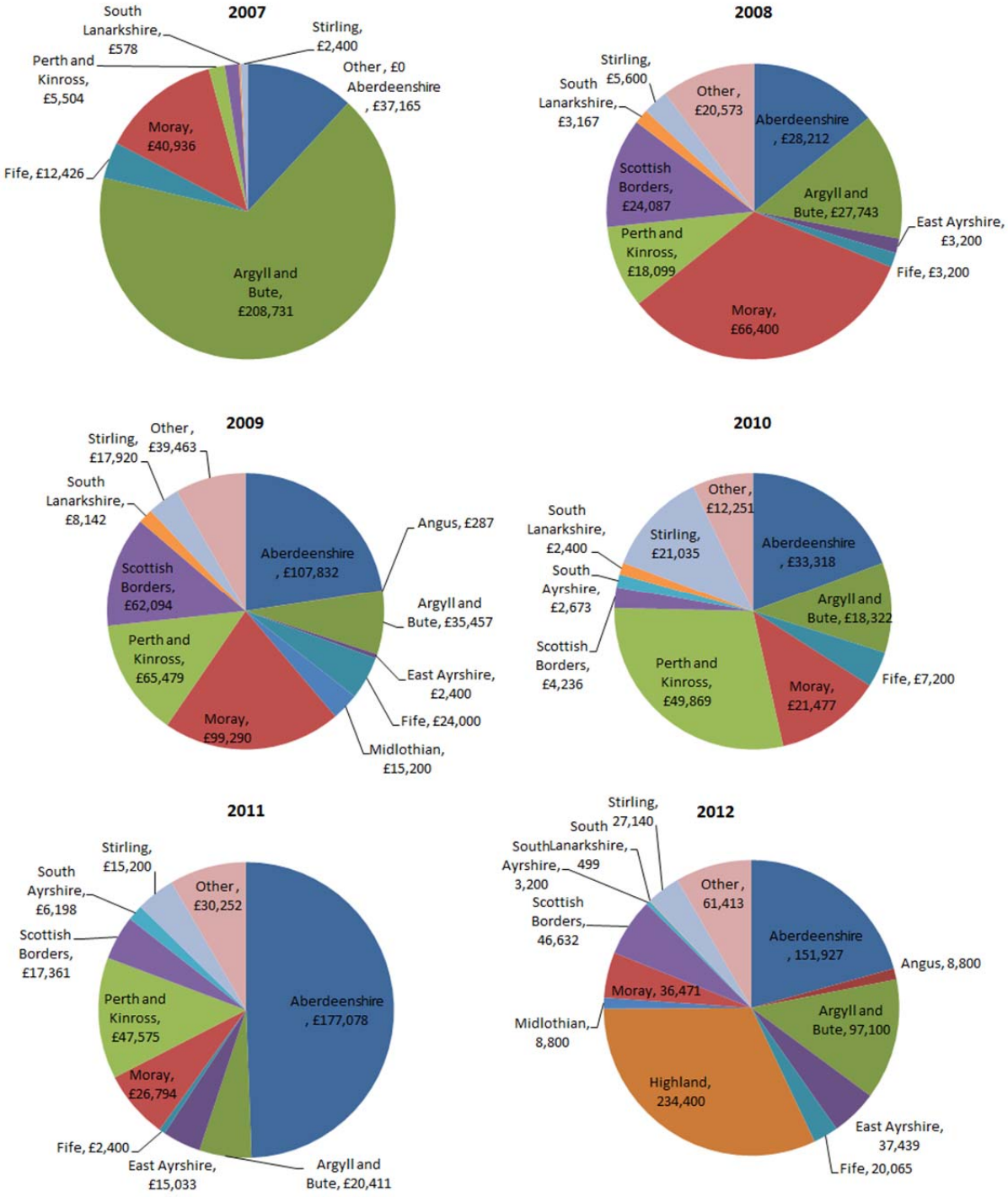


Figure 1a: Spend for Type B supplies in the selected 13 local authorities and the remainder (Other) based on data returns per calendar year since 2007. Note: 2006 grants were awarded only in Scottish Borders.

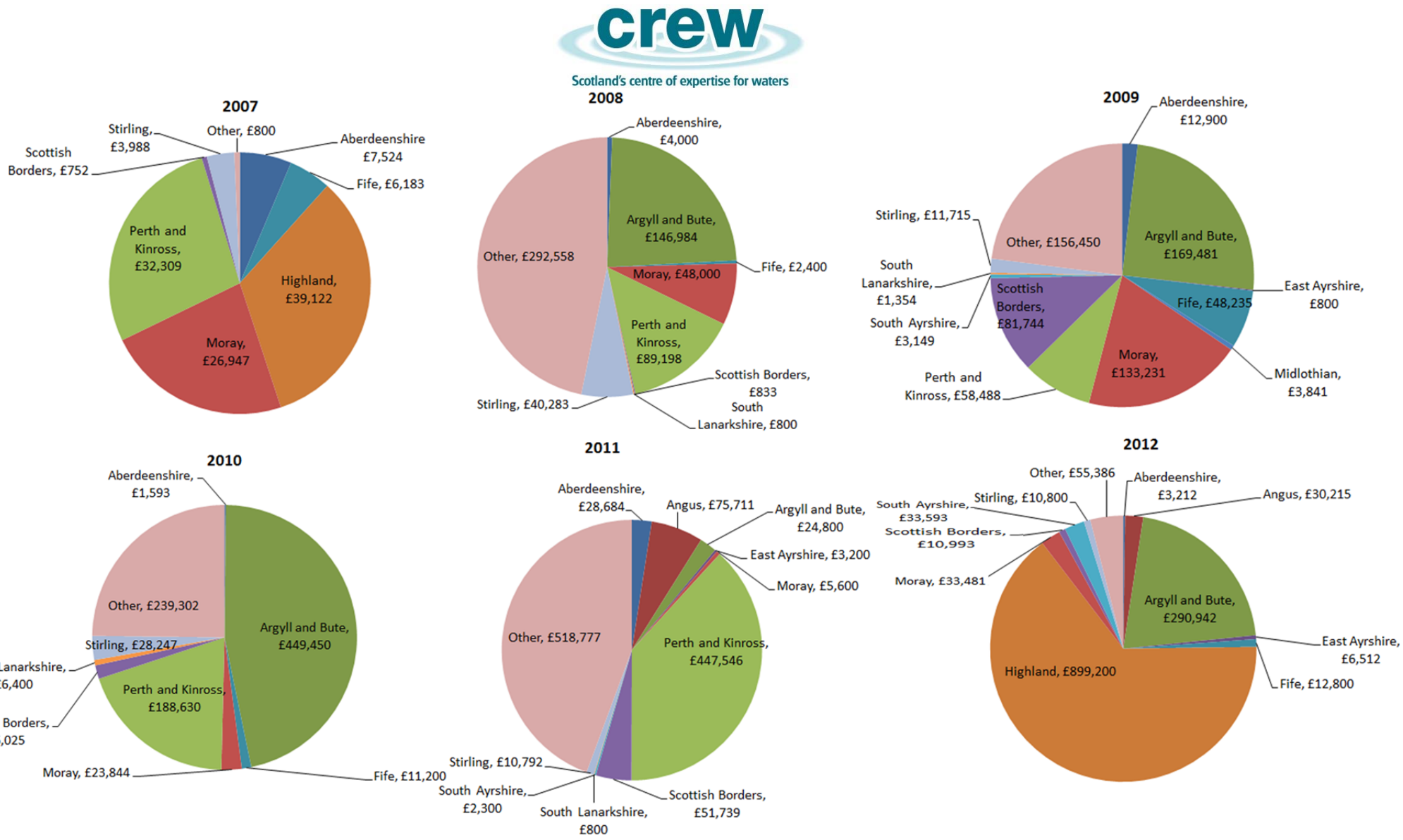


Figure 1b: Spend per local authority on Type A supplies based on data returns per calendar year since the PWS Grant Regulations came into force.

2.5.2 Treatments undertaken using the Grant Scheme

Questionnaire responses and follow-up interviews showed mixed approaches to resolving PWS problems, from point of use (PoU), through point of entry (PoE), to intermediate storage and protecting the source (borehole). Some of the interventions were quite onerous, requiring significant engineering work on multiple land parcels, with consequent legal issues about access rights and responsibilities. There were mixed views on the need to treat non-drinking water – some felt that treating all water (i.e. PoE) was not necessary, but others, with coloured or turbid water, felt it was necessary.

Table 3: Where changes were made in the water system by sample type (n=50)

Where changes were made in the system	Household	Business
Point of use (e.g. kitchen taps, UV, particle filtration, pH modification)	45%	37%
Intermediate storage (e.g. pipe works, storage tank)	25%	43%
Point of entry (e.g. where pipe enters building)	25%	33%
Protecting source (e.g. fencing, covering supply)	20%	17%
New supply	15%	10%
Other	-	7%
Base	**20**	**30**

The questionnaire data suggest that for people whose supplies had bacteria and chemical contamination, the most common treatment is at the point of use. Both the follow up interviews and the LA interviews drew attention to the fact that some treatments were not particularly robust, for example, many were struggling with how to treat iron in PWS. A questionnaire respondent and several LA officers commented that the most robust and cost-effective treatment would be to connect properties to the public water supply, and were disappointed that the grant could not be used for this. An interesting observation made by interviewees was that some PWS were drying up in summer months, and climate change predictions suggest that this may become a bigger problem in future. Therefore, these interviewees saw connection to the mains as a way to try to 'future-proof' water supply in dry areas.

According to the PWS regulations, LAs conduct a risk assessment and once they spot risks and failures they liaise with 'relevant persons' in defining a holistic and sustainable approach to control risks. Grants for PoE treatments and protection of source (supply point measures) have the potential to benefit more properties at a lower cost than PoU measures at each property separately. The effectiveness analysis suggests that where LAs are able to use the grant scheme to tackle multiple properties on one supply, the cost per property decreases. Figures 2a and 2b show the spend per Type A and Type B supply, and the spend per property per Type A and Type B supplies in the 13 LAs

in the period 2006 - 2013. Figures 2a and 2b also show mean spend per supply and per property (calculated as the total spend per LA divided by the number of supplies or properties, respectively, per LA) for Type B supplies for the same period. Both figures (Fig 2a and Fig 2b) indicate additional benefits when LAs took a holistic approach, tackling the issues recorded in the risk assessment at the unit of the supply, rather than a piecemeal approach, treating individual properties separately. Some LA officers noted that where a whole supply was tackled, economies of scale meant that the combined pot of several £800 grants was also able to cover improvements to the supply e.g. new pipes or holding tanks, beyond just filter and UV treatment at PoE or PoU. However, there are often problems with taking a whole supply approach, given issues with collaborative applications (see 2.3.5 below), and difficulties in locating or accessing remote supplies in many rural areas.

