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Assessing the effectiveness of Scotland's public flood warning service: Summary report

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FLOOD ALERT

FLOODING IS POSSIBLE. BE PREPARED.





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Research Summary

Research questions

1. Are customers happy with the Floodline service that they currently receive?
2. What information would customers like to receive in advance of/immediately prior to and during potential flooding?
3. What action, if any, do customers take on receipt of flood messages to reduce the impact of flooding?

Main findings

- Levels of overall satisfaction with the Floodline service are high, in relation to message content, timeliness and frequency.
- Customers are keen to receive messages which are more specific to their local situation, and are less satisfied when they feel that message scope is too broad to be locally meaningful.
- There is a significant degree of misunderstanding about the geographical scope of Floodline messages. In particular, Flood Alerts are often misunderstood by recipients as being specific to more local areas. Lack of clarity over this was a source of frustration and negative perceptions among Alert-registered customers.
- Floodline message recipients do take action to mitigate flood impacts: some 82% of those receiving a message reported that they had taken one or more actions. Most frequently reported actions were: ensuring mobile phones were charged; having a list of key telephone numbers; checking roads and availability of a safe exit; moving documents and vehicles; and obtaining more information from the Floodline service.
- Responses to the Floodline messages are significantly associated with prior experience of flooding, level of educational attainment, satisfaction with Floodline messages, and with use of and satisfaction with the detailed information on SEPA's live update website.
- Prior flooding experience is often associated with higher levels of action. Evidence points to those who were flooded

being more aware of a local flood group, and more likely to participate in one.

- Differences in message frequency, flood impact and prior flood experience are associated with differences in customer preparedness e.g. in one customer group, those previously flooded were more than twice as likely to have prepared a flood plan (38% of respondents) compared with those not previously flooded (17%).

Background

Flood Warnings and Flood Alerts have been offered in Scotland since the 1980s and have become a key element of delivering flood resilience as a response to the threats presented by climate change. High levels of demand have been translated into high levels of customer satisfaction as the delivery of services has spread and have embraced new technologies to better meet the needs of users. The direct messaging service of Floodline was initiated in 2011 and currently has around 25,000 registered customers. This study was commissioned by SEPA to take stock of the progress which has been achieved.

Research undertaken

This research explores the effectiveness of the Floodline service in Scotland by examining the experiences and opinions of users in their own individual contexts – social, flooding history, and geographical.

The principal method used was a web-based questionnaire survey completed by more than 1,300 customers drawn from three main registration groups: customers registered for Flood Alerts only; for Flood Warnings only; and customers registered for both messages (Alert and Warning). Respondents were not told what service they were signed up for, allowing the survey to be done 'blind'. The survey analysis was greatly aided by 96% of respondents providing postcodes, allowing geospatial analysis to be undertaken, linking responses to Alert regions, Warning areas and other publicly available neighbourhood social descriptors.

Three community workshops were held to explore key issues in detail, and were complemented by thousands of free text responses to the on-line questionnaire.

1.0 Introduction

1.1 Background and scope

The Floodline service in Scotland provides more than 25,000 customers with messages by SMS text message and/or automated telephone messages to warn of the risk of flooding. Warnings are issued on the basis of assessments of risk from river, or coastal flooding, or a combination of both. Customers voluntarily opt in to receive these messages. The service is provided by the Scottish Environment Protection Agency (SEPA).

Floodline has evolved substantially since the first services were launched in the 1980s. The number of areas covered by Flood Warnings has expanded to 269 in 2017. These warnings are based on locally specific information about water levels, rainfall, ground conditions and other locally specific factors. Each warning is based on robustly developed numerical models and procedures designed to ensure reliability of message content, maximum achievable lead times and helpful guidance to recipients.

The other major element of the current Floodline service is the provision of regional Flood Alert messages. These messages are issued for 19 regions covering the whole of Scotland, meaning that individuals and businesses in all parts of the country can benefit from the Floodline service. The services provided are explained further in Figure 1 below.

Every message is issued by an experienced member of SEPA's flood warning team, and is published on SEPA's web site which is publicly available. Recipients may also opt to call Floodline to hear this information or seek individual advice if they wish. Whenever SEPA issue a new or updated message, direct notification is sent to customers registered for that area. This notification message advises that a Flood Alert/Warning message has been issued and directs the customer to the website or phonenumber for full information.

