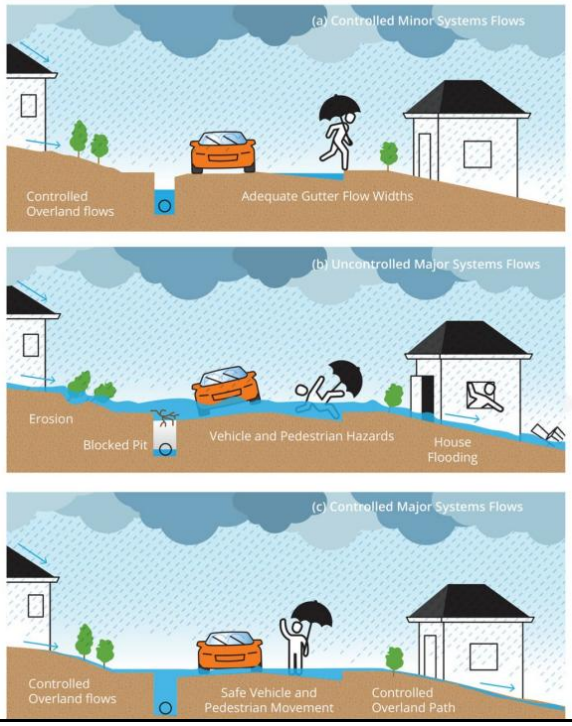
Slide 1

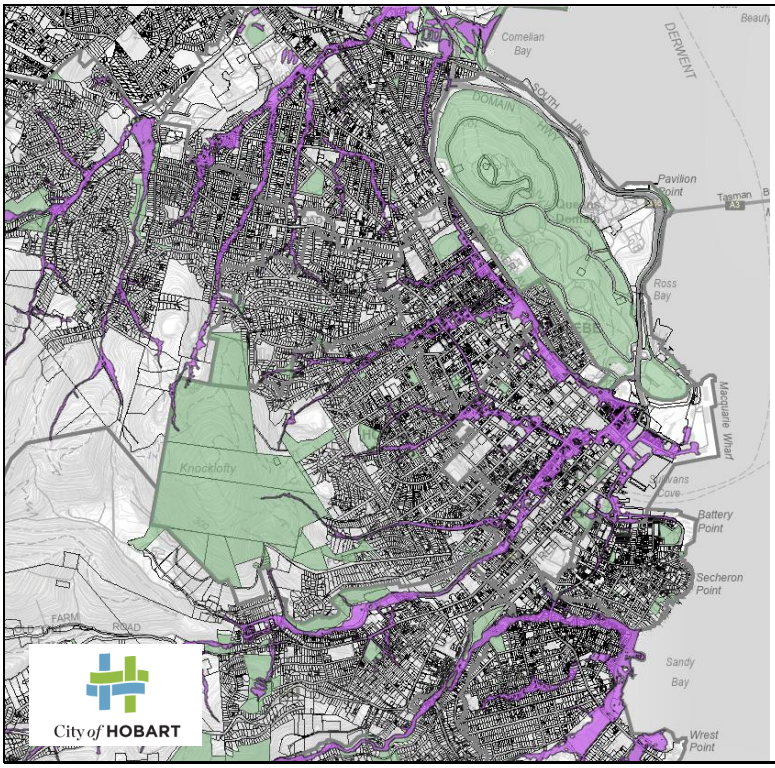
Selecting climate change factors for stormwater and flooding management

City of HOBART

Figure 8 Minor and Major Concepts for Conveyance Networks image from ARR 2019 Chapter 9



Slide 2



Why are we here?

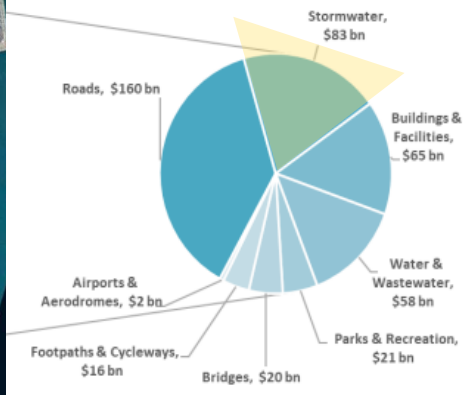
- New climate change factors
- Consideration of risk and investment

Climate change is increasing rainfall intensity and frequency. National guidelines have changed, and we need to reassess our assumptions to ensure our stormwater systems are fit for purpose. This is about risk, investment, and community safety.