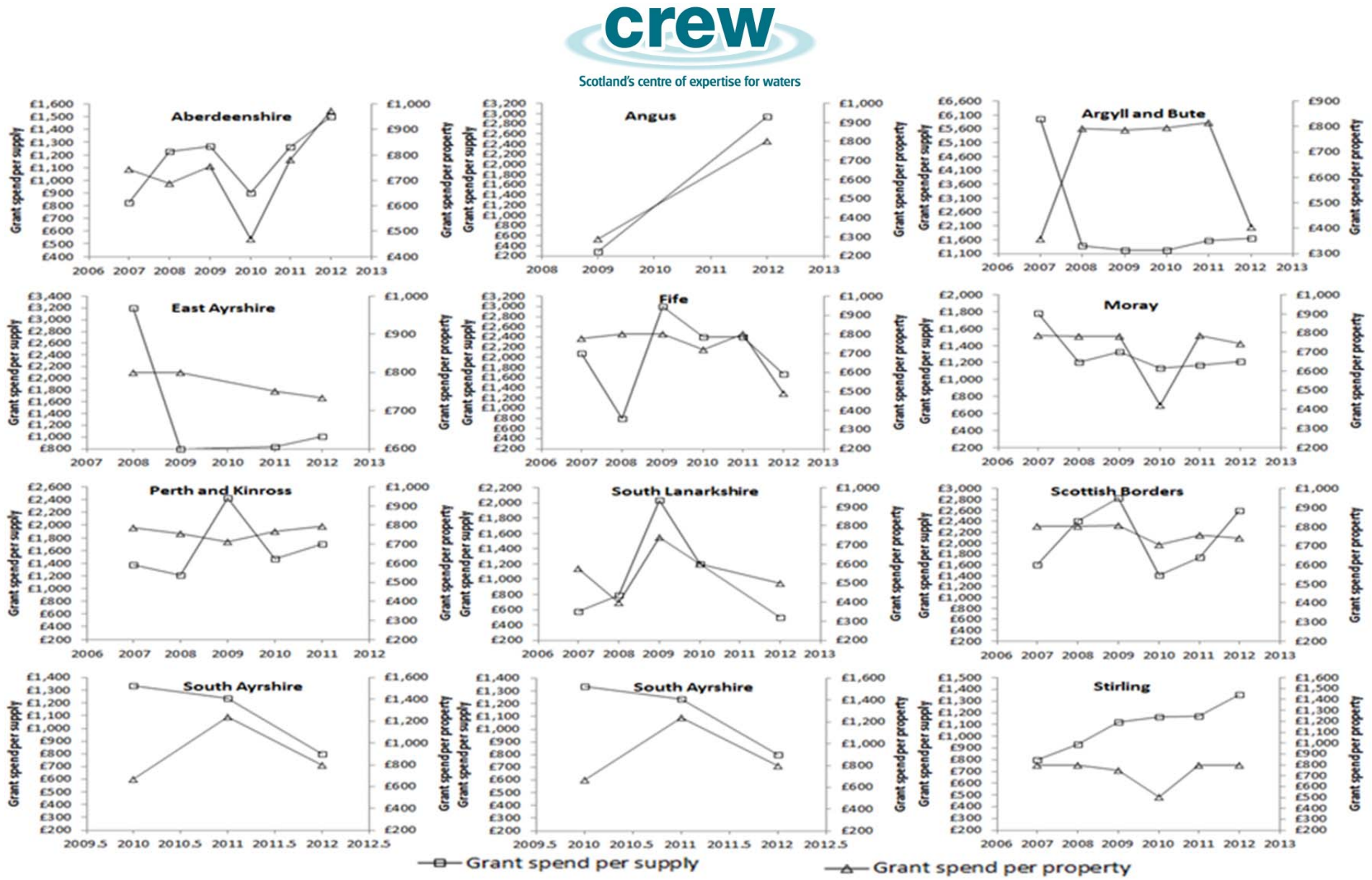


Figure 2a. Type A PWS. Spend per supply and property in the 12 selected local authorities (data for Midlothian available only for 2009 (£3,841) and 2013 (4,800).

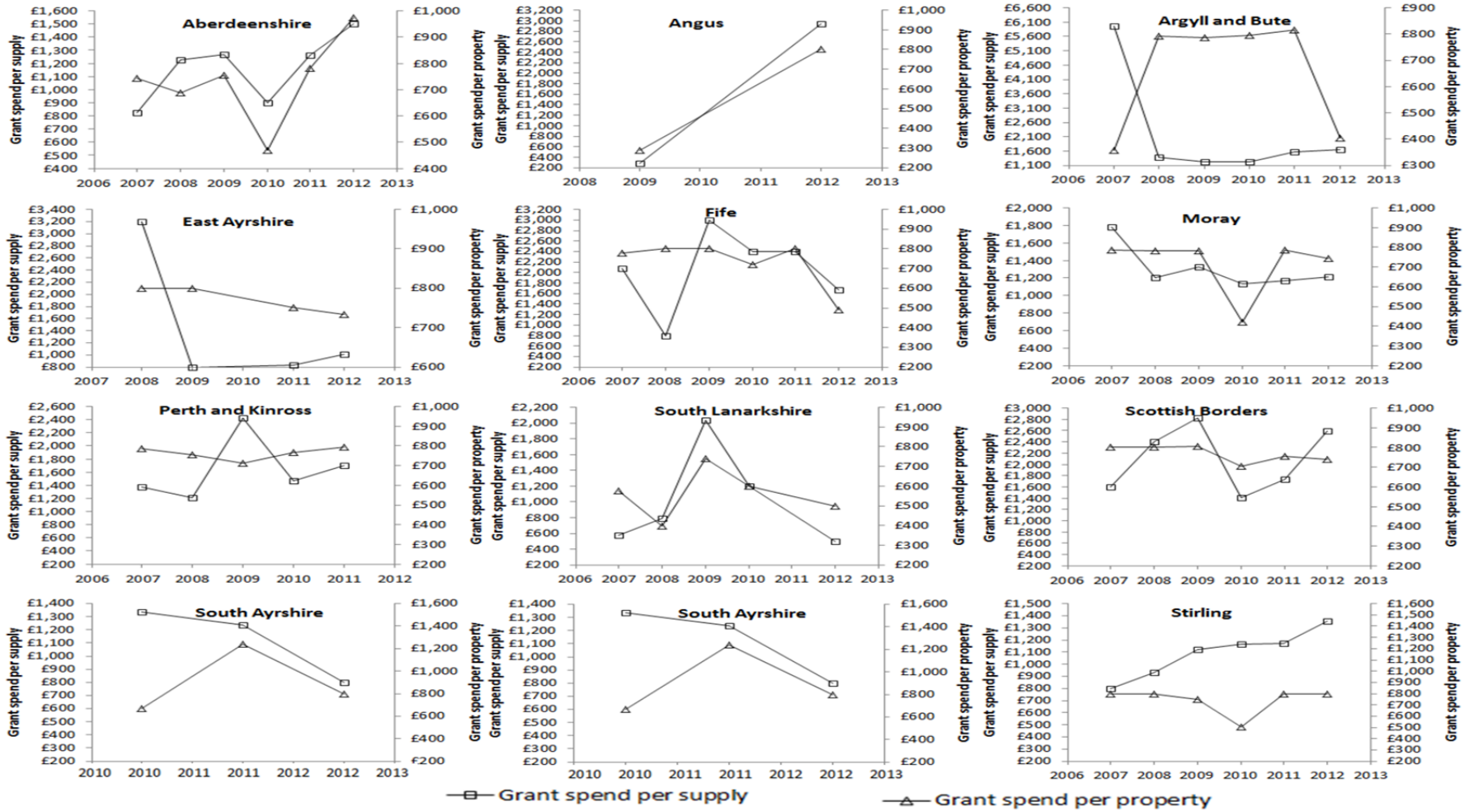


Figure 2b: Spend per Type B supply and property. Highland spend: £1,309.50 in 2012. Midlothian spend: £15,200 per supply and £800 per property in 2009; £1,760 per supply and £800 per property in 2012.

2.5.3 Costs of treatment v amount of grant

Although four in ten of questionnaire respondents stated that they did not know the total cost of the work on their property, a combined total of 44% indicated that work to their property cost £2,000 or less. One in ten respondents stated that work to their property cost more than £10,000. Just under half of all respondents who received a grant did not know the amount they were awarded. Approximately one quarter stated that they were awarded £800; other amounts recorded in the questionnaire ranged from £1,600 to £14,000.[4] All of these respondents (except one who mentioned a grant of £4000) were businesses. Only two of these respondents mentioned that they had collaborated with others (the one who received £3000 and one who received £7000), which may explain the high amounts of these grants. A small proportion of survey respondents (14%) suggested that a larger grant should be provided, and businesses were more likely to state that a larger grant was required. This corresponds to other survey findings that show that businesses generally spend more than households in installing treatment measures.

Most follow-up interviewees received the standard £800 grant per household/business, although one received £11,000 (split between a business and 9 downstream houses). Another mentioned one of their estate houses being refused a grant for filters as they were not willing to replace a tank as recommended by the local authority. All reported paying something additional to the grant to cover the total cost of the work. In a couple of cases, the interviewee did the work themselves, which helped keep the cost down.

However, the LA officers were very clear that the maximum paid to any one property would be £800, unless they were eligible for a means-tested hardship grant. Whilst rarely used, this grant could provide considerably more than £800 (up to £3800 in one LA) and was useful for cases where expensive interventions (e.g. replacing lead pipes) were required. The criteria and application requirements for exceeding the £800 grant seem to be locally defined, although most LAs required a senior manager to sign off these grants, ensuring some form of scrutiny and accountability.

