Knowledge, perceptions, and intentions in relation to driving into and avoiding driving into urban flash flooding in Newcastle

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KNOWLEDGE, PERCEPTIONS, AND INTENTIONS IN RELATION TO DRIVING INTO AND AVOIDING DRIVING INTO URBAN FLASH FLOODING IN NEWCASTLE, AUSTRALIA

2021 Research Report

SES NSW STATE EMERGENCY SERVICE

City of Newcastle

UNSW SYDNEY

Griffith UNIVERSITY Queensland, Australia

MENZIES HEALTH INSTITUTE QUEENSLAND

This research report was produced by the authors as part of a joint project between the NSW SES and the City of Newcastle.

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The views expressed herein do not necessarily reflect the views of the New South Wales Government or the City of Newcastle.

ABOUT THE NSW STATE EMERGENCY SERVICES

The NSW State Emergency Service (NSW SES) is an emergency service and rescue agency, primarily responsible for responding in times of floods, storms, and tsunamis, as well as other services, such as land rescue, land search, and interagency support. NSW SES is an agency in the Department of Communities and Justice, under the NSW Government Stronger Communities Cluster.

COMMUNITY CAPABILITY

NSW SES is committed to working alongside communities to enhance their capability to be prepared for severe weather events and is responsible for coordinating preparedness and response activities throughout the Hunter and Central Coast areas. The Community Capability Team works in collaboration with NSW SES Units, the community, Local and State Government to build preparedness and resilience to floods, storms, and tsunami.

ABOUT GRIFFITH UNIVERSITY'S MENZIES HIQ

Based at Griffith University, the Menzies Health Institute Queensland undertakes research across the lifecycle to identify key factors that influence health. From this, we develop and test strategies to improve health and wellbeing for individuals, families, and communities.

With exceptional biomedical, nursing, allied health, social and behavioural scientists, clinical researchers, and research candidates, Griffith's Menzies HIQ has achieved remarkable outcomes. Four overarching programs—Disability and Rehabilitation, EPIC Health Systems, Healthcare Practice and Survivorship, and Infectious Diseases and Immunology—encapsulate our research strengths and align with local and national health priorities. Underpinning the work of these programs is a focus on innovation, data science, research translation, and meaningful clinical and community partnerships.

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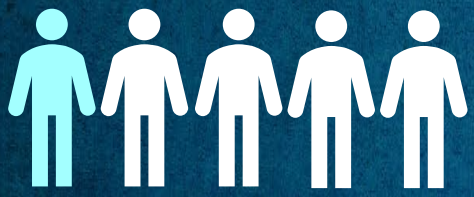
WE SURVEYED NEWCASTLE DRIVERS ABOUT DRIVING INTO AND AVOIDING DRIVING INTO FLOODWATER IN NEWCASTLE

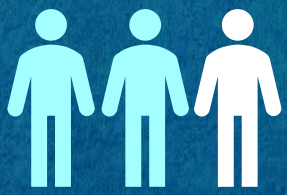
217 RESIDENTS OF NEWCASTLE LGA AND SURROUNDING SUBURBS

AGED 18-86 YEARS

57% FEMALE



1 IN 5 HAD PREVIOUSLY DRIVEN INTO FLOODWATER IN NEWCASTLE



2 IN 3 HAD PREVIOUSLY AVOIDED DRIVING INTO FLOODWATER IN NEWCASTLE

63% **HAD ENCOUNTERED A FLOODED ROAD IN NEWCASTLE AT LEAST ONCE IN THE PAST YEAR**

A KEY DETERMINANT OF INTENTION TO DRIVE INTO AND AVOID DRIVING INTO FLOODWATER IN NEWCASTLE WAS PERCEIVED SOCIAL APPROVAL/DISAPPROVAL

FORMING PLANS AHEAD OF TIME FOR WHAT TO DO IN DIFFERENT SCENARIOS CAN REDUCE WILLINGNESS TO ENGAGE RISKY DRIVING BEHAVIOURS DURING URBAN FLASH FLOODING

BACKGROUND

Flooding causes significant loss of life, injury, and economic harm. Driving into floodwaters is an often avoidable cause of injury and death. In addition, resources and rescuers' lives are risked through the act of coming to the aid of those in need of rescue. This report details research undertaken in the Newcastle region of New South Wales (NSW). The research explores why people do and do not drive into urban floodwaters. It seeks to provide the NSW State Emergency Service (NSW SES) with insight into how the City of Newcastle Unit's volunteers can better encourage the local community to avoid driving into urban floodwaters.

Global and national context

Drowning is the third leading cause of injury-related deaths worldwide [1]. The risk of drowning increases with floods. Activities such as driving into, walking near, or playing in floodwater are commonly reported as preceding drowning [1]. In Australia, reports have shown that around 53% of unintentional flood-related fatal drowning, and 55% of all river flood-related unintentional fatal drowning [2], were the result of driving into floodwaters. The use of personal vehicles, predominantly cars, to navigate flooded roads, has been identified as a precursor to flood-related drownings in Australia [1,3]. Globally, drowning fatality statistics likely underestimate the true extent of drownings caused by driving into floodwaters due to limitations around International Classification of Diseases (ICD) drowning codes and the exclusion of disaster and transportation-related drowning [4,5] from global tolls. Despite mass media campaigns aimed at reducing driving into floodwaters (e.g., 'Turn Around Don't Drown', [6]; 'If it's flooded, forget it', [7]), fatal and non-fatal incidents continue to occur regularly, resulting in rescuers placed at increased risk [8] and a national call for research into behaviours around floodwater: "Therefore, strategies that encourage appropriate response among the community before entering floodwaters are of vital importance".[3]

Newcastle context

Newcastle is a large city which is home to over 165,000 people [9]. Risk to life on roads from urban flash flooding is a key issue for the city. As such, the present research seeks to directly focus on the local government area (LGA) of Newcastle NSW, and driver perception, knowledge, and understandings of urban flash flood risk among local residents.

Almost three quarters of the LGA is located on the extensive coastal floodplain of the Hunter River. As Newcastle was settled by Europeans, the wetlands of this coastal floodplain were drained, to allow for settlement on low lying land around the Harbour and on the floodplain. The city is therefore subject to three types of flooding: riverine, oceanic (from storm surge) and flash flooding. Some of the city's upper catchments are steep, and because much of the city is paved or impervious, intense rain can quickly turn into runoff. Modern major drains are typically sized to carry flows for storms that, on average, occur once every ten years. So, for storms and floods that are more severe, drains fill, overtop, and stormwater flows overland across flood prone land, including roads. The consequences are compounded by the fact that historic land settlement and drainage systems are not informed by current floodplain development principals.

Key features of flash flooding are its rapid onset and unpredictability. Warning times from peak rainfall to peak flood can be very short, from between 30 to 90 minutes[10].It can also be difficult to predict exactly where and when intense rainfall bursts will fall in these relatively small urban catchments. Floating debris, mobilised by stormy winds, can block drains; traffic congestion and very localised road conditions can influence the consequences of flooding for the city's residents and visitors. The significant 2007 Pasha Storm impacted the city during peak hour on a Friday afternoon. Many parts of the city's road network became quickly inundated by floodwater. 5000 vehicles in Newcastle and surrounding LGAs were written off; and numerous flood rescues were made by trained NSW SES volunteers, the police, and civilians [11]

In 2012, the City of Newcastle's Flood Risk Management Study identified that many arterial roads in Newcastle become major flow paths during infrequent or extreme flash flooding, and the most significant risk to life from flooding in Newcastle is to people in cars travelling (or stuck in congestion) on roads that become flood ways during flash flooding [10]. Given the historical nature of development in the city and extent of risk during major flood events, engineering controls cannot be relied on alone to reduce this risk to life. The study indicates that it is "critical that the community knows how to self-respond to an actual flood without assistance from combat agencies" [10] (page 174). Council has developed a range of flood education materials to enable the community to know their flood risk. It has also in recent years developed a free, opt in 'flood alert' service which is now being offered to people across the city.

For a largely volunteer emergency response organisation such as the NSW SES, urban flash flooding poses several challenges. The unpredictable nature of flash flooding can make it difficult to pre-deploy resources to different parts of the city with certainty. It can be impossible to effectively mobilise volunteer flood rescuers and emergency responders given the short warning times. Road inundation, traffic congestion, and associated powerline hazards can make it difficult to attend calls for assistance. The widespread nature of road inundation can overreach the resources available to respond. Because flash flooding often occurs during storms, NSW SES Volunteers are also tasked with responding to other storm hazards such as damage to properties by wind and rain.

RESEARCH AIMS

The present research aimed to understand Newcastle drivers' knowledge of urban flash flood risk, and their perceptions and intentions to drive into and avoid driving into urban floodwaters as a result of a flash flood in Newcastle, in order to gain a comprehensive understanding of drivers' decision making when floodwaters are encountered. The research draws on previous published work by the research team [12–16] and the research partners' knowledge of the specific flood risks in the city.

For the current project, we implemented a two-phase methodology. Phase 1 used quantitative methods which adopted online survey techniques to understand individuals' knowledge, perceptions, and intentions toward driving during urban flash flooding; specifically, driving into urban floodwaters and avoiding driving into urban floodwaters. Given research suggests that performing and not performing a given behaviour are not conceptual opposites, and that different motivational pathways may operate in guiding individuals' decisions to engage in an action or behaviour and decisions to desist or avoid one, it was important that both the desired behaviour (intentionally avoiding driving into urban flash floodwaters) and the risky behaviour (intentionally driving into urban flash floodwaters) were explored in the present research. Phase 2 used qualitative methods adopting one-on-one interview techniques to gain a rich understanding of individuals' knowledge, perceptions, and intentions, as well as personal experiences toward driving during urban flash flooding and driving into and avoiding driving into floodwater—and provided data triangulation with the Phase 1 quantitative study.

METHODS

Ethics approval

Human research ethics approval has been received from Griffith University Human Research Ethics Committee (2021/102) for the conduct of both phases of this research.

Survey development

The research questionnaires and interview scripts were developed by researchers at Griffith University and University of New South Wales in collaboration with the NSW SES, the NSW SES City of Newcastle Unit and City of Newcastle. Measures were based on established guidelines [17] and have been used in the research teams' prior research [15].

Phase 1: Quantitative survey

Participant recruitment and data collection

The City of Newcastle Local Government Area (LGA) is divided into four wards. Participants were 217 residents of the Newcastle LGA and its surrounding areas who hold an open or provisional driver's licence. Participants completed an online survey containing a range of multiple choice and Likert-style questions. Participants were sourced through an independent research panel company. Data were collected in April 2021. Please see appendices A, B, and C for the breakdown of suburbs, and number of participants from each suburb.

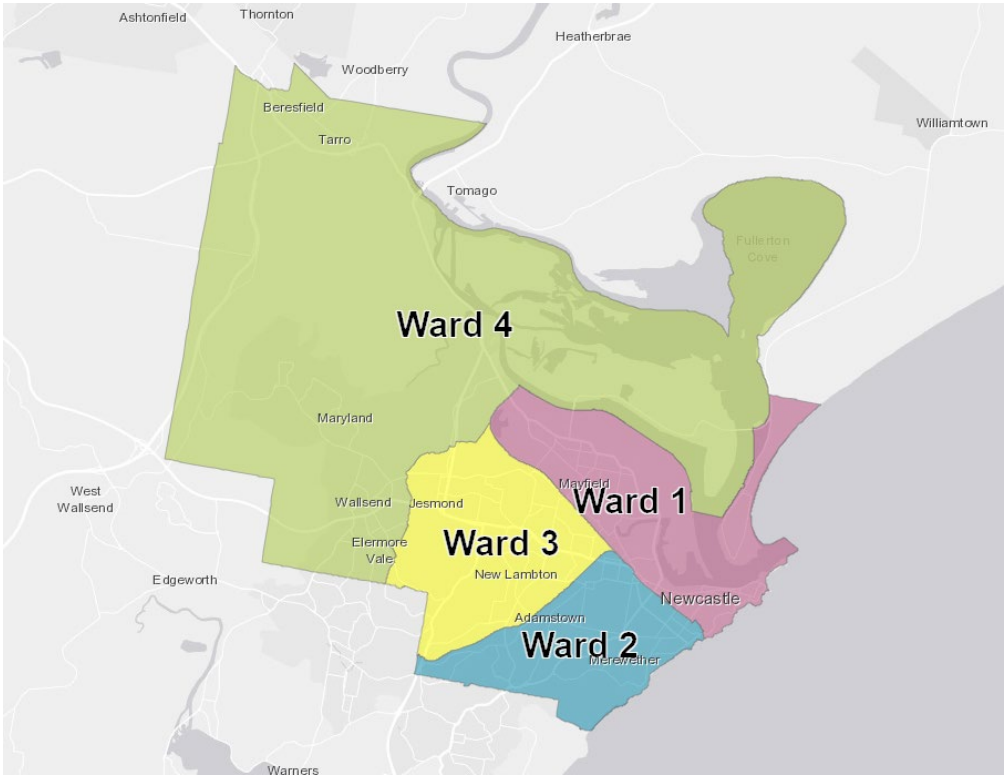


Figure 1. *Newcastle Local Government Area, NSW (sourced from:* https://newcastle.nsw.gov.au/council/about-council/ward-maps)

Study design

The study adopted a cross-sectional correlational design with measures administered within an online survey hosted by Qualtrics.

Data quality

Two questions were embedded within the quantitative survey in Phase 1 to assess inattentive responding [18]. The questions instruct the choice of a particular answer so that it is not possible to answer the question incorrectly if the item is read carefully (e.g., "please choose option two to ensure you are paying attention"). Participants who did not answer both of the questions correctly were excluded from the analyses (*n*=9).

Measures

Prior to completing the measures, participants were provided with the following information: "The questions in this survey will ask about your beliefs and behaviours relating to driving into floodwater in Newcastle. 'Floodwater' refers to water that occurs with storms and heavy rain, when floodwater covers most or all of the driving lane, or flows quickly over the road. This can occur during flash floods and can appear and disappear within hours. It can also occur as inundation of whole roadways for days after severe storms and major floods. We are not asking about smaller scale ponding, especially ponding that occurs outside of driving lanes and during fine weather. Please now imagine you are driving in your vehicle in Newcastle during or immediately after a flash flood. You approach a section of the road where floodwater covers all of the driving lane..." This message was accompanied by the image below, which has been rigorously pilot tested and subsequently validated in previous research [15]. The image was followed by the instructions "For the next questions, please think about driving into floodwaters in Newcastle, keeping in mind the above scenario".

Intention

Intention to drive into floodwater in Newcastle was measured by three items (e.g., "It is likely that I will drive into floodwater in Newcastle"). Similarly, intention to avoid driving into floodwater in Newcastle was measured by three items (e.g., "It is likely that I will avoid driving into floodwater in Newcastle"). Responses were provided on a 7-point scale (1 = *strongly disagree* and 7 = *strongly agree*).

Attitude

Attitude towards driving into floodwater in Newcastle was assessed using three items preceded by the common stem: "Driving into floodwater in Newcastle would be…". Responses were provided on semantic differential scales (e.g., 1 = *bad* and 7 = *good*). Similarly, attitude towards avoiding driving into floodwater in Newcastle were assessed using five items preceded by the common stem: "If I were to avoid driving into floodwater in Newcastle, it would be...".

Subjective norm

Subjective norm was measured using five questions prompting participants to rate the extent to which important others would want them to drive into floodwater in Newcastle and whether people similar to them would drive into floodwater (e.g., "Most people who are important to me would approve of me

driving into floodwater in Newcastle"). Similarly, subjective norm regarding avoiding driving into floodwater was measured using five questions (e.g., "Most people who are important to me would approve of me avoiding driving into floodwater in Newcastle"). Responses were provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Perceived behavioural control

Perceived behavioural control was measured using two items assessing drivers' perceptions of their ability to control the behaviour (e.g., "I am confident I could drive into the floodwater in Newcastle"). Similarly, perceived behavioural control regarding avoiding driving into floodwater was measured using two questions (e.g., "I am confident I could avoid driving into the floodwater in Newcastle"). Responses were provided on 7- point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Perceived risk

Perceived risk was measured using two items assessing drivers' perception of the risk associated with driving into floodwater in Newcastle (e.g., "It would be risky for me to drive into floodwater in Newcastle"). Responses were provided on 7- point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Anticipated regret

Anticipated regret was measured using three items assessing the extent to which participants thought they would regret driving into floodwater in Newcastle (e.g., "If I were to drive into floodwater in Newcastle I would feel regret"). Responses were provided on 7- point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Planning

The extent to which participants planned to avoid driving into floodwater in Newcastle was measured using three items (e.g., "I have a plan for how to avoid driving into floodwater in Newcastle"). Responses were provided on 7- point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Moral norm

The extent to which participants viewed avoiding driving into floodwater in Newcastle as a moral obligation was measured using three items (e.g., "It is morally responsible to avoid driving into floodwater in Newcastle"). Responses were provided on 7- point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Data analysis

Data analyses were conducted using a range of statistical techniques. Descriptive statistics were generated, and t-tests and one-way ANOVAs were performed using SPSS v27. Structural equation models were estimated using WarpPLS [19]. Furthermore, we statistically tested for differences in results between participants who live in the Newcastle LGA vs. participants who live in the suburbs surrounding Newcastle LGA, for all of the analyses, and found that location did not significantly affect any of the results. As such, all results in this document are reported based on the entire sample of participants.

Phase 2: Qualitative interviews

Participant recruitment and data collection

The theory of planned behaviour underpinned the interview guide [20]. The interview questions elicited information about behavioural beliefs for the advantages and disadvantages; normative beliefs about those who would approve and disapprove; and control beliefs comprising barriers and facilitators related to driving into or avoiding driving into floodwater. The theory of planned behaviour components included in the interview guide can be seen in Table 1, and the complete interview guide in Appendix E.

Participants were 11 residents of the Newcastle LGA and its surrounding suburbs who hold an open or provisional driver's licence and had either driven into or avoided driving into floodwater in the Newcastle area. Interviews took place over May-July 2021 in Queensland, Australia, via telephone and ranged from 13-49 minutes in duration. Recruitment and interviews continued until no further themes emerged from the data [21,22].

Table 1: *Theory of planned behaviour components included in the interview guide*

TPB component	Elicited beliefs	Question
Behavioural beliefs	Advantages	"What did you identify as the advantages of avoiding/driving into floodwater?"
	Disadvantages	"What did you identify as the disadvantages of avoiding/driving into floodwater?"
Normative beliefs	Normative approval	"Who were the individuals or groups that would have approved of you avoiding/driving into the floodwater?"
	Normative disapproval	"Who were the individuals or groups that would have disapproved of you avoiding/driving into the floodwater?"
Control beliefs	Barriers	"What were the factors that made it difficult for you to avoid/drive into the floodwater?"
	Facilitators	"What were the factors that made it easier for you to avoid/drive into the floodwater?"

Data analysis

Interviews were audio recorded, transcribed, and coded in a qualitative data management software by one data coder. Based on the principles of theoretical thematic analysis[21,23], transcripts were coded deductively, coding to the theory of planned behaviour. Furthermore, the data coder inductively identified codes. Participant quotations are presented to illustrate themes and subthemes, with each quotation identified (gender, age) in Appendix F.

Limitations

It is important to consider the findings presented in this report within the context of some limitations. This study is cross-sectional in nature and thus causal inferences cannot be made. Responses to both the qualitative and quantitative components of the study are self-reported in nature and thus may be subject to biased estimates of self-assessed behaviour and beliefs. Finally, the planning exercise was a single arm trial, meaning effects were not measured against a control group who did not receive the planning exercise.

Open science

All study data, analysis scripts, and materials are available at the Open Science Framework project site at: https://osf.io/jkq7f.

