

## **Get water ready: Tanks, pumps and sprinklers**



Chair: Malcolm Hackett OAM

Presenter: Dr Justin Leonard

### **The Q&A process**

Members of the audience submit questions during the Q&A sessions. The Moderator passes a selected question to the Chair who asks for a response from the presenter.

### **Transcript of Q&A sessions**

#### **1. Sprinklers: roof or ground mounted?**

**Must I have roof-mounted sprinklers or are ground installed ones are just as good?**

**Justin Leonard**

Wow, we might have to break that down into a couple of sections. So, roof versus perimeter. Roof-mounted sprinklers are very good at wetting a roof. Roofs in Australia are non-combustible, so a wet non-combustible roof and a dry non-combustible roof are as effective as each other.

Water sprays on a roof can put water into gutters. And the question is what's the most effective way to get that water into gutters if you're trying to solve a gutter ignition risk. And probably the most effective way is to directly deliver the water to the gutter, rather than try to pass it through the air, have it wind affected and maybe not get to all the gutters under very windy conditions. So, I would sort of question the efficacy of actually having roof-mounted sprinklers at all. I find that the perimeter sprinklers, ones out in the broader area of the garden projecting back towards the house, are potentially far more effective because they get in under the eaves, they get on the wall surfaces, and they deliver water to all those ground and surface fuels that I've spoken about in the previous slides.

#### **2. Sprinkler distance and wetting objective**

**Ground installed sprinklers: how far away from the house should they be set and should the water be actually hitting the house or just wetting the ground around the house?**

**Justin Leonard**

I guess all sprinkler heads aren't created equal, and they are all designed to operate at different pressures and have different throws. So, I would start with thinking about the particular sprinkler head and definitely err towards those impact style. Look at the pressures and what you've got available and we'll talk a little bit about water pressures in the second half of the presentation. And once you've got that sort of coverage distance, well, you know your magic numbers.

You really should be trying to project water onto your house. It should impact the house, it should impact all the elements that you're trying to wet out and protect. So, it might only be a deck, so wet the entire deck. It might be a combustible fascia on your house and eaves, well, wet the fascias and eaves. It doesn't have to be constantly wetted, but an impact sprinkler that keeps coming around and intermittently passing is certainly fine for that.

### 3. Sprinkler types

**Has there been much investigation of sprinkler types and fire protection systems that have actually worked through a bushfire situation, that aren't theoretical but have really been seen working in real life?**

**Justin Leonard**

Yes and no. A lot of domestic systems failed under, for instance, the conditions like Black Saturday. And they didn't necessarily fail because the spray systems themselves weren't adequate for the task, they failed quite prolifically because the petrol- and diesel-powered pumps couldn't handle the heat of the day, and in some cases the heat of the day and the heat of the fire.

So, it's actually quite challenging to find the ones that worked and persisted throughout because they're quite rare. But where they do show up as being quite effective are metal pipework, wherever it's above ground. And very frequent spray heads either mounted on the house or in that perimeter array projecting back onto the house using an impact sprinkler are the other key ones that really do work. So, short distance fans on the house or distant impact-sprinklers that keep coming past.

### 4. Plastic Tanks

**Someone wants to know how safe plastic tanks are, and how far around a plastic tank should be clear? In this case, they've got short grass around their tanks**

**Justin Leonard**

Plastic tanks do fail quite prolifically in a fire. But the ones that do survive have nothing around them. And, I guess, short grass is about all they can handle. Dry, short grass. Anything at all beyond that, it could be a treated-pine raised bed perimeter that forms the base that the plastic tank's been put on, it might be even just another plastic tank right next to it, with short dry grass under both of those, it could be one piece of wood leant against the tank. Anything at all is enough to feed off the tank and cause it to fail and let all its water out. And that can actually present quite a significant impact to an adjacent thing, like if it's a tank next to a house for example.

So the tanks can survive but you have to be absolutely fastidious to not have anything around it at all.