There is a driver from consultants to and development to know which new factors to use. Councils now need to make decisions around climate change factors which they did not have the responsibility to make before. It is possible to push this towards consultants but this would be a problematic and unfair approach.

Slide 3

Infrastructure investment – second largest infrastructure asset class



Infrastructure assets controlled by local government June 2023

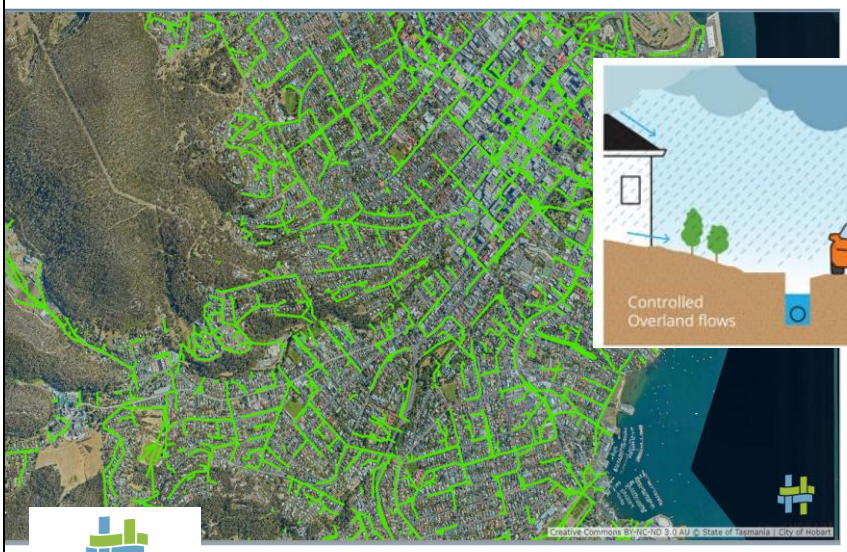
National State of the Assets Report

City of HOBART

Stormwater is the second largest infrastructure assets class in Local gov after roads. There is huge investment in this space and the levels of service to the community will either need to change or we are looking at significant infrastructure investment. Probably both will be required.

Slide 4

Minor v Major infrastructure and consequences.



1. Minor pipes
2. Trunk mains
3. Overland flow paths
4. Rivulets

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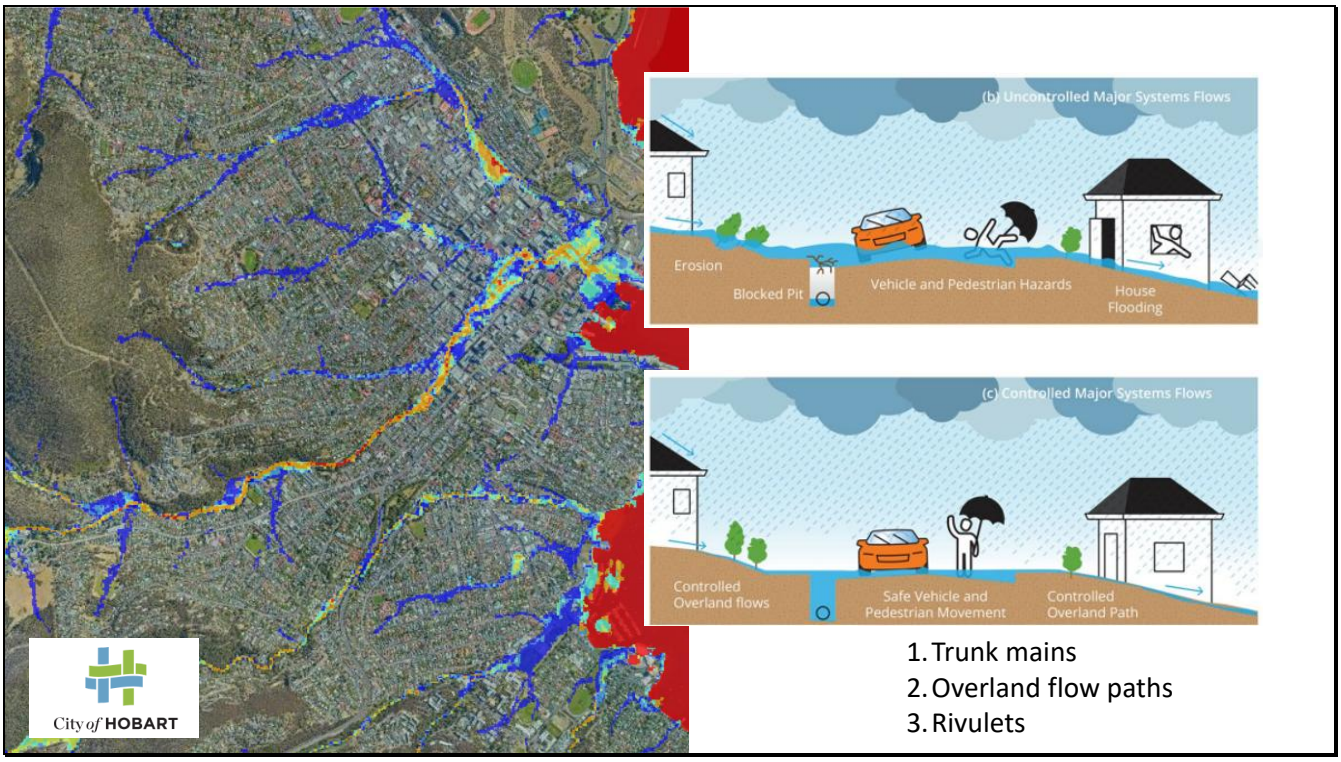
We hold most of our investment in Hobart in our underground minor pipe network. As per ARR guidelines these networks are predominantly for managing nuisance flows rather than flood impacts. This is not well understood by general public or necessarily elected members.