Participant characteristics

Table 2. *Participant demographic characteristics.*

Demographic characteristic	Phase 1 (*n* = 217)	Phase 2 (*n* = 11)
Gender		
Male	93 (42.9%)	5 (45.5%)
Female	124 (57.1%)	6 (54.5%)
Relationship status		
Married registered	41 (18.9%)	7 (63.6%)
Married de facto	26 (12.0%)	2 (18.2%)
Separated/Divorced	20 (9.2%)	0 (0.0%)
Widowed	10 (4.6%)	0 (0.0%)
Never Married	41 (18.9%)	2 (18.2%
Prefer to not answer	5 (2.3%)	0 (0.0%)
Employment status		
Full-time work	52 (24.0%)	3 (27.3%)
Part-time/casual work	52 (24.0%)	3 (27.3%)
Full-time student	7 (3.2%)	1 (9.1%)
Part-time student	1 (0.5%)	0 (0.0%)
Unemployed/home duties	81 (37.3%)	4 (36.4%)
Highest educational attainment		
Completed junior school (yr 10)	34 (15.7%)	0 (0.0%)
Completed senior school (yr 12)	20 (9.2%)	1 (9.1%)
TAFE certificate / diploma	78 (35.9%)	4 (36.4%)
Undergraduate degree	45 (20.7%)	2 (18.2%)
Postgraduate degree or higher	39 (18.0%)	4 (36.4%)
Prefer to not answer	1 (0.5%)	0 (0.0%)
Age		
Mean (SD)	55 (18)	50 (13)
Minimum	18	33
Maximum	86	71
Do you have any dependents under 18 years of age?		
Yes	43 (19.8%)	4 (36.4%)
No	174 (80.2%)	7 (63.6%)
Language background		
English	203 (93.5%)	11 (100%)
Non-English	10 (4.6%)	0 (0.0%)
Prefer not to answer	4 (1.8%)	0 (0.0%)
Location of residence		
Newcastle LGA suburb	80 (36.9%)	7 (63.6%)
Surrounding suburb ≤45min drive of Newcastle CBD	82 (37.8%)	4 (36.4%)
Surrounding suburb >45min drive of Newcastle CBD	55 (25.3%)	0 (0.0%)

RESULTS

Phase 1: Quantitative Survey

Phase 1 used quantitative methods adopting online survey techniques to understand individuals' knowledge, perceptions, and intentions toward driving during urban flash flooding; specifically, driving into and avoiding driving into urban floodwaters.

General driving behaviour and characteristics

Of the 217 people who completed the Phase 1 survey, most had lived in the area for more than 10 years (77.9%), and similarly, most reported having more than 10 years of driving experience (88%). Most participants reported their primary vehicle was a small passenger vehicle (40.1%), with the second most common vehicle being an SUV/small 4WD (35.5%). 35.9% of participants reported driving daily, 35% reported driving almost daily, 24.9% reported driving a few days a week, with the remaining participants generally driving a few days per month or less (4.1%). We asked participants if most of their driving usually involved taking the same route (e.g., to work and back), to which 70% said 'yes', and 30% said 'no'.

Newcastle urban flash flooding knowledge, perceptions, and past behaviour

We asked participants whether any of the roads they routinely drive on in Newcastle are prone to flash flooding, to which over half of the participants said 'yes' (52%; see Figure 2). We also asked how many times participants had encountered a road in Newcastle where floodwater covered all or most of the driving lane in the last 12 months (see Figure 3).

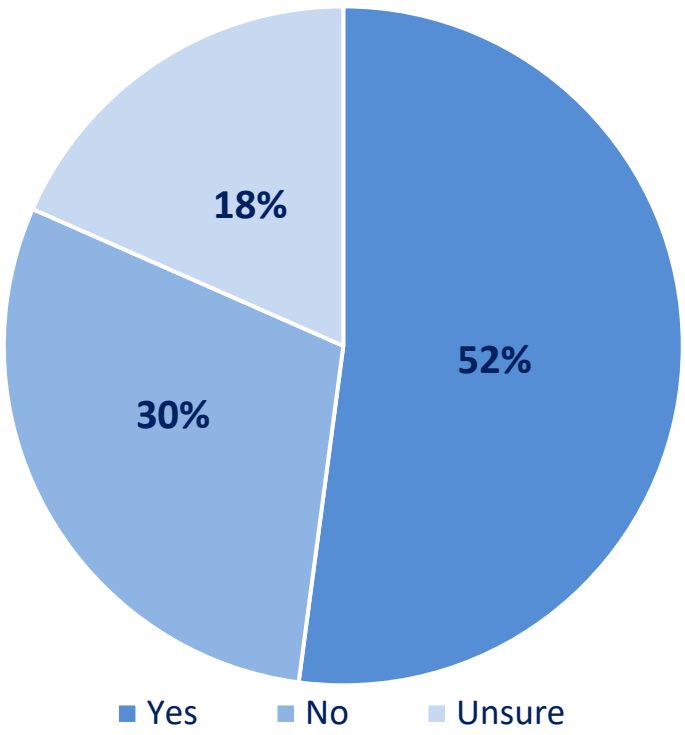


***Figure 2**. Are any of the roads that you routinely drive on in Newcastle prone to flash flooding?*

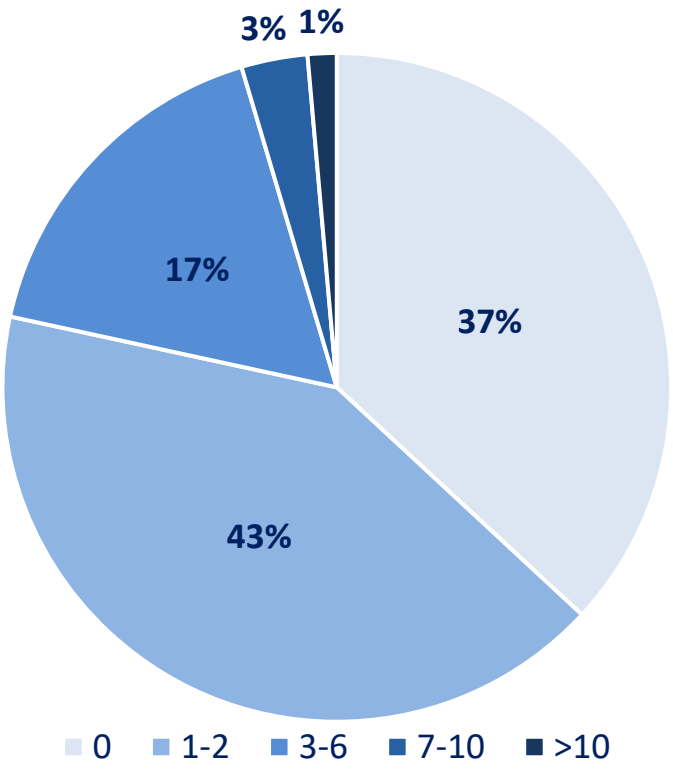


Figure 3. *In the last 12-months, how many times have you encountered a road in Newcastle where floodwater covered all or most of the driving lane?*

We asked participants about their past behaviour regarding driving into or avoiding driving into floodwater. Figure 4 shows the percentage of participants who have and have not driven into floodwater in Newcastle, and Figure 5 shows the number of participants that responded in each category on a scale asking how often they have driven into floodwater in Newcastle the past 12-months. Figure 6 shows the percentage of participants who have and have not avoided driving into floodwater in Newcastle, and Figure 7 shows the number of participants that responded in each category on a scale asking how often they have avoided driving into floodwater in Newcastle the past 12-months.

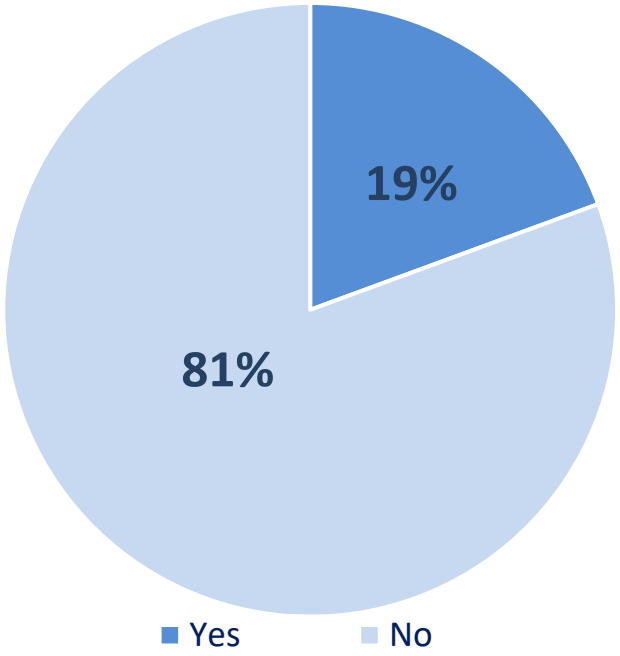


Figure 4. *Have you ever driven into floodwater in Newcastle?*

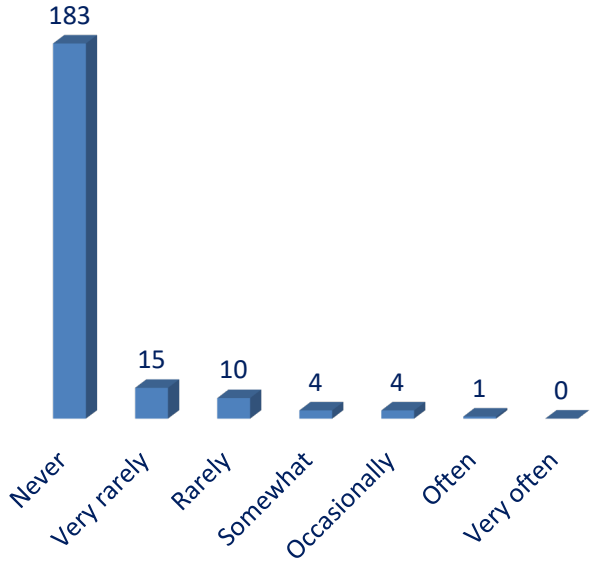


Figure 5. *How often have you driven into floodwater in Newcastle in the past 12 months?*

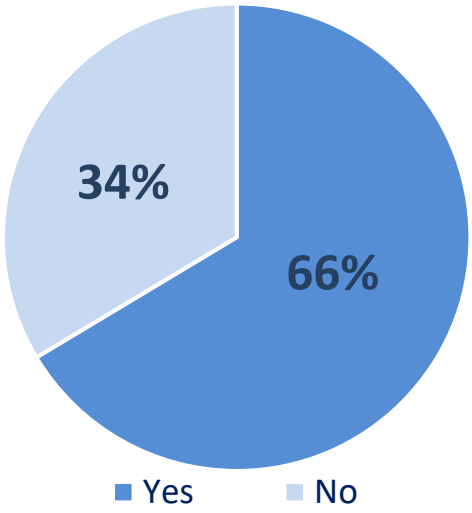


Figure 6. *Have you ever avoided driving into floodwater in Newcastle?*

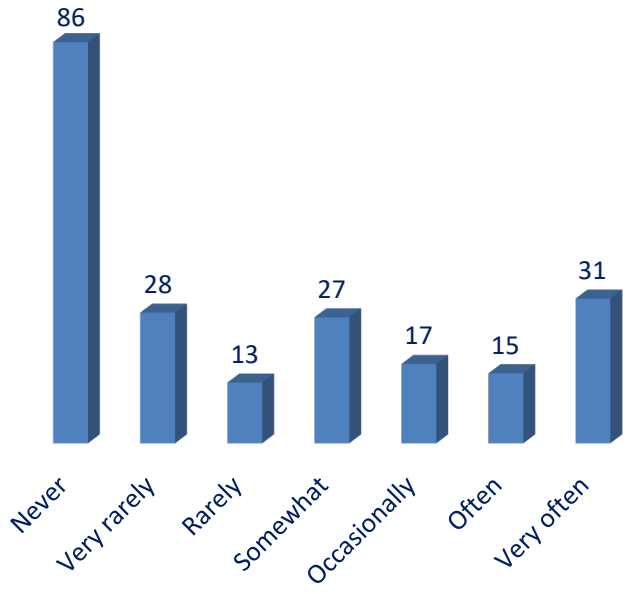


Figure 7. *How often have you avoided driving into floodwater in Newcastle in the past 12 months?*

We also asked participants about the extent to which they believed moderate or major flash flooding makes roads unsafe in Newcastle, with the most frequent response being an ‘extremely large extent’. Figure 8 shows the number of participants that responded in each category on the scale asking what extent they believe moderate or major flooding makes roads unsafe in Newcastle.

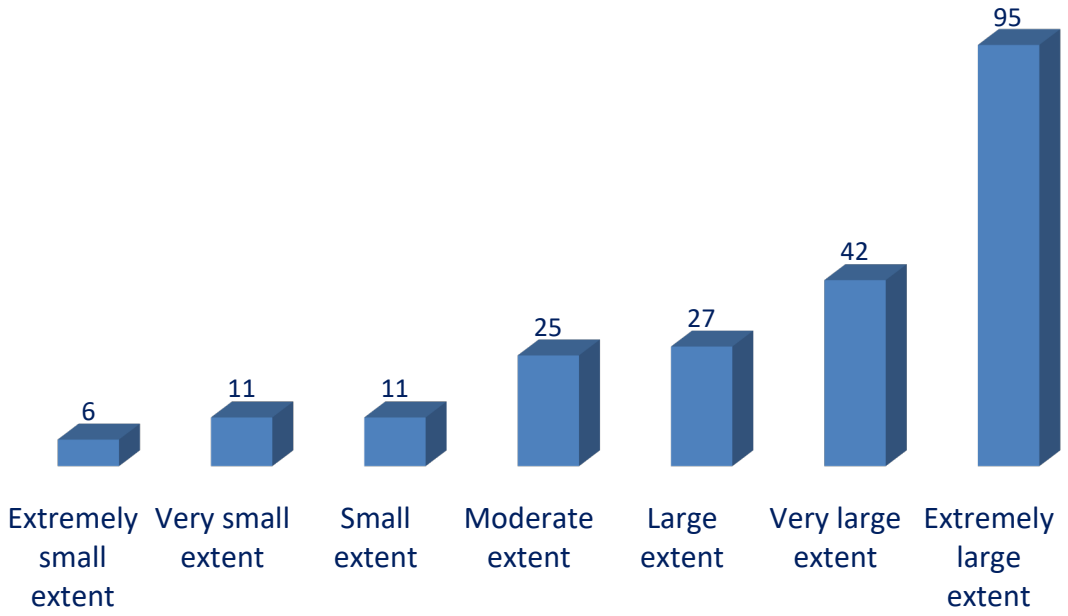


Figure 8. *To what extent do you believe moderate or major flooding makes roads unsafe in Newcastle?*

Do you have a plan for what you would do if you received a flood warning but/and you had an important trip to drive?

Almost half (48.4%) of the participants reported that they have a plan for what they would do if they received a flood warning but/and they had an important trip to drive, while the other half (51.6%) said they did not.

Have you ever delayed a trip due to flash flooding in Newcastle?

More than half of the participants (54.8%) reported having delayed a trip in the past due to flash flooding in Newcastle. The rest reported they had not (45.2%).

Would your workplace allow you to delay your trip if flood warnings were made for Newcastle?

We asked participants if they thought their workplace would allow them to delay their trip if flood warnings were made in Newcastle. The majority of participants said their workplace would allow it (63.1%), with only a small number saying their workplace would not allow it (6%). However, a notable proportion of participants were unsure if their workplace would allow them to (30.9%).

We asked participants if they are subscribed to the free 'Flash flood alert service' from the City of Newcastle, and the vast majority said they were not (82.9%), while only 7.4% said they were, and the rest were unsure (9.7%). Finally, we asked whether participants were in their car on the afternoon of the 2007 Pasha storm; 32.3% of the participants said they were, 59.9% said they were not, and the remaining 7.8% were unsure. To follow up on this, we were interested in whether level of perceived risk of driving into floodwater in Newcastle differed depending on whether participants reported having been in their car on the afternoon of the 2007 Pasha storm. Figure 9 depicts the results of an analysis of variance which showed that level of perceived risk of driving into floodwater in Newcastle did not significantly differ based on whether participants were in their cars on the afternoon of the 2007 Pasha storm, [F (2,214) = .645, p = .521]. The same analysis also showed that both intention to drive into, [F (2,214) = 1.01, p = .367], and intention to avoid driving into floodwater [F (2,214) = .655, p = .521], in Newcastle did not significantly differ based on whether participants were in their cars on the afternoon of the 2007 Pasha storm.

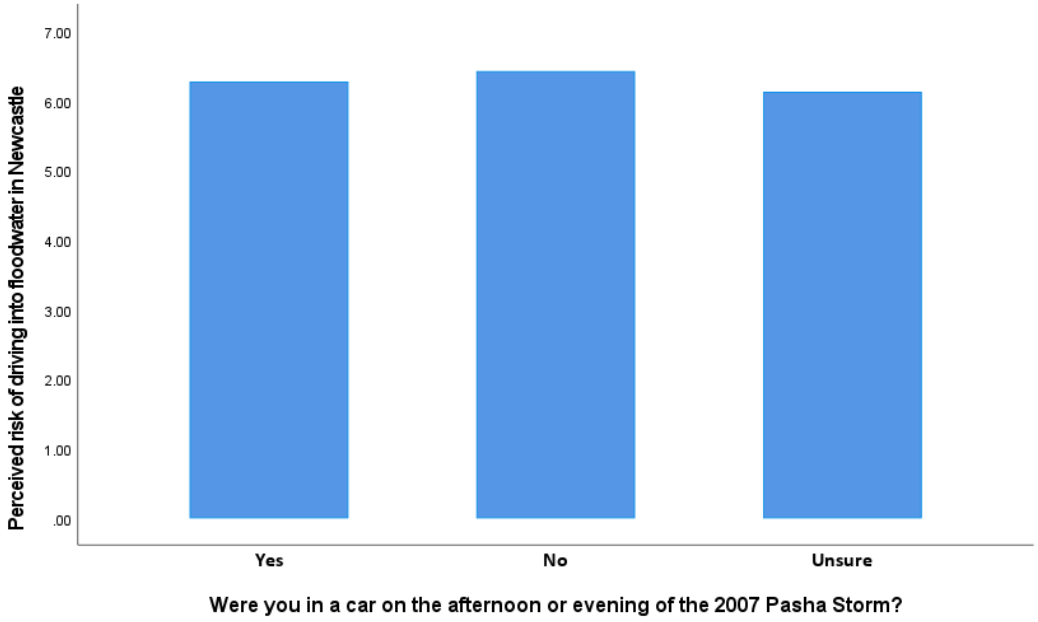


***Figure 9**. Level of perceived risk based on whether participants were in a car during Pasha storm*

We were also interested in whether perceived risk, and intentions to drive into and avoid driving into floodwaters in Newcastle differed between participants with and without dependents. Participants' level of perceived risk for driving into floodwater in Newcastle [*t* (215) = -1.71, *p* = .09], as well as their intentions to avoid driving into floodwater [*t* (215) = -1.34, *p* = .18], did not differ significantly between participants with and without dependents. However, we did find that intentions to drive into floodwater in Newcastle were significantly higher among participants with dependents compared to those without dependents [*t* (215) = 2.518, p = .01], which is graphically depicted in Figure 10.