The interviews suggested that the grant amount covers simple PoU treatments for single issue failures, and that some contractors know the amount available and tend to charge up to the maximum grant amount. Follow-up interviewees talked about fitting the treatments themselves to save money and bring the cost of the job to within the grant amount. Grant amounts have not increased since 2006, yet the cost of both materials and labour has increased since then.

As noted in section 2.2, the grant amount does not cover more complex interventions required to treat multiple pressures such as sediment and/or colour removal and/or pH correction. One LA officer gave an example of an estate spending £160,000 to treat all their properties and only

[4] £1,600 (mentioned by 2 respondents); £3,000 (1); £4,000 (1); £7,000 (1); £12,000 (1); £14,000 (1) although it is likely that these would have been either the costs incurred, or the total grant received covering multiple properties, given what LA officers confirmed in interviews.

received £40,000 in grants; even then the parameters for colour were still exceeded after a spate in the surface water source. Certainly, the grant will not cover the full cost of installing a new borehole or replacing lead pipes where ground work is required, yet these may be the treatments required to allow the supply to comply with the parameters required under the DWD.

There are further issues arising: firstly, there may be some type of path dependency developing from the grant criteria where most properties opt for the UV treatment, even if it is not the most effective way to tackle the water quality issues at source, and may not be robust protection if not properly maintained (see 2.3.4). Interviewees wanted to see more grant funding available where the risk assessment suggested more extensive and expensive treatments were required. Indeed one officer said "It may be something that would put people off applying. Once you have had a supply tested owners are then obliged to rectify problems which in some cases could prove very expensive .e.g. bacto failure and lead piping"

Secondly, LA officers also raised the issue of how the grants are paid. LAs rarely pay the contractors directly, and in most cases, the property owner has to pay and then reclaim the grant amount from the LA, once the PWS complies at the point of use. This can mean up to a month or more delay between paying for works and being reimbursed, which may be difficult for those on low incomes to afford.

2.5.4 Availability of advice and contractors

Many, but not all LAs provide lists of local contractors, but those who did were very explicit that these were contact details and not recommendations. However, only two follow-up interviewees mention getting a list of contractors, with some of them finding it hard to source the relevant expertise. Of survey respondents, 12% with a grant suggested that the LA could provide a more extensive list of potential contractors.

Some follow-up interviewees and LA officers thought that some contractors are not able to deal with complex or specialist treatments. There is no formal approval of the contractor by the LA, or any checks on the quality of their work. Indeed, some LA officers noted coming across very poor quality work with inexperienced contractors giving poor advice, causing confusion and extra expense. An experienced contractor is often more expensive, and more difficult to access, than a local plumber. Many LA officers noted that their colleagues in trading standards have a 'trusted traders' scheme and this would be helpful for PWS contractors.

In two cases interviewees did not feel the LA contact had sufficient expertise to help them resolve the problem with their water supplies; both interviewees felt they should have used a different intervention with hindsight. Another felt the solution required by the risk assessment was 'overkill' (this interviewee noted that their supply was 'clear' but not acceptable for commercial premises).

There seems to be variability in whether LAs require one or more quotes for the work before a grant application is accepted. It would appear that getting more than one quote, or even the job done itself, can be a problem in in remote areas (e.g. Angus Glens, Scottish Borders, South Lanarkshire, and Highland) but much easier when closer to cities or intensive agricultural areas.

2.5.5 Maintenance

In total, two thirds of questionnaire respondents reported that they had taken follow up action after the grant work was completed. Most interviewees were doing some maintenance – either outsourcing or doing it themselves, although a few were unclear about how often to change the filters etc; a couple commented on the lack of information or guidance about ongoing maintenance. One in ten survey respondents with a grant suggested that the scheme could provide more information about maintenance.

This was reiterated by LA officers, who worried that, especially for Type B supplies with no follow up assessments, PWS users may get a false sense of security about the risks to their water quality if they have been awarded a grant. Just because the sample passed all parameters at the time does not necessarily mean that the supply remains safe in the future. Interviewees perceived it to be a waste of money to fund treatment that could soon become ineffective if follow up action was not encouraged. Some local authorities send letters with final awards to remind people about the need for ongoing maintenance.

LA officers were clear that without maintenance UV filters become ineffective as the pre filters need to be changing regularly (between 2 weekly – 2 monthly where sediment is a big problem) and the UV needs to be checked annually at a minimum. Many commented that often new owners of properties on PWS are unaware of the treatment installed or how to maintain it. Given the prevalence of UV treatments, some LA officers wondered how property owners would behave when it was time to replace these units and there was no further grant available. The grant scheme legislation was intended to incentivize 'relevant persons' to do something about their water supplies ('the carrot' approach) instead of enforcing e.g. imposing fines in the case of non-compliance ('the stick' approach). The grant covers part of the capital cost of the improvement required, but maintenance costs must be covered by the 'relevant person'. However, some LA officers pointed out that other, more expensive interventions, such as pipe replacement to solve lead contamination did not require any ongoing maintenance.

Most LA officers recommended that owners have a water safety plan (WSP) but do not require it to comply with the PWS regulations. They believed a change in the regulations would be required to achieve full compliance with WSP implementation for Type A supplies. A lack of maintenance was deemed partly responsible for ongoing failures with post-grant supply parameters (see table 6, section 2.5). Some LAs are now sending letters to Type A supplies reminding them about maintenance prior to risk assessment and compliance monitoring to try to help increase the chance of samples being passed.

2.5.6 Collaborative approaches

Although LAs in rural areas in general are moving towards 'resilient communities' and communities looking after each other, one LA officer claimed that relationships between property owners on a supply were the biggest problem rather than the water quality itself when trying to tackle non-compliance with the PWS regulations.

Just over a third (36%, n=50) of those survey respondents who had received grants had collaborated with others on the water supply when applying. Figures were broadly the same for business and household respondents, with 35% of households and 37% of businesses saying they collaborated with others on the water supply in making an application.

All the follow-up interviewees shared a water supply with others; but only three had made a collaborative application (one interview was unclear). These interviewees suggested that collaborative processes can be difficult, with two interviewees reporting long delays due to working across multiple land parcels.

Many LA officers recognised that whilst it would be desirable to have collective applications covering a whole supply, this doesn't happen very often as "getting communities together is not the easiest thing… it's hard work because you've got to meet with a lot of people they say we can't afford all this. One person opting out means the others don't want to pay the extra money. It's a bit of a nightmare, really". The main exception to this is when an estate organises all those on their supply and that seems to work well.

Collaborative applications tend to occur most often when it is a high cost intervention (e.g. borehole, source control fencing, or replacement pipework) and LA officers will suggest collaboration if it seems suitable. Some LA officers pointed out that the grant will only be awarded if they do the treatment required on risk assessment, and if that requires treating the source, the grant will have to be used to cover that and will generally require multiple properties to collaborate.

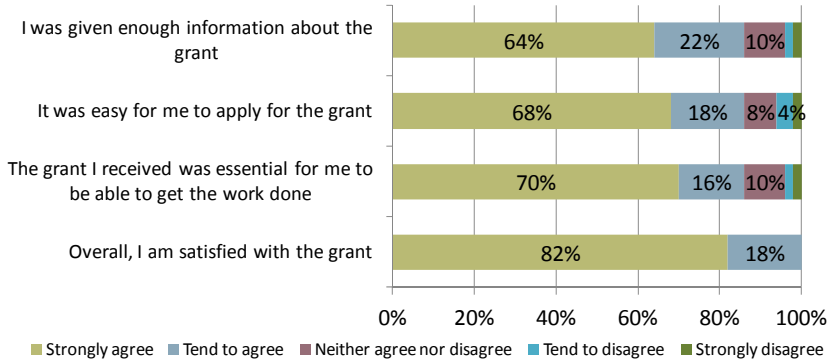
One benefit of a collaborative application is that if more than one person knows about the treatment this means the knowledge is more likely to be retained if one household moves; however, other LA officers highlighted problems of collaborative grant applications where one applicant moves away and it is unclear whether the new owner will take responsibility and pay for their share over and above the grant amount.

2.6 Satisfaction with the grant scheme

Most LAs do not have any formal feedback processes in place but get feedback through discussion or if things go wrong, when people phone up to complain. Three LAs do use specific feedback instruments.

Most of the follow-up interviewees found the grant process to be smooth and prompt, although the overall process of improving their PWS could be lengthy once something more than a PoU system was implemented; this was acknowledged in the LA officer interviews. Questionnaire respondents were generally satisfied with their water quality after the grant: two thirds stated they were "very satisfied"; a further one in five were "fairly satisfied" (Figure 3). Household respondents were more likely to say they were very satisfied (80%) compared to business respondents (57%). Most respondents (62%) stated that no improvements in the grant scheme were required.

Figure 3: Views of the grant process and overall satisfaction (n=50)



2.7 Improvements in Water Quality

The stakeholder perception data suggest that the grant scheme is perceived to have improved water quality and/or supply in many cases at the point of use. In three quarters of the cases of households who had received the grant, the improved water was used solely by one household (75% n=20). In the other quarter of the cases up to five other households used the water that the grant aimed to improve (25% n=20). Domestic respondents were also asked how many adults and how many children use the water that the grant aimed to improve. The average number of adults was 4 and the average number of children (among those who had at least one child) was 2.3 (this included both those whose grant improved the water in one household, and those where the grant improved the water used in up to five other households).

Nearly two thirds of all businesses who received a grant indicated that their staff and customers use the water the grant aimed to improve (63% n=30), while the remaining one third stated that the water is used by their staff only (37% n=30).

Nearly half of household respondents felt that their improved water quality meant that they were more confident that they would not become ill from using their water. One third indicated they were happier about inviting people to their house, their water was clearer, and it had saved them money. Businesses that received a grant reported benefits from the improved water quality. In total, 60% felt that their improved water quality meant that they were happier about using the water in running their business, and nearly half were more confident that the water is suitable for staff and customers. Approximately one third indicated that it has saved them money and that their water is clearer.