### 5. Minimum water storage

**What's the minimum volume of water storage that's recommended to supply a sprinkler system for an average size, single-storey four-bedroom house assuming you've got fire pumps and sprinkler situation?**

**Justin Leonard**

It's really a "how long is a piece of string?" question, in that it's about what you need to target and protect. So, there isn't a typical system for a typical house, because a house should ideally have passive protection wherever possible, and the few things that aren't economical to passively protect by changing them to non-combustible materials, etc, you could use a spray system. And then I think you basically have to go through and look at the water requirements for all the things you need to protect.

If you attempted to say, "Look, I've got a combustible house, combustible fascia, and I'm not prepared to change it, I'm going to try and wet the whole thing down throughout a fire event," and it could be a typical single-storey house, I would say you would need upwards of 25,000 to 30,000 litres of water to protect that house throughout its entire event, if it was, I don't know, say, something like a BAL-19/BAL-29 type scenario.

**Chair**

That's a lot of water and some fire events go for a long time as we discovered on Black Saturday. You can have used all your water up before the fire even comes if you're trying to wet things down.

**Justin Leonard**

That's actually why the volumes are so great. You might spend 5,000 to 9,000 litres of that to get through the peak of the fire, but there's hours and hours of persistent deluge of embers that will keep coming. And under those conditions, things dry out quite quickly, and you need to keep wetting and keep defending.

## **6. Pump enclosure**

**Should a pump be enclosed or open to the air? And what about petrol pump vapour lock? Should a pump have its own sprinkler?**

**Justin Leonard**

Petrol pumps do have that problem, and did prolifically conk out during conditions of say Black Saturday. So, despite them being a fire fighter supply-pump, the engine side of that actually isn't that adequate to work at the 40°plus conditions running flat out under those fire conditions. Let alone handle the ember attack, the radiant heat, and whatever other heat loads are applied on it. So, they do prolifically cut out, and in a lot of cases won't be able to restart.

They do need to be put in quite a special protected place to be much cooler than the ambient conditions, and must be protected from embers and all those other things to have any chance of operating. And you can understand that that can be quite tricky. A steel enclosure can be quite hot.

You really actually need thermal inertia around it like a masonry enclosure to really get to a point where you could get a petrol pump through one of these events.

## **7. Remote controlled pump systems**

**What are the merits of remote controlled systems operable from your mobile in order to operate a sprinkler system around the perimeter and/or on the roofline of your home?**

**Justin Leonard**

I guess that cuts to the heart of this passive versus active system. And, I guess an active system needs to be turned on and ideally it doesn't need you to be physically there to turn it on. I mean, the ultimate life safety strategy is not being at your house. So, setting up a system that doesn't require you to be there to help defend your house by turning on your spray system, for example, is going to be prolifically better.

So, automated activatable systems, I think, are a fantastic idea. And they're certainly a step above the, "Oh well, I'm going to stay until x time before the fire turns up, turn everything on, and hope it continues for the duration", because that's another compromise you're making about your life safety by leaving it as late as you can to leave. Nothing's worth those life safety compromises. So, I would say once you get to a point of having a reliable water storage, a pumping system, you should go that extra step and have it as an automated activation.

## **8. Garbage bins of water, mops and plastic hoses**

**Is it okay to fill garbage bins with water and have a mop handy, and to put them around the house, and are plastic hoses okay?**

**Justin Leonard**

The old knapsack and mops are an extremely effective way to put out a lot of ignitions with very little water. And I think in observing the realities that the power shuts off and your mains water supply dwindles to nothing, and you're left with what's in your tanks, and what you can get out of your tanks, and what you've already filled up your rubbish bins and your bathtubs with, it really does come down to those being very effective strategies to get by: particularly around that sort of constant onslaught of embers and continued ignitions in the many hours after the event itself, when it has reached a point where it's safe enough to move outside and continue that defence.

