

Influence of Track Ten on Flood Levels at Loch Sport



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Cover Photo - shows Track Ten inundated in the June/July 2007 flood. Photo credit, West Gippsland CMA.

All levels referenced in this report are to Australian Height Datum (AHD).

Summary

Purpose:

Wellington Shire Council commissioned this study to assess whether Track Ten—a causeway crossing Lake Reeve near the township of Loch Sport—affects flood levels during major Gippsland Lakes floods. Community members have expressed concern that the causeway may impede water movement and increase flooding at Loch Sport.

Track Ten Characteristics:

Track Ten extends southeast from the Longford–Loch Sport Road to provide access to coastal properties. The track includes a low gravel causeway across Lake Reeve at an elevation of approximately 0.8 m Australian Height Datum (AHD)¹. The causeway has a total of 8 culverts, and these are sufficient to accommodate normal tidal and wind-driven flows. However, these culverts, have limited flood conveyance capacity. Aerial photographs show Track Ten was upgraded to its present alignment in the late 1960s.

Hydrological Setting:

Lake Reeve is a long, shallow lagoon parallel to the coast, connecting to Lake Victoria near Trapper Point. Water movement is slow and primarily driven by inflow from local catchments, tides, wind, and floods from the broader Gippsland Lakes system. During large floods in the Gippsland Lakes, water moves south-westerly along Lake Reeve from Lake Victoria toward Golden Beach, potentially ponding against Track Ten, before overtopping it.

Afflux and Flood Influence:

“Afflux” (a temporary rise in water level upstream of a constriction) may occur at Track Ten during the early stages of flooding when water flows through culverts. However:

- Once the water level reaches the top of the causeway, approximately 0.8 m, the causeway is overtopped, allowing free flow across the causeway structure.
- At higher floods, when Track Ten is fully submerged (“drowned”) it will have no material effect on flood levels.

Historical Flood Evidence:

- **June/July 2007 Flood:** One of the largest events since 1978 (peak ~1.5 m at Loch Sport). Photographs show Track Ten overtopped and inundated, confirming there was no material effect on peak flood levels.
- **June 2012 Flood:** Peak at ~1.0 m (1-in-7-year). Track Ten may have been briefly overtopped; no evidence of adverse impact on Loch Sport.
- **1993 and 1995 Floods:** Historical photographs also show Track Ten submerged.

Conclusions:

During Gippsland Lakes floods, Track Ten may cause a small, localised rise in water level (afflux) until the water level reaches about 0.8 m. Once the Track Ten causeway is overtopped, and hydraulically drowned, it ceases to restrict flow.

During significant events—including design floods—Track Ten is fully inundated so does not materially influence peak flood levels. Therefore, structural modification of Track Ten will not materially reduce the flood risk from these large events.

¹ All levels in this report are relative to AHD – Australian Height Datum

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1. Introduction

Wellington Shire Council is seeking to quantify the potential influence of Track Ten on flood levels within Lake Reeve along the southeastern edge of the Loch Sport township. This is in response to concerns expressed by some members of the community, that the Track Ten causeway may increase flood levels under certain circumstances.

This report provides information on relevant aspects of the Track Ten causeway. This is followed by a discussion of the available information on Gippsland Lakes flood levels and the interaction of flood waters in Lake Reeve with Track Ten.

1.1. Scope and limitations

This report addresses the question: *Does Track Ten materially affect peak flood levels at Loch Sport during Gippsland Lakes floods propagating from Lake Victoria into Lake Reeve?*

The report does not quantify flood risk associated with flow along Lake Reeve from the west that is, it does not investigate local runoff into Lake Reeve or inflows from Merriman Creek or Carr Creek.

2. Track Ten

Track Ten starts at the Longford-Loch Sport Rd 4.5 km southwest of the Loch Sport outskirts (Charles St) and travels southeast providing access to the 90 Mile Beach Holiday Retreat and other properties (Figure 1). Track Ten crosses Lake Reeve on a low causeway which is generally at an elevation of 0.8 m (Figure 2) (survey details are provided in Appendix A). The tidal range of Lake Reeve in this area is small and the causeway section of Track Ten is above the general water level in the Lake, except in flood conditions.

Historical aerial photography (Appendix B) shows Track Ten was present in 1967 and was formalised by 1970 probably as part of the pipeline construction works for oil and gas extraction which started in the late 1960s². Community submissions assert that the crossing was again improved around 1998. This could not be independently verified or hydraulically quantified. Track Ten, up to the southern end of the causeway, was gazetted as a Government Road on 13 August 1998³. It has been maintained by Wellington Shire since this time.

There is a total of eight culverts under Track Ten, in three banks (Figure 3) (Appendix C). All culverts are relatively low capacity (Figure 4) but are adequate to allow passage of tidal flows, wind driven flows and local runoff under normal (non-flood) conditions.