The effectiveness analysis partly reflects this confidence. In exactly half of the cases examined the grant was found to benefit drinking water quality of Type A supplies by increasing compliance by 0.2 to up to 21%. Table 4 assesses the effectiveness of the grant scheme by comparing the percentage of supplies complying with the standards before and after the improvements implemented with grant support. This assessment uses the total number of **tests** performed and recorded during check and audit monitoring. It shows that only the grants awarded in 2010 benefited compliance figures. It also shows that several local authorities did not perform tests before or after awarding the grant. In particular, for the supplies awarded a grant in Scottish Borders, Moray, Fife, Stirling, and East Ayrshire there is no consistent record of compliance before or after improvement. These may be data recording errors or result from difficulties in completing monitoring for businesses on

Type A supplies that operate very restricted opening times. It should be emphasised that this indicator of effectiveness does not tell whether all properties awarded the grant were tested, or whether and how many of the properties served by a supply were improved, as the latter is impossible to conclude from the current dataset. However, it does reinforce our findings on persistent failures associated with parameters such as *e-coli* and *cryptosporidium* in tables 4 and 5 below.

Table 4: **Effectiveness of the grant scheme to increase compliance in Type A private water supplies (by all *available* test data) in each local authority. (Data based on data returns per calendar year values).**

Year	LA	Grant spend	% Compliance before	% Compliance after	(%increase in compliance	Benefit
2006	Scottish Borders	£32,200	no data	89	No data	😐
2007	Aberdeenshire	£7,524	90	95	4.2	☺
2007	Scottish Borders	£752	no data	no data	no data	😐
2007	Fife	£6,183	82	98	15.9	☺
2007	Highland	£39,122	96	93	-3.4	☹
2007	Moray	£26,947	97	96	-1.0	☹
2007	Perth &Kinross	£32,309	93	94	1.6	☺
2007	Stirling	£3,988	no data	97	no data	😐
2008	Aberdeenshire	£4,000	92	96	4.1	☺
2008	Argyll and Bute	£146,984	84	92	7.1	☺
2008	Scottish Borders	£833	no data	no data	no data	😐
2008	Fife	£2,400	97	no data	no data	😐
2008	Moray	£48,000	92	no data	no data	😐
2008	Perth &Kinross	£89,198	92	91	-1.3	☹
2008	S. Lanarkshire	£800	97	97	0.6	☺
2008	Stirling	£40,283	95	92	-2.9	☹
2009	Aberdeenshire	£12,900	87	94	7.0	☺
2009	Argyll and Bute	£169,481	92	86	-5.7	☹
2009	East Ayrshire	£800	no data	100	no data	😐
2009	Fife	£48,235	97	98	0.8	☺
2009	Midlothian	£3,841	98	98	-0.7	☹
2009	Moray	£133,231	93	no data	no data	😐
2009	Perth &Kinross	£58,488	89	89	-0.8	☹
2009	Scottish Borders	£81,744	98	97	-0.7	☹
2009	South Ayrshire	£3,149	93	98	5.4	☺
2009	S. Lanarkshire	£1,354	87	94	7.0	☺
2009	Stirling	£11,715	94	88	-5.5	☹
2010	Aberdeenshire	£1,593	95	98	3.1	☺
2010	Argyll and Bute	£449,450	91	91	-0.4	☹
2010	Fife	£11,200	98	98	-0.4	☹
2010	Moray	£23,844	92	93	0.8	☺
2010	Perth &Kinross	£188,630	90	91	0.2	☺
2010	S. Lanarkshire	£6,400	75	96	21.2	☺
2010	Scottish Borders	£16,025	93	98	4.2	☺
2010	Stirling	£28,247	96	92	-3.2	☹
2011	Aberdeenshire	£28,684	96	96	0.2	☺
2011	Angus	£75,711	94	94	-0.1	☹
2011	Argyll and Bute	£24,800	94	97	3.0	☺
2011	East Ayrshire	£3,200	81	100	18.9	☺
2011	Moray	£5,600	92	98	6.0	☺
2011	Perth &Kinross	£179,921	88	88	0.2	☺
2011	Scottish Borders	£51,739	92	100	7.7	☺
2011	South Ayrshire	£2,300	81	93	11.9	☺

2011	S. Lanarkshire	£800	98	100	1.8	☺
2011	Stirling	£10,792	96	97	1.7	☺
2012	Aberdeenshire	£3,212	93	92	-1.0	☹
2012	Angus	£30,215	93	90	-3.4	☹
2012	Argyll and Bute	£290,942	92	95	2.4	☺
2012	East Ayrshire	£6,512	no data	91	no data	😐
2012	Fife	£12,800	96	94	-2.0	☹
2012	Highland	£899,200	89	91	1.5	☺
2012	Moray	£33,481	92	94	2.6	☺
2012	Scottish Borders	£10,993	97	99	2.0	☺
2012	South Ayrshire	£33,593	87	95	8.1	☺
2012	Stirling	£10,800	84	98	13.8	☺

Decreases in compliance should not necessarily be interpreted as lack of effectiveness of the grant scheme. As shown in Table 5, there are discrepancies between the number of supplies granted support and the number of supplies tested for compliance with the water quality standards. Given that all supplies need to be monitored according to the PWS Regulations, it is not known whether this discrepancy indicates non-compliance with check monitoring or incomplete recording of the procedure followed to justify awarding of a grant. Table 5 shows that the grant scheme has not decreased the number of **supplies** failing to comply with the water quality standards; in the majority of cases there is an increase in the number of supplies deviating from regulations in the post-grant period. Three main causes of bias in the interpretation of the effectiveness of the grant to increase compliance can be observed:

(i) Tests from totally different supplies are reported before and after the grant
(ii) Tests from more supplies before than after awarding the grant are recorded
(iii) Tests from more supplies after than before awarding the grant are recorded

Despite the inconsistent recording and the discrepancies mentioned above, Tables 4 and 5 show that assessing the effectiveness of the grant could be approached in two ways. Firstly, by assessing the compliance achieved in terms of the number of tests meeting the water quality standards. Secondly, by the improvement achieved in terms of increases in the number of supplies in compliance with the standards. The overall finding is that only in a few cases could the grant be linked to improved water quality at a local authority level.

Table 5: Performance of the grant scheme in terms of the number of supplies found to fail the water quality standards of the PWS Regulations before and after the granting of the financial support for improvement. (Data based on data returns per calendar year).

Year	LA	No of PWS awarded Grant	No. of PWS tested	% of PWS tested	% of PWS failing before
2007	**Aberdeenshire**	**9**	**8**	**89**	**50**
2007	**Fife**	**4**	**3**	**75**	**33**
2007	**Highland**	**19**	**14**	**74**	**57**
2007	**Moray**	**7**	**6**	**86**	**67**
2007	**Perth and Kinross**	**7**	**6**	**86**	**50**
2008	**Aberdeenshire***	**2**	**2**	**100**	**50**
2008	**Argyll and Bute**	**38**	**34**	**89**	**50**
2008	**Perth and**	**26**	**23**	**88**	**78**

	Kinross				
2008	South Lanarkshire	1	1	100	100
2008	Stirling	11	8	73	63
2009	Aberdeenshire	14	11	79	64
2009	Argyll and Bute*	31	27	87	59
2009	Fife	7	6	86	83
2009	Midlothian*	2	2	100	50
2009	Perth and Kinross	35	27	77	89
2009	Scottish Borders	12	7	58	57
2009	South Ayrshire	1	1	100	100
2009	South Lanarkshire	1	1	100	100
2009	Stirling	12	9	75	89
2010	Aberdeenshire	2	2	100	100
2010	Argyll and Bute	16	13	81	85
2010	Fife	2	1	50	100
2010	Moray	9	9	100	67
2010	Perth and Kinross	47	37	79	86
2010	S. Lanarkshire	4	4	100	100
2010	Scottish Borders*	6	4	67	50
2010	Stirling	10	7	70	43
2011	Aberdeenshire	11	7	64	100
2011	Angus	10	10	100	80
2011	Argyll and Bute	8	8	100	75
2011	East Ayrshire	3	3	100	33
2011	Moray	4	4	100	75
2011	Perth and Kinross	29	10	34	90
2011	Scottish Borders	6	6	100	33
2011	South Ayrshire	1	1	100	100
2011	South Lanarkshire	1	1	100	100
2011	Stirling	5	3	60	100
2012	Aberdeenshire	2	2	100	100
2012	Angus	12	12	100	100
2012	Argyll and Bute	44	43	98	86
2012	Fife	4	4	100	100
2012	Highland	324	290	90	100
2012	Moray	10	10	100	90
2012	Scottish Borders	6	6	100	33
2012	South Ayrshire	3	3	100	100
2012	Stirling*	7	4	57	75

Note: Total number of supplies awarded the grant and total number of supplies tested for compliance are also shown. *Different supplies tested for compliance before and after the grant was awarded. Local authorities with incomplete record (i.e. no data on tests) are not included. Calculation of failure 'before' and 'after' the Grant was based on numbers of PWS tested.