It is also possibly that the publics expectation of investment does not match our infrastructure spend and maybe we shoud look at skewing more towards overland flow management which can manage both minor nuisance flows and major/ flood flows.

Slide 5



We ran the new factors through our risk profiles, to do so we separated out infrastructure classes based on risk.
Minor pipes – that carry lower flows,
Smaller overland flow paths,
Trunk mains – which in this case are large mains intended to carry flows greater than the minor event – often approaching the major event capacity.
Rivulets – our creeks, most major flow paths.

Noting that we have quite a few major flow paths and Rivulets that have been undergrounded into ghost Rivulets over the years.

Slide 6

Climate change factors – current (2024)

Uncertainty

	≤ 1 hr
Central (median) estimate (%/°C)	15
'Likely' range (corresponding to ~66%[a] range) (%/°C)	7-28

[a]Consistent with terminology used by the IPCC the 66% range

Climate Change Factors

Rainfall Factors

SSP1-2.6

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.11
2050	1.22	1.2	1.18	1.17	1.15	1.15	1.14	1.13	1.12	1.11
2060	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2070	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2080	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2090	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2100	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12

SSP2-4.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12
2050	1.27	1.24	1.23	1.21	1.19	1.18	1.17	1.16	1.15	1.14
2060	1.3	1.27	1.25	1.23	1.21	1.2	1.19	1.18	1.16	1.16
2070	1.33	1.3	1.28	1.26	1.24	1.22	1.21	1.19	1.18	1.17
2080	1.37	1.33	1.31	1.28	1.26	1.24	1.22	1.21	1.2	1.19
2090	1.4	1.36	1.34	1.31	1.28	1.26	1.24	1.23	1.21	1.2
2100	1.41	1.37	1.35	1.32	1.29	1.27	1.25	1.24	1.22	1.21

SSP3-7.0

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2050	1.29	1.26	1.24	1.22	1.2	1.19	1.18	1.17	1.16	1.15
2060	1.35	1.32	1.3	1.27	1.25	1.23	1.22	1.2	1.19	1.18
2070	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2080	1.5	1.45	1.42	1.38	1.35	1.33	1.3	1.28	1.26	1.25
2090	1.59	1.53	1.49	1.44	1.4	1.38	1.35	1.33	1.3	1.29
2100	1.66	1.59	1.55	1.5	1.45	1.42	1.39	1.37	1.34	1.32

SSP5-8.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.2	1.18	1.17	1.16	1.14	1.13	1.13	1.12	1.11	1.11
2040	1.26	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.14
2050	1.34	1.31	1.29	1.26	1.24	1.23	1.21	1.2	1.18	1.18
2060	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2070	1.52	1.47	1.43	1.4	1.36	1.34	1.31	1.29	1.27	1.26
2080	1.63	1.57	1.52	1.48	1.43	1.4	1.37	1.35	1.33	1.31
2090	1.77	1.69	1.64	1.58	1.52	1.49	1.45	1.42	1.39	1.37
2100	1.86	1.77	1.71	1.64	1.58	1.54	1.5	1.47	1.43	1.41

The climate change factors released contains lots of numbers. We started to narrow it down by

+ looking to 2100 – the piped network that we install now will still be in use in 2100 and beyond, any additional capacity will be utilized so the investment will not be wasted during that time.
+ Narrowed it down to the sub 1hr number as our catchments – especially in urban areas are particularly flashy. I note that if we had longer duration rivers we may have to choose a different time frame for some areas and overlap both.