1.2 Vision and impact

At the time of commencing this research, SEPA's vision for the Floodline service was to "help Scottish communities and responders to take action, tackle flooding together and reduce the impact that flooding could have on lives through maintaining and increasing our capabilities as a respected and influential flood warning authority" (SEPA flood warning strategy 2012-2016). SEPA's Flood Warning Development Framework 2017 to 2021 continues the ethos of this vision into their new 4-year planning period, albeit with a shortened text which simply states 'Everyone is aware of their flood risk and we give enough time for people to take action and reduce the impact of flooding'.

1.3 Aim and objectives

The aim of the research is to:

- Assess how far SEPA has achieved its vision, through the assessment of the effectiveness of flood warning messages which are issued; and
- Gain customer feedback to help shape the future service provided.

The objectives of the research are to:

1. Identify whether Scotland's flood warning service is meeting the needs of its customers through damage mitigation actions
2. Identify whether customers value the current flood warning service as a vital tool in being more resilient to flooding
3. Understand whether all customers have identical requirements of the flood warning service or whether the service is used differently by separate and unique customer groups

LIVE FLOOD INFORMATION	
 <p>FLOOD ALERT FLOODING IS POSSIBLE. BE PREPARED.</p>	<p>Flood Alert:</p> <ul style="list-style-type: none"> • means flooding is possible; • provides an early indication of potential flooding from coasts, rivers or surface water; • raises awareness of flood risk; • enables you and the emergency response services to prepare for possible flooding; • issued as early as possible (up to a maximum of 36 hours ahead of potential flooding) and usually between 8am and 6pm.
 <p>FLOOD WARNING FLOODING IS EXPECTED. IMMEDIATE ACTION REQUIRED.</p>	<p>Flood Warning:</p> <ul style="list-style-type: none"> • Issued when flooding is expected for a defined local area; • Issued 3 to 6 hours in advance of expected flooding although in some areas rivers respond very quickly to rainfall so this time may be shorter; • only available for some communities and stretches of coastline. <p>If you receive a flood warning:</p> <ul style="list-style-type: none"> • Take action immediately to protect yourself and your property; • Avoid making unnecessary journeys and where travel is required check local information
 <p>SEVERE FLOOD WARNING SEVERE FLOODING. DANGER TO LIFE.</p>	<p>Severe Flood Warning:</p> <ul style="list-style-type: none"> • issued whether there is a risk to life and significant disruption to essential services, such as water and electricity supplies; • is a status rather than an advanced warning; • will generally be issued when flooding is creating potential impacts that require further action such as evacuation

Figure 1: Descriptions for Flood Alerts and Flood Warnings currently used in Floodline (Source: SEPA)

4. Understand how customers respond to direct messaging received from Floodline. Identify what actions customers take as a result of receiving flood alert and/or warning messages, including actions to mitigate flooding
5. Present the benefits of the flood warning service (both tangible and intangible).

This report provides an overview of the methodology and findings, a more detailed account is provided in Geddes et al (2017).

1.4 Methodology

On-line questionnaire survey

The principal means by which the research objectives were investigated was by use of three related but independent on-line questionnaires – respectively for Warning customers, Alert customers and those registered for both. It was understood that some customers were unclear about what service they were registered for, so participation invitations were sent separately to customers in each of these three groups without identifying the service signed up for.

Each survey was structured in a series of sections, namely:

1. Why you registered with Floodline;
2. Your experiences of being flooded;
3. Your general preparedness for flooding;
4. Floodline messages;
5. Overall satisfaction with Floodline;
6. Further comments;
7. About yourself.

Responses to sections 1, 2 and 7 provided background information to support insightful analysis of customer behaviour and satisfaction. Routing questions within each questionnaire allowed follow-on questions to be asked specific to the responses offered by participants. Free text questions were included to allow detailed replies to be given. Postcodes were asked for and were provided by 96% of respondents, allowing geospatial linkage between survey respondents and Alert Regions and Warning Areas.

Table 1 shows the numbers of respondents to the surveys in relation to the total numbers of customers. Analysis focused on the production of cross-tabulations and graphs to allow comparisons between groups. The sample of respondents was investigated and found to be broadly representative of the entire customer population.

	All surveys	Survey of Alert-registered customers	Survey of Warning-registered customers
Respondents by registration category	Alerts only: 603 Warnings only: 377 Both: 361	Alerts only: 603 Both: 361	Warnings only: 377 Both: 361
	Total: 1,341	Total: 964	Total: 737
Approximate total customers	18,000	14,500	16,900
Approximate response rate	7%	7%	4%

Table 1: Survey response by type of survey

Focus groups

In addition to the surveys, three focus groups were arranged in communities which were selected in order to give exposure to a range of local experiences of flooding and Floodline. Details of these groups are provided in Table 2. Findings from the focus groups and free text responses have been integrated in the main report within the findings from the questionnaires.