To elucidate the reason for the lack of effectiveness of the grant at the unit of supply or LA area or slight changes in compliance, we examined the causes of failure in each reporting year and local authority (findings for check monitoring parameters shown in Annex 4). It is interesting to note that these parameters match the perceptions of water quality problems highlighted in 2.4. However, it also supports the concern that those who have taken up the grant should not be falsely confident that their water quality will remain improved, if maintenance is not adequate. Several parameters were found to cause failure before and after the improvement with the support of the grant, including:

- Health-related parameters:
  - Pathogenic microorganisms
    - Total coliforms; their presence suggests inadequate treatment, post-treatment contamination, but not necessarily faecal, or excessive nutrients.
    - *Clostridium perfringens,* suggesting historic or intermittent faeca contamination, ineffective disinfection, and probably the presence of other sporia forming faecal bacteria (e.g. *Cryptosporidium)*.
    - *E. coli,* suggesting faecal contamination from sewage, livestock or wild birds, and ineffective treatment.
  - Heavy metals
    - Lead, suggesting its use in plumbing in these areas.
    - Iron, suggesting use of coagulants
  - Chemical compounds
    - Nitrite (only in Highland), suggesting the presence of ammonia (e.g. from sewage effluents) and the excessive use of nitrate fertilizers in farming.
- Aesthetic parameters
  - Colour, suggesting the presence of humic substances, metals such as iron and manganese, or highly coloured industrial wastes.
  - Odour (Angus), suggesting the presence of organic substances due to increased biological activity or from industrial wastes.
- Chemical parameters
  - pH, suggesting that pH may not be in the optimal range for effective disinfection.
  - Turbidity, which affects the acceptability of water to consumers, the selection and efficiency of treatment processes, and increases the susceptibility of a supply to bacterial growth.
  - Aluminium (only in Argyll and Bute, Moray), suggesting the use of coagulants

This indicates problems with maintenance of the treatment installed to improve water quality. Given that the same causes of failure are observed before and after the grant period in more or less the same supplies, it remains to be explored whether this is related to maintenance per property or per supply. These findings suggest that contamination of water supplies is largely related to adjacent land use (presence of sewers, farming, and livestock) and probably the underlying hydrological pathways enabling transport of contaminants from soils to water supplies. Land use and underlying hydrology may also interact with the applied disinfection equipment. This confounds the assessment of the effectiveness of the grant, on the basis of % change in compliance. It suggests that the grant should be combined with a catchment based approach in certain LAs, reinforcing the DWQR's 'source to tap' philosophy.

4.0 Discussion

The survey and interview results showed overall support for the grant scheme. The results provide evidence about the performance of the grant scheme to improve the water quality of Type A supplies**.** The major finding is that supplies have water quality issues for the same parameters that deviated from standards before the grant or for new issues that may not have been recorded in the risk assessment. However, the data seem to indicate that treatment at source, rather than point of use, may be more effective and economical, reflecting the DWQR's philosophy of managing water quality from source to tap.

These findings are of interest from both public health and DWD compliance perspectives. The public health issue arises from the fact that Type A supplies either service a large number of domestic properties or service commercial properties. Many of these commercial properties are involved in the food and drink industry or tourism, so the impact on consumers beyond local residents is much increased. This is important, given that local residents may develop some immunity to untreated water, and that other data from LA officer interviews suggested that consumers may not always realise they are drinking from a PWS that is potentially non-compliant with DWD (and therefore WHO) parameters. LAs have a statutory duty to enforce risk assessments for both Type A and B supplies, in order to comply with the DWD or to meet public health obligations.

Although compliance is still high among the PWS awarded the Grant, it is not higher than the compliance rates observed over the total number of Type A supplies monitored in Scotland (see data on compliance in DWQR, 2014). Indeed, the overall compliance figures provided by DWQR (2014) may provide an overly positive picture, given that the effectiveness data indicate persistent failures, particularly those associated with e-coli and cryptosporidium, which have worrying public health implications. There is much less we can say about the effectiveness of Type B supplies, yet these potentially affect a large number of rural residents. Whilst there is no infraction threat with a lack of improvement in water quality, there could well be opportunities to improve public health outcomes if more were known. Our research has raised some questions about monitoring practices by LAs, including 'missing' test monitoring data, and variable charging practices for risk assessment and monitoring associated with the grant process.

Our results are indicative because data returns (grant amount, number of properties per supply) and risk assessments refer to supply codes whereas tests for compliance with drinking water quality standards are performed at points of compliance (tap water) and therefore may be refer to a different property each time a failure is reported. Currently it is impossible to account for causes of failure at a property level. In addition, inconsistencies and gaps in the data returns include:

(i) Lack of information on tests performed before or after a grant was awarded. This is an important finding. According to the PWS Grant Regulations a grant is awarded only when tests show that the works done has aligned the supply's quality with the standards. It is impossible to link the effectiveness of the grant with compliance under the current management of the grant scheme.

(ii) The coding system is confusing, with some supplies coded in exactly the same way and differing only in a space between coding letters. This must be amended to ascertain that errors will not bias the assessment.
(iii) In many cases, some supplies are sampled while others, although awarded a grant for improvement, have no monitoring record at all. This greatly influences the assessment of the effectiveness of the grant, and also affects implementation of both the PWS Regulations and the PWS Grant Regulations.
(iv) Inconsistent or incomplete data in the LA voluntary recording system, especially for Type B supplies

We have therefore not been able to quantify the benefits of the grant-aided interventions for individual households and businesses, beyond what has been reported in terms of questionnaire and interview respondents' perceptions. The difficulties in linking grants to compliance test results pale into insignificance when considering how to link these data to public health epidemiology and health records. Yet it seems that there is a lack of awareness of the actual water quality of PWS, and of the risks, both long term and acute, to individual health. Whilst we must avoid scare-mongering, as one LA officer put it, given that many local residents are very happy with their water supply and enjoy being independent from the public water supply, it may be useful to have more interaction with Type B supplies to raise awareness. Furthermore, PWS are not 'free'; the LA have legal responsibilities to maintain drinking water standards and this may require both financial outlay and ongoing maintenance work by the relevant persons (owners or occupiers of the properties).

The evidence does not suggest many problems with the grant scheme per se, although this may reflect the views of a limited sample. There are some recommendations for improvement, but overall it does seem that the wider problem is the fact that the grant scheme is not incentivising individuals to collaborate to tackle water quality and water supply issues at source, but supports piecemeal interventions at the PoU. These interventions are reliant on adequate maintenance that does not always seem to be taking place. It is also unclear whether these interventions can withstand the multiple pressures that interact to create water quality problems in PWS. This issue is already evident, and is particularly concerning in light of climate change likely leading to more extreme events, resulting in more surface run-off carrying sediment, chemicals, pesticides, and faecal contamination. Alternatively, the grant scheme may be working well, but either the monitoring is not picking up all the potential risks, or the risk assessments are not promoting the appropriate treatment chains to address the PWS quality.

Respondents and interviewees were grateful that the grant scheme existed, given that PWS users in England and Wales are not given any support. They were aware that non-means tested support was unusual in the current climate of reduced public expenditure, but felt that although it did not cover the full cost of treatment, it helped LAs encourage relevant persons to comply with the risk assessments and take action. Currently, DWQR can only request information from LAs as they are responsible for implementing the PWS regulations. Although LAs have a duty to serve notices

requiring properties to take action to improve their PWS[5], most LAs prefer to provide advice and encouragement rather than strictly enforce the regulations. The exceptions to this rule tended to be those LAs with limited numbers of PWS where officers were able to take a much closer interest in the chain between the risk assessment and whether action was taken, for both Type A and B supplies.

Overall we are able to provide only limited evidence of positive effectiveness of the grant scheme, due to the methodological challenges. It appears that some PWS are still not complying with DWD, despite these investments.

[5] Under the DWD for Type A supplies; and under public health duties for type B supplies.

5.0 Recommendations for using the grant scheme to improve PWS quality

Recommendation One – New Recording System: a new recording system tracking the effectiveness of the grant per property needs to be introduced within each LA. The way to fill the gap and improve the recording of data linking the grant with the improvements in compliance would be as follows:

(i) Record numbers of supplies, tests, and compliance before and after the grant; number of supplies and properties per supply failing standards before and after the grant; and cause of deviation from DWD.
(ii) Record when monitoring of supplies supported by the grant is not taking place and for what reason.
(iii) Record the parameters targeted with the improvements supported by the grant.
(iv) Ensure properties are locatable using Ordinance Survey data (i.e. unique property reference numbers) to permit the creation of GIS map layers for analysis and education.

Some LAs have unique property reference numbers (UPRN) that allow them to link properties to supplies to samples and grants, but few of those we interviewed have a comprehensive computerised system that would allow these data to be quickly and easily retrieved. The records for Type A supplies seem to be most comprehensive, but LA officers noted that they often do not have a complete picture of Type B supplies. In future, all DWD and grant returns should record UPRNs.

It would be important to ensure that all fields are filled (no blanks) particularly with regard to the grant breakdown. This will allow DWQR to make assessments of the benefits of the PWS grant scheme in future. LA officers were pleased that the SG return forms now allow them to make notes on the treatment per property, but this should be required data from all LAs, rather than voluntary. It would also be useful to link the recording system of the grant spend by reporting year with each LA's recording system of administrative costs (calendar year) to allow for planning in the future.

Recommendation Two – Investigate persistent failures: reasons for persistent failures per water supply with grants should be further investigated by the LA to understand whether these failures were due to non-compliance with the issues recorded in the risk assessment; or via monitoring finding new pressures on the source; or poor maintenance of the PWS measures. SG should provide guidance on grants which requires that post-compliance sampling is performed and that the LA has enacted its regulatory duties under the DWD and in terms of public health risks (with regard to Type B supplies).

Recommendation Three – connection to the mains: SG should investigate allowing use of the PWS grant to connect appropriate properties to the mains.

Recommendation Four – grants as percentage of overall cost: a sliding amount of grant should be available to cover a percentage of treatment costs rather than a fixed amount (i.e. less for a PoU UV filter but more than £800 when major works are required). This may help to overcome the perception that PoU filters are being installed when these may not be the most appropriate measure, especially in cases of colour combined with pathogen contamination.

Recommendation Five- Risk Assessments: LAs use the risk assessment process to identify source protection or PoE schemes if that is likely to be most cost-effective. Risk assessments should be enforced, but low cost options can be included (e.g. running taps if there are lead pipes) to encourage uptake of measures.

Furthermore, if the public health risks warrant it, consideration should be given to reinstating the rolling programme of risk assessing Type B supplies every 5 years.

Given the seeming discrepancies in how different LAs approach charging for risk assessments and monitoring as part of the grant process, the SG could remind LAs of the existing guidance on risk assessment and monitoring requirements, including arrangements for cost-recovery and charging.

Recommendation Six – registration of properties: if possible, all relevant persons should be required to register their property using a Type A or Type B supply with the appropriate area of the LA who deal with the PWS regulations. However, this may require an amendment to the Water (Scotland) Act 1980 as it would not be possible under the current Private Drinking Water Supplies (Scotland) Regulations 1996.

Recommendation Seven – PWS information to relevant persons: Given turnover in rural housing, information about PWS quality, options for treatment, the grant scheme, and the need for maintenance should be provided as part of the home report and within tenancy agreements. LAs should be reminded that any relevant person is eligible for the grant. 'Relevant person' covers either the owner or the occupier of the property, therefore tenants are eligible for the grant scheme so long at the owner gives their permission for the work to be done.