This brings it down to 4 numbers that were considered. Also to note is the potential variation, the selected numbers are based on a 15% increase in rainfall per degree of temp increase, this could be as high as 28% per degree or as low as 7% per degree.

Slide 7

WMA water https://ccc.wmawater.com.au/

Home | WMA Climate Change Calculator

A historical 1.0% AEP event (BOM 2016 IFD) is equivalent to a 1 in X AEP event in the future

	SSP1	SSP2	SSP3	SSP5
2024	52.6	52.6	52.6	52.6
2030	49.1	48.5	48.3	46.0
2050	41.5	36.0	32.7	28.4
2090	40.5	23.9	15.2	10.9
Mean over design life	42.1	32.3	25.6	20.5

A historical 1.0% AEP (BoM 2016 IFD) will become more likely in the future depending on the climate change SSP. The table shows what the new probability of the 1 in 100 AEP will be (1 in X AEP where X is the number in the table).

This table shows how And is a good communication tool. a 1% AEP event today becomes more frequent under future scenarios. Under SSP5-8.5, it could become a 1 in 11 year event by 2090. This highlights the urgency of adapting our design standards.

Slide 8

Urban Drainage Act (Tasmania) 2013

4. Objects of Act

The objects of this Act are –

(a) to protect people and property by ensuring that stormwater services, infrastructure and planning are provided so as to minimise the risk of urban flooding due to stormwater flows; and

(b) to provide for the safe, environmentally responsible, efficient and sustainable provision of stormwater services in accordance with the objectives of the resource management and planning system of Tasmania as set out in Schedule 1 .

Our legal obligation exists: we must protect people and property and provide stormwater services that are safe, efficient, and sustainable. But what this means in practice is pretty grey. How much protection? What is reasonable?

Slide 9

Risk Management Framework

What is an acceptable level of risk to community??

Risk Categories	Consequence Scale				
	Insignificant Issue that is managed as part of Business as Usual.	**Minor** An event, the consequence of which can be absorbed but management effort is required to minimise the impact. Localised impact for a Group or Network	**Moderate** A significant event, which can be managed under normal circumstances. Impact requiring Executive oversight and Director-level action	**Major** A critical event. Impact requiring ELT management and oversight and notification to Council	**Catastrophic** A disaster. Long-term or widespread impact requiring ELT and Council time and effort over multiple months and deviation from strategic plan
Customer and Community The impact on the City's customers including ratepayer and its communities.	Insignificant impact on customers and the community. Essential communication systems unavailable for up to 2 hours. Decline of economic activity and/or loss of asset value <0.004% of gross area product (~<$350,000).	Affected community can continue to function without unreasonable impact. Essential communication systems unavailable for 4 hours. Decline of economic activity and/or loss of asset value >0.004% of gross area product (~>$350,000).	Standard community function likely to be affected. Costs may be incurred by individuals and businesses whilst services are reinstated. Inability to resume essential communication systems for 1-2 days. Decline of economic activity and/or loss of asset value >0.04% of gross area product (~>$3.5 mil).	Standard community function will to be affected. Significant costs may be incurred by individuals and businesses whilst services are reinstated. Essential communication systems unavailable for 2-5 days. Decline of economic activity and/or loss of asset value >0.4% of gross area product (~>$35 mil).	Significant and ongoing impact to community function. Significant community costs incurred. Essential communication systems unavailable for more than 5 days. Decline of economic activity and/or loss of asset value >4% of gross area product (~>$350 mil).