Results

Survey results show that customers receiving Floodline direct warning messages do take action to mitigate flood impacts. Most frequently reported actions taken following receipt of a message were: ensuring mobile phones were charged; having a list of key telephone numbers; checking on others who might need assistance (e.g. family, friends, or neighbours), checking roads and availability of a safe exit; and moving documents and vehicles. For those with property-level protection, the majority reported deployment following a message. Among Warning-only customers for whom flooding of land was important, the majority moved livestock on receipt of a Floodline message. Some of the most common responses are shown in Box 1.

Responses to Floodline messages are also significantly associated with a range of other factors: prior experience of flooding, satisfaction with Floodline messages, and with use of and satisfaction with the additional detail on developing flood situations available on the Floodline website. In other words there is a complex set of relations underpinning mitigation actions, and it cannot be proven that actions arise purely as a result of receiving a message. Nevertheless, evidence suggests that message receipt is an instigator of actions.

Survey results suggest a relatively high level of misunderstanding among customers of the types of message Floodline provides and type they are registered to receive. Close to a fifth of all survey respondents indicated they did not know which message type they registered for (Warning vs Alert vs both), while more than a third of those registered for Alerts indicated incorrectly they were registered for messages for locally specific areas. Lack of clarity of the broad-scale nature of Alerts was a source of frustration and negative perceptions among Alert-registered customers that should be addressed (Box 2).

The majority of respondents reported that they had used the detailed information on SEPA's live update website after receiving a Floodline message. Percentages reporting they had accessed detailed information via the phonenumber were much lower. More than a quarter of respondents receiving a direct message had used neither SEPA's live update website nor the phonenumber to seek more detailed information.

Location	Broad characteristics of area	Attendee characteristics
Menstrie, Clackmannan-shire	Alert messages generally for flood risk on the River Devon. One nearby Warning Area, Menstrie Industrial Site, but this was not a concern for meeting attendees	<ul style="list-style-type: none"> • People interested in their homes and the community (none of the attendees were Floodline customers) • No one had been badly affected by flooding
Nethy Bridge, Highland	Covered by the Aviemore/Dalfaber to Grantown Flood Warning area: a rural area dominated by agricultural flooding interests.	<ul style="list-style-type: none"> • Two farmers (one a Floodline customer). Both affected by flooding • Other six concerned about their homes and the community
Aviemore, Highland	Within River Spey catchment. Two local Flood Warning Areas: Aviemore/Dalfaber to Grantown; Aviemore and Dalfaber, covering domestic, business and agricultural customers.	<ul style="list-style-type: none"> • A Catchment Initiative Project Officer – lives in village • A village resident – affected by flooding for over 40 years • A resident working in fisheries • Manager of Aviemore Holiday Park • Another resident had experienced regular flooding • Three are registered with Floodline

Table 2: Summary of local community meetings held

Most customers value Floodline as part of their preparedness for flooding, as evidenced by high levels of overall satisfaction with the service. Nevertheless, a substantial proportion of the survey respondents cited aspects which could be improved to enhance benefits to them. Notably, customers registered for Flood Alerts are seeking information more specific geographically to their own locations. Many customers reported using additional sources of information, and a desire for better access to additional or improved real-time water level and forecast services.

The survey results gave insights into aspects of message communications that matter most to customers, especially message timeliness and frequency. High rates of overall satisfaction in turn suggest that the service is able to deliver on these demands. All the same, messages issued very frequently for geographically broad Alert areas may be having a corrosive effect on satisfaction with the service and also effectiveness.

Levels of preparedness for flooding are associated with socio-economic differences and with flooding experience. The survey results showed that home-owning and higher-educated respondents were more likely to have altered their property to provide direct flood defence, and were also more likely to participate in a local flood action group. Flood plans however, were more commonly found to have been prepared among less highly-educated respondents. Past exposure to a flood was linked to a greater tendency to take preparedness steps.

The preparedness steps and response actions taken by customers points to the array of tangible and intangible benefits arising from Floodline. Benefits such as the avoidance of damage to possessions which are moved, or the avoidance of property damage in the case of installing effective property level protection, point to major tangible benefits of the service. Intangible benefits include reductions in emotional distress and major inconvenience. Often, tangible and intangible benefits go hand-in-hand, e.g. avoidance of material damages and increases in personal safety arising from warnings to avoid travel routes at risk of flooding. Additional benefits accrue to other people who are known to use SEPA's website and/or phonenumber but without becoming registered as Floodline customers.