Recommendation Eight – Collaborative Applications: Whilst the existing regulations allow for collaborative applications, they should be strengthened to either *require* a collaborative application to be made if there is more than one relevant person using the source, or collaborative applications could be *incentivised* to recognise that protecting the supply rather than the property is normally more cost-effective.

Recommendation Nine – Maintenance: a maintenance plan is required as part of the ongoing compliance for Type A supplies, and more advice and guidance on maintenance is provided by LAs to all those applying for a grant. Some overall guidance on these topics from DWQ Division to LAs would be appreciated. DWQR could host an interactive web-forum as part of their website on PWS, allowing PWS users to exchange information and ideas about how to manage and maintain PWS treatments, what treatments have been most cost-effective, and to provide peer recommendations on contractors.

Recommendation Ten – Trusted Trader Scheme: The DWQR should explore the development and implementation of a trusted trader scheme to ensure that contractors are well-informed regarding the design, fitting, and maintenance of PWS measures.

Recommendation Eleven – Further research: there are further avenues of research that could be useful to explore. Overall, a useful follow-on project building on these findings would be to explore international examples of good practice in incentivising improvements to water supplies to ensure that the grant scheme is as effective as possible. Research is also needed on barriers to collaborative applications and means to incentivise more collaborative applications and/or reduce

the barriers; and to design a methodology to register water supplies and properties on them, learning from SEPA septic tank registration scheme where appropriate.

Other potential research could include:

- identifying how many supplies have low grant to total cost ratio, and plot these on a map relative to Scottish Water supplies to help target appropriate interventions. The relationships between surface water and groundwater sources and supplies could also help identify the most sustainable and holistic approaches for each supply.
- assessing to what extent connection to the mains supply would function as a way to try to 'future-proof' water supply in dry areas under scenarios of climate change.
- carrying out follow up interviews with contractors about expertise and costs; with health stakeholders about public health risks and residents' perceptions; and to follow up with those who were aware of the grant but chose not to pursue it; or those whose applications were refused.
- exploring more about how social and tied housing PWS are monitored and improved, particularly given eligibility constraints on accessing the grants for public bodies.

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Annex one: research methods

The final methodology was informed by insights from participants at a workshop held on 7th July 2014 involving representatives from the Scottish Government and five local authorities (ranging from those with several thousand PWS within their administrative area to those with very few), and a meeting with SG held on 11th September 2014.

The method comprises three aspects:

1. Effectiveness analysis (in terms of achieving compliance with drinking water quality standards) of existing PWS data from Scottish Government
2. Primary data analysis on survey and interview responses
3. Combined insights from (1) effectiveness analysis and (2) stakeholder analysis

A decision was made to focus on 13 rather than all 32 LA areas in Scotland to target resources to understanding the areas with most PWS (these 13 have more than 90% of the PWS in Scotland). These LAs reflect a variety of climatic and land use conditions; and include both remote and accessible rural areas.

Effectiveness Analysis

This part of the project aimed to develop indicators of the grant's performance from 2006 until 2013 to help assess and monitor its effectiveness in improving the drinking water quality of PWS in Scotland. We did this by reviewing and collating the annual data returns from 13 LAs to the DWQR from 2006 to 2013.

The data refer to PWS that have undergone a risk assessment. These data describe:

- results of check and audit monitoring per water quality parameter, with compliance and failure assessed in line with the PWS Regulations
- date of grant being awarded per supply
- amount of grant per supply and property
- number of properties per supply
- type of treatment

Effectiveness is directly linked to the ability of the grant to ensure compliance of a PWS with the specified water quality standards. In order to analyse this, we need to understand:

- Reasons for poor water quality of private supplies
- Whether a grant was obtained to improve a supply
- What treatment was carried out; and
- Whether the treatment has led to improved water quality

In many cases, data on whether the grant was awarded for point of use, point of entry, or protecting the source treatment were not available on a consistent basis. In addition, the findings of the risk assessments are not known. Therefore it is difficult to use the available information to draw robust and final conclusions about the effectiveness of the grant scheme in each LA.

In addition, LA data are returned to the DWQR on the basis of private water *supplies* whereas data on grants are on the basis of applications i.e. the *premises or properties* improved. One supply may

service several properties, and not all data connect the specific properties that have taken up the grant to the overall supply. Furthermore, grants are awarded to the relevant person, which may be the property owner, but may also be the property tenant, or the owner of the source of the PWS, etc. This makes connecting data held on water quality with data on PWS user behaviour more complicated.

Private water supplies are classified in two types. Whilst Type A supplies have a programme of regular monitoring of water quality parameters, most local authorities do not monitor Type B supplies on a regular basis. This severely restricts our ability to look at the long term effectiveness of grants on Type B supplies, as there are rarely data on changes in water quality (due to lack of consistent and long-term pre- and post- grant monitoring).

Data returns to the DWQR on grant scheme performance are not a statutory requirement for LAs. Therefore, the grant amount is not consistently assigned to the outcome of check or audit monitoring per supply and per property. Although the grant award requires compliance to have been achieved, the compliance data do not equate to individual properties so we do not know if the test results arise from those properties previously improved with or without a grant.

To make an assessment of the grant scheme using available data we used data returns from each LA per calendar year and followed four steps to identify:

1. the supplies being awarded the grant in each year in each LA.
2. compliance[6] for Type A supplies in the PWS awarded a grant in the years before and after the award.
3. which parameters cause departure from the specified standards before and after the implementation of improvements with the help of the grant.
4. inconsistencies and gaps in the information recorded so far to help recommend a fit-for-purpose data logging system to assess the effectiveness of the grant scheme.

The advantage of this approach is that it gives an overview of the performance of the grant scheme in each LA. For example, if the grant is linked to increases in compliance this shows that the particular LA, in collaboration with owners and users of a PWS, have managed to improve water quality in the long term. Conversely, decreases in compliance and knowledge of which particular parameters were causing failure would indicate weaknesses of the grant scheme and help identify what needs to be done to improve effectiveness.

Stakeholder Perceptions

This part of the project aimed to find out:

- why PWS owners take up the grant (or not)
- how the grant is used to improve PWS

[6] Compliance is defined as the percentage of compliances over the total number of tests performed as part of monitoring for all parameters. 'Compliance before the grant' refers to tests performed both in the years before and during the year the grant was awarded; 'Compliance after the grant' refers to tests performed in the years after the grant was awarded.

- stakeholders' levels of satisfaction with grant processes and outcomes; and
- views of the effectiveness of the grant scheme held by PWS owners and by local authorities.

There were two parts to our approach: a **telephone survey** using a structured questionnaire with a random sample of potential recipients of grants; and **semi-structured telephone interviews** with households, businesses[7] and local authority grant officers. The questionnaire and interview templates are available in Annexes 2 and 3.

All potential users of PWS in the 13 LA areas were targeted. This is partly because we did not have access to a definitive list of properties that had received grants, and partly because we wanted to talk to people on PWS who had not applied for a grant to find out why not. We are limited in what we can say based on the survey results due to the small sample that were surveyed. Of the 1, 745 people who agreed to participate in the questionnaire across the 13 Local Authority areas[8]; around three quarters replied that were not on PWS, therefore the final useable sample comprised just 412[9] responses, which represents 1% of the potential properties on PWS in the 13 LA areas. Of these 412 respondents, only 50[10] had taken up the grant. This proportion of our sample (12%) of those on PWS having taken up the grant is half of the average percentage of properties improved by the grant across the 13 LAs (25%). The breakdown by LA area and type suggest that the 50 respondents with a grant represented a spread of areas and supply types, so there is no obvious bias in the data. Some of the grants were awarded up to five years prior to the survey, which may explain the number of 'don't know/can't remember' responses to some questions.

We undertook seven follow-up interviews with questionnaire respondents with experience of the grant scheme. The seven interviewees[11] came from Argyll and Bute (3); Aberdeenshire (1); Moray (1); and Perth & Kinross (2). Three were commercial and four were domestic properties. However, no respondents who were refused a grant or reported being unhappy with the grant system were willing to be interviewed so we were unable to learn more about these negative experiences. Finally,

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[7] Although the PWS administration refers to Type A and Type B supplies, whereby domestic users could be accessing Type A supplies or Type B supplies, the questionnaire focussed on distinguishing between households and businesses as many respondents did not know if they were on a Type A or Type B supply.

[8] The market research company purchased a sample of 15,000 households and 8,094 businesses within specified postcodes where PWS incidence was known to be higher than average (as provided by the James Hutton Institute). 1,745 of these households and businesses agreed to participate in the survey (only 9% of calls were refused, the rest did not answer or there was an answerphone, etc). Of this sample of 1,745, 3% were not responsible for the PWS and could not answer and 73% were not on a PWS. This figure (73%) is surprising given the spatial targeting of areas and could mask those who were on PWS but said they were not as they did not want to participate in a telephone survey.

[9] 209 were domestic customers (49%) and 203 were commercial businesses (51%). Of the domestic ones; 7% were on Type A, 67% on Type B and the rest did not know.

[10] Only 50 (20 households and 30 businesses) of these had received the grant in question

[11] 33 participants agreed to be contacted but of these only 14 had had the grant. We tried to contact all of these but only 7 answered and were willing to complete the interview. There were no respondents refused a grant who were willing to be interviewed. We did not interview any respondents who had not taken up a grant although they were on PWS, and this is an area we could explore for the future.

we did not interview anyone who chose not to access a grant. Therefore, we must be cautious in extrapolating from these experiences, which may not be representative of all PWS users.

Interviews with 12 local authority staff, one for each LA area selected for the research, were completed after the questionnaire results were analysed, allowing us to follow up on any particular issues raised in the questionnaires. We did not repeat the interview with Perth & Kinross as we had already got much of the information from a scoping interview in July 2014. Therefore, the final sample was the same 13 LAs selected for the effectiveness analysis.

Combining the two sources of data

For various reasons, it was not possible to relate specific responses from the questionnaire and interviews to the PWS data analysed (mainly data protection issues and the mismatch between data held by supply and stakeholder perceptions by LA or individual properties). However, as illustrated in the findings, we were able to use the results from the effectiveness analysis and the stakeholder perceptions work to compare and contrast trends and themes emerging, particularly where data seemed contradictory or raised further questions.