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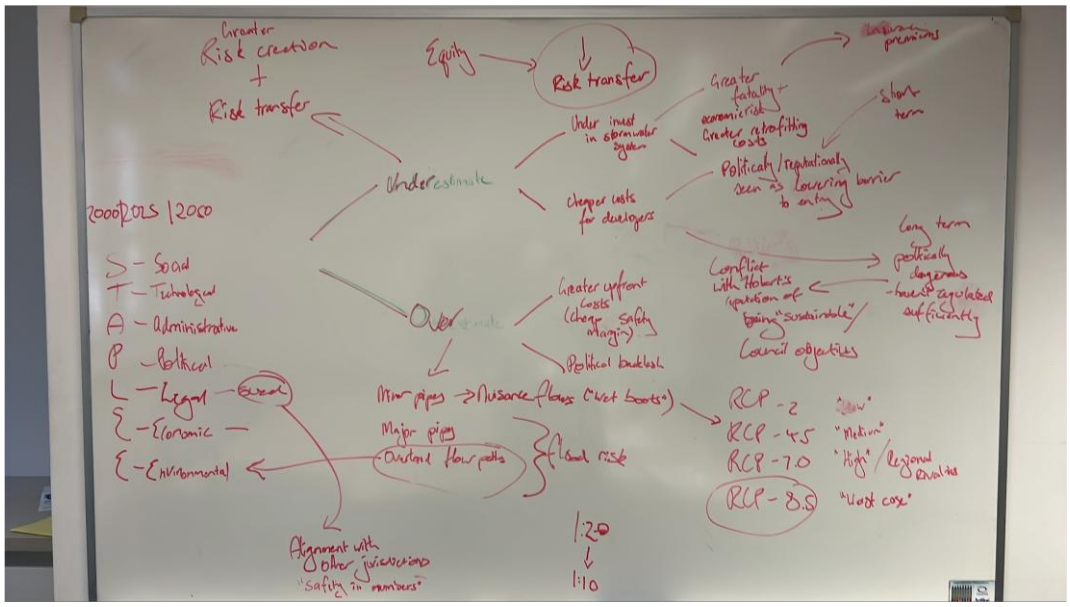
Based on federal guidance on climate risk, we've used the City's existing Risk Management Framework to assess which climate scenario is most appropriate for each asset type.

One of the asset categories we considered was customer and community. While stormwater assets will have a financial impact internally which we also looked at we needed to consider the risk to community under the act.

This risk category was a good start to refer to but was not specific to flood risk and what flood risk Council or the community would be willing to accept which would have been ideal.

Slide 10

Risk based approach - process



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The lack of clarity referring to flooding and as this is the first time we have run through this process it was difficult to get our head around the best way to do it. It took some time to work out a useable approach and even then we refined it throughout the process.

Slide 11

Risk based approach - process

Asset type	Estimation of climate scenarios	Hazard / Risk	Effect	Current Controls	Risk category	Likelihood	Consequence	Risk Rating	Risk Mitigation options	Ranking of importance	Notes	
Major pipes / Trunk mains	(SSP1-2.6)	Underinvestment in capacity	Increased costs in the future to retrofit. Stormwater impacts other council infrastructure and assets e.g.	Renewals at end of life	Financial	Possible	Moderate	Medium	Strategic upgrades based on risk mapping Integrated infra planning		Trunk mains act as major network infrastructure. In some areas these trunk mains operate instead of overland flow paths and there may not be a feasible OFP available.	
		Increased exposure to both nuisance and significant flood events – to communities and assets	Property damage; injury Possible litigation re allowing stormwater / flooding into properties		Customer and community	Possible	Major	High				
		Advice does not align with community expectations or broader Council strategies/objectives of developing Hobart's resilience and safety	Reputational damage - saying one thing, doing another		Brand and reputation	Likely	Moderate	High	Community engagement on their expectations and risk tolerance Strategic planning alignment			
		Risk transfer from developers to Council	Legal and financial liability		Financial				Appropriate developer contribution		Consideration of developers floor levels and potential dentention requirements.	
	(SSP2-4.5)	Increased exposure to both nuisance and significant flood events – to communities and assets	Property damage; injury Possible litigation re allowing stormwater / flooding into properties		Customer and community	Possible	Major	High				what are the trade offs between high risk that requires mitigation investment v medium risks that may not require investment.
		Advice does not align with community expectations or broader Council strategies/objectives of developing Hobart's resilience and safety	Reputational damage - saying one thing, doing another		Brand and reputation	Rare	Moderate	Low	Community engagement on their expectations and risk tolerance Strategic planning alignment			
		Risk transfer from developers to Council	Legal and financial liability		Financial				Appropriate developer contribution		Consideration of developers floor levels and potential dentention requirements.	
		Investment in capacity that is never utilised greater than what is needed to manage 1% flows. - may help with managing flood risk from larger flood events.	Increased costs to Council	Renewals at end of life	Financial	Rare	Moderate	Low				

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We then worked all four infrastructure categories through the risk profile and came up with some hazards to assess against. As we went through we realized we should probably be running each of the risks against each of the SSP categories. So we built a large spreadsheet – only a bit of it is shown here.