There remains a gap in knowledge of responses among non-home users of the Floodline messaging service. Almost one third of the survey respondents indicated that concern to their own home was not their primary reason for registering with Floodline. Respondents in this group indicated various reasons for registering e.g. concerns about impacts on journeys made, on services and amenities, on other people, on business premises. Some exploration of responses taken by this group was possible e.g. among respondents who indicated that land owned or rented was their reason for registering, the majority moved livestock on receipt of a direct message. However, further investigation is required into whether Floodline is promoting the most effective or appropriate responses among this customer group.

What actions do people take on receipt of a Flood Warning?

- 38% of all respondents removed vehicles on receipt of a flood warning
- 71% of those who stated they had bought these measures, deployed property level protection
- 62% of those who said flooding of land was important to them moved livestock

Box 1: common Flood Warning responses

Customers registered for Flood Alerts were slightly more likely than other customers to use detailed live flood update information on the SEPA website after receiving a Floodline message: 63% of Alert-only registered customers compared with 54% of customers registered for Flood Warnings only and 57% of customers registered for both Alerts and Warnings.

However, Alert-registered customers gave a lower rating to the information on the website: 20% of Alert-registered respondents gave the website information a neutral or lower rating, compared with 14% of Warning-only customers and 12% of customers registered for both message types.

Frustration was expressed by several Alert-registered users over the lack of geographical detail pertinent to their own circumstances. Some viewed Alerts as 'crying wolf' too often, resulting in messages being ignored even when received:

"I have had flood warnings and there has been no heavy rain! If I prepared every time I got a flood warning I would be very busy and would have to take a lot of time off work. Floodline doesn't really work for me but I will keep on with it as we have nothing else. I weather watch which is more help to me."

"It's usually too wide reaching and we continue to receive flood warnings but never see any change in river flow. Sometimes we don't even listen to message as it's unfortunately unfounded and a waste of resources."

"I am not happy about just getting a 'flood' warning. One can develop the 'crying wolf' attitude to the warning and not act when it is a serious flood. I do find myself getting blasé about the calls now."

Misunderstanding in regional Flood Alerts:

- 35% of the regional Alert-only customers believe it's a service providing locally specific warning, and;
- 74% of Alert-only customers who said messages were too frequent also said the impacts were not as bad as conveyed.

Box 2: Responses from Flood Alert customers

While Flood Warning Areas are defined to benefit specific local communities, they vary considerably in terms of frequency with which Floodline messages are issued and the impact flooding may have on that particular area and its communities. The possible impact of these variations on the receiving users were explored by aggregating Flood Warning Areas into nine classes (Low, Moderate or High message frequency by Low, Moderate or High flood impacts). These classes were defined based on input from SEPA experts.

Interestingly the survey results suggest a positive association between the level of overall satisfaction and the level of message frequency. The graph in Figure 2 shows that percentages giving a 'High' overall satisfaction rating are highest among

survey respondents in Warning Areas classed as High Frequency (HF), second highest among respondents in Warning Areas classed as Medium Frequency (MF), and lowest among those in Warning Areas classed as Low Frequency (LF). This trend is evident regardless of the level of local flood impact (Low Impact (LI), Moderate Impact (MI) or High Impact (HI)). A possible interpretation of this finding is that a higher frequency of messages contributes towards reassuring customers that they are being actively monitored and protected against flooding. It should also be remembered here that customers registered for Flood Warnings benefit from messages which are more tailored to their local area than is the case for those registered for Flood Alerts only.

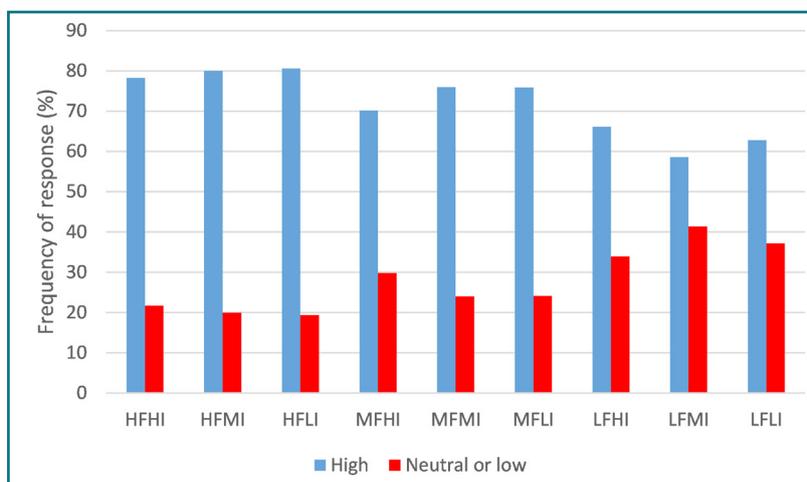


Figure 2: Overall satisfaction rating for survey respondents registered for Flood Warnings, by Message Frequency-Flood Impact class of Flood Warning Areas