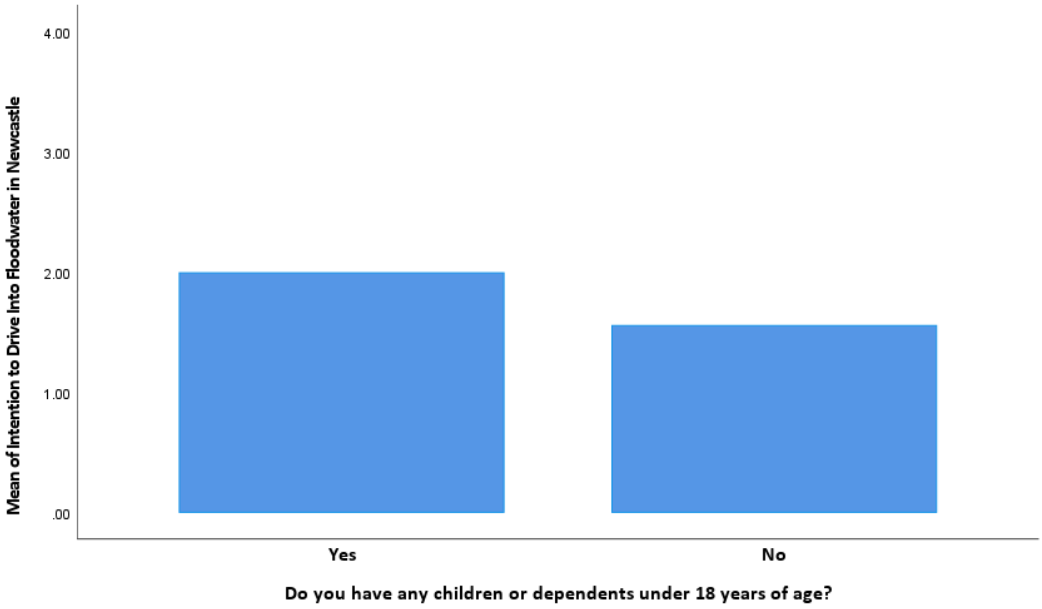


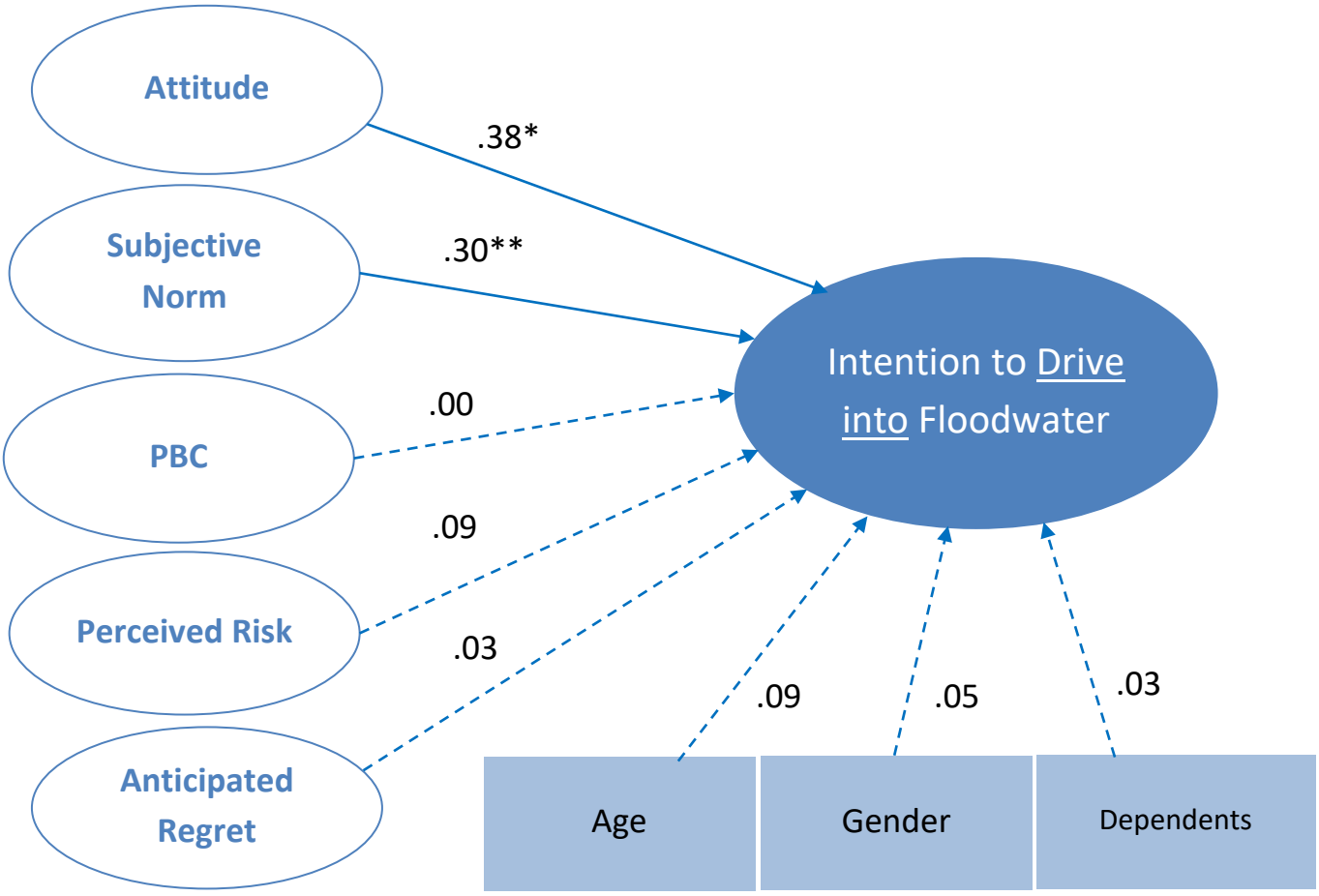
***Figure 10**. Level of intention to drive into floodwater based on whether participants have dependents*

Testing predictors of driving intentions

We tested two structural equation models predicting intention to drive into floodwater in the Newcastle City area (see Figure 9) and intention to avoid driving into floodwater in the Newcastle City area (see Figure 10) using theoretical constructs and demographic characteristics (gender, age, dependents) as predictors.

Intention to drive into floodwater

The structural equation model presented in Figure 11 explained 46% of the variance in intention to drive into floodwater in Newcastle. In other words, 46% of people's intention to drive into floodwater in Newcastle could be predicted by their attitudes (e.g., driving into floodwater would be good/bad), subjective norms (e.g., extent to which important others would want them to drive into floodwater, extent to which people similar to them would drive into floodwater), perceived behavioural control (PBC) (e.g., confidence in driving into floodwater), perceived risk (e.g., it would be risky for me to drive into floodwater), and anticipated regret (e.g., extent to which they would feel regret driving into floodwater) – after controlling for differences based on age, gender, and whether or not participants have dependents aged under 18 years. The strongest predictors of people's intentions to drive into floodwater in Newcastle were their attitudes and subjective norms.



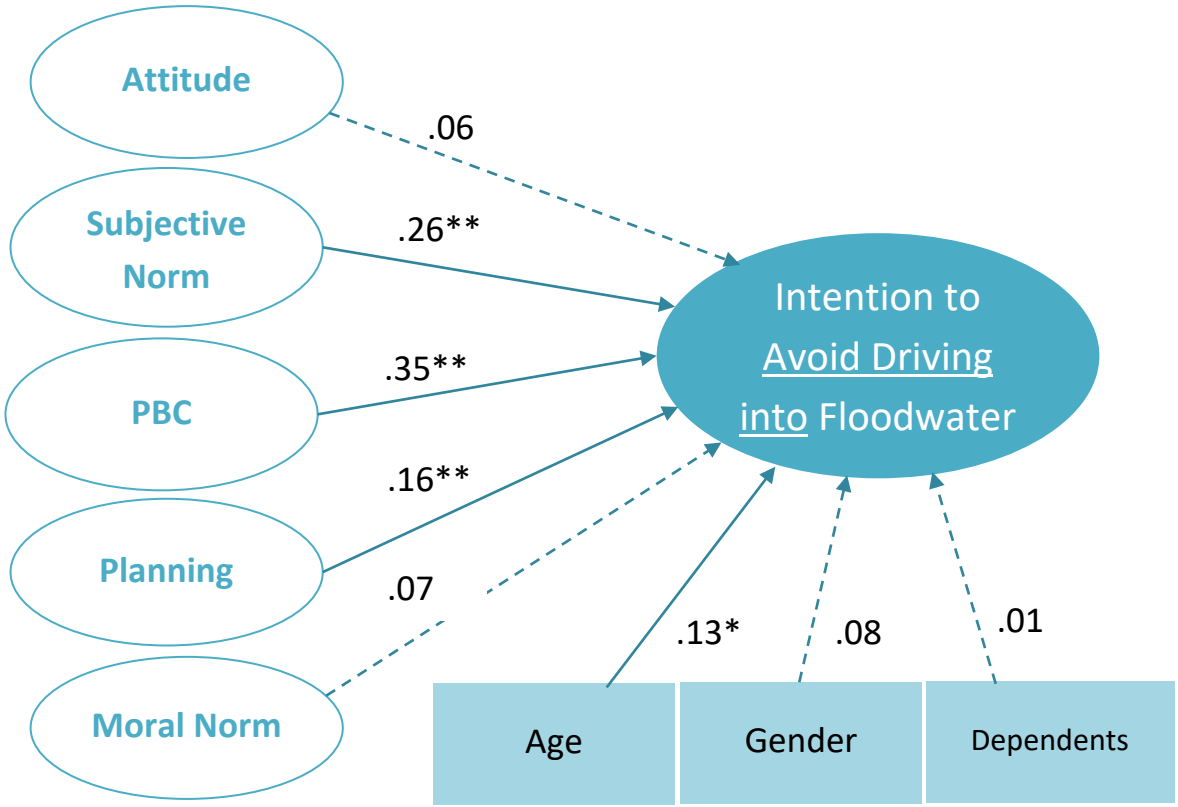
*Note: *=p<0.05; **=p<0.01*

***Figure 11**. Structural equation model predicting intention to drive into floodwater*

Intention to avoid driving into floodwater

The structural equation model presented in Figure 12 explained 49% of the variance in intention to avoid driving into floodwater in the Newcastle City area. In other words, 49% of people's intention to avoid driving into floodwater in Newcastle could be predicted by their attitudes (e.g., avoiding driving into

floodwater would be good/bad), subjective norms (e.g., extent to which important others would want them to avoid driving into floodwater, extent to which people similar to them would avoid driving into floodwater), perceived behavioural control (PBC) (e.g., confidence in avoiding driving into floodwater), planning (e.g., the extent to which participants planned to avoid driving into floodwater), and moral norms (e.g., the extent to which participants avoided driving into floodwater as a moral obligation) – after controlling for differences based on age, gender, and whether or not participants have dependents aged under 18 years. The strongest predictors of people's intentions to avoid driving into floodwater in Newcastle were their subjective norms, perceived behavioural control, and planning. The results also indicated that peoples' intentions to avoid driving into floodwater increased with age. It should also be noted that intention to avoid driving into floodwater in Newcastle was lower among participants aged 40 years and younger, whereas almost all participants over the age of 40 had positive intentions to avoid driving into floodwater in Newcastle.



*Note: *=p<0.05; **=p<0.01*

***Figure 12**. Structural equation model predicting intention to avoid driving into floodwater*

Planning exercise

Even when people are motivated to engage in a behaviour, they may not always translate their intentions into action. Behavioural scientists often refer to this as the 'intention-behaviour gap' [24]. Planning is a self-regulatory strategy that can facilitate goal attainment (i.e., the translation of intentions to behaviour). Specifically, implementation intentions in the form of 'If-then plans' can provide a mental association between representations of specified cues (road underwater) and means of attaining goals (turning around and taking another road – avoid driving into floodwater), which will become activated when the cue is encountered [25].

We were interested in testing the effect of 'If-then plan' formation on drivers' willingness to engage in risky driving behaviour around floodwater in Newcastle. At the end of the quantitative survey we implemented a planning exercise where participants formed 'If-then' contingency plans for what to do in the following 3 scenarios:

1. They approach a flooded section of road in their vehicle
2. They have a trip planned, but they receive an alert to potential moderate or major flooding in Newcastle before they have started driving
3. They approach a flooded section of road, and they are being pressured by other cars to drive into the floodwater

Participants were prompted with sentences beginning with "*If…….*" and "*then I will…*" and were instructed to record their own plans for what they would do in each of the 3 scenarios. The following are examples of plans recorded by participants for each scenario:

Scenario 1: *"**If** the road is underwater, **then I will** pull off road and turn around if possible"*
Scenario 2: *"**If** it is time to leave work and I receive an alert of a moderate or major flooding, **then I will** stay at work until it is safe for me to proceed"*
Scenario 3: *"**If** cars behind me are pressuring me to drive through floodwater, **then I will** turn my hazards on and let them pass, then turn around"*

We asked participants to rate their willingness to drive into floodwater in each of the 3 scenarios at the beginning of the survey, and again directly after recording their plans. For example, we asked participants: (1) "*How willing would you be to drive into floodwater in Newcastle?*"; (2) "*If you were alerted to potential moderate or major flooding in Newcastle, how willing would you be to stay put and not get in your car to drive to a destination?*"; and (3) "*Imagine you approach a section of road in Newcastle that is completely covered in water. How willing would you be to drive into the urban floodwater if cars behind you were pressuring you to keep moving forward?*" Responses were recorded on 7-point scales (1 = *Not at all willing* and 7 = *Very willing*).

We then performed three paired-sample t-tests comparing participants' willingness to drive into floodwater in each of the 3 scenarios before (T1) and after (T2) the planning exercise, to test whether forming plans for what to do had an impact on people's willingness to drive into floodwater in each of the scenarios.

Planning exercise results

Participants' willingness to drive into floodwater in Newcastle did not change significantly after forming a plan for what to do if they approach a flooded section of road their vehicle (Scenario 1). However, we observed significant changes to participants' willingness to stay put and not drive if alerted to potential urban flash flooding (Scenario 2), and willingness to drive into floodwater if they feel pressured by other cars on the road (Scenario 3), after forming the 'If-then' plans.

Figure 13 shows '*willingness to stay put and not get in your car to drive to a destination'* was significantly higher after the formation of the 'if-then' plan compared to before, t (216) = -3.37, $p < .001$. Figure 14 shows '*willingness to drive into the urb an floodwater if cars behind you were pressuring you to keep moving forward'* was significantly lower after the formation of the 'if-then' plan compared to before, t (216) = -3.37, $p < .001$.

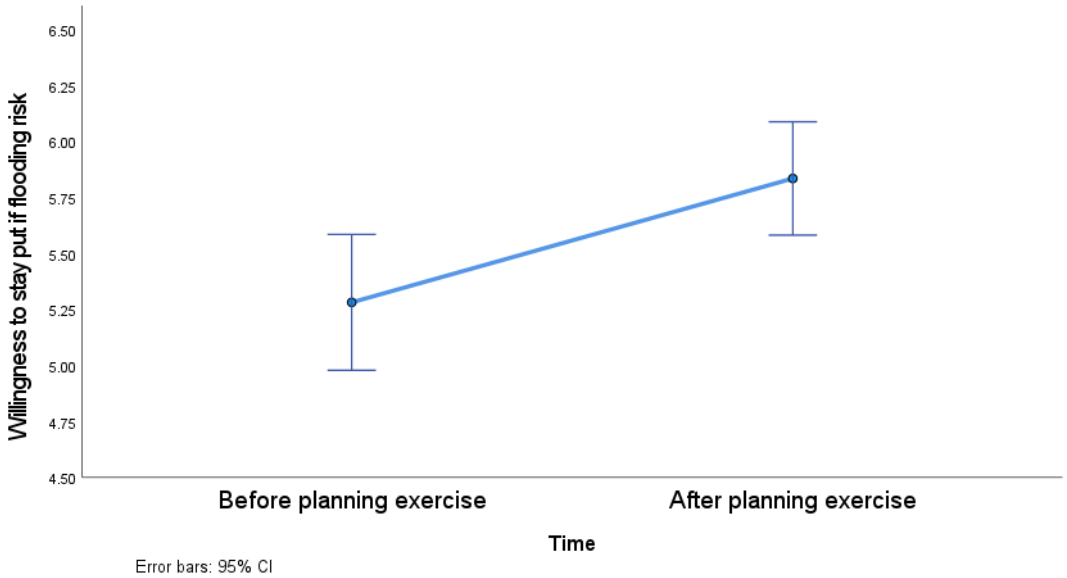


Figure 13. *Graph showing significant increase of willingness to stay put and not drive if alerted to potential flooding risk after planning exercise.*

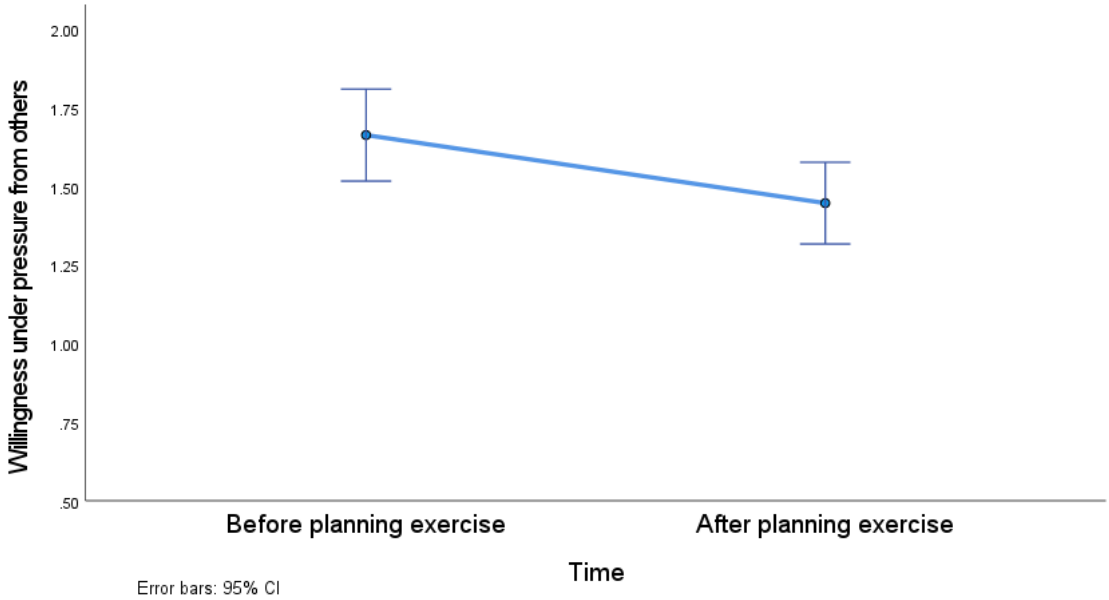


Figure 14. *Graph showing significant decrease of willingness to drive into floodwater when under pressure from other drivers after planning exercise.*

Phase 2: Qualitative interviews

Participants included 11 adults (n=6, 54.5% female), with a mean age of 50 ± 13 years, and 30 ± 16 years' experience driving. All of the participants had avoided driving into floodwater (n=11, 100%) and eight had experienced driving into floodwater in the Newcastle area (73%). Quotes and themes from participants are included in Appendix F.

DRIVING IN NEWCASTLE

The driving routines of participants included driving to and from work, university, school, sporting commitments, appointments, shopping, hobbies, and weekend outings. It was believed that "a number of

roads in Newcastle … are prone to flooding" and "there's a few areas which have the potential to be really unsafe." It was said that "when the rains have become heavy and yeah they have become unsafe, you've got to slow right down and yeah being rather unnerving."

There were "a combination of factors" that were thought to cause roads to flood in Newcastle during heavy rain and storms. Drainage was perceived as a considerable factor including "rain in excess of the drainage capability", "the drain water systems aren't wide enough", and "the drainage system … becomes overloaded". The "geography of the town" and "the nature of the Newcastle city, that we're geographically a bowl" was a factor, along with "it's so close to the harbour [and] if the tides rise the flooding kind of the backflow comes into the drainage system. And then the water on the roads has nowhere to go because the drains are already full from the harbour." The combination of "high tides", "low lying areas" and "super strong weather events" were thought to be contributing factors causing roads to flood in Newcastle.

When asked if their workplace would allow them to leave work early or arrive late, if there was a risk of urban flash flooding on a particular day, responses varied. Some participants had experienced telling staff to "go home because there [was] going to be flash flooding" which was mostly communicated within the workplace verbally. There was also the thought that "nowadays they would probably send out a text message" with this information. Others believed it was different for different workplaces "my workplace would ... But my partner's workplace not at all" or different for people in different positions within an organisation; "I could have done what I wanted [as senior manager]. But you know the production workers probably wouldn't have felt that they could do that." Some participants perceived "it would be a completely independent decision" and with instances where they had asked, "if we could all go home because of the severe weather warning". Whilst the majority of participants had experienced delaying a trip due to concerns about floodwaters, some explained "the inverse is true" and "if anything [they] leave early"; pre-empting flooding.

DRIVING INTO URBAN FLASH FLOODING IN NEWCASTLE

Control beliefs

Control Beliefs refers to the things that make it easier and more difficult to drive into floodwater in Newcastle.

Barriers to driving into floodwater

Factors that made it difficult to drive into floodwater included a "momentary risk [assessment]" asking "is this a smart thing to do?". Another individual shared that they knew it was unsafe, dangerous, and risky; "It was literally flash flooding … there wasn't much of a choice ... I knew it was quite unsafe. I knew it was you know it was quite dangerous. I was putting myself and my child at risk, who was in the car at the time. But I was unsure of what else I could have done in the situation."

The unknowns regarding "what was under the surface" and possible obstructions were mentioned along with concerns such as "I was concerned about how my car was going to handle the water". One driver who drove through floodwater said "I had no control it seemed over the car other than being able to steer. I didn't try using the park brake at all, but I just remember I just seemed to have no brakes it seemed at all."

Facilitators to driving into floodwater

For many of the individuals that experienced driving in floodwater, it wasn't a conscious decision as they were not aware that there was floodwater ahead; "Well the thing is I didn't really know I was actually driving into floodwater because the visibility was so bad and I'd actually only just driven through that same area, three-quarters of an hour earlier."

For others it was described as 'peer pressure' from the line of traffic with the following encounters: "I was in a line of traffic, and I was basically being forced to drive through these floodwaters. Because I couldn't pull off the side of the road because it was flooded. It was on a fairly significant main roadway, and it was dangerous if I'd stayed still … so I decided to just go with the flow of traffic, not that I was really given much choice. But yeah, yeah it was I guess peer pressure … I just felt that I needed to do the right thing by the other people on the road because I was uncertain of … what the outcome would have been if I'd pulled over." In addition, "If you're caught in heavy traffic and you've got people … pushing you up and you're caught in between all these cars. And … you try to get out and cars just won't let you out. Yeah, there's been the odd time like that where you've tried to pull out and no one will let you pull out. Yeah, that's a frustrating thing sometimes when you're in peak hour traffic they won't let you pull out so you know you're just forced to go through with everyone when you don't want to."