These data give an indication of potential trends and therefore this research should be viewed as exploratory, and recommendations for data collection to enable a more comprehensive analysis are made in section 5 above. Earlier drafts of this report were discussed with DWQR to correct any errors and ensure the recommendations were fit for purpose.

Annex two: questionnaire template

9525: Private Water Supply Research
FINAL Questionnaire 15.08.14

INTRODUCTION

Hello, I'm [name] calling from Progressive Partnership to ask if you can help me with research on the effectiveness of grants for Private Water Supplies. The Scottish Government is funding the research and it's being carried out by the James Hutton Institute in Aberdeen. We're calling on their behalf to find people who have a private water supply and asking them to take part in our survey. Would you mind answering a few questions about it? This will take about 5-10 minutes.

If you take part, you will not be identified and no information about you will be shared with anyone outside of the research team. Data will be kept securely, and only general results will be presented in the research reporting. You don't have to agree to take part in the research, and if you do participate you can stop at any time.

ASK ALL

Q1. Firstly, can I just check if your property is a household or a business?

[Interviewer note: Business if used for any business purposes, eg work from home; occasional paying guests, base for mobile business]

	CODE
Household	1
Business	2

Q2. And are you the person wholly or jointly responsible for the water supplies and other utilities at the property?

	CODE	ROUTE
Yes	1	Q3
No	2	If not responsible, ask to speak to the person who is. If not available, arrange a suitable call back time and date.

Q3. Do you have a private water supply?

	CODE	ROUTE
Yes	1	Q4/Q5
No	2	THANK AND CLOSE
Don't know	3	Prompt: it is a private water supply if they pay no water rates. If still don't know, thank and close.

IF Q1=1 (HOUSEHOLD/DOMESTIC)

Q4. What type of domestic supply do you have?

	CODE	ROUTE
Type A	1	Q6
Type B	2	Q6
Don't know	3	Prompt: Type A is where more than 50 people get water from the same supply, ie source. If still don't know, go to Q6

IF Q1=2 (BUSINESS/COMMERCIAL)

Q5. What industry is the commercial business part of? (Single code)

	CODE
Agriculture, Forestry & Fishing	1
Human health & social activities	2
Arts, entertainment & recreation	3
Manufacturing	4
Accommodation & Food Service	5
Mining/Quarrying Industries	6
Electricity, Gas, Steam & Air con	7
Water supply/sewerage/waste	8
Construction	9
Retail & Wholesale	10
Transport & Storage	11
Information & Communications	12
Financial & Insurance activities	13
Real Estate	14
Professional, scientific & technical activities	15
Admin & support services	16
Public admin & defence	17
Education	18
Other services (specify)	19

Q5a. Other services _____

ASK ALL

Q6. Are you aware that you can get a grant to improve your private water supplies?

	CODE	ROUTE
Yes	1	Q7
No	2	Q24 (postcode), then thank and close

Q7. Have you applied for the private water supply grant from the local council?

	CODE	ROUTE
Yes	1	Q7a
No	2	Q9

IF YES @ Q7

Q7a. Have you received the grant from the local council?

	CODE	ROUTE
Yes – grant received	1	Q8
No – still awaiting a decision	2	Go to Q24 then Q25 (postcode then invite to interview)
No – was refused a grant	3	

Q8. When did you receive the grant? ____[enter year]_____

IF NO @ Q7

Q9. Which of the following reasons best explain why you have not taken up the grant? [Read out, multicode]

	CODE	ROUTE
I don't need to improve my private water supplies	1	Thank and close
I am a tenant	2	
I don't want the bother of applying	3	
I'm not eligible for the grant	4	
I can't afford to get the work done	5	
I can't find anyone to quote for the work	6	
Someone else applied for a grant which covers my water supply	7	
I can't find anyone to do the work	8	
Other (specify)	9	Q9a then thank and close

Q9a. Other reasons _____

ASK ALL WHO RECEIVED A GRANT

Q10. How did you first find out about the grant? [Do not read out, single code]

	CODE
As the result of a risk assessment	1
Local Council advert about the grant	2
Scottish Government website on private water supplies	3
I contacted someone at the council	4
Person I called to assist with private water supplies problem (e.g. manufacturing company, contractor)	5
Friend/neighbour/relative	6
Don't know / Can't remember	7
Other (specify)	8

Q10a. Other info source _____

Q11. Why did you decide to apply for a grant? [Do not read out, multicode]

	CODE
To help improve my water quality	1
To provide more reliable water flow in dry periods	2
To improve water pressure	3
The financial benefit	4
Risk assessment identified work needed to be done	5
Illness in the household /business identified problems with the water quality	6
Expecting a new baby in the family using the water	7
Expecting visitors	8
Neighbours told me about problems in their private water supplies	9
To improve my private water supplies before selling my property	10
To improve my private water supplies after buying my property	11
Other (specify)	12

Q11a. Other reason _____

Q12. At what point in your water supply system were the changes made? (Read out, multicode)

	CODE
New supply	1
Protecting source (e.g. fencing, covering supply)	2
Intermediate storage (e.g. pipe works, storage tank)	3
Point of entry (e.g. where pipe enters building)	4
Point of use (e.g. kitchen taps, UV, particle filtration, ph modification)	5
Other (specify)	6

Q12a. Other point in the supply system _____

Q13. Did you collaborate with other home owners when you applied for the grant? *[Prompt: did you make the application yourself or did you get together with a neighbour, for example, to get the grant?]*

	CODE
Yes (in collaboration with others on the water supply)	1
No (alone)	2
Don't know	3

Q14. What problem(s) with the private water supplies did the grant aim to address? [Read out, multicode]

	CODE
Bacteria/pathogen contamination	1
Colour	2
pH (acidity/alkalinity)	3
Chemicals (e.g. pesticides, lead, aluminium, nitrate)	4
Turbidity/sediment	5
Taste/odour	6
Inadequate supply in drought	7
Inadequate supply pressure	8
Don't know	9
Other (specify)	10

Q14a. Other problems _____

IF Q1=1 (HOUSEHOLD/DOMESTIC)

Q15. How many households use the water that the grant aimed to improve?

	CODE
My household only	1
Up to 5 other households	2
Between 6 and 20 other households	3
Between 21- 50 other households	4
More than 50 other households	5
Don't know	6

Q15a. And how many people use the water that the grant aimed to improve?

Q15a1. Number of adults _____

Q15a2. Number of children_____

IF Q1=2 (BUSINESS/COMMERCIAL)

Q16. Who uses the water that the grant aimed to improve?

	CODE
My staff only	1
My staff and customers	2
Don't know	3

Q16a. And how many people use the water that the grant aimed to improve?

Q16a1. Number of staff _____

Q16a2. Approximate number of customers per year_____

ASK ALL

Q17. To what extent were you satisfied or dissatisfied with your water quality immediately after the work?

	CODE
Very satisfied	1
Fairly satisfied	2
Neither satisfied nor dissatisfied	3
Fairly dissatisfied	4
Very dissatisfied	5

Q18. To what extent would you agree or disagree with the following statements?

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly Disagree
It was easy for me to apply for the grant					
I was given enough information about the grant					
The grant I received was essential for me to be able to get the work done					
Overall, I am satisfied with the grant					
It was easy for me to apply for the grant					

Q19. Please tell me if the improved water quality has had any of these effects on you and the members of your household [Read out, multicode]

	CODE
I am happier about inviting people to my house	1
I'm more confident that I won't get ill from my water	2
I can now give the water to my children	3
I don't have to buy bottled water anymore	4
I don't have to treat my drinking water anymore	5
The water is clearer	6
The water pressure has improved	7
I now have a more reliable supply in dry times	8
It has saved me money	9
Don't know [DO NOT READ OUT]	10
It has not improved [DO NOT READ OUT]	11
None of these [DO NOT READ OUT]	12
Other (specify)	13

Q19a. Other effects _____

Q20. How much was the total cost of the work to your property? [Single code]

Interviewer note: this is the total cost including any grant they received

	CODE
Less than £1000	1
Between £1001-2000	2
Between £2001-3000	3
Between £3001-4000	4
Between £4001-5000	5
Between £5001-7500	6
Between £7501-10,000	7
Don't know	8

Q21. What amount of grant were you awarded? [Single code]

	CODE
Less than £800	1
£800	2
£1200	3
Don't know	4
Other (specify)	8

Q21a. Other amount _____

Q22. What follow up action (if any) have you taken after completing the work with the grant? [Read out, multicode]

	CODE
Had my private water supplies tested	1
Prepared a water safety plan	2
Routine maintenance carried out by members of family/household	3
Contracted routine maintenance	4
Further contractual work	5
Nothing, I've not done anything after doing the work I did with the grant [DO NOT READ OUT]	6
Don't know	7
Other (specify)	8

Q22a. Other actions_____

Q23. Now that you have had your grant, how, if at all, can we improve the grant service? [Multicode]

	CODE
Provide more information about maintenance	1
Provide a more extensive list of potential contractors	2
Provide a larger grant	3
Less associated paperwork	4
Speed up the process	5
Nothing, the grant service worked well	6
Other (specify)	7

Q23a. Other improvements_____

Q24. Can I confirm that your postcode is [read from sample system]?

(If not, enter correct postcode – but allow respondents to refuse – reassure them it is used for analysis purposes only, not to identify individuals)

ASK IF Q6=1 (AWARE OF GRANTS – I.E. EXCLUDE THOSE WHO WERE NOT AWARE OF GRANTS BUT HAVE BEEN ROUTED THROUGH TO THE POSTCODE QUESTION)

Q25. Finally, would you be willing to have a further chat over the phone at a later date (of around 20 minutes) to give more details about your experience of the grant?