Have you prepared a flood plan? LFHI-Not flooded are much less likely to have prepared a flood plan as LFHI-Flooded and HFLI; 17% of respondents compared to 38% and 49% respectively.

Have you obtained protection products? LFHI-Not Flooded respondents were less likely to have obtained protection products than LFHI-Flooded and HFLI; 12% of respondents compared to 38% and 33% respectively.

Have you listed key contact numbers? Generally there are higher response rates, but with a similar differential: LFHI-Not Flooded 27%; LFHI-Flooded 44%; HFLI: 61%. High message frequency is linked to the highest levels of uptake of this action.

Have you prepared a flood kit? Here only HFLI respondents yielded a high response (36%), compared with LFHI: 13% (Flooded) and 20% (Not flooded) – the non-flooded customers register a higher response than the flooded.

Have you altered buildings? HFLI are twice as likely to do so (12%), compared with LFHI-Flooded (6%) and LFHI-Not Flooded (5%).

Have you provided information on flood risk to others at registered locations (e.g. employees, tenants, visitors)? HFLI (36%) customers and LFHI-Flooded (31%) were three times more likely to do this than LFHI-Not Flooded (10%).

Perhaps oddly, 50% of LFHI-Not Flooded respondents indicated that they participated in a local flood action group, much higher than the percentage of HFLI customers (20%) and LFHI-Flooded (33%), even though awareness of the existence of a local flood group was lower in LFHI-Not Flooded (10%) compared to the other two groups (HFLI 14% and LFHI-Flooded 20%).

Box 3: How do Flood Warning Area characteristics affect flood preparedness among Warning-registered customers?

2.0 Conclusions

Floodline in Scotland is meeting the needs of its customers through damage limitation actions. This is evidenced by prior preparedness steps and actions taken in response to a Floodline message. In terms of preparedness steps, common steps were knowing how to shut off utility supplies and having adequate insurance, while more than a third of respondents also had a flood plan in place. In response to receiving a Floodline message, the most common actions were ensuring mobile phones were charged, having a list of key telephone numbers, checking on others, checking roads and availability of a safe exit, and moving documents and vehicles. The main report for this work investigates differences in response rates according to gender, age, educational qualifications and other characteristics.

In relation to achieving flood resilience, customer satisfaction can be taken as an indication of the value respondents place on Floodline. Some 67% of respondents considered their satisfaction with Floodline as high or very high, while only 7% had less than neutral satisfaction. However, many customers, especially those registered for Alerts only, expressed a desire for messages which are more specific to their own location/s. This represents a significant technical challenge for the future. Participants expressed a range of ideas about how improved information could be provided to help them, including better integration of information sources and increased access to real-time monitoring.

Considering the requirements of customer groups, it was clear from the questionnaire and focus group results that all users sought messages which are specific to their own interests and locations (rather than relating to a large area of hundreds or thousands of km²), containing reliable information and delivered in a timely manner (lead times as long as possible, and avoiding during the night, if possible). But differences were found between customers registered in relation to their own homes being at risk of flooding, compared with others. The latter group were more likely to be concerned with flooding to roads and included people with animals at risk of flooding on low-lying land.

The research investigated 15 actions listed on the Floodline website which recipients might implement on receiving a

message. A range of response levels was found, from 71% of those with property-level protection deploying it to less than 15% of respondents turning off power and vacating – perhaps reflecting individual on-the-ground assessments of when flooding might actually occur. However, many striking differences were found between the responses of those who looked up additional information on the Floodline website and those who did not, typically involving higher rates of taking action among those who did obtain additional information.

The scale of the benefits arising from the Floodline service is evidenced by the number of customers signed up and receiving forewarnings, the numbers of non-customers also accessing the website during periods of possible flooding, and the actions being taken in response to the information provided. The potential benefits arising from this extend beyond those who are registered to family members, friends and neighbours. In the event of flooding occurring, benefits include tangible benefits such as damages avoided, as well as intangible benefits such as reassurance and reduction of stress arising both during flood events and at other times when risks are low. The quantification of such benefits is a complex matter which may warrant a separate investigation in its own right.