Plastic hoses invariably are burnt out and useless if they were out during the fire event itself. So, the surface fires that sweep through take them out. They could be pressurized typical plastic garden hoses, or they could

be empty of water or not pressurized. They actually just fail when the surface fires come through and impact them.

## **Chair**

I know some of my neighbours have as part of their fire plan that the hoses are rolled up and brought inside so they can go out and reconnect them later, hoping they've still got some water left to use.

### **9. Diesel pumps in high temperature conditions**

**You've addressed the inadequacy of petrol pumps under sustained high temperature conditions. Do diesel pumps behave in similar ways, or are they better?**

#### **Justin Leonard**

The diesel doesn't cause vapour lock like the petrol ones, so the vapour doesn't create the problem in the carby. So, they're a bit less heat affected and can run to a slightly higher ambient temperature than the petrol ones. However, the diesel ones are just as susceptible to ember attack or surface fire as the petrol one. So, if the diesel pumps suck in embers into their paper air cleaners, it'll cause a flaming ignition of that paper air cleaner and that will snuff out the diesel motor, just the same as it would a petrol one.

The diesel ones do have a slight advantage, and that is around the prospects of safely refuelling them mid-fire. I would feel a little bit more confident trying to refill a diesel fuel tank than a petrol one, only because it's far less volatile and more difficult to ignite from ember attack. Although I would be particularly nervous in either scenario because you're effectively trying to pour a fuel - diesel or petrol into a tank on a very hot engine. And, of course, if you splash diesel on a hot engine it can burst into flames. And it can be up to a temperature where those embers can ignite and you could have a major problem on your hands. So, it does flag the issue that diesel is better than petrol but the question of how big your fuel tank is and what your prospects are to refuel it are key considerations in the design of your system.

### **10. Gravity fed tanks**

**Are gravity feed tanks preferable over pumps and electric generators or for when there is a power failure? Would gravity feed provide enough pressure for sprinklers?**

#### **Justin Leonard**

That'd be pretty much the gold standard, if you had enough height to get your tank up above your sprinkler-head level. Then it's absolutely reliable, and if the tank's designed the right way, well, you've got water and attack pressure, and you don't have to rely on any means like a pump to give you the pressure. Now, how much pressure you actually need is a question about certain sprinkler-heads need certain pressures. But, you can do a little bit of maths with heights and pressures and you end up finding that a fire hydrant really needs to supply pressure at around 150kPA as an absolute minimum, and that equates to about 15m of pressure-head height. So, the tank needs to be 15m above your house to give you that equivalent level.

So, if you can get to that amount and be as good as a fire hydrant then you're doing really well. If you come down less than that height, like if you're down in the 10-15m range, you really have to be careful about the particular heads and how the whole system will work for that lower pressure.

## **Chair**

I certainly know from my property, having a two-inch pipe feeding from the tank down the hill the size of the feed pipe actually has an impact on how much pressure you're going to get at the bottom too. If you've only got a one-inch pipe, it's going to be significantly less.

## **11. Larger fuel tanks for pumps**

**Is it feasible to attach a larger external fuel container directly to a pump to get that extra fuel tank size?**

**Justin Leonard**

Most definitely. And I'd encourage that approach and actually to remotely mount the tank, like off the pump itself. That certainly avoids the additional risk of heating from the pump and the heat feedback, which is one of your problems with vapour lock for your petrol pumps. And it also solves the issue of vibration. So, trying to mount a large fuel tank on a small pump that's vibrating is going to lead to fatigue and issues as well. So, definitely explore that remote mounting approach. Obviously still needs to be above the pump because they're made as a gravity feed.

## **12. Poly pipes and fittings**

**How deep should poly pipe be buried?**

**Justin Leonard**

We've found that once you get around 10cm below the ground, the temperatures are not adequate to melt poly in the ground except in the event that you put a significant fuel load on the ground itself. So, if you had a vehicle that burned or a pile of wood or a fence burnt above along that line and it was only 10cm below ground, then you might have enough heat. But the typical fire burning of things above ground is not enough to affect things. There's a difference in certain soils and what not as well but, as a rule, at least 10cm below the ground, unless you're going past something quite significant, then you must go a lot deeper.