Slide 12

Minor pipes

Primary parties: Developers and Councils

Possible risks:
- More frequent nuisance flooding
- Increased cost – short vs long term
- Under/over investment in capacity
- Legal action taken against Council
- Reputational damage

Recommended climate change scenario: SSP1-2.6

Risk matrix settings

Consequence							
	5	*Catastrophic*	M 5	H 10	H 15	E 20	E 25
	4	*Major*	M 4	M 8	H 12	H 16	E 20
	3	*Moderate*	L 3	M 6	M 9	H 12	H 15
	2	*Minor*	L 2	M 4	M 6	M 8	H 10
	1	*Insignificant*	L 1	L 2	L 3	M 4	M 5
			Rare	*Unlikely*	*Possible*	*Likely*	*Almost Certain*
			1	2	3	4	5
			Likelihood				

SSP3-7.0
SSP2-4.5
SSP1-2.6

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From the previous spreadsheet we mapped the hazard results.

Manage frequent, low-volume flows. Failure causes nuisance flooding (e.g., gardens, sheds). Low safety risk.

Lower impact if we select a scenario that underestimates the actual level of climate change - assuming additional flows are safely managed through overland flow paths. Regardless of scenario chosen (even the lowest one SSP1-2.6), there will still be an increase in the total expected flow volume.

The current ramification is that additional flows are held in detention designed and installed at development stage. The burden is then shared by development and Council as we upgrade or duplicate our systems as need arises.
Selecting the lower approach minimises the requirement to upgrade our network sizes long term.

Slide 13

Trunk mains

Primary parties: Council

Possible risks:
- More frequent flooding – injury; property damage
- Increased cost – short vs long term
- Under/over investment in capacity
- Legal action taken against Council
- Reputational damage

Recommended climate change scenario: SSP3-7.0

Risk matrix settings

Consequence							
	5	*Catastrophic*	M 5	H 10	H 15	E 20	E 25
	4	*Major*	M 4	M 8	H 12	H 16	E 20
	3	*Moderate*	L 3	M 6	M 9	H 12	H 15
	2	*Minor*	L 2	M 4	M 6	M 8	H 10
	1	*Insignificant*	L 1	L 2	L 3	M 4	M 5
			Rare	*Unlikely*	*Possible*	*Likely*	*Almost Certain*
			1	2	3	4	5
			Likelihood				

SSP2-4.5

SSP3-7.0

SSP1-2.6

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Higher risk assets. Sizing of new major pipes. Decisions around these mains are likely to affect Council only. Flood modelling will affect properties in the vicinity of these mains. These areas are likely already affected by the Flood-Prone Areas Hazard Code.

Slide 14

Overland flow paths

Affected parties: Developers, residents, Council

Possible risks:
- More frequent flooding
- Increased cost – short vs long term
- Under/over investment in capacity
- Legal action taken against Council – constricted development
- Reputational damage

Recommended climate change scenario: SSP3-7.0

Risk matrix settings

Consequence							
	5	*Catastrophic*	M 5	H 10	H 15	E 20	E 25
	4	*Major*	M 4	M 8	H 12	H 16	E 20
	3	*Moderate*	L 3	M 6	M 9	H 12	H 15
	2	*Minor*	L 2	M 4	M 6	M 8	H 10
	1	*Insignificant*	L 1	L 2	L 3	M 4	M 5
			Rare	*Unlikely*	*Possible*	*Likely*	*Almost Certain*
			1	2	3	4	5
			Likelihood				

SSP1-2.6

SSP2-4.5

SSP3-7.0

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Safety and liability risk; precautionary scenario aligns with risk profile and Council obligations. May require new planning overlays or infrastructure upgrades.

Properties affected by flood mapping. Residents affected by overland flow flooding. Note flooding in these areas can create significant damage but is low risk to life. Likely to be less than 500mm deep and lower velocities. Can contain very high volumes over a storm event.