3.0 Recommendations

The following recommendations are made on the basis of the findings achieved:

1. **Continue with the Floodline Service**
2. **Review the whole of the information landscape provided for Floodline on-line customers**

Well engaged customers have an appetite for more information. Feedback from some of the open-ended survey questions and from most participants in the local workshops revealed interests in:

- Integrating real-time monitoring data into an information-rich website which provides customers with additional information to the current provision. This may drive response, in that

customers would be able to decide on actions on a better-informed basis. There is scope to include live data feeds on rainfall, river levels and sea levels.

- Providing local contextual information and historical references in connection with floods – e.g. the River Tweed at Kelso is presently reading X metres and has risen xx metres in the past hour. For comparison, the record flood of 1948 reached M metres while the 2015 flood reached N metres at the same location.
- Incorporating locally specific information such as arrangements for sandbag distribution, if available.
- Access to forecast data, suitably qualified in terms of potential uncertainty.

3. Maintain and continue to develop awareness-raising activities While mindful of existing best practice and the difficulties of increasing reach, we argue that the benefits of Floodline may be increased by:

- Continuing to innovate in the raising of awareness of Floodline.
- Promoting better understanding of the information content and applicability of Floodline messages (not least distinction between Alerts and Warnings).
- Improving understanding of how Floodline works as a means of managing expectations – when messages are issued, why, the scope of messages, and to whom they are issued.
- Continuing to raise levels of preparedness, e.g. via collaborations with local authorities and Scotland's National Centre for Resilience.
- Raising understanding of responsibilities – who does what (e.g. householder installation of property-level flood protection products, local authority emergency responses).
- Issuing an annual registration confirmation message, confirming messaging preferences and offering the chance to alter preferences – e.g. dual messaging by SMS/email/voice call.

4. Review flood warning message content

- Ensure the severity of the forecast flood is reflected in the message (e.g. 'this flood is expected to be larger than any experienced in the past 40 years'; 'in most areas, this flood is expected to be similar in height and extent to the event experienced last week').
- Provide additional guidance, addressing likelihood of flood occurrence, extent and impacts, e.g. example messages at sign-up and within an annual service confirmation communication.
- Consider indicating how long a warning should be expected to be in force, and when a 'no longer in force' message will be issued.

5. Review Flood Alerts

We recommend that Flood Alerts are subject to review given the high level of customer comment/criticism and extent of confusion about what the service does and does not provide. This review should take into consideration:

- That it is important to continue offering a service to persons

not located within Flood Warning Areas. However, these individuals were the least satisfied respondents, with the lack of geographical specificity to messages being key to their concerns.

- Weaknesses identified with Flood Alerts by continuing to add to the number (and extent) of Flood Warning Areas.
- How to continue to encourage new customer registrations, not least in under-represented groups: those in coastal areas and younger persons.

6. Introduce a 'no warning'/reassurance message type

- In order to enhance customer satisfaction by building on the observed direct link between message frequency and overall satisfaction, we recommend that an additional message be offered for Flood Warning Areas, in the form of 'SEPA is aware of heavy rainfall and is monitoring the situation, at the present time there is no expectation that flood warning levels will be reached'.
- Messages could be issued when the flood risk is in the area but flooding issues are not currently expected in the particular flood warning area. A link to live rainfall, river level etc. feeds would support this message.
- The issue of a Flood Alert to Flood Warning customers may serve the required purpose well.

7. Review the potential for tailored content Possible aspects to consider here include:

- Content based on precise location within a Flood Warning Area, recognising that each Warning Area has a vertical profile, such that those closer to normal water levels will typically be more often/significantly at risk than those on higher ground. It may be foreseen that some customers in a Warning Area will not be at any meaningful risk on a particular occasion when a Flood Warning is issued, owing to the elevation of their property.
- Content based on customer type (not just registration type) – e.g., exclusively for transport and utility operators, office complexes, factory operators, agricultural customers, operators of vulnerable properties (such as a nursing home or caravan park), or vulnerable individuals. Some of these may face difficulties in responding within a normal warning window but may be willing to accept lower-confidence warnings as the price for benefiting from greater lead times.

8. Maintain the SEPA live update phone line

This service, while used much less than the SEPA website is important in maintaining service resilience, coverage and meeting the needs of a minority of customers dependent on voice-based communication.



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