Facilitators for others that made it easier to drive into floodwater included proximity to home "I could see my house", knowing the roads, and local knowledge; "local knowledge was pretty good with that. So I knew where the roundabout was, I knew the shape and profile of the roundabout. I knew where obstructions may be and won't be. So, I suppose a good understanding of what was under the water I was about to drive through was really helpful too."

For others previous experience with crossing flooded creeks assisted; "I grew up … having to cross over flooded creeks and things so you know I was prepared" and "I have travelled quite a bit in this car, had to go through a lot of river crossings and things like that so I know the capability of the car as well as I know the correct way to do it."

Normative beliefs

Normative Beliefs refers to the people or groups who would approve and disapprove of driving into floodwater in Newcastle.

Individuals who are unsupportive of driving into floodwater

Key individuals that participants felt would disapprove of them driving into floodwater included "emergency services" including SES, ambulance, police, rescue, and volunteers; "Pretty much everyone. The police tell us not to, the SES tell us not to, the ambulance tell us like yeah everyone tells you not to." Family, "sensible people" and "older people" were also mentioned as individuals that would disapprove.

One participant believed it may depend on the situation or individual; "Maybe the enforcement and people who do rescues and things like that. They may have but given the circumstances and the actual depth of the flooding I'm not so sure. Maybe they would have disapproved from the point of view of the fact that if I drove through in a four-wheel drive others may well follow in cars that were not able to make that. So maybe that would be why they disapproved, I'm sure they probably disapprove because of you know they would see it as a risk. But that's without having knowledge of the car maybe and the skills of the driver and the area as well. And yeah, a combination of those things, they may well disapprove."

Individuals who are supportive of driving into floodwater

Responses regarding the individuals or groups who would have approved of participants driving into floodwaters varied. Some stated that no one would approve of driving into floodwaters. Some believed it would depend on the severity; “I guess it’s the degree thing. If it’s only light floodwater and it’s not of any high velocity I don't think anybody would really be concerned about it. But if it’s you know fast running water and you’re unaware of the depth certainly I wouldn't recommend anybody driving through it.” If it were less severe flooding it was thought “in terms of groups or bodies of people, I think everybody would have been okay with that particular scenario”.

Drivers of four-wheel drive were mentioned as individuals who would approve of driving into floodwaters; “Only the other drivers who all seemed to have four-wheel drives and didn't really care. Yeah, I think they’re the only ones who would have approved of that situation [driving into floodwater]” Along with “macho males” as it was thought they could “brag about this creek and driving through this flood and I survived” describing it as a “colloquial thing”.

Alternatively, from a female respondent, it was perceived that males had less logical reasons for driving into floodwater compared to females; “I really feel that this is going to sound quite sexist, but I feel that men have a tendency to take more risks when driving just in my personal observations, than women. And I feel that women have quite logical reasons as to why they need to drive through floodwater rather than men just going ‘Well I just need to get home I have a four-wheel drive I’ll be fine’. That’s a very generalised and sexist view on things but from my personal observations yeah that’s what I have experienced.”

Consequences for others

When asked if driving into floodwaters can have consequences for others, responses varied. It was perceived “if you drive through in a situation like that you may encourage others to follow you through” and just because they made it through the floodwater that may not be the case for others behind them; “I drove through in a four-wheel drive others may well follow in cars that were not able to make that”. There was the consideration of others that could be put in harm’s way; “there would have been other people who would have been put at risk if they had to come and get me out of there. Or if my car had smashed up against someone else’s … When you sit back and think about it, [it’s a] dumb thing to do”. In addition, to a more severe extent; “if you are killed or injured or end up in hospital that can have social consequences on your family and all of that you know. If you’re, you know a young parent going through and you drown because you drove into that then you’ve left kids that have to grow up without a father or a mother. Yeah, the consequences are manifold.”

Additional consequences expressed by one participant included; “potentially heavier vehicles can then cause damage to the road pavement which may not trouble themselves but the vehicles coming behind then might have you know potholes or eroding surfaces that their vehicles wouldn't get through … The other one is that again larger vehicles going through can create sort of a bow wave and that could for a small vehicle, even you know lift the car up and the wheels lose traction, and they get washed away. Or … the waves themselves can sort of go into yards and you know cause damage to people’s property.”

Behavioural beliefs

Behavioural Beliefs refers to the positive and negative outcomes of driving into floodwater in Newcastle.

Advantages of driving into floodwater

The main advantage of driving into floodwater was that participants were able to get to where they needed to go and were not stranded; “I made it home rather than have to, you know being stuck outside in the car somewhere on the hill”. One participant stated there were no advantages, and another participant described “the cynical one” in how the Australian culture would praise the fact that an individual survived and overlook the dangerous nature of the act; “the Australian culture would be one of trying to talk up how, not so much the stupidity of it, but the ‘look what I did, and I survived’”.

Disadvantages of driving into floodwater

Some participants reflected on the “worst case scenario” and the potential accident that could have occurred. Particularly having seen the damage that occurred to other cars during floods such as those during the 2007 Pasha Bulker storms; “When I saw some of the aftereffects of the Pasha Bulker storm, stormwater drains with cars in them, and you know just terrible”. In addition, the risk of damaging their car was a disadvantage mentioned; “I did risk my car not working essentially”.

One participant described feeling a lot of guilt after driving into floodwater; “guilt around the actions that I had taken …. there were swift water rescues locally during that time … there was a lot of guilt around that, that could have been us, what was I thinking? More mental health stuff around that. Something that you know may have lasted two or three minutes is still quite significant to me.”

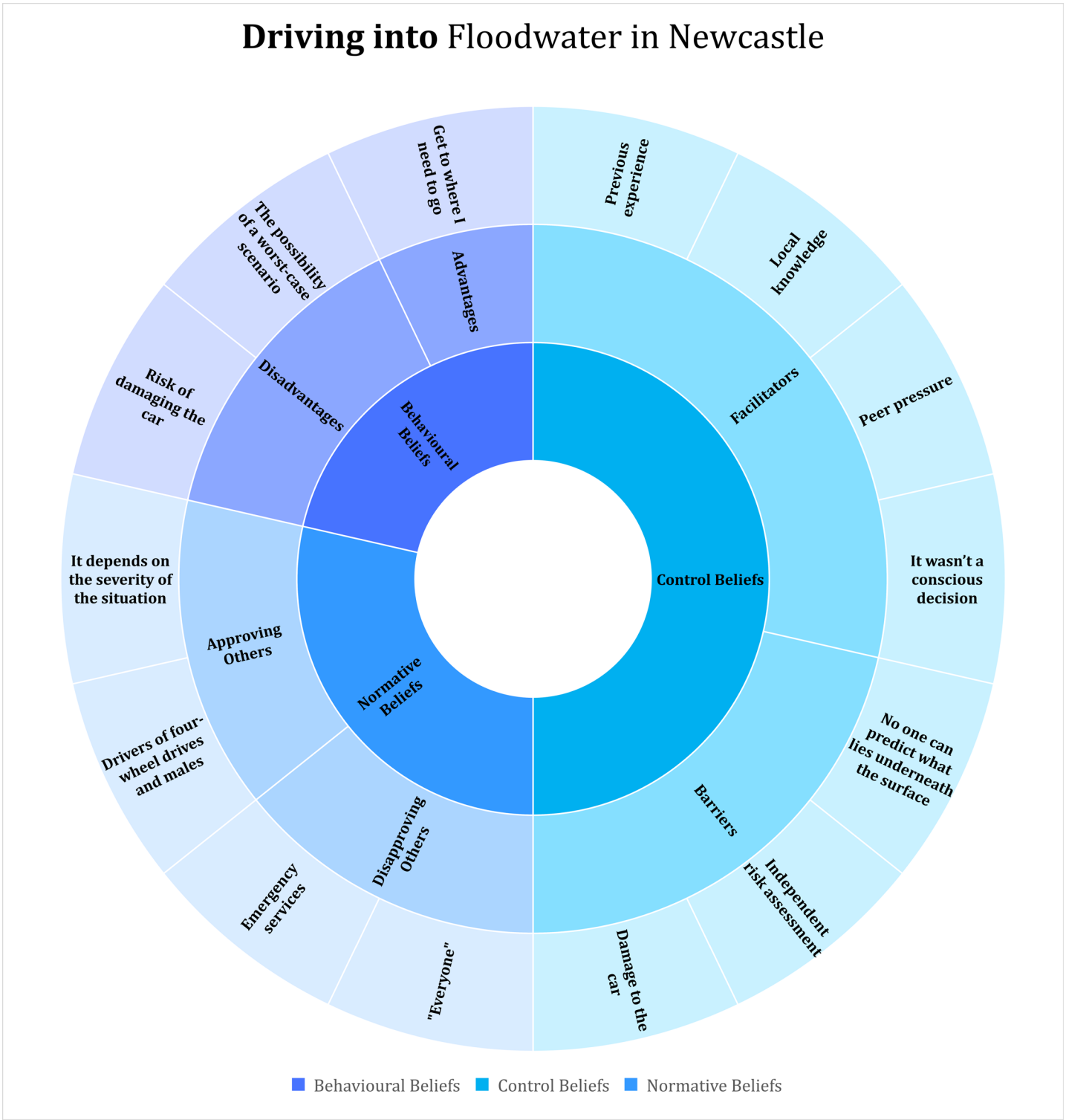


Figure 15. *Thematic map showing the major themes relating to participants' beliefs about driving into floodwater in Newcastle that emerged from the interviews.* ***Behavioural Beliefs*** *refers to the positive and negative outcomes of driving into floodwater in Newcastle.* ***Control Beliefs*** *refers to the things that make it easier and more difficult to drive into floodwater in Newcastle.* ***Normative Beliefs*** *refers to the people or groups that would approve and disapprove of driving into floodwater in Newcastle.*

Control beliefs

Control Beliefs refers to the things that make it easier and more difficult to avoid driving into floodwater in Newcastle.

Barriers to avoiding driving into floodwater

Factors that made it difficult to avoid driving into floodwater included driving at night, limited options for alternate routes “it’s a small city right so there’s only so many alternatives and alternative routes” which sometimes means “there’s no other way to get where I need to go”.

Facilitators to avoiding driving into floodwater

Key facilitators to avoiding driving into floodwater included having “knowledge of the roads themselves”, “knowledge of the area” and “knowing the high ground”. Having lived in the area for many years allowed participants to be able to problem solve and seek alternate routes; “the only reason why I didn't get stuck was because I’d lived in Newcastle all my life and I knew other ways to get to where I was going to”. This level of knowledge was described as “technical knowledge” as they reported having to “mentally put a contour map over Newcastle” with the critical thing was knowing where the low points are and driving “the highest of the contours” and “the ridges”. For some, the fact that SES had put out warnings and “warning signs” or had blocked the road off, assisted in avoiding driving into floodwater. However, they also needed to be proactive and “listen out or look up you know on the phone and that sort of thing because you know a lot of the time those warnings come out before they are able to actually close the roads off”.

Some participants attributed their “knowledge of how dangerous it is” to drive through floodwaters, with learnings having come from past experiences “you learn through your life experiences”. Past experiences included “losing traction”, “physically see the cars stuck” and witnessing “a road that had been washed away” which led to a moment of realisation; “Whoa you wouldn't know that that road was washed away underneath the water”.

Campaigns and advertisements had created awareness of “how little … the water needs to be”, “how quickly floodwaters can move” and the confronting footage had stuck with them and steered them to “always err on the side of caution with any sort of wet weather driving now”. For others, they were naturally “a risk averse person”.

Normative beliefs

Normative Beliefs refers to the people or groups that would approve and disapprove of avoiding driving into floodwater in Newcastle.

Individuals who are unsupportive of avoiding driving into floodwater

There were various individuals that participants believed would disapprove of them avoiding driving into floodwaters. This included “impatient people” and “people whose car park I’d parked in” along with workplaces and possibly university lecturers. There was mention to drivers with four-wheel drives, the

“cowboy variety who’d give anything a go”, and individuals who have “fabulously big cars”. It was felt they may “enjoy [driving in floodwaters] a bit more than they probably should” and “that’s why they have a four-wheel drive so they can … drive anywhere they want when they want”. One participant recalled an instance where they “decided to turn around and [do] a uey [u-turn] or to stop and not go through and therefore block cars behind me … and people get angry at that.” In addition, another recalled, “you get drivers that don't like it when you slow down.”

Individuals who are supportive of avoiding driving into floodwater

Individuals or groups that would have approved of individuals avoiding driving into floodwaters were thought to be “emergency workers” including SES, rural fire service (RFS), police, ambulance, and rescue organisations along with friends, family, and “people I know and trust”.

Despite approving avoiding driving into floodwaters, more could be done

However, one participant said, “there’s like a cultural conversation … [in] the circles I move in and my local neighbourhood community about flooding in our streets. But like I couldn't put my finger on the last time I saw messaging from like our council or police or SES that’s specific to us”. It was mentioned that there was a lack of messaging specific to areas that are prone to flooding, with the suggestion of “signs saying this area is prone to flooding”. For others they felt existing campaigns such as “if it’s flooded forget it” are not effective; “honestly it doesn’t tell people what to do. And it would be so much better if it said if it’s flooded go back” and “I mean what does forget it mean?”.

Consequences for others

When asked if avoiding driving into floodwaters can have consequences for others, emergency workers were mentioned again; “the consequence would generally be positive I would imagine … my not putting others at risk by needing to come and save me”. In addition, “herd mentality” was highlighted by participants as other drivers “may see the opportunity to follow someone in a path around floodwater”. In their experiences some participants had been the leader “I decided to back out … and like four other cars did it” whereas for others they had followed “I was copying the cars ahead of me and what they were doing. And I was just following them basically because I didn't really know what I was doing.”

Lack of messaging from organisations

It was perceived that some community groups could be more supportive of avoiding driving into floodwater including pre-schools, schools, kid’s sporting groups, and workplaces. It was felt that it was the individual’s responsibility to be proactive in pre-empting floods, and there was a lack of messaging from organisations or groups; “I love my preschool, but they’ve never said don't [drive through floodwater], because they want us to come and pick up the kids. Or the school too, the local school, it’s like I feel like it’s my responsibility to clock that that might happen and so I come and get [my children]. Where I don't see those messages of safety come from the school or the preschool”.

It was believed there was a pressure to continue to drive to work and workplaces were not supportive; “[My husband] still goes all the time [to work at a leading global resources company], like regardless [of flooding], because he feels like he has to … we never get anything to say ‘please don't come’ you know whatever, ‘be safe’. There’s none of that. He’s just expected to sort of still go so there’s lots of that pressure … it would be the same for me as well [as a social worker].”

Behavioural beliefs

Behavioural Beliefs refers to the positive and negative outcomes of avoiding driving into floodwater in Newcastle.

Advantages of avoiding driving into floodwater

Key advantages of avoiding driving into floodwater identified by participants included “not risking your life or the life of others” and avoiding the “risk of damaging your vehicle”. Additional advantages included saving the “time and effort involved with emergency workers” and avoiding situations that may also risk their safety; “it can be so upsetting when you hear of a case where … they shouldn't have had to go and rescue that person. Because that person shouldn't have been there”. For one participant they recalled during the Pasha Bulker storms, they had a “sixth sense” that they should avoid a particular road and “found out the next day that about that time that I would have gone through, there were several vehicles that were actually washed into the concrete stormwater drains”.

Disadvantages of avoiding driving into floodwater

Disadvantages of avoiding driving into floodwater identified by participants included “not being able to get to where I want to go”, “the waste of time” as trips take longer, and “if the trip takes longer it uses more petrol which is not you know that’s not an efficient use of time or petrol if you’re trying to get from A to B”. Missing events or pressing matters was described as an inconvenience; however, it was also said, “the only disadvantage is you don't get to where you want to go. But the consequences quite outweigh the disadvantage.”

Seeking alternate routes to avoid driving into floodwater led to “more congestion on particular roads” as “other people are [also] trying to avoid those places” and there was expressed frustration “that our city isn’t built properly” and “we can’t use the city, it’s not liveable when it floods”.

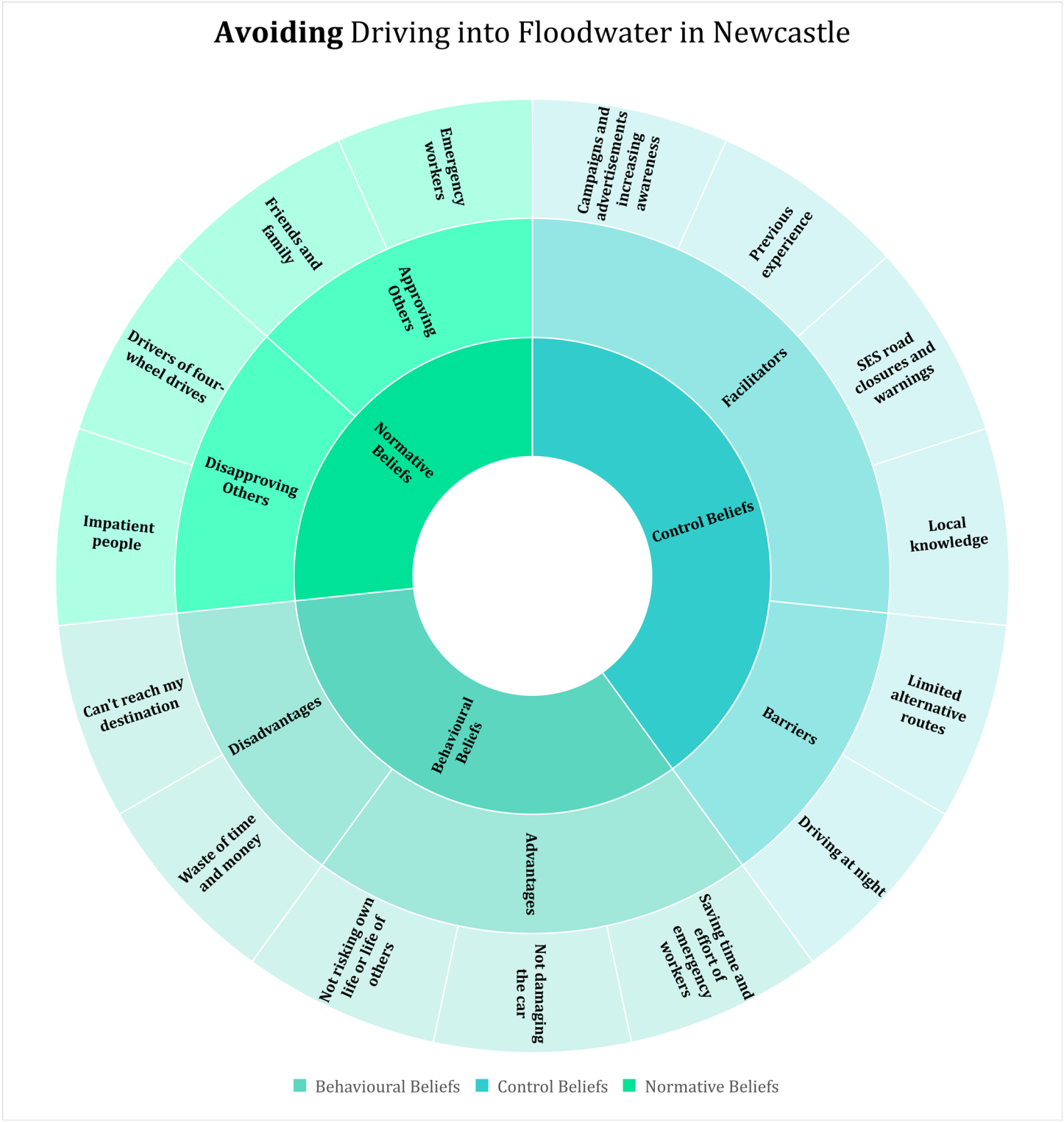


Figure 16. *Thematic map showing the major themes relating to participants' beliefs about avoiding driving into floodwater in Newcastle that emerged from the interviews.* ***Behavioural Beliefs*** *refers to the positive and negative outcomes of avoiding driving into floodwater in Newcastle.* ***Control Beliefs*** *refers to the things that make it easier and more difficult to avoid driving into floodwater in Newcastle.* ***Normative Beliefs*** *refers to the people or groups that would approve and disapprove of avoiding driving into floodwater in Newcastle.*

PLANNING DURING URBAN FLASH FLOODS

Tools that participants used regularly to avoiding driving in floodwaters included social media (particularly Facebook), smartphone applications, the radio, and local websites. If participants had a trip planned to drive and the roads became impassable during urban flash floods many said they would delay, postpone or cancel the trip; “I would delay it and I have done that in the past. There was an instance where I was supposed to be driving to Sydney and there were flash floods between Newcastle and Sydney, and I just simply put it off and said, ‘I'm not driving in this weather’. And they understood and we just postponed it for a week.” Some would try to seek alternate routes and “plan ahead in terms of which way is the safest way”, and in planning ahead others would leave early and be prepared for not being able to return home; “If we had to go it would be go early ... and we pack enough that if we couldn't get home that that’s okay we could just go and stay at a friend’s house or family.”