**Chair**

I can add an anecdote to this from Black Saturday. Our supply came from a dam above the house, and the poly had been put in some years ago and it weaved its way between pine trees. The roots of the pine trees caught fire, the poly pipe was about 150mm in the ground, and it put holes in the poly pipe. So, I'd be urging people to go as deep as you can and stay away from other stuff.

**Justin Leonard**

And that's probably a really pertinent example, because it's poly pipe, full of water pressurized by a tank, and the water pressure wouldn't have let up but it still melted through the poly. So, you just can't rely on plastic hoses even if there's water or flowing water inside them. They can burn through.

## **13. Reticulated water supply in a fire**

**If our water supply taps off a fire hydrant line, how reliable will our water supply be if there's fire in our area and the fire brigade is in attendance locally?**

**Justin Leonard**

Fairly unreliable because the fire fighters have an upper hand in that regard. They've got a pump on their truck where they can actually suck water out of the hydrant system. So, when they connect up they will want to fill their trucks as quickly as possible and they'll actually pump out of the hydrant. Unfortunately that leaves all the other hydrant outlets with little to no water.

So, you can also assume that at some point that hydrant system is connected to the mains system somewhere and that's connected to a pumping station that may or may not fail in its power supply. So, invariably we lose mains pressure, the hydrant systems aren't adequate and we certainly don't have any power. So, we really have to think about our spray systems and the reliability of water supply. It comes back to tanks, dams, gravity feed on property and reliable pumping systems.

#### **14. Fuel storage containers**

**What kind of container should fuel be stored in and where should it be stored?**

**Justin Leonard**

You'll notice deliberately that fuel cans are metal, typically metal, with a plastic lid. And the plastic lid is actually what you would call the fusible link. When that gets heated up, the cap itself melts and relieves pressure and lets the fuel vapour out. If it was a metal fuel container with a metal lid and it was heated, it would build up to an extreme pressure and then really catastrophically explode, if it was heated enough.

So, that's the ultimate issue and compromise between what you should store things in. You should store it in a purchased specific fuel can that's designed for that purpose. Where you put the fuel can is another important question. I would in a shed somewhere remote on your property and don't go near it during the bushfire.

#### **15. Copper sprinkler piping**

**This participant was told that the copper sprinkler piping is unsuitable for bushfires. Will copper withstand the radiant heat and flames?**

**Justin Leonard**

I found copper, and particularly copper with water in it, survives adequately in bushfires. So, I would challenge that as a suggestion.

#### **16. Double skin steel tanks**

**I have seen double-skin steel tanks that sort of have an air pocket between two lots of steel with the liner on the inside. Have you got any information about how effective they are?**

**Justin Leonard**

No, I'm not aware of that, but anything with a double skin is going to have a huge effect on mitigating the heat to the inner skin. So, that sounds like a really good approach. I'm not sure what's the specific approach to going to a double skin design. Is that to keep you the water cooler, or --

**Chair**

I think they're specifically for bushfires, the one I've seen. I think I saw it at a field day and it looked pretty clever. Had a premium price, but it was probably still a lot, as you say, a lot cheaper than concrete because you could go up to those large volumes.

#### **17. Fibreglass tanks**

**Do fibreglass tanks have the same problem as plastic tanks?**

**Justin Leonard**

They have the same problem. They're in fact significantly worse than plastic tanks, so I don't know if they're actually in production anymore. But, occasionally, you see a very old fibreglass tank which is like two moulded things coming together in a seam around the middle. They fail, quite absolutely with certainty, with a very mild exposure. So, even more vulnerable than the poly tanks.

## 18. Shielding pumps

**People were interested in that pump shielding material. Is that a thick cement sheet or was it some special material?**

**Justin Leonard**

A suitable material to do that would just be any cementitious board—a non-combustible cementitious board would be fine. Even if it's a relatively dry environment and it's protected from the weather. Even some cut pieces of plasterboard would be adequate.