	CODE	ROUTE
Yes	1	Q26
No	2	Thank and close

Q26a. Name _____

Q26b. Email address _____

Q26c. Confirm best telephone number _____

Annex three: interview templates

Draft interview template for survey follow ups

(Fill in boxes throughout as part of interview prep**)**

INFORMATION FROM SURVEY RESPONSES

1. commercial ☐ industry ☐
2. domestic ☐ Type A ☐ Type B ☐
3. LA ☐
4. Grant received ☐ grant refused ☐ waiting for grant ☐

A. FOR PEOPLE RECEIVING A GRANT/AWAITING A GRANT (if awaiting, adapted re stage of process reached in survey plus any progress since)

Introductory remarks Hello, I'm [name] calling from the James Hutton Institute in Aberdeen. We were given your name by Progressive Partnership surveys because you said you would be able to help us with research on the effectiveness of grants for Private Water Supplies. If you are still willing to talk a bit more about your private water supply is it possible to give me 20 minutes now? [If yes but not now arrange time and call back].

If you take part, you will not be identified and no information about you will be shared with anyone outside of the research team. Data will be kept securely, and only general results will be presented in the research reporting. You don't have to agree to take part in the research, and if you do participate you can stop at any time. If you would like more information about the project I can give you a contact at the end of the interview (If yes, Sue Morris at the James Hutton Institute, 01224 395219, sue.morris@hutton.ac.uk.) Research results will be available in November/December this year on the CREW website (www.crew.ac.uk

Q10 Awareness of grant ☐

Probes

- grant known about before water problem arose? awareness locally, eg among neighbours, friends, relatives? Ease of access to information about grant?

Q11 Decision to apply

Probes

- feelings about getting a risk assessment (RA)- seen as necessary; desirable; risky? RA done as part of grant application? RA done before deciding to apply?
- experience of application process-duration? problems at any point? satisfaction with the process? recommendations for improving the process?
- If collaborative application (Q13) and not mentioned probe for experience of collaborating

Q12 Part of supply changed

Probes

- any specific or peculiar aspects of this part of your supply, eg issues with access, old pipes/tank, local micro-climate?

Q14 Problem addressed

Probes

- been a problem in the past? common problem in area? what were the effects of the problem for the household for use as drinking water, washing water? any illness attributed to water problem?

Q20 Cost of the work

Probes

- what work was done? easy to find contractor? disruptive work? value for money? satisfaction with work standard?

Q17 satisfaction with water quality immediately after work done

Probes

- issues after longer period eg 6 months, 2 years; new problems? return of problem? more maintenance now? less?

Q22 Follow up action

Probes

- Views of importance of follow up action? ease of maintenance regime? costs? views of safety plan? reasons for further contractual work and views of this?

Q23 How to improve the grant service

Probes

- Explore response, then widen to ask for views on how effective the grant scheme is for improving Scottish water quality, including their views on any alternatives, eg mains connection, bottled water?

Anything else you would like to say?

Closing remarks thank you very much for taking part in our study. Without your help we wold not be able to provide Scottish Government with information to help improve water quality in PWS, especially people's views on the grant scheme.

Interviews with LA officers

Hello this is [name] calling from the James Hutton Institute to talk to you about the Private Water Supply Grant Scheme. I'm planning to use the interview questions we sent to you but can I just confirm that you are happy for me to record our conversation? The recording is for the research team use only and to ensure accuracy in reporting your views. Data will be kept securely and only general results will be presented in the research reporting. If you change your mind about participating then you can stop at any time. If you would like more information about the research I can send this on after the interview. Research results will be available later this month or in December.

Role in the grant scheme

1. Role in grants for PWS

2. How is their role triggered?

3. Who do they report to on their aspect of the grant system?

PWS and risk assessment

4. How does the annual risk assessment for Type A supplies work?

5. Do Type B owners only come into the system if they apply for a grant?

6. Are different public health risks associated with different types of water supply, eg surface/groundwater, and whether rainwater, well, borehole etc?

7. Do different risks entail different issues re treatment and maintenance?

PWS treatment and maintenance

8. How far do treatment/maintenance costs differ for different types of PWS/water supply?

9. How far does the current fixed maximum non means-tested amount for the grant go in paying for effective treatment where risks are identified?

10. If grant application is approved, how are contractors selected to do the work?

11. Does work often involve ongoing maintenance by PWS owners after treatment?

Views and experience of the grant scheme

12. Do you hold any information on people's perspectives of the grant system/funding

13. Experience of grant administration

a) How often are applications made?

b) What is the split between Type A and Type B applications?

c) Are applications for Type A associated with annual assessment by LA?

d) Are there any patterns emerging for Type B applications?

e) Can you describe a typical case from grant application to contracting for the work to completion of work/grant payment for a) Type A and b) Type B

13. Overall views on effectiveness of PWS grants and their benefits (ie final outcomes and ongoing water quality and health protection)?

That's all that I wanted to talk to you about but I would be grateful if you could give me the name of any contractors in your area. We also want to interview a small number of contractors to get their views.

if you have any further comments or information that you think would be helpful I would like to hear them.

Annex four: causes of failure before and post-grant in supplies awarded a grant

		Cause of failure before or at reporting year															Cause of failure in the post-grant period														
Reporting year	LA	Ammonium	Coliform Bacteria	Colony Counts 3d	Colour	E. coli	pH	Odour	Taste	Turbidity	Lead (25)	Iron	Clostridium perfringens	Aluminum	Nitrite	Trihalomethanes	Coliform Bacteria	E. coli	Nitrite	pH	Clostridium perfringens	Lead (25)	Odour	Taste	Turbidity	Colour	Iron	Total Trihalomethanes	Aluminium	Ammonium	Colony counts 3@22oC	Colony counts 48@37oC
2006	Scottish Borders																Yes	Yes	Yes													
2007	Aberdeenshire		Yes			Yes	Yes				Yes				Yes		Yes	Yes		Yes	Yes	Yes			Yes	Yes						
2007	Scottish Borders																															
2007	Fife																			Yes												
2007	Highland		Yes		Yes	Yes	Yes					Yes			Yes		Yes	Yes		Yes	Yes				Yes	Yes	Yes					
2007	Moray					Yes	Yes										Yes	Yes		Yes						Yes						
2007	Perth and Kinross		Yes		Yes	Yes						Yes	Yes				Yes	Yes		Yes	Yes					Yes						
2007	Stirling																Yes				Yes	Yes				Yes	Yes					
2008	Aberdeenshire						Yes										Yes	Yes														
2008	Argyll and Bute		Yes		Yes	Yes	Yes					Yes	Yes				Yes	Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			
2008	Scottish Borders																															
2008	Fife		Yes			Yes																										
2008	Moray		Yes		Yes	Yes	Yes			Yes	Yes	Yes		Yes																		
2008	Perth and Kinross	Yes	Yes		Yes	Yes	Yes			Yes		Yes	Yes				Yes	Yes		Yes	Yes					Yes	Yes			Yes		
2008	South Lanarkshire										Yes						Yes					Yes										
2008	Stirling		Yes		Yes	Yes	Yes				Yes	Yes	Yes				Yes															
2009	Aberdeenshire		Yes		Yes	Yes	Yes					Yes					Yes	Yes		Yes	Yes				Yes	Yes	Yes					
2009	Argyll and Bute		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes				Yes	Yes	Yes		Yes			
2009	East Ayrshire																															
2009	Fife		Yes							Yes		Yes		Yes			Yes	Yes			Yes											
2009	Midlothian		Yes														Yes	Yes														
2009	Moray		Yes		Yes	Yes	Yes			Yes		Yes	Yes																			
2009	Perth and Kinross		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes	Yes			Yes	Yes	Yes					
2009	Scottish Borders												Yes		Yes		Yes	Yes			Yes											
2009	South Ayrshire		Yes			Yes															Yes											
2009	South Lanarkshire		Yes		Yes	Yes				Yes			Yes				Yes	Yes			Yes											
2009	Stirling		Yes		Yes	Yes	Yes				Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes	Yes			Yes	Yes	Yes					
2010	Aberdeenshire		Yes				Yes													Yes												
2010	Argyll and Bute		Yes		Yes	Yes	Yes			Yes		Yes	Yes				Yes	Yes		Yes						Yes	Yes					
2010	Fife																Yes	Yes														
2010	Moray		Yes		Yes	Yes	Yes						Yes				Yes	Yes	Yes	Yes		Yes			Yes							
2010	Perth and Kinross		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes				Yes	Yes		Yes	Yes				Yes	Yes	Yes	Yes				
2010	South Lanarkshire		Yes		Yes	Yes	Yes			Yes	Yes		Yes		Yes		Yes	Yes		Yes	Yes	Yes			Yes							
2010	Scottish Borders					Yes							Yes				Yes															
2010	Stirling		Yes			Yes							Yes				Yes	Yes		Yes	Yes					Yes						
2011	Aberdeenshire		Yes			Yes	Yes				Yes									Yes		Yes										
2011	Angus		Yes		Yes	Yes	Yes						Yes			Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes							
2011	Argyll and Bute		Yes		Yes	Yes					Yes	Yes	Yes				Yes	Yes			Yes	Yes				Yes	Yes					
2011	East Ayrshire	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			Yes		Yes																	
2011	Moray		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			Yes			Yes												
2011	Perth and Kinross		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes					Yes	Yes					
2011	Scottish Borders		Yes		Yes	Yes							Yes																			
2011	South Ayrshire		Yes		Yes	Yes				Yes		Yes	Yes	Yes			Yes	Yes		Yes					Yes							
2011	South Lanarkshire						Yes																									
2011	Stirling		Yes		Yes	Yes						Yes	Yes				Yes	Yes			Yes					Yes	Yes					
2012	Aberdeenshire		Yes			Yes	Yes					Yes								Yes					Yes							
2012	Angus	Yes	Yes		Yes	Yes	Yes		Yes				Yes				Yes	Yes		Yes	Yes			Yes		Yes						
2012	Argyll and Bute		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes		Yes		Yes	Yes	Yes		Yes			
2012	East Ayrshire		Yes																													
2012	Fife		Yes			Yes	Yes					Yes													Yes		Yes					
2012	Highland	Yes	Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes					
2012	Moray		Yes		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes							Yes		Yes			
2012	Scottish Borders		Yes			Yes																					Yes					
2012	South Ayrshire		Yes		Yes	Yes	Yes			Yes		Yes	Yes	Yes			Yes			Yes												
2012	Stirling		Yes		Yes	Yes	Yes				Yes	Yes	Yes				Yes	Yes								Yes						

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