However, if the scenario for needing to drive included parenting responsibilities some participants felt they would be more inclined to drive in floodwater; “that would pretty much be the only reason why you would ever find me anywhere near floodwater is if I was needing to get my children or get my children out of somewhere ... I imagine that would be similar for most people”. One participant said typically they would pull over on the side of the road to avoid driving in floodwater; however, if needing to get to their children their plans would change; “I would pull over that’s what I have been doing. And I just stay where I am like wherever that safe spot is … Unless my children needed me … if they were at home, I wouldn't worry about it. But if they were without family so to speak I would [drive through floodwater].” Another felt that “barring that type of absolutely critical situation [for needing to drive] I'm not seeing anywhere in Newcastle that there isn’t an alternate, just simply a slightly longer alternate route that you could take”.

REMEMBERING THE 2007 PASHA BULKER STORM

Many participants reflected on the 2007 Pasha Bulker storm; “biggest thing I’ve seen. We’ve had flooding events since but nothing like that Pasha Bulker storm”. It was said, “everyone who lived here during Pasha Bulker knows the reality; it could get shit kicker real”. They described “stormwater drains with cars in them”, and “several hundred cars flooded and abandoned at different points”. From this experience participants said they learnt “it could happen really quickly and that it become[s] really unsafe”.

During the Pasha Bulker storm, some participants were stranded; “we couldn't actually get home. So, we actually spent the night in a shop that we had at the time. Because it was basically bumper to bumper and we just you know nobody was going anywhere. So, we felt well it was probably better just to go back to where we were and you know I mean for hours and hours all you could hear was sirens going up and down the you know the main street.” Others initially thought they could wait it out; however, when the rain didn’t subside decided to drive; “I’ll just stay back at work and then leave later. But it just continued. It didn't back off and it just got worse … I stayed at work for as long as I could and then I decided I had to go, that it wasn’t going to back off any time soon and I wasn’t staying there [at work] all night because it was Friday night”.

DISCUSSION, KEY FINDINGS AND RECOMMENDATIONS

The current research used a comprehensive mixed-methods approach across two studies to investigate the knowledge, perceptions, attitudes, and behaviour of Newcastle drivers with respect to driving into and avoiding driving into urban flash flooding in the Newcastle City area.

What should the messaging say?

Results indicated that intention to drive into floodwater in Newcastle was predicted by attitude and subjective norm, and avoid driving into floodwater by subjective norm. The more positive people's attitudes were towards driving into floodwater in Newcastle, and the more they perceived driving and avoid driving into floodwater as acceptable in the eyes of their significant others, the greater people's intentions were to drive into floodwater in Newcastle.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to ensure flood safety communications to drivers in the Newcastle LGA use persuasive communication techniques to improve attitudes, and to improve subjective norms highlighting the approval of others in the community regarding their avoidance of driving into floodwater as well as highlighting the disapproval of others in the community regarding their driving into floodwater.

e.g. *"Oh mum probably. My friends that work for SES and RFS and places like that and they always do rain events they mind about driving through floodwater. So if I'd told them that I had avoided they'd probably be happy. Yeah and I'm sure a lot of emergency workers in the area and outlets would be best pleased with that decision too."*

"Pretty much everyone. The police tell us not to, the SES tell us not to, the ambulance tell us like yeah everyone tells you not to."

Intention to avoid driving into floodwater in Newcastle was also positively predicted by perceived behavioural control and planning. The greater perceived control people felt over their behaviour of avoiding driving into floodwater, and the greater the degree to which participants planned to avoid driving into floodwater in Newcastle, the greater people's intentions were to avoid driving into floodwater in Newcastle. The present research also found that willingness to engage in risky driving behaviour in two urban flash flooding scenarios significantly changed in favour of safer driving decisions following the formation of 'If-then' plans for what do in those situations.

Specifically, willingness to stay put and not drive if alerted to a flash flooding risk had increased, and willingness to drive into floodwater when there is perceived pressure from other cars to drive into the floodwater had decreased, following the formation of the 'If-then' plans.

Recommendation: To improve people's intentions to avoid risky driving behaviour during flash flooding in Newcastle, NSW SES and NSW SES City of Newcastle Unit should use techniques such as mastery and vicarious experience to improve perceived behavioural control and encourage people to formulate plans, using the simple 'if-then' format, to identify the relevant situation (e.g., **if** I'm at work and I'm alerted to a flash flooding risk) and the plan for what will be done when faced with the scenario (e.g., **then I will** stay at work and not drive home until I know it is safe).

Herd mentality was described for both avoiding and driving into floodwaters and it was felt that other drivers may follow the car in front of them in both situations.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to ensure flood safety communications to drivers highlight the consideration of one's own driving behaviour on others. This includes pressuring other drivers ahead to drive into floodwaters and also vehicles creating 'bow waves' which can cause problems for people in other cars, adjacent homes and shops, particularly in some built up areas.

Who should messaging be targeted at?

Age positively predicted intention to avoid driving into Newcastle floodwaters, where the older people were, the stronger their intentions were to avoid driving into floodwater. In fact, practically all participants over the age of 40 had positive intentions to avoid driving into floodwater in Newcastle, whereas a number of participants aged 40 years or younger had responses indicating they did not intend to avoid driving into floodwater. This finding suggests NSW SES and NSW SES City of Newcastle Unit should target their messaging towards drivers aged 40 years or younger.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to focus their strategies and flood safety messages towards drivers aged 40 years or younger. One such strategy might be using SES volunteers of a similar age to discuss flood safety with younger drivers.

Furthermore, it was found that intention to drive into floodwater in Newcastle was significantly higher for participants with dependents compared to those without dependents. One explanation for this may be that people have greater perceived pressure to get to a destination (e.g., home from work, to school drop-off or pickup etc.) when they have dependents for whom they are responsible, which may lead to riskier driving intentions and behaviour. However, it was felt that some community groups could be more supportive of avoiding driving into floodwater including pre-schools, schools, kid's sporting groups, and workplaces. It was felt that it was the individual's responsibility to be proactive in pre-empting floods, and there was a lack of messaging from organisations or groups. This further supports the approach of delivering communication at workplaces, pre-schools, and schools.

Recommendation: NSW SES and NSW SES City of Newcastle Unit target people with dependents to encourage the formulation of 'if-then' plans for what to do in the scenario that there is a flood risk warning, and they have care responsibilities which may be impacted. Communications should be delivered to workplaces and schools in flood-prone areas to alleviate pressure on motorists to travel during times of flood.

Local knowledge was a key facilitator to avoiding driving into Newcastle floodwaters. As Newcastle undergoes gentrification, new residents may need to be informed about which roads are prone to flooding and higher ground alternatives. To the individuals that had driven through floodwaters, a key barrier identified to driving into floodwater was not knowing what was under the surface and possible obstructions. Highlighting this may make these concerns more prevalent, particularly to those that are choosing to drive through floodwaters.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to provide information to residents regarding the roads that are prone to flooding and higher ground alternatives. Messaging should also highlight the fact that no one (including those with local knowledge) can predict what lies underneath the surface when roads are flooded.

Participants felt individuals driving a four-wheel drive were more likely to be supportive of driving into Newcastle floodwaters. This finding suggests NSW SES and NSW SES City of Newcastle Unit should also target their messaging towards drivers with four-wheel drives.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to focus their strategies and flood safety messages towards drivers who drive a four-wheeled drive.

For those that resided in Newcastle at the time of the Pasha Bulker storm the graphic visuals of "stormwater drains with cars in them" and "several hundred cars flooded and abandoned at different points" remained with them. From this experience participants said they learnt "it could happen really quickly and that it become[s] really unsafe"." Continuing to share these visuals may be helpful to highlight the severity and damaging nature of floodwaters.

Recommendation: For NSW SES and NSW SES City of Newcastle Unit to continue to use Pasha Bulker as a case for avoiding driving into floodwaters in Newcastle.

How could these messages be communicated?

The research supports that theory-based targets should be considered for the development of intervention programs for Newcastle drivers, due to their association with intention to drive into and avoid driving into floodwater. These findings can inform the development of community engagement protocols for NSW SES City of Newcastle unit volunteers to deliver effective messaging to reduce risky driving behaviour during urban flash flooding. Such messaging may involve using quotes in print materials or 'repeating what other drivers have said' in conversations with Newcastle drivers, with the statements reflecting community members' expectations that other drivers should and would avoid driving into urban floodwaters in Newcastle.

Recommendation: Consider the use of "real stories" and/or first person experiences in talking with the community about risk when driving into floodwater. e.g. *"I knew it was quite unsafe. I knew it was you know it was quite dangerous. I was putting myself and my child at risk, who was in the car at the time. But I was unsure of what else I could have done in the situation."* *"If you drive through in a situation like that you may encourage others to follow you through."* *"I drove through in a four-wheel drive others may well follow in cars that were not able to make that"* *"It affects all those emergency workers that have to respond"* *"It affects friends and family if something were to happen to you that's really awful"* *"It would affect probably the wider community too especially in Newcastle"*

Results highlight the relevance of normative beliefs and social pressures with respect to driving intentions around urban floodwaters, with subjective norm predicting both intention to drive into and intention to avoid driving into floodwater, respectively.

Further implementation strategies could include embedding messages targeting the beliefs identified in the current study (i.e., attitudes and perceived behavioural control) within driver education, public safety campaigns, and community outreach, to promote safer beliefs and intentions regarding driving during urban flash flooding in the Newcastle area. For example, presenting statistics associated with driving into floodwater; providing information about the uncertainty of conditions when water is covering the road; and providing specific information about the effect of floodwater on vehicles may be effective strategies to promote more negative attitudes toward driving into floodwater in Newcastle.

Similarly, messaging should target drivers' beliefs in their confidence to avoid driving into floodwater, especially in the face of barriers such as the need to make an important trip, or perceived pressure from other vehicles. Perceived behavioural control toward avoiding driving into floodwater may also be improved through an 'If-then' planning strategy (see next paragraph).

The present research demonstrated the efficacy of a simple 'If-then' planning exercise for changing people's willingness to engage in risky driving behaviour in two scenarios: (a) it increased willingness to stay put and not drive if alerted to a flash flooding risk, and (b) it decreased willingness to drive into floodwater when there is perceived pressure from other cars to drive into the floodwater. The formation of 'If-then' plans is a versatile strategy for changing intentions and behaviour which has the potential for largescale implementation, across many different driving scenarios. Furthermore, it is believed that by explicitly making the causal connection between the critical cues (e.g., perceived pressure from other drivers to drive into floodwaters) and the goal-directed response (e.g., safely stopping the car, turning around or turning left off not a side street to avoid driving into floodwater) through the if-then format, the plans effectively move people from planning to automatically carrying out the behaviours [26,27]. Encouraging automatic enaction of safe driving decisions and behaviours by Newcastle drivers is especially important if Newcastle LGA urban flash flooding is expected to increase in frequency and severity in the future.

Finally, the relative low uptake among the phase 1 respondents of the flood alert messaging system (83% were found not to have subscribed) represents an opportunity for further promotion by the City of Newcastle and NSW SES City of Newcastle Unit. Similarly, findings suggest another avenue for the NSW SES City of Newcastle Unit may be working with employers on effective strategies they can use with respect to their duty of care over employees driving during times of flood, and to empower employees with respect to their own safety when driving during times of flood.

Recommendation: NSW SES and NSW SES City of Newcastle Unit volunteers should use messaging about social approval/disapproval (i.e., subjective norm) about driving into floodwater in conversations with the community; and use strategies to promote people's belief in their ability to avoid driving into floodwater (i.e., PBC), such as the formation of an "if-then" plan. Communication materials could be developed to instruct drivers on how to formulate if/then plans for different scenarios (flooding predicted, on road during times of flood, faced with floodwater on the road). Furthermore, community members should be advised on the best way to ensure they are alerted to potential flash flooding (e.g., helping people to sign up to Council's free Flood Alert system).

Future research

Future research should seek to test the effect of embedding behaviour change techniques targeting the identified beliefs and theoretical mechanisms in driver education programs and public safety campaigns aimed at reducing intention to drive into urban flash floodwaters in Newcastle. Future research should also test the efficacy of 'If-then' plan formation for changing drivers' intentions and behaviour, in a randomized controlled trial. Finally, future research should seek to examine the relationship between intention to drive and avoid driving into floodwater on actual behaviour in "real-world" contexts, such as during flood events.

Limitations

While the study uses a rigorous mixed-methods approach to investigate the attitudes and beliefs of Newcastle drivers regarding driving into and avoiding driving into floodwater, the results should be considered in light of some limitations. Specifically, both studies used cross-sectional observational designs which means that causal inferences cannot be made. Further, due to ethical and practical implications associated with directly observing driving during flood events, self-report measures of intention and willingness to drive into floodwater and avoid driving into floodwater in a hypothetical scenario were used.

We sought to improve this measurement; however, by using a picture that was rigorously pilot tested to aid the learner drivers in imagining and relating to the hypothetical scenario. Finally, the planning 'intervention' was a single-arm trial, prohibiting the comparison of effects against a control group.

Conclusions

This study has important implications for the prevention of flood-related deaths among Newcastle drivers, and *reducing the burden placed on emergency services personnel during flooding events.* Specifically, the study identifies modifiable social psychological factors that predict intention to drive into and avoid driving into floodwater in Newcastle. The findings from this research can inform flood communications, community outreach events, media releases and other communications aimed at discouraging motorists from entering floodwater in the Newcastle Local Government Area. Findings will be published in academic journals and presented at conferences.

References

1. World Health Organisation. *Global Report on Drowning: Preventing a Leading Killer*. WHO; 2014. https://apps.who.int/iris/bitstream/handle/10665/143893/9789241564786_eng.pdf
2. Peden AE, Franklin RC, Leggat P, Aitken P. Causal pathways of flood related river drowning deaths in Australia. *PLOS Curr Disasters*. 2017;1:1-24. doi:doi: 10.1371/currents.dis.001072490b201118f0f689c0fbe7d437
3. Australian Water Safety Council. *Australian Water Safety Strategy 2016-2020*.; 2016.
4. Peden AE, Franklin RC, Leggat PA. Fatal river drowning: the identification of research gaps through a systematic literature review. *Inj Prev*. 2016;22(3):202 LP - 209. doi:10.1136/injuryprev-2015-041750
5. Peden AE, Franklin RC, Mahony AJ, Scarr J, Barnsley PD. Using a retrospective cross-sectional study to analyse unintentional fatal drowning in Australia: ICD-10 coding-based methodologies verses actual deaths. *BMJ Open*. 2017;7(12):e019407. doi:10.1136/bmjopen-2017-019407
6. NOAA. No Title. Turn around don't drown. Published 2004. http://www.nws.noaa.gov/os/water/tadd/
7. Queensland Government. No Title. If its flooded, forget it. Published 2017. http://floodwatersafety.initiatives.qld.gov.au/
8. Keech JJ, Smith SR, Peden AE, Hagger MS, Hamilton K. The lived experience of rescuing people who have driven into floodwater: Understanding challenges and identifying areas for providing support. *Heal Promot J Aust*. 2019;30(2):252-257. doi:https://doi.org/10.1002/hpja.181
9. City of Newcastle. No Title. City of Newcastle community profile. Published 2021. https://profile.id.com.au/newcastle
10. BMT WBM. *Newcastle City-Wide Floodplain Risk Management Study and Plan for Newcastle City Council*.; 2012.
11. Verdon-Kidd D, Kiem AS, Willgoose G, Haines P. *East Coast Lows and the Newcastle/Central Coast Pasha Bulker Storm*.; 2010.
12. Hamilton K, Keech JJ, Peden AE, Hagger MS. Changing driver behavior during floods: Testing a novel e-health intervention using implementation imagery. *Saf Sci*. 2021;136:105141. doi:https://doi.org/10.1016/j.ssci.2020.105141
13. Hamilton K, Peden AE, Pearson M, Hagger MS. Stop there's water on the road! Identifying key beliefs guiding people's willingness to drive through flooded waterways. *Saf Sci*. 2016;89:308-314. doi:https://doi.org/10.1016/j.ssci.2016.07.004
14. Hamilton K, Peden AE, Keech JJ, Hagger MS. Driving through floodwater: Exploring driver decisions through the lived experience. *Int J Disaster Risk Reduct*. 2019;34:346-355. doi:https://doi.org/10.1016/j.ijdrr.2018.12.019
15. Hamilton K, Peden AE, Keech JJ, Hagger MS. Changing people's attitudes and beliefs toward driving through floodwaters: Evaluation of a video infographic. *Transp Res Part F Traffic Psychol Behav*. 2018;53:50-60. doi:https://doi.org/10.1016/j.trf.2017.12.012
16. Hamilton K, Price S, Keech JJ, Peden AE, Hagger MS. Drivers' experiences during floods: Investigating the psychological influences underpinning decisions to avoid driving through floodwater. *Int J Disaster Risk Reduct*. 2018;28:507-518. doi:https://doi.org/10.1016/j.ijdrr.2017.12.013
17. Ajzen I. Constructing a theory of planned behavior questionnaire. Published online 2006. doi:https://people.umass.edu/~aizen/pdf/tpb.measurement.pdf
18. Maniaci MR, Rogge RD. Caring about carelessness: Participant inattention and its effects on research. *J Res Pers*. 2014;48(1):61-83. doi:10.1016/j.jrp.2013.09.008
19. Kock N. WarpPLS User Manual: Version 7.0. *ScriptWarp Syst*. Published online 2020.
20. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179-211. doi:10.1016/0749-5978(91)90020-T
21. Braun V, Clarke V. *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE; 2013. https://books.google.com/books?id=EV_Q06CUsXsC&pgis=1
22. Braun V, Clarke V. To saturate or not to saturate? Questioning data saturation as a useful concept

for thematic analysis and sample-size rationales. *Qual Res Sport Exerc Heal*. 2021;13(2):201-216. doi:10.1080/2159676X.2019.1704846
23. Braun V, Clarke V. *Using Thematic Analysis in Psychology*. Vol 3. Taylor & Francis Group; 2006. doi:10.1191/1478088706qp063oa
24. Sniehotta FF, Scholz U, Schwarzer R. Bridging the intention–behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychol Health*. 2005;20(2):143-160. doi:10.1080/08870440512331317670
25. Gollwitzer PM. Implementation intentions: Strong effects of simple plans. *Am Psychol*. 1999;54(7):493-503. doi:10.1037/0003-066X.54.7.493
26. Oettingen G, Hönig G, Gollwitzer PM. Effective self-regulation of goal attainment. *Int J Educ Res*. 2000;33(7):705-732. doi:https://doi.org/10.1016/S0883-0355(00)00046-X
27. Bayer UC, Gollwitzer PM. Boosting scholastic test scores by willpower: The role of implementation intentions. *Self Identity*. 2007;6(1):1-19. doi:doi:10.1080/15298860600662056

Appendix A: Breakdown of quantitative respondents by Newcastle LGA suburb

Newcastle LGA Suburb	n	%
Adamstown	2	2.5
Adamstown Heights	1	1.3
Bar Beach	1	1.3
Beresfield	2	2.5
Carrington	3	3.8
Cooks Hill	1	1.3
Dudley	1	1.3
Fletcher	4	5.0
Garden Suburb	1	1.3
Hamilton	3	3.8
Hamilton East	1	1.3
Hamilton South	2	2.5
Islington	1	1.3
Jesmond	2	2.5
Kotara	1	1.3
Lambton	3	3.8
Maryland	4	5.0
Maryville	2	2.5
Mayfield	5	6.3
Mayfield East	1	1.3
Merewether	3	3.8
Merewether Heights	1	1.3
New Lambton	7	8.8
Newcastle	10	12.5
Rankin Park	3	3.8
Tarro	1	1.3
The Hill	2	2.5
The Junction	2	2.5
Wallsend	1	1.3
Warabrook	2	2.5
Waratah	4	5.0
Waratah West	1	1.3
Wickham	2	2.5
Total	**80**	**100.0**

Appendix B: Breakdown of quantitative respondents by suburbs within a 45-minute drive of Newcastle CBD

Surrounding Suburbs Within 45mins of Newcastle CBD	n	%
Belmont	4	4.9
Blackalls Park	4	4.9
Cameron Park	1	1.2
Cardiff	4	4.9
Cardiff heights	1	1.2
Carey Bay	2	2.4
Caves Beach	2	2.4
Charlestown	10	12.2
Edgeworth	4	4.9
Eleebana	8	9.8
Fennell Bay	1	1.2
Fern Bay	4	4.9
Fullerton Cove	2	2.4
Gateshead	2	2.4
Glendale	1	1.2
Holmesville	1	1.2
Jewells	1	1.2
Macquarie Hills	1	1.2
Medowie	5	6.1
Mount Hutton	1	1.2
Redhead	2	2.4
Salamander Bay	1	1.2
Speers Point	2	2.4
Swansea	4	4.9
Swansea Heads	1	1.2
Thornton	4	4.9
Valentine	2	2.4
Warner's Bay	2	2.4
Whitebridge	1	1.2
Windale	1	1.2
Windella	1	1.2
Woodberry	1	1.2
Woodrising	1	1.2
Total	**82**	**100.0**

Appendix C: Breakdown of quantitative respondents by suburbs greater than a 45-minute drive from the Newcastle CBD

Surrounding Suburbs >45mins of Newcastle CBD	n	%
Anna Bay	1	1.8
Arcadia Vale	2	3.6
Balcolyn	1	1.8
Boat Harbour	1	1.8
Brightwaters	1	1.8
Catherine Hill Bay	1	1.8
Clarence Town	2	3.6
Cliftleigh	1	1.8
Cooranbong	4	7.3
Corlette	3	5.5
Dora Creek	3	5.5
Duns creek	1	1.8
Fingal Bay	1	1.8
Fishing Point	1	1.8
Gillieston Heights	2	3.6
Maitland	3	5.5
Morisset	2	3.6
Morisset Park	1	1.8
Murrays Beach	1	1.8
Nelson Bay	3	5.5
Pokolbin	2	3.6
Port Stephens	1	1.8
Rathmines	1	1.8
Raworth	2	3.6
Rutherford	3	5.5
Rutherford in Maitland	1	1.8
Shoal Bay	1	1.8
Soldiers Point	2	3.6
Tanilba Bay	2	3.6
Toronto	4	7.3
Wallalong	1	1.8
Total	**55**	**100.0**

Appendix D: Breakdown of qualitative respondents by suburbs

Suburbs	n	%
Newcastle LGA Suburb		
Mayfield East	1	9.1
Mayfield	1	9.1
Merewether	2	18.2
Jesmond	1	9.1
Adamstown	1	9.1
Islington	1	9.1
Surrounding Suburbs Within 45mins of Newcastle CBD		
Rankin Park	1	9.1
Charles Town	1	9.1
Marmong Point	1	9.1
East Maitland	1	9.1
Total	**11**	**100.0**

Appendix E: Complete interview guide

Part 1 – Ice-breaker questions
Please describe your normal driving behaviour/driving routine (*e.g., how often do you drive and what time(s) of day; do you usually travel the same routes/make the same trips; trip distance, what suburb do you live in*)
Are any of the roads that you routinely drive on in Newcastle prone to flooding associated with heavy rains and storms?
What do you think is the likelihood is of roads around the Newcastle City area becoming unsafe if rain is very heavy?
What do you think causes the roads to flood in Newcastle during heavy rains and storms?
Would your workplace allow you to leave work early or arrive late if there was a risk of urban flash flooding that day? If 'yes', ask: "How does your workplace communicate this information to you?
Have you ever delayed a planned trip due to concerns about floodwaters?