## 19. Sprinkler usage when water supply is low

**During a long hot summer, water supplies are often low. At what point in the fire do I obtain maximum benefit from having sprinklers on, and should there be pauses during the sprinkler use?**

**Justin Leonard**

I guess that comes down to the specific thing you're using the spray systems for. We went through in the beginning of the seminar what you're really targeting the spray system to do. If it's to protect your windows from radiant heat, you're in the peak of the fire, well, you need them on for the whole duration of that peak. If you're trying to prevent your deck from igniting from the ember onslaught, well, you need to intermittently wet that deck during and for hours after the event, possibly through the night. It really comes down to exactly what the purpose of the spray system, and what it's trying to protect, will dictate exactly how it needs to operate to minimize the water use and achieve the outcome.

## 20. Calculating pipe sizes

**Is there a way that people can actually calculate the diameters required for their manifolds and connecting pipes when they're designing a sprinkler system? Or do you have to go to an expert and get them to do it?**

**Justin Leonard**

You can actually find some online calculators that help you size pipes and predict the amounts of pressure drop over the lengths and the elbows in a system. So, I would say if you're really getting down to sort of nutting out or designing your own system, yes, definitely find one of those calculators and do the end-to-end solution.

## 21. Electric pumps

**One person says that they went to a major agricultural supplier looking for an electric pump compared with a petrol pump and they got brushed off. What should they look for in an electric pump? Where should they go?**

**Justin Leonard**

I would go to a specialist. You really need to go to Davey or start leafing through the Davey catalogues and looking at the proper pumps. They're not going to be the types of pumps you typically use in a domestic supply, you're sort of going next level up. They're not necessarily expensive pumps, but you can find an electric pump to do pretty much any pressure or any volume task you need. You just have to work through that entire system and find the expert pump suppliers, like Davey. Davey have an incredible range, for example.

## 22. Protecting plastic pipes

**How do you provide radiant heat protection if you've got plastic pipe supplying a pump from an elevated tank?**

**Justin Leonard**

I think my last three slides pretty much showed exactly how to do that. If you had a really long run and you were looking for a really durable approach, you could think about enclosing it or shielding it with some type of

masonry-type exterior cover. If you want a really long-term solution, but otherwise the lagging and covering approach I showed there was pretty straightforward.

### **23. Ring main system**

**Does a ring main system have advantages?**

**Justin Leonard**

A ring main, I guess, closes back on itself. It does help to give you a more even pressure around the entire ring. So, it's like you can be more effective as the last head in the network doesn't get the least pressure, the ring main gives you a more even pressure delivery to all your heads.

### **24. Sprinkler head spring failure**

**Do the springs in a sprinkler head fail or weaken with heat?**

**Justin Leonard**

It's been observed with sprinkler heads that weren't operational during the peak of the fire. So there's actually been flame contact on the sprinkler head, and that can weaken the spring and cause it to relax and then not function properly. I haven't seen any evidence that an operating sprinkler could get hot enough that it would fail.

### **25. Trailer mounted fire tanks**

**Have you got any views on these trailer-mounted fire tanks - 1,000 litre with a petrol engine coupled to a fire hose, those sorts of fire fighting trailers?**

**Justin Leonard**

They were amongst the many that failed during the peak of the exposures in Black Saturday. The petrol pumps aren't typically enclosed on those trailers. A lot of those were backed up to dams and were used as the, "set-and-forget, hopefully we'll still get pressure out of it," type approaches. I would treat them more like the hoses. You've got to actually bring them inside and protect them, say, in your shed and bring them out and use that in the aftermath of the peak of the fire. And it would be quite a useful portable water resource in that post-fire event, but don't expect it to survive outside, especially if it's trying to be operated throughout the peak of the fire event outside.