Slide 15

Rivulets

Primary parties: Residents and Council

Possible risks:
- More frequent flooding
- Increased cost – short vs long term
- Under/over investment in capacity
- Liability
- Community – death, injury and property damage
- Reputational damage

Recommended climate change scenario: SSP3-7.0

Risk matrix settings

Consequence							
	5	Catastrophic	M 5	H 10 SSP2-4.5	H 15	E 20 SSP1-2.6	E 25
	4	Major	M 4	M 8	H 12	H 16	E 20
	3	Moderate	L 3	M 6 SSP3-7.0	M 9	H 12	H 15
	2	Minor	L 2	M 4	M 6	M 8	H 10
	1	Insignificant	L 1	L 2	L 3	M 4	M 5
			Rare	Unlikely	Possible	Likely	Almost Certain
			1	2	3	4	5
			Likelihood				

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Very high risk. Potential for major flooding. SSP3-7.0 balances precaution with alignment to Tas Govt scenarios.

May consider precautionary approach by adopting the SSP 5-8.5 scenario which ensures a precautionary approach is embedded given high levels of uncertainty and may benefit parallel uses of these spaces. Protecting larger areas of land along our Rivulets may provide greater community benefits. Land use planning considerations.

Slide 16

Recommendations

1. Endorse that Council undertakes work to formalise Councils approach to management of overland flow paths in private property.

2. Adopt SSP1-2.6 with 5% AEP events as an interim climate change factor for the management of minor pipes.

3. Adopt SSP3-7.0 with a 1% AEP as an interim climate change factor for the management and mapping of overland flow paths.

4. Adopt SSP3-7.0 with a 1% AEP as an interim climate change factor for trunk main management and modelling.

5. Adopt SSP3-7.0 with a 1% AEP as an interim climate change factor for the management of Rivulets

6. Endorse a project funded through the current Integrated Hazard Vulnerability Assessment project to investigate:
- Financial impact of adopting different climate factors to Council
- Risk and liability impact to council of adopting different climate factors to Council and to the community
- Community engagement to assist in determining acceptable or expected levels of service and risk tolerance
- Development of a flood related risk statement or level of service guidelines to support consistent decision making and investment.

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. Our internal recommendations – have not yet been adopted by Council but have been internally endorsed.
I found it interesting that we didn't land on SSP 2 – 4.5 for any class – I note that a nearby Council has selected SSP 2 – 4.5 for the piped network but have reduced their level of service / design requirements from a 5% event to a 10% event, which from a flow point of view is similar to the SSP 1 – 2.6 and a 5% event design requirement.

Slide 17

Next steps

Disaster Ready Fund Project – economic pathways analysis – understand level of future investment required to meet expected service levels

Community education and risk tolerance

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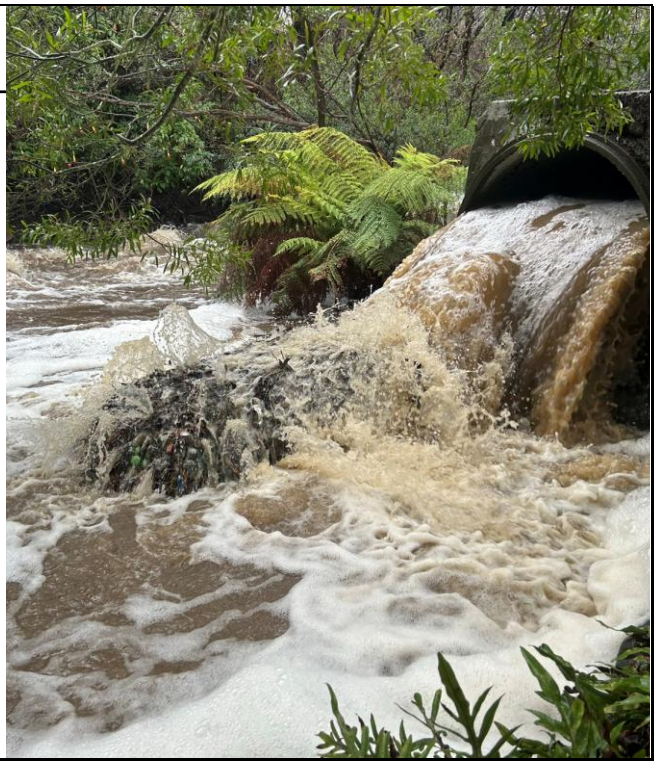

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