Part 2 – **Drivers' Experiences**
[Ask the following question depending on whether they have previously driven into or avoided driving into floodwater] Can you tell me about the circumstances that led up to you **driving into** / **avoiding driving into** floodwater? Can you tell me about the actual experience of driving into or avoiding driving into floodwater? Please describe the flooding event (e.g., major event such as Pasha Storm or routine inundation)

Eligible participants will have said yes to at least one of these questions when they signed up, but also confirm this info when scheduling the telephone interview and make a note of it. • Have you ever driven into floodwater in the Newcastle City area? (If yes, ask participant **Part 3** questions) • Have you ever avoided driving into floodwater in the Newcastle City area? (If yes, ask participant **Part 4** questions)

Part 3 –*Beliefs about DRIVING INTO FLOODWATER* *ASK ONLY IF PERSON HAS **DRIVEN INTO** FLOODWATER*
You indicated that you have previously driven into Floodwater in the Newcastle City area, so the next questions will ask you about that experience…"
What were the factors that made it easier for you to drive into the floodwater?
What were the factors that made it difficult for you to drive into the floodwater?
Who were the individuals or groups that would have approved of you driving into the floodwater?
Who were the individuals or groups that would have disapproved of you driving into the floodwater? Do you think driving into floodwater can have consequences for others? What might they be?

(e.g., Whether people mention bow waves running through properties which can cause floodwaters to have greater impact than otherwise - particularly a concern for 4wd in high density suburbs / suburban main streets; SES volunteer time)
What did you identify as the advantages of driving into floodwater?
What did you identify as the disadvantages of driving into floodwater?

Part 4 – *Beliefs about AVOIDING DRIVING INTO FLOODWATER* *ASK ONLY IF PERSON HAS **AVOIDED** DRIVING INTO FLOODWATER*
"You indicated that you have previously avoided driving into Floodwater in the Newcastle City area, so the next questions will ask you about that experience…"
What were the factors that made it easier for you to avoid driving into the floodwater?
What were the factors that made it difficult for you to avoid driving into the floodwater?
Who were the individuals or groups that would have approved of you avoiding driving into the floodwater?
Who were the individuals or groups that would have disapproved of you avoiding driving into the floodwater? Do you think avoiding driving into floodwater can have consequences for others? What might they be? *(e.g., setting examples for others behind you; fear of writing off the car)*
What did you identify as the advantages of avoiding driving into floodwater?
What did you identify as the disadvantages of avoiding driving into floodwater?

Part 5 - **Plans**
Do you have a plan for what you would do if roads became impassable during urban flash floods and you had an important trip planned to drive (e.g., for important trips such as caring responsibilities or work)? Are your plans different for different scenarios/reasons for needing to drive (e.g., having parenting responsibilities, caring responsibilities, work responsibilities, pets/animals etc.)

Appendix F: Themes and quotes derived from qualitative interviews

Table 1: *Themes and quotes regarding driving in Newcastle*

Driving in Newcastle	
Various driving routines	"Usually either to uni or to do groceries or to appointments. Yeah it's all suburban driving." (Female, 37) "Mainly travelling to and from there [university] a couple of days a week." (Female, 33) "So regularly drive to and from work so the time of day that I would be driving is in the morning any time between 8a.m and 9a.m. and then again in the afternoon between 5.30p.m and 6.30p.m." (Female, 53) "Driving to and from work with the same start point and end point. " (Male, 66) "I drive to golf, I drive to SES, drive to the shops, drive to visit people." (Male, 71) "I drive to sporting activities for the children in the afternoons. And on weekends yeah we're very active outdoors people so we're always out and about going to different places, doing different things." (Male, 47) "Mostly it's residential so it's just between my home, taking my child to preschool, I walk the other kids to school. And my work is a couple of blocks away so I either just quickly drive over or mostly I walk over. And then going to the shops if we go to a you know a mall I suppose, which is about twenty minutes away."(Female, 37) "I pretty much drive every day around Newcastle definitely school runs in the mornings and school pick-ups in the afternoon. I drive to and from work as well. On the weekends I drive actually out to the Hunter Valley for school sports, kids sports and things like that. So that's a decent hour drive on a Saturday so I spend about two hours on the road then. Yeah so every day definitely during the school hours, then work hours."(Female, 37) "[I] even drive around during work hours because I go visit, do home visits"(Female, 37) "Normally it's like either to go to specialist appointments, the doctor or to at times pick up my husband, do the shopping, take my dog to the vet. Going to Newcastle to attend a concert or go attend a craft market or something like that you know things of interest." (Female, 52)
Roads are prone to flooding	"Yes, yes there's on particular section called University Drive that went under" (Female, 33) "There's a number of roads in Newcastle that I know of that are prone to flooding. Usually oh during major events we only get nuisance water over the road in other events but yeah there is a few." (Male, 47) "Not significant flooding but flash flooding and regular flooding in heavy rains." (Female, 37) "Yes definitely. Especially recently because my children are going to school in Wallsend and one goes to school in Wallsend and one goes in Maryland and there's only one road that goes out from Maryland. And also Wallsend just floods really badly." (Female, 37) "They are. So I can drive down King Street there's a particular intersection in King Street that is prone to flooding. It seems to have improved in the last couple of years, we've had couple of really big new apartment buildings go up and that drainage has improved a little bit. And then there's also some low lying areas just because I'm, we're literally right near the harbour. And also around where kind of the beaches are around the Junction there's also some low lying areas there." (Female, 53) "Oh if it was heavy, very heavy for a prolonged period I certainly know that there are areas that are at risk."(Male, 61) "There are the odd yeah there are some of the low ones yeah."(Female, 52)
Roads can become unsafe	"Some of them can be unsafe. In certain areas yeah." (Male, 71) "I would say that they're" (Female, 37)

"Yeah there are some sections … it can be a problem" (Female, 33)

"There's a high likelihood." (Female, 53)

"It's very high, very high probability because the shape or the topography of Newcastle is that there's a ridge along the south side of the city and then running up the west side of the city. So forming like making the centre part of the city a low basin, a flat basin. And historically that part of Newcastle was always low lying, swampy flood plain type areas. And with all of the, I wouldn't say creeks and streams but certainly in the past before civilised…before western civilisation there was, if there was heavy rain it would all run downhill and onto the flood plain. And then with the development of Newcastle the industries were built on the flood plain and so were many of the suburbs. So as the city has tried to fill up these flooded areas then creeks and watercourses get covered in and or sometimes they don't get covered in. And so if there is a deluge at a particular point then the water can all run down then create dangerous flooded road sections and intersections at particular points in Newcastle." (Male, 66)

"There's a few areas which have the potential to be really unsafe. But I've lived in Newcastle all my life and I've also worked in a drainage management team so I'm pretty well aware of where they are." (Male, 47)

"I think it happens fairly frequently. I would say like once every four to six, no six is too long like every three to four months there'll be a weather event where there is too much water on the roads and we will choose to drive alternative ways to get places because it is unsafe." (Female, 37)

"Yeah there is that possibility you know like what happened in 2007 where you know it flooded badly in a lot of parts of Newcastle."(Male, 53)

"Yeah very likely. And like they don't say, they always say they're going to do something but the same roads are constantly flooding all the time." (Female, 37)

"Oh I have been on them when the rains have become heavy and yeah they have become unsafe, you've got to slow right down and yeah being rather unnerving. There's been heavy rains, especially when you get drivers that don't like it when you slow down."(Female, 52)

A combination causing factors

"I would say a lack of drainage" (Female, 37)

"Just rain in excess of the drainage capability." (Male, 71)

"There's a suburb on the outer called Wallsend and apparently they have a lot of trouble with flooding because the drain water isn't wide enough. The drain water systems aren't wide enough and the place, the CBD at Wallsend always goes under essentially if there's been rain" (Female, 33)

"Well thinking of those outer suburbs it's definitely the issue with the storm water drains not being wide enough. As for the area around where I live, I don't live in Wallsend, I'm not really too sure." (Female, 33)

"Because it's so close to the harbour the, if the tides rise the flooding kind of the back flow comes into the drainage system. And then the water on the roads has nowhere to go because the drains are already full from the harbour." (Female, 53)

"Oh a combination of factors, large amounts of rain in short periods … rolling the rain over longer periods, high tides because we have low lying areas" (Male, 47)

"The cause of it there are multiple factors but one factor is where does the downpour start and then when the water runs downhill can it get away? And can it get away quickly? And I guess also another fall the further down it gets is the tide banking up at the other end. So some of the mitigation work that our council has done in recent years is actually about putting big blocks of sandstone and reeds in the upper regions of the watercourses to hold the water back from flowing down. So in the old days when there was just a concrete drain and they just want to drain the water away as quickly as possible. These days they're trying to hold it back. And there are some other quirks. In Wallsend in particular the storm water drain there goes down through and under part of the main street of Wallsend which is called Nelson Street. And it goes under and then the storm water drain takes a 90 degree bend to the right, runs for about 100 metres and then

takes a 90 degree bend to the left. And so when you look at it on an aerial picture you look and you go "Well there's two bends in the water way which clearly a choke point, at least I can see that". And so but the tides do have an effect as well because in town at Steel Street it often does flood and that's because all the water rushes down and if there is this high tide backing it up the water there can flow over that particular intersection very, very quickly." (Female, 37)

"if there's heavy rain there'll always be water on the roads" (Female, 37)

"the nature like I'm not a geography person but I think it's the nature of the Newcastle city that we're geographically a bowl. And so the rain when it's heavy rain it flows through from sort of the top of the bowl down into where we live. Because we live in the bottom of the city. And so I think it's like the rain, what do you call that like the rain water washing through the streets? Really quickly inundates the drainage system so I think yeah and I also I believe really strongly in coastal erosion and climate change. And I think that the reality is we're a low lying wetlands, original wetland city like this is a wetlands in pre-colonial times. And so it's that combination of the water is rising on our tides and then we're getting super strong weather events. And it's the nature of the geography of the city anyway so there's that yeah." (Female, 37)

"But like you know the city couldn't have been designed properly because there wasn't that engineering knowledge and campaign knowledge but we could be doing so much better than what we are doing. Especially around sea level rises and our tidal creeks here. Like it's going to be, it's already really significant and it's only going to get worse. So I find it really frustrating that better town planning isn't happening around that." (Female, 37)

"Basically a lack of drainage. The drainage system just you know becomes overloaded and you know takes longer to empty out and yeah just becomes blocked as a result." (Male, 53)

"They haven't done any work on them really. Like they were supposed to do umm….like work particularly in Wallsend, but I don't think they've got approval for it. They keep fighting for it, like it's not from our end, I think it's from state government. Like I'm not technical with it but I think it's like the guttering and where the water goes in the dips in the roads and things like that. They still haven't done any of it." (Female, 37)

"I think it can be preventable because it's not like we have low lying rivers or anything like that. Like if they just did the work that they were supposed to do then I reckon it could avoid a lot of it." (Female, 37)

"I'd say the majority of it the majority would just be the geography of the town. If you're particularly in the inner city area when you try and build up an area that was you know sand dunes and the swamps and sort of lagoons. And you try and put a cap on it, it's very flat and water takes a long time to drain away. So I mean yeah you could look back and say "Well that means there's a lack of infrastructure sort of water drainage. But if they covered all that there'd be no room left for people to live so yeah. It comes back I guess to the geography and the way that the city has been constructed on top of the geography, doesn't allow for the water to drain in extreme weather events." (Male, 61)

Varying support from workplaces

"Yes actually. They would. We, I had to be class parent at a lecture that we had and we had storm warnings and I actually asked for, if we could all go home because of the severe weather warning, so that was okay." (Female, 37)

"Yes, yes they would. And they did a couple of months ago with staff that were affected." (Female, 33)

"So that has occurred in the past where we've told people go home because there's going to be flash flooding. We've let people go early …

We just discuss it and then let staff know as required. It's not generally a broadcast email or anything like that, it's generally just "Okay who is going to be affected by this? You might want to take off now so that it's not too bad an impact"." (Female, 53)

"I could have done what I wanted [as senior manager]. But you know the production workers probably wouldn't have felt that they could do that. They would probably have tried to go to work or to get home." (Male, 66)

	"Sure … I think nowadays they would probably send out a text message, an automated text message." (Male, 47)
	"Yeah my workplace would ... But my partner's workplace not at all. So like yeah personally yes I would be allowed to go home." (Female, 37)
	"They wouldn't I would be making that call and I just know confidently that my management, I would just tell them that I was doing that and they would support me. But it would be a completely independent decision." (Female, 37)
	"Yes, yes I would say we were a pretty flexible organisation so yes" (Male, 61)
Leave early or delay the trip	"Yes I have." (Female, 37)
	"These recent floods happened around Easter time … and I was going to go up to Port Macquarie to visit my parents. And I just decided to put it off until Mother's Day weekend just because of the bad weather." (Female, 33)
	"If I was going somewhere and I kind of knew by listening to the radio that there were floods in a particular area I'd probably would have, in the old days, delayed going. Or tried to avoid that area." (Male, 66)
	"Yeah. During the Pasha Bulker storm I delayed leaving work because I was looking at the land form and you know can't rain this heavy for a long time so I'll just stay back at work and then leave later. But it just continued. It didn't back off and it just got worse." (Male, 47)
	"It's sort of the opposite. Have I delayed a trip yes I have, I have like changed my mind about visiting people or doing, going particular ways because I know that it wouldn't be right to travel through certain roads. But the inverse is true as well where like I will make, if it's a heavy rain day we go and pick up our kid early so that we don't have this situation where we might have to walk through the carpark or the park flooded and the preschool calling us to come and get them. So we often pre-empt that."
	"No if anything I leave early so that I can get to work on time if I have to take one of the alternative routes." (Male, 53)
	"Yes in certainly extreme rainfall yes." (Male, 61)

Table 2: *Themes and quotes regarding driving into floodwaters in Newcastle*

Control beliefs	
Barriers to driving into floodwater	"I was concerned about how my car was going to handle the water. I mean I have driven through significant puddles before where my car at the time had not appreciated that. So I was a little concerned about how that was going to play out. It was, that's why I was driving so slowly because I didn't want to get any water up into the motor. Yeah I think I was more about you know if so long as I'm careful I'll be okay." (Female, 37)
	"I knew it was quite unsafe. I knew it was you know it was quite dangerous. I was putting myself and my child at risk, who was in the car at the time. But I was unsure of what else I could have done in the situation." (Female, 37)
	"I have a kind of momentary risk, does the risk help you with this? Like is this a smart thing to do? But I think because I could actually see the road on the other side, like I could see it wasn't flooded as far as the eye can see kind of thing. It was just, it looked like just a big giant puddle." (Female, 53)
	"Probably the unknown about really what was under the surface or exactly where the roundabout and the obstructions that come with the roundabout are." (Male, 47)
	"Just as I said we just had no control over the, I had no control it seemed over the car other than being able to steer. I didn't try using the park brake at all but I just remember I just seemed to have no brakes it seemed at all." (Male, 53)

Facilitators to driving into floodwater

"I could see my house, it was common, not common but because there is usually water in the gutter in the street normally it's fairly standard to need to drive through the water on a regular basis. So I felt quite familiar with the situation. Yeah I think it was more the familiarity situation rather than recognising it as actual flooding. But you know reflecting on that the road was flooded." (Female, 37)

"I was following the line of traffic. And you know just basically going with the flow, I was already in the situation so that was, that made it easy. It was literally flash flooding so I guess in a lot of situations there wasn't much of a choice. Yeah." (Female, 37)

"I knew the road. I like I kind of didn't have, I would have had to reverse and kind of go back the way I came and find another way so it was a little bit of an oh just do it, I'm here quick, quick and easy, quick and nasty kind of just do this and get it over with. It was like…pulling a band aid off but it wasn't like that. And I guess because I saw the other car go through it and I thought yeah it's not that deep even though I could see the water splashing up yeah." (Female, 53)

"Okay so the factors that went through my brain, the engineer brain is were…firstly the cars in both directions are always just, were they hugging the centre of the road that tends to be higher than each side. So the first are they hugging the centre or on both sides? So they were in both sides. The second was were the cars, my car was just a four cylinder sedan just a Toyota Corona and were smaller cars getting through like a Toyota Corona and the answer was yes they were getting through. The water was not flowing, it was still so it was, and actually that is probably not strictly true. It probably was flowing but it wasn't gushing it was, it must have been moving across the road a little bit. And also I had a bit of a rule of thumb in my head which was that cars, if the water depth is greater than the height of your tyre I think that's sort of a rule of thumb that says, well if it's flowing it can push your car sideways. So that, the depth of rubber is sort of a rule of thumb I use. I must have picked that up somewhere. So when I see on the news see people driving through and you're looking and you say "Well the water there is above their door sills on the car" to me that's crazy yeah." (Male, 66)

"It was more a case of an unknown situation. I knew there was floodwaters around but I didn't know that particular street because of its location, I thought it was above the areas that were flooded. So I'd actually driven into the floodwaters just expecting to see that the road was, it was night time and the road was wet and so it wasn't fast moving water. So there was no real clarification that you were driving into deeper water. It was just that it was water across the road, so I was unaware of its depth at that particular time. (Male, 71)"

"knew the roundabout was the low point. So I knew that coming up to that roundabout that if I could get through that roundabout it was definitely the low point and the water on the other side was nowhere near as deep." (Male, 47)

"Knowing the capability of the car. I have travelled quite a bit in this car, had to go through a lot of river crossings and things like that so I know the capability of the car as well as I know the correct way to do it. So I did drive past cars that were stuck on that roundabout. Small cars that were up on the roundabout and obviously tried going in and didn't get out. Yeah. So was probably a combination of having skills and knowledge of the vehicle. Having a four-wheel drive, I wouldn't have done it without a four-wheel drive." (Male, 47)

"But local knowledge was pretty good with that. So I knew where the roundabout was, I knew the shape and profile of the roundabout. I knew where obstructions may be and won't be. So I suppose a good understanding of what was under the water I was about to drive through was really helpful too." (Male, 47)