### **26. Non-flammable hose**

**Are there any non-flammable fire hoses for domestic use?**

**Justin Leonard**

The typical roll-flat hoses are flammable. They're made of a natural fibre. I'm not aware of a completely inflammable one though.

**Chair**

And I notice here on the Q&A feed that a volunteer fire fighter says the traditional canvas hoses will hold moisture and they only likely to burn when they're subject to prolonged flame.

### **27. Hoses inside**

**Should hoses should be brought until you're going to use them?**

**Justin Leonard**

Yes, I guess you do. If they're dry they obviously can burn through. But, correct me if I'm wrong, I guess it's a good one for the fire fighters. Those natural fibre hoses, when charged and wet, tend to be able to handle spotting and a bit of surface fire activity and don't burn through like a typical garden hose.



## **28. Corrugated iron protecting pump housing**

**One person here was concerned about the corrugated iron that was on top of their pump enclosure, and wondered about how well it was fixed in place and whether that fire housing could be a problem in strong winds?**

**Justin Leonard**

Oh yes, most definitely it did look a little bit flimsy. But, I guess the attention's in the detail. I'll have to zoom in and see how many screws were holding it down.

## **29. Fire retardants**

**What about these fire retardants that you can apply. Is it worth spending the money on fire retardants, or you go out and buy a better pump and generator and so on?**

**Justin Leonard**

I guess that's referring to the hydrating gels and things that you could possibly spray over everything as a preventative. Well, they're a hydrated gel, and the gel itself, before you hydrate it, is possibly a vegetable-oil-based hydrating gel, or a slightly different type. Once they dry out, they're no longer effective, and in the case that they're vegetable-oil-based, they dry out and then you basically have a house covered in vegetable oil, which isn't that ideal in a fire event. So, it's really down to how much you get on, how thick it is, and how much it dries up during the event. And if applied the right way, and are thick enough, and they're done in a short enough duration before the fire event then sure, they might protect the elements you've put them on.

The problem with them are numerous, in that once you've put them on it's very difficult to get them back off, particularly in the event that they get baked on in situ. So, if you're going to invest in one of those approaches, you would look for the evidence of specifically how easy it is to get it back off and how benign for the environment it is. And, of course, there's obviously the other side effect that you're going to get it everywhere and it's going to be slippery. So, there could be some slips and trips issues.

## **30. Wetting down vegetation**

**Here's a home where there's vegetation 1-3m high 15m from the house. Is wetting that down before a fire impacts worthwhile?**

**Justin Leonard**

It really comes down to how wet it is at the time the fire turns up. So, if you imagine a Black Saturday condition and wetting out an elevated hedge or something like that, try to imagine how quickly that'll return to being dry again. Like, we're talking 5% relative humidity, 60km winds and 40° heat. It's not going to be that long after you wet that vegetation down before it's back to its dry state. So, it really comes down to wetting it down immediately before or during the fire event.

## **31. Pump plastic suction pipes**

**Plastic suction lines to the pump. Are they likely to fail?**

**Justin Leonard**

They rely on their rigidity. They're under suction means that the water pressure is doing everything it can to collapse the pipe, but it's got plastic ribbing and whatnot in the pipe to hold it open. If the water inside is hot or there's significant heat around it, then it might not be strong enough to keep itself open and it could collapse.

### **32. Smoke and pumps**

**Will smoke on its own stop a fire pump?**

**Justin Leonard**

Really dense smoke that has most of the oxygen consumed will cause the pump to drop significantly in power and possibly cut out, but it won't permanently immobilize the pump. So, it might actually be able to be restarted.

### **33. Pump outlet size**

**The 50mm outlets on most water tanks, are they actually big enough to do the job?**

**Justin Leonard**

Once again it comes down to the design of your whole system and what you're trying to do with your system. If you're talking about some of the biggest systems where you're trying to wet down an entire house, I would say you're nowhere near the mark with a 50mm outlet. You might need multiple ones of those. Yes, it really comes down to overall design and sizing. And that's over to the recommended calculators.