"The rain increased and it was so heavy that visibility was like virtually zero. And I went through a part of Hillsborough Road where it had flooded and there was no real way of turning back because you didn't know if you were turning into oncoming traffic. And there was basically I had no control over the brakes it seemed." (Male, 53)

"Well just that I didn't even really know I was actually driving into floodwater at that stage." (Male, 53)

"Well the thing is I didn't really know I was actually driving into floodwater because the visibility was so bad and I'd actually only just driven through that same area, three quarters of an hour earlier." (Male, 53)

	"Having grown up in the outback I grew up you know having to cross over flooded creeks and things so you know I was prepared. I took it slowly you know the way I'd been trained to you know just taking it slow and steady. Keeping you know a constant speed and I knew the road where I was crossing and where it was there was no cars coming from the opposite direction so I was in the sort of more to the centre so that I wasn't near the edges where there was possible damage to the road. And I got across."(Female, 52)
	"If you're caught in heavy traffic and you've got people you know pushing you up and you're caught in between all these cars. And you know you try to get out and cars just won't let you out. Yeah there's been the odd time like that where you've tried to pull out and no one will let you pull out. Yeah that's a frustrating thing sometimes when you're in peak hour traffic they won't let you pull out so you know you're just forced to go through with everyone when you don't want to." (Female, 52)
Normative beliefs	
Individuals who are supportive of driving into floodwater	"There was a lot of SES around at the time in the suburb. So I think that they would have been okay with, I could see the other side of the road, I mean the flooded area of the road was quite minimal in terms of the street itself flooding and I was driving to higher ground. So I believe that I made the right choice at the time. In terms of groups or bodies of people I think everybody would have been okay with that particular scenario." (Female, 37)
	"Only the other drivers who all seemed to have four-wheel drives and didn't really care. Yeah I think they're the only ones who would have approved of that situation." (Female, 37)
	"Oh no one. I know that, no one would have approved of that" (Female, 53)
	"Well no I don't think so. I mean that's a funny sort of question I mean the macho males sort of thing is oh yeah we can get that and we can brag about this creek and driving through this flood and I survived. That sort of colloquial thing. But my leaning towards safety is a little bit more, no I don't want to get trapped." (Male, 66)
	"No one. I guess it's the degree thing. If it's only light floodwater and it's not of any high velocity I don't think anybody would really be concerned about it. But if it's you know fast running water and you're unaware of the depth certainly I wouldn't recommend anybody driving through it." ? (Male, 71)
	"people that knew me well potentially would have approved of me driving into that floodwater because they know a little bit about me and you know I'm not a risk taker. And other things combined they know that I do a bit of four-wheel driving and they know my skills that I have there. And yeah that group my close friends." (Male, 47)
	"I really feel that this is going to sound quite sexist, but I feel that men have a tendency to take more risks when driving just in my personal observations, than women. And I feel that women have quite logical reasons as to why they need to drive through floodwater rather than men just going "Well I just need to get home I have a four-wheel drive I'll be fine". That's a very generalised and sexist view on things but from my personal observations yeah that's what I have experienced." (Female, 37)
	"Umm…my husband he doesn't have any issues with me because he knows that I'm sensible and that I don't go driving through anything silly. And where I crossed over to where I was going the group over where I was going to they knew that I was being sensible about where"(Female, 52)
Individuals who are unsupportive of driving into floodwater	"Pretty much all the emergency services who tell you not to drive through floodwater." (Female, 37)
	"Everybody would have been very upset" (Female, 37)
	"Pretty much everyone. The police tell us not to, the SES tell us not to, the ambulance tell us like yeah everyone tells you not to." (Female, 53)
	"Family … police and rescue and SES and volunteers and sensible people and probably older people would be all the ones that would disapprove of me or anyone else driving into floodwater." (Male, 66)

"Oh just about any rescue people, SES for instance, police, ambulance. Quite often with that situation there's usually if it's a known problem there's usually somebody there with warning lights or something to tell you not to go into it. But certainly any of those police, ambulance, rescue whatever authorities they would certainly not if I was driving into floodwaters." (Male, 71)

"Maybe the enforcement and people who do rescues and things like that. They may have but given the circumstances and the actual depth of the flooding I'm not so sure. Maybe they would have disapproved from the point of view of the fact that if I drove through in a four-wheel drive others may well follow in cars that were not able to make that. So maybe that would be why they disapproved, I'm sure they probably disapprove because of you know they would see it as a risk. But that's without having knowledge of the car maybe and the skills of the driver and the area as well. And yeah a combination of those things, they may well disapprove." (Male, 47)

"I never really spoke to anyone about it." (Male, 53)

"There was no one there that would have disapproved at the time because the height of the water at the time wasn't deemed as unsafe. It hadn't come up at a high level at that stage."(Female, 52)

Consequences to others

"Absolutely. Because if something had happened if I'd you know if the car had just been picked up by the water, even though it felt like it was a puddle, it wasn't like a river or something, but there would have been other people who would have been put at risk if they had to come and get me out of there. Or if my car had smashed up against someone else's or yeah. When you sit back and think about it, dumb thing to do. Thankfully I only did that once." (Female, 53)

"There's two levels of consequences. The first is if you drive into floodwaters and then your car breaks down and you're trapped there and then you're on the news you're going to suffer the humiliation of being on the news for being an idiot. And I mean every time I see it on the news it's what sort of an idiot was that? And I'm sure that everyone does that. But I think Australian culture and this is probably most about males and females as well is you drove through the floodwaters and it was dicey but you survived, then you want people to cheer how great you were. And the story you tell probably gets exaggerated. But the ongoing consequences obviously the first one is you know your loss of your car if it (?) deliberately in the floodwaters and a car breaks down and the electrics are gone then it's probably a write off. Then the second is if you've then lost your car and you need the car for work or to run kids around or whatever and then you've got that car issue. And then of course if you are killed or injured or end up in hospital that can have social consequences on your family and all of that you know. If you're you know a young parent going through and you drown because you drove into that then you've left kids that have to grow up without a father or a mother. Yeah the consequences are manifold." (Male, 66)

"if you drive through in a situation like that you may encourage others to follow you through." (Male, 71)

"I drove through in a four-wheel drive others may well follow in cars that were not able to make that" (Male, 47)

"The thing that I really hadn't considered in all those questions or in what I've done around floodwater is until answering the questions the fact that people may well follow you into floodwater. Or you know depth of water when their car is not capable or their skills aren't capable but yours are. I'd never really considered that when doing it which is something that now I'll always be mindful of." (Male, 47)

"And if someone is watching you and they see you drive through they may just think "Oh he made it I'll go through". So it's just something that's just challenged my thinking" (Male, 47)

"Potentially heavier vehicles can then cause damage to the road pavement which may not trouble themselves but the vehicles coming behind then might have you know pot holes or eroding surfaces that their vehicles wouldn't get through. They're not expecting it but it could be an issue. The other one is that again larger vehicles going through can create sort of a bow wave and that could for a small vehicle, even you know lift the car up and the wheels lose traction and they get washed away. Or the you know the waves themselves can sort of go into yards and you know cause damage to people's property."(Male, 61)

	"If you go into oh levels that are too high or you know there's fast running waters yes there are consequences. You could be washed away you know if you're not familiar with the area and your car stalls that sort of thing yes. Then you require rescuing and that puts other lives at risk."(Female, 52)
Behavioural beliefs	
Advantages of driving into floodwater	"I got to where I needed to be in an effective way, in a safe manner. And I was able to get home to a safe place at higher ground." (Female, 37)
	"I yes I got to where I needed to get to. That was pretty much it. That was, that's the only significant factor that I can think of that was a positive." (Female, 37)
	"Here's the cynical one which is you know if you drove in and then your car started to get washed away and you survived you come out with a horror story of this is what I did. Like wasn't I stupid and don't anyone ever do that. But I'm sure that the Australian culture would be one of trying to talk up how not so much the stupidity of it but the look what I did and I survived."
	"There are none."
	"I got home. Laughs I got home…yeah was able to spend the night at home. I would have got home anyway I would have been able to oh probably walk through or around. And I'd probably stay in the car I'm not sure. The advantages were that I made it home rather than have to, you know being stuck outside in the car somewhere on the hill."
Disadvantages of driving into floodwater	"The disadvantages the bottom line is the yeah potential accident and potential well worst case scenario if it was a larger flood than what I had attempted it would be not good. When I saw some of the after effects of the Pasha Bulker storm, storm water drains with cars in them and you know just terrible." (Female, 53)
	"I did risk my car not working essentially." (Female, 37)
	"I think there was a lot of, at the time, guilt around the actions that I had taken. I know that there was, I do know that there was people I don't know if they died. But you know there were swift water rescues locally during that time. So yeah there was a lot of guilt around that, that could have been us, what was I thinking? More mental health stuff around that. Something that you know may have lasted two or three minutes is still quite significant to me. My child was in a car seat so she would have you know it would have been a few years ago now because she's now fourteen. So yeah it was significant enough that I can still you know it's still quite vivid." (Female, 37)
	"Well just seeing all those other as I said there were a lot of other vehicles that took the same chance and you know they were probably, what I recall, smaller vehicles than what mine was. Mine was a Ford Falcon station wagon so probably had a bigger motor, bigger wheels, bigger chassis. So it was less likely to get you know it was more likely to retain control than what a lot of smaller vehicles would have." (Male, 53)

Table 3: *Themes and quotes regarding avoiding driving into floodwaters in Newcastle*

Control beliefs	
Barriers to avoiding driving into floodwater	"Time of day is quite significant. In terms of if it's night time and other roads are closed you know it's, I sometimes will avoid travelling all together if I can't find a safe way to go. A lot of my classes go till nine thirty at night so yeah I will definitely travel further in a safer way to get home if I know that particular routes have a lot of water on the road." (Female, 37)
	"Other than obviously the roads were, it was a little restrictive as to where we could go. But it wasn't difficult … I just didn't do it [drive through floodwater]." (Female, 53)

"Well yeah I found driving at night I probably didn't have sufficient information when I ventured out to know where all the flooded roads were. And I'd made an assumption that the road I drove down was well above the floodwaters and wouldn't have any flooding. And of course it was."

"Depending on if there's no other way to get where I need to go like with the preschool there's only one, there's sort of two ways in and out of that particular area where it is. And so at a certain point push comes to shove we do have to drive through it. Same with the parking in some places here. I think it's a small city right so there's only so many alternatives and alternative routes. If we want to go down the main street, like even our street there's only two ways you can get here. From the east or the west and so if both were flooding there's not a lot we would be able to do we would have to drive through the floodwater."

"You know they say that stat about how most accidents happen close to home. Because people are just in auto mode." (Female, 37)

"if I'd been another half hour later, you know maybe I would have struggled further finding an alternate route given the car I was in." (male, 61)

Facilitators to avoiding driving into floodwater

"I think most people would avoid driving through floodwater if they can. You know you do quite regularly the way I travel to uni there's a road that is significantly flooded quite often. And you know I still drive that way but you know I make sure that the road is open for starters and secondly that I can drive around the flooded area. Usually there is, it's…you can't call it a puddle, it's much, much bigger than a puddle but it does have a tendency to pool to one side. So being able to go around that or I just don't go that way at all." (Female, 37)

"Knowledge of the roads themselves. Knowing that if you, you know it's been raining consistently for six hours that is not the way that you're going to go home tonight." (Female, 37)

"You learn through your life experiences I guess so a case of a bit more caution as you get older and little less gung ho." (Male, 71)

"I've always been really hesitant about driving in floodwater and I was also remembering too I think a few years ago I saw a random video on social media I don't know where. I think it was somewhere in Australia, where it just showed how quickly floodwaters can move. And how quickly the water went from a little trickle down a dry sort of creek area right through to being a big …in the space of about five or ten minutes it completely went over the road. And actually started to take the road away with it. It was really confronting. So I think that footage is always kind of stuck with me and I just always err on the side of caution with any sort of wet weather driving now." (Female, 33)

"But yeah I remember particularly avoiding that part, University Drive from that day when we did see sort of flash flooding. And then last year it was I'd just knew that it was a problem spot. And I just decided to stay at home." (Female, 33)

"I knew there was other ways to go easily if I needed to. So in that particular situation last year I knew that if I had to go in there'd be plan B or C. But yeah I ended up just staying at home, I was like I'm not going out in this weather." (Female, 33)

"My previous experience of losing traction." (Female, 53)

"Plus you know obviously there was a lot of, lot of, lot of information around do not drive in the floodwater, do not drive into the floodwater. And I'd also actually seen a road that had been washed away previously with my own eyes. And I was kind of like "Whoa you wouldn't know that that road was washed away underneath the water"." (Female, 53)

"Yeah I think it was definitely the experience because up until then I was still a little bit blasé about it. And not just the experience but also the experience of actually seeing the road with my own eyes that was completely washed away in the floods and thinking "Oh my goodness if I had driven through that and I didn't know that the road was just cracked and broken open underneath" yeah that's eye opening stuff." (Female, 53)

"If there's an alternative route to get to where you're going on higher ground or a safer route to go there. If there isn't you don't go." (Male, 71)

"It wasn't as clear the depth of water. And there was a little bit more movement in the water and to be honest the other side of the roundabout I knew was lower than the actual roundabout so I knew the depth of water was going to be getting deeper as I went out the other side." (Male, 47)

"Knowing the high ground, knowing an alternate route umm yeah I think they're the key elements to avoid driving into it." (Male, 47)

"Knowledge of the area would be the key one." (Male, 47)

"I've got a road design and drainage design background so you know those skills really help as well in making decisions about you know potentially where the higher ground is. Just knowing the area you might be you know you might not be able to determine where low points are and things like that." (Male, 47)

"I could see it up ahead and I could see the line of traffic and I could see the roundabout was under water. So I took a left turn and went up a hill and up and around before I got down as far as that roundabout. Because I also knew beyond that roundabout it actually went downhill. So if that roundabout was under water there was a greater depth beyond it." (Male, 47)

"I'm someone who avoids it, I definitely know that that's not yeah like that's me I'm a risk averse person. And that's my personal style in driving anyway like I'm a risk averse driver" (Female, 37)

"I think in the Pasha bulker it was before I personally drove but I think that 2007 I think those floods were an experience that meant we knew that like it could happen really quickly and that it become really unsafe" (Female, 37)

"my knowledge of the back streets really helps me because I've lived here for long enough that I know the way to get around my problem" (Female, 37)

"The weather forecast … That information from the weather report means I go "Okay well I won't be driving that way" (Female, 37)

"I think I'm so averse to it. I really don't like the idea, even if it was super mild and the car just drifted and it was you know nothing and then you just kept going through it. I don't like the idea of losing control of the steering." (Female, 37)

"I personally make decisions where I go no because it would be unfair to other people who are put in danger if I made you know that choice." (Female, 37)

"it's that thing about the difference between local knowledge and technical knowledge and then I suppose emergency response knowledge would be really different as well." (Female, 37)

"And I knew from the radio that one of the intersections near us that was not one that I would normally drive through but I knew that it was low lying one. So as I drove out my own brain sort of I thought about the contour map of Newcastle and I knew that what I had to do was drive along the top of the ridges and not down in the low areas." (Male, 66)

"And the guy ahead of me he pulled up and I pulled up my car and thought well we're not going to get through that, there's no other cars getting through there we're not going to get through there. So we turned around on our side of the road back and then turned up hill and went along the top of the ridge." (Male, 66)

"I went my way around following the highest of the contours if you like and the ridges… So I was able to get there without going through any water at all" (Male, 66)

"Being able to mentally put a contour map over Newcastle, work out where the ridges were which was relatively easy. But the more critical thing was knowing where the low points were." (Male, 66)

"I thought if I didn't have this skill of knowing where the ridges were and all the (?) and whatever and where the drains were running down then I probably would have just taken the most direct route home. Which would have taken me through a one to three probably three places where the road would have certainly been cut." (Male, 66)

"Correct and the engineer in me is always thinking cause and effect all of the time and so thinking that way you know that where the bulk of people would just go "Well I'm here and my house is there I need to follow the route that I always follow to get there". That's what most people would do of course. And my view is just "No, no to get home the circumstances have changed and I have to do something quite different". And you know when I think about the route that I took yeah some were the main roads and others were back streets because I knew where to go. And I knew the places to avoid and yeah so that was yeah quite an interesting storm." (Male, 66)

"First was when I sort of came over a rise and then saw this lake in front of me that was normally four lanes of traffic at that time of the day. And there was no traffic it was just water. My first thought was "Oh holy smoke this is a really unusual thing"." (Male, 66)

"And the extent of the water was such that it was not inviting us to go through." (Male, 66)

"Sometimes you know country roads the water can be on the road but the centre of the road, if it's high enough, can be dry in the centre. So if you can see that you'd say "Alright well then I know that the water on both sides of the road is not that deep". But in this particular case we couldn't see the centre of the road surface. So there was nothing to suggest that the water was that we should attempt to go forward. So even if that car hadn't of been there I would have turned around and stuck to the ridges anyhow." (Male, 66)

"But the only reason why I didn't get stuck was because I'd lived in Newcastle all my life and I knew other ways to get to where I was going to that,…like I said, it's always the same roads." (Female, 37)

"And I took all the back streets and eventually I got to where I needed to be but only because I knew the streets and all the different ways to get to where I wanted to go." (Female, 37)

"So when we get the heavy rain if I'm in the car I'll pull over, now I don't go anywhere." (Female, 37)

"I could physically see the cars stuck that I went a different way. But now I'm aware like of how little you know the water needs to be and I think that's all from like media. You know hearing it on the radio don't drive through floodwaters. You know seeing the social media posts things like that, which happens now. So now I wouldn't even attempt it whereas probably previously I would have. I would have thought oh that doesn't look too bad I might just go through that." (Female, 37)

"Yeah so like depending on where, if I need to get to my kids basically because they're in those areas. So if I didn't know and it rains really heavy or I think I had to do just recently, where did I have to go? I had to go somewhere again for my children like it would have been like for kid's sport or something like that they didn't cancel, I can't remember. And that was up near Maitland way and I wasn't familiar with that area. And yeah found myself flustered and not knowing you know what to do and whether or not I could get through. But there were people standing there like in, must have been like SES workers or something and they were alright to navigate like around that. But yeah I wouldn't have known what to do." (Female, 37)

"It would be now I guess my understanding and knowledge of how dangerous it is. I have this now it might be because back in (?) days I didn't have children whereas now I do. So I guess I'm more cautious when it comes to emergencies. Like yeah I'd say that, like there's more, I have to think about more people other than myself. Yeah." (Female, 37)

"I say I had previously had a couple of scenarios with floodwaters outside of Newcastle that maybe had given me an insight as to how water and cars interact. Maybe that was what was you know created that sort of intuition."(Male, 61)

"They've started putting up you know like the warning signs, also listen out for yeah like on the radio. They usually are putting out warnings, if they haven't got them out to start closing the roads they normally issue warnings on the radios before you know they've been able to get out and close roads off a lot of the time. So you know I always listen out or look up you know on the phone and that sort of thing because you know a lot of the time those warnings come out before they are able to actually close the roads off."(Female, 52)

Normative beliefs

Individuals who are supportive of avoiding driving into floodwater	"I think everybody would approve of me avoiding it." (Female, 37) "Oh mum probably. My friends that work for SES and RFS and places like that and they always do rain events they mind about driving through floodwater. So if I'd told them that I had avoided they'd probably be happy. Yeah and I'm sure a lot of emergency workers in the area and outlets would be best pleased with that decision too." (Female, 33) "Well hopefully all the ones that tell you not to so yeah police and SES and you know ambulance and rescue and all of these people." (Female, 53) "The SES I think the police, they would all not want people to drive in the floodwater." (Female, 37) "And then people I know and trust who actually are engineers, I think they are people who would be like don't drive through floodwater." (Female, 37) "There was a four-wheel drive because he put up two wheels onto the median strip to give him extra height and he went through I remember that. But the car in front of me his brain was probably the same as mine and go "Well that guy has got a four-wheel drive we haven't" so him turning around and going back, which technically would be against the flow of traffic but there was eerily no traffic behind us. So him doing that and then me doing the same was sort of a, I was nearly going to say no brainer. It wasn't a no brainer at all, we both came to the same conclusion that this is what we need to do." (Male, 66) "Probably the schools that's about it." (Female, 37)
Despite approving avoiding driving into floodwaters, more could be done	"I find it really interesting that like there's like a cultural conversation that a lot of people that I, the circles I move in and my local neighbourhood community about flooding in our streets. But like I couldn't put my finger on the last time I saw messaging from like our council or police or SES that's specific to us. "(Female, 37) "I just find it really interesting like we obviously get like the BOM messages, the Bureau messages that are like you know 'Flash flooding warning' and it's definitely something that like we'll look at what the warnings are on big weather event days. But that said there's no like personalised messages for Islington. And yet there's like systemic flooding issues here and everyone who lived here during Pasha bulker knows the reality it could get shit kicker real. (?) But also that like it just happens so frequently that we do change the way we're driving or we can't park on certain streets if it's going to be a heavy rain week. And yet there's, like I'm someone who is quite like I get the paper every day and I know who the councillors are and that kind of thing. And I don't, I can't think of any messaging. There's no signs saying this area is prone to flooding but it is prone to flooding. And there's no work there's no street works happening and we live along one of the main creeks that leads to the ocean here. It's one of like two big creek rivers in Newcastle it's a creek though not a river. And it floods. Every time there's a high tide and a storm that coincide but there's no messaging along the park. So if you weren't from here you wouldn't know that. Yeah and it just crossed my mind." (Female, 37) "the thing that gets my goat about the flood one is that there's ads campaigning that says if it's flooded forget it. Because honestly it doesn't tell people what to do. And it would be so much better if it said if it's flooded go back." (Male, 66) "I mean what does forget it mean?" (Male, 66) "I could physically see the cars stuck that I went a different way. But now I'm aware like of how little you know the water needs to be and I think that's all from like media. You know hearing it on the radio don't drive through floodwaters. You know seeing the social media posts things like that, which happens now. So now I wouldn't even attempt it whereas probably previously I would have. I would have thought oh that doesn't look too bad I might just go through that." (Female, 37)
Individuals who are unsupportive of avoiding driving into floodwater	"Umm impatient people I've been caught up before in lines of traffic where I've just decided that I will just pull over and turn around and go another way. That does tend to piss people off a little bit, especially in a big four-wheel drives. Yeah." (Female, 37) "If it wasn't as severe possibly my uni lecturer might have yeah. They might have said "Oh you've got to come " but no, they were okay with it so I suppose that could have been a possibility" (Female, 33)

"Not as great as if you had driven into it. You know maybe the people whose car park I'd parked in might not be too happy. But at the time it didn't really matter, it wasn't important." (Female, 53)

"No not any sensible person." (Male, 71)

"Yeah so totally like my cousins who all work in the mines who all have fabulously big cars they love it. So they do do it and they also like, I think they like helping people so they would be like "I'll come and help" and it's like "No because I don't think you're supposed to be here either". Like so I do feel like there's a cultural group of people in my life who have fabulous cars that are more built for it. And so those can hassle me to drive through floodwater. But also you know you enjoy it a bit more then they probably should." (Female, 37)

"this is probably not just Australian culture but there is always the culture of you know "Oh we'll be right and let's go" and that's probably influenced by things like Survivor shows and Lost shows where they accept all these challenges." (Male, 66)

"Oh well only people with four-wheel drives. You know people in four-wheel drives think they own the roads at times. And you know that's why they have a four-wheel drive so they can you know drive anywhere they want when they want."

" Because I know my husband still goes to work, I know my new job I have to go to work as well. Yeah it would need to come from, it would need to be a directive from like I don't know Gladys or something like that for us to like feel okay with not doing those things. Because I don't think we really have the opportunity or that privilege I guess." (Female, 37)

"Probably work." (Female, 37)

"I can imagine a few more of the sort of cowboy variety who'd give anything a go" (Male, 61)

Consequences for others

"Yes I …the consequence would generally be positive I would imagine and you know my not putting others at risk by needing to come and save me. Also you know insurance you know I'm not being an idiot driving through floodwaters. And I think there usually is some follow on from the council, the roads I would imagine, would be less damaged if those cars you know were not driving over them when they're covered in water." (Female, 37)

"It affects all those emergency workers that have to respond" (Female, 33)

"It affects friends and family if something were to happen to you that's really awful" (Female, 33)

"It would affect probably the wider community too especially in Newcastle" (Female, 33)

"No I don't think it has any consequences for others other than the same way as they may follow you through floodwater they may see the opportunity to follow someone in a path around floodwater."

"Oh like we're cancelling the family barbecue. Like no, I don't think of reasons, yeah they block off our street otherwise we would have traffic on them. I reckon that people might get pissed off that you're backing out of and blocking their way. I reckon that's definitely happened to me here in Newcastle. Where it's like I've decided to turn around and a Uey or to stop and not go through and therefore block cars behind me. And those, that has happened and people get angry at that. "(Female, 37)

"I definitely feel like if one person does that U-turn like that happened recently at the railway crossing near our house I decided to back out … And like four other cars did it. So I think there is that herd mentality yeah" (Female, 37)

"You do it your way, so you watch and if they've gone through and like you see a car and they make it for example then you think "Oh I can make it". Like most likely you'd be watching that's what I even did like when I was coming in the (?) I was copying the cars ahead of me and what they were doing. And I was just following them basically because I didn't really know what I was doing. So I assume they did." (Female, 37)

Lack of messaging from organisations

"I've never heard that from the community groups like I love my preschool but they've never said don't, because they want us to come and pick up the kids. Or the school too the local school, it's like I feel like it's my responsibility to clock that that might happen and so I come and

	get him. Where I don't see those messages of safety come from the school or the preschool so that was interesting. I've never thought about that before though. "(Female, 37)
	"Yeah so like depending on where, if I need to get to my kids basically because they're in those areas. So if I didn't know and it rains really heavy or I think I had to do just recently, where did I have to go? I had to go somewhere again for my children like it would have been like for kid's sport or something like that they didn't cancel, I can't remember. And that was up near Maitland way and I wasn't familiar with that area. And yeah found myself flustered and not knowing you know what to do and whether or not I could get through. But there were people standing there like in, must have been like SES workers or something and they were alright to navigate like around that. But yeah I wouldn't have known what to do." (Female, 37)
	"And he still goes all the time like regardless because he feels like he has to. And they don't say like we never get anything to say please don't come you know whatever, be safe. There's none of that. He's just expected to sort of still go so there's lots of that pressure. I would be, it would be the same for me as well." (Female, 37)
	"Really I don't think like I said I think if it doesn't come from, if it's not, you know how they are now with Covid? Like everybody seems to sort of follow that, well it needs to be the same with floodwater because just otherwise we're going to go in them because we're going to need to be going to work. We're going to need to be going to school and things like that." (Female, 37)
Behavioural beliefs	
Advantages of avoiding driving into floodwater	"Having a functioning car." (Female, 37)
	"So long as I'm safe then you know I've got a lot of people who rely on me. So I'm still around to do what I need to do. Emergency Services are there for accidents and emergencies, I haven't caused any issues. Yeah and not needing to call my insurance provider to say that I need to make a claim." (Female, 37)
	"it sucks going out in the rain as it is, so staying warm and dry is a nice advantage. But obviously you know not just the risk to your life but also the risk of damaging your vehicle. Damaging any I don't know if it could happen but you could potentially damage the road or something like it possibly you know. Obviously there's time and effort involved with emergency workers to assist you if you're in that situation. So there's resources there" (Female, 33)
	"Well getting home in one piece and not ending up in a stormwater drain like some of the other people. Not having to be rescued by anyone in any boats and all that kind of stuff that you know we've watched happen." (Female, 53)
	"That you complete a safe journey." (Male, 71)
	"Oh obviously you know avoiding floodwater you can avoid damage to your vehicle, you can avoid you know potentially loss of life or injury. "(Male, 47)
	"And so I know that the risk is not worth it. And so that's why I choose to go a different way." (Female, 37)
	"Control of driving, I really hate the idea of being able to lose control of my steering." (Female, 37)
	"I think damage to the car like I go "No the water would totally come in" because a Prius is really low lying. And it's not you know it's not insulated properly. So that kind of thing. And so like water would come in." (Female, 37)
	"And then like I'm very acutely aware of it puts emergency workers in danger and that's something really passionate, like it feels, it can be so upsetting when you hear of a case where it's you know they shouldn't have had to go and rescue that person. Because that person shouldn't have been there or you know. So unfair." (Female, 37)
	"Oh well not risking your life or the life of others that may be with you." (Male, 53)
	"That I stay safe. That I don't lose my car basically." (Female, 37)

	"Safety you're not going to get caught out if the road, you can't see the road underneath obviously. If the road surface has deteriorated and you know something had happened you get caught in it so safety would be an advantage. I think that's probably the biggest one that I can think of."
	"Well I guess the key one was pretty simple I actually got home in one piece. You know I wasn't as if I was going to have to make a detour that would cause me to be you know hours late or dramatically inconvenienced. It was just simply accepting that here's an alternate way. It really wasn't going to, other than you know making a three point turn on a road where you couldn't sort of see where the gutters were. You know really there wasn't a great deal for you to lose out of making the decision. It was just a case of I want to avoid something that I think could be nasty." (Male, 61)
Disadvantages of avoiding driving into floodwater	"Has a tendency to take longer, the trip takes longer. Which, and if the trip takes longer it uses more petrol which is not you know that's not an efficient use of time or petrol if you're trying to get from A to B. There is more congestion on particular roads due to more people travelling if I'm trying to avoid some places I would assume other people are trying to avoid those places too. Yeah so yeah I guess time, money ummm yeah that's pretty much it." (Female, 37)
	"Oh certainly not I mean if you've got some sort of pressing matter that you need to attend to and you miss that, I'm sure that can be inconvenient." (Female, 33)
	"The only disadvantage is you don't get to where you want to go. But the consequences quite out weigh the disadvantage." (Male, 71)
	"Not being able to get to where I want to go. Like the waste of time, the frustration that our city isn't built properly"
	"we can't use the city it's not liveable when it floods." (Female, 37)
	"Time, my personal time my family's time" (Female, 37)
	"The disadvantage is that it affects some of us more than others" (Female, 37)
	"I had to avoid that road as well which made my trips to work a lot longer." (Male, 53)
	"Well it would be if I really wanted to go somewhere or get to someone yeah that would be it." (Female, 37)
	"No in my circumstances it was a really minor inconvenience again yeah. Had circumstances been a little different where I was trying to get to or if I was on a really tight timeframe, would I have done it? I don't know but for me there was really no downside to it." (Male, 61)

Table 4: *Themes and quotes regarding planning during urban flash floods*

Planning during urban flash floods	
Scenarios for needing to drive	"I can really plan ahead in terms of which way is the safest way. I will generally if it's some kind of medical appointment or something along those lines I will ask if we can reschedule. But if that's not possible I will try, I might even ask someone to drive with me. Or take a safer car, a higher car. I have a couple of friends with four-wheel drives, just I feel that's a little safer sometimes than driving quite a low sedan. But usually it's a spur of the moment type decision. It's like "Oh I can see this water on the road, I will go along this street as opposed to this street if I can't reschedule"." (Female, 37)
	"Mmm I'd probably contact the SES for some sort of assistance. I would, if it I mean if it yeah I guess obviously I would try to cancel the trip if at all possible. But if it was you know something that couldn't be avoided I'd probably contact the SES for some sort of assistance. Whether they could help get me out by boat or something like that potentially." (Female, 33)

	"I would delay it and I have done that in the past. There was an instance where I was supposed to be driving to Sydney and there were flash floods between Newcastle and Sydney and I just simply put it off and said "I'm not driving in this weather". And they understood and we just postponed it for a week." (Female, 53)
	"yeah because I'm involved in that area with the SES I worked out alternative routes to avoid the flooded areas if I need to get to the unit which is a call out. Got alternates available if I need to, alternate routes yeah." (Male, 71)
	"Don't take chances, if you know there's floodwater there you know don't take any risks at all." (Male, 47)
	"Stop and turn back and re-plan for another day." (Male, 47)
	"our Plan A whenever we know it's going to, there has been a flash flood warning or we know that flash floods could happen, our Plan A is always well we will just stay home and bunker down" (Female, 37)
	"But if we had to go it would be go early. And it would be like okay so like let's, the sooner we can leave, and we pack enough that if we couldn't get home that that's okay we could just go and stay at a friend's house or family. And I think it's about thinking about which way we would go. So like I , that's just part of our when it rains heavily we think about which way we drive. So we wouldn't go along the streets we know that do flood and we'd avoid the creek line. We'd avoid where the road does become a bridge over a river or creek." (Female, 37)
	"My test point and my mental test point is, is the thing that I'm going to life critical or not? And if it's not life critical then I'd have no trouble turning around and just coming back home and just ringing people." (Male, 66)
	"I'm level headed enough and good in an emergency to work around alternate things." (Male, 66)
	"that would pretty much be the only reason why you would ever find me anywhere near floodwater is if I was needing to get my children or get my children out of somewhere. Yeah and that, and I imagine that would be similar for most people Like as if they would feel like they have to like go through it to get to where they need to be because they're worried about there being no other way." (Female, 37)
	"I wouldn't go. I just wouldn't do it. So I would pull over that's what I have been doing. And I just stay where I am like wherever that safe spot is. Because yeah and tough. Unless my children needed me like… Yeah if they were at home I wouldn't worry about it. But if they were without family so to speak I would." (Female, 37)
Helpful tools	"Facebook is quite useful and oh what's it called? Live traffic something like that, I have them at the top of my Facebook feed. So I generally know what's happening. There are a number of other Facebook groups that I'm part of that usually will tell you what roads are flooded and other ways to go." (Female, 37)
	"Yeah so I use Live Traffic app and I watch social media before I leave. If I'm going anywhere I'll just kind of check social media and see what the conversation is about. And the radio." (Female, 53)
	"I can get on flood watch an emergency type thing" (Male, 66)
	"generally I use you know it pops up on Google Maps on my phone. That usually sort of gives you some advice plus I look at local council websites or the local publication to see if there's any information there plus what I know from what I hear on the radio. And quite often you get you know some mixed messages there as well as far as who ..or is it opened or proceed with caution." (Male, 53)

Table 5: *Quotes for the theme 'remembering the 2007 pasha bulker storm'*

Remembering the 2007 pasha bulker storm
"And you know I think it was 14 years ago yesterday that the Pasha bulker washed up on Newcastle beach. And I didn't work there at the time of course but the staff said yeah they were given the option to leave. Otherwise if staff wouldn't leave when it got very bad they essentially bunkered down and they were looked after for those couple of days" (Female, 33)
"no it was just really heavy rain, it was just a nothing like I'm thinking obviously the Pasha Bulker storms that happened you know 14 odd years ago. I didn't drive at all in those because I'd already had that experience previously. And yeah I learnt not to basically after that first one. It only took one instance to feel the weight of a car that has no weight is a really scary thing." (Female, 53)
"The disadvantages the bottom line is the yeah potential accident and potential well worst case scenario if it was a larger flood than what I had attempted it would be not good. When I saw some of the after effects of the Pasha Bulker storm, storm water drains with cars in them and you know just terrible." (Female, 53)
"I was going home from work of an afternoon, it was actually during the Pasha Bulker storm. And there was a lot of floodwater, we were alerted at work that there was a lot of floodwater so we were taking off early, leaving early to avoid it. And I again took kind of the roads that I knew would be high up out of water. But I did come across one dip that was, one dip in the road that had floodwater at the bottom of it and I didn't even go through it I basically just backed off and found another way around. Parked my car at the top of the road and then just walked down and went and collected my car later." (Female, 53)
[advantages of avoiding driving] "Well getting home in one piece and not ending up in a stormwater drain like some of the other people. Not having to be rescued by anyone in any boats and all that kind of stuff that you know we've watched happen." (Female, 53)
"The most recent one was the Pasha Bulker storm once. My daughter was trapped to some extent in Hamilton during the height of the flooding but I'd been working in Curry but it didn't rain there that day. And I'd come home from work and it wasn't until I got back towards Newcastle that I found that there was a lot of flooding going on. And my daughter asked since she couldn't get her out where she was working, she had a small car. She said it wasn't that bad and I had a ute which had you know reasonable clearance so I went to pick her up. But I wasn't aware of the extent of the flooding at the time and as I approached where she worked I, because it was night time wet roads and flooding don't look much different. And I started, I was approaching her works from one particular direction and suddenly I was driving in water which was probably only a foot deep or so. So I backed out of that and I went up to higher ground and got around to where she worked and came down her street and the guttering was overflowing into her works. But my vehicle could quite easily drive through that to pick her up. So I picked her up to take her home but on the way home, I came home, I said well I'll go home by higher ground to avoid any flooded areas. Which made sense. But one of the streets I took again it was night time, the roads were all wet and shiny. Unbeknown to me this particular road, back street was flooded and I didn't know that until I actually ran into the floodwater. But I as I drove along that street because it obviously was a higher area but for some reason that particular dip in the road was flooded and I hit the floodwater and I had no real option but to keep going. Because if I stopped I would have been trapped in it and I managed to drive through it okay. But the water was up to just above the door sills in the car. I didn't lose any control of the car, I drove through and I kept going and it was about maybe fifty yards wide that I drove through. Without any problem but I continued home then and as I said I took higher ground to avoid floodwaters to get back to our place. Then the daughter stayed with us until the floodwaters subsided further out so that I could then take her home late at night. That was the most recent driving through floodwaters." (Male, 71)
"Yeah. During the Pasha Bulker storm I delayed leaving work because I was looking at the land form and you know can't rain this heavy for a long time so I'll just stay back at work and then leave later. But it just continued. It didn't back off and it just got worse." (Male, 47) "So the one where I delayed leaving work because I saw how much flooding was happening during that Pasha Bulker storm. And I'd never seen anything like it so I thought the intensity of that rain is going to back off and that's when I'll leave work rather than go in the middle of that storm. I stayed at work for as long as I could and then I decided I had to go, that it wasn't going to back off any time soon and I wasn't staying there all night because it was Friday night you know. And so yeah I went and got in the car and started to drive home, the regular route I drove home, I got maybe half way home and a roundabout was under water. And

so I diverted around that roundabout to find some higher ground and a different way home. It took me to another roundabout which was under water and I could see the depth of water and I could see the other side and it climbed out of the water. So I also drive a four-wheel drive so I put it into , the car into low range and just drove through that roundabout at the time. Drove out the other side and then continued home, managing to get home by following the high road so to speak." (Male, 47)

"I thought my poor mum is stuck she could well put herself you know at risk. And without knowing it. So I knew where she was going and what direction she was taking so I thought I'd go out and try and find her and help her. But yeah only as I said I only got so far and then I hit floodwater again and it was yeah it was too risky to go through it. So I turned back and in this instance there was no alternative route to where I thought she was. So I had to go home and wait for her to call." (Male, 47)

"Biggest thing I've seen. We've had flooding events since but nothing like that Pasha bulker storm." (Male, 47)

"I think in the Pasha bulker it was before I personally drove but I think that 2007 I think those floods were an experience that meant we knew that like it could happen really quickly and that it become really unsafe. And so people didn't drive anywhere and I remember that really clearly that it was you know it impacted our life so significantly. And particular memories like I just have memories of like recently the last couple of years that I've been driving that I choose, I can see up ahead or I know that a particular part of our main street is going to flood. And if it looks like there's too much water I move away, like I'll drive a different way to get home. "(Female, 37)

"everyone who lived here during Pasha bulker knows the reality it could get shit kicker real." (Female, 37)

"And I think in Newcastle in that storm I'm sure there was several hundred cars flooded and abandoned at different points." (Male, 66)

"Correct and the engineer in me is always thinking cause and effect all of the time and so thinking that way you know that where the bulk of people would just go "Well I'm here and my house is there I need to follow the route that I always follow to get there". That's what most people would do of course. And my view is just "No, no to get home the circumstances have changed and I have to do something quite different". And you know when I think about the route that I took yeah some were the main roads and others were back streets because I knew where to go. And I knew the places to avoid and yeah so that was yeah quite an interesting storm." (Male, 66)

"when we went back through the following day there was probably about thirty vehicles scattered around that area that had drifted off the road." (Male, 53)

"Oh like just I remember seeing vehicles you know scattered everywhere." (Male, 53)

"Actually going back to the June storms and the 2015 storms we couldn't actually well back in June 2007 we couldn't actually get home. So we actually spent the night in a shop that we had at the time. Because it was basically bumper to bumper and we just you know nobody was going anywhere. So we felt well it was probably better just to go back to where we were and you know I mean for hours and hours all you could hear was sirens going up and down the you know the main street." (Male, 53)

"The reason why that has always struck me is that if I had continued, I'm not sure of the street names mean much to you, but continued Dumaresq Street on my plan then up Chatham Road I found out the next day that about that time that I would have gone through there were several vehicles that were actually washed into the concrete storm water drains up on Chatham Street. So you know at almost that identical time that I just felt something was wrong. Yeah I just made the call to head in a different direction. And yeah it was as I say at the time, when vehicles of a similar size or even a bit larger were being taken out. So I … I know that probably where the questions are going ahead, I can't honestly say that it was really you know concrete decision working A + B you know = C type thing. But the just the, and I wasn't specifically thinking of overflow of the drains in that area. But something just said this is not looking good you need to find some slightly higher territory and stick on the higher territory." (Male, 61)