This study did not assess culvert maintenance issues such as degree of blockage or vegetation growth. These may affect water levels prior to the overtopping of the Track Ten causeway.

2.1. Stockyard Hill Causeway

Track Ten is 8.44 km southwest of another crossing of Lake Reeve, the Stockyard Hill Causeway, which is closer to the Loch Sport township (Figure 1). The next crossing of Lake Reeve to the west is the Longford-Golden Beach Rd which is 19 km southwest of Track Ten. The behaviour of the Stockyard Hill Causeway during large floods is briefly discussed below.

² Bass Strait overview and history <https://www.woodside.com/what-we-do/operations/bass-strait> (accessed 30 October 2025)

³ Victorian Government Gazette G32 13 August 1998, page 2182



Figure 1: Location of Track Ten (Google Earth, 21 August 2025)

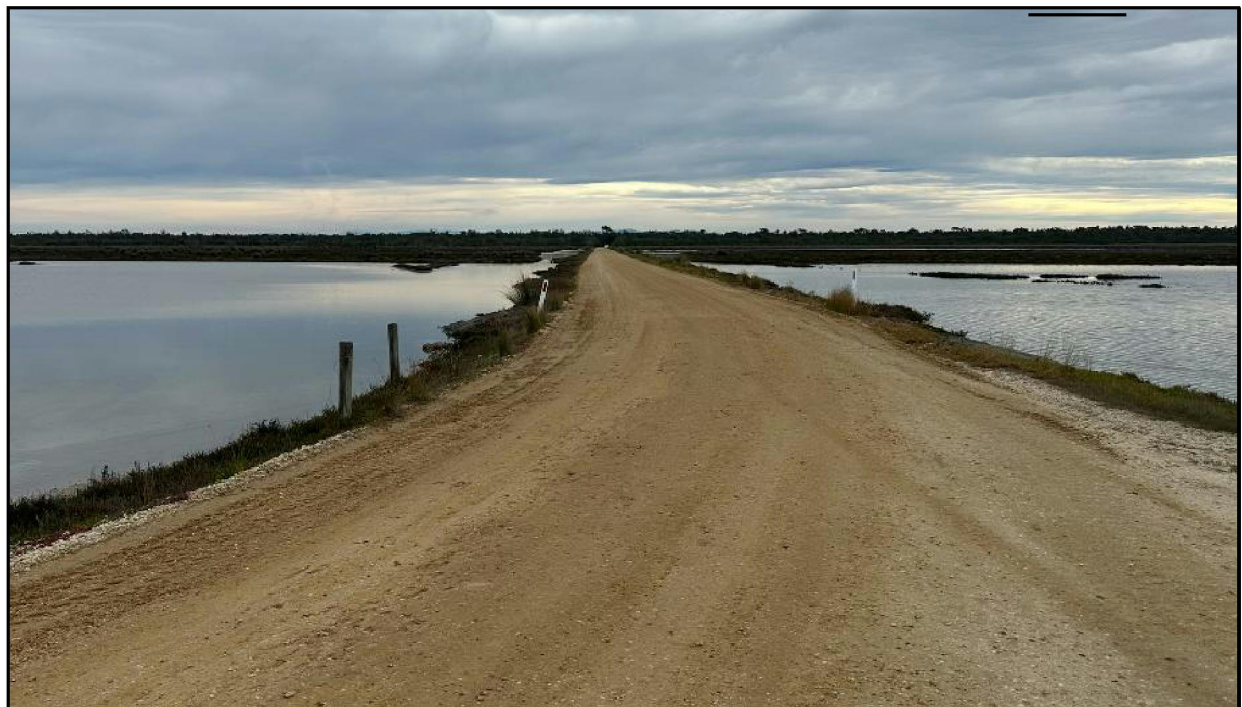


Figure 2: Track Ten (6 June 2025⁴).

⁴ Photo credit



Figure 3: Location of Track Ten culverts



Figure 4: Culverts at the southeastern end of the Track Ten causeway. This is a bank of 4 culverts, 2 upper and 2 lower. Culvert diameter is 430 mm.

2.2. The potential influence of Track Ten on flood levels at Loch Sport

Lake Reeve runs parallel to the coast for about 60 km from Seaspray to Trapper Point. The width of Lake Reeve varies from about 1.5 km down to narrower sections of about 200 m. The topography of the lakebed is almost completely flat so that under normal (non-flood conditions), local runoff and any inflow from Merriman or Carr Creek will pond, evaporate or infiltrate. Evaporation leads to hypersaline conditions which are a feature of Lake Reeve⁵. Near Track Ten, any flow along Lake Reeve under normal conditions will be the result of local runoff, wind and tide.

Generally, high water levels in Lake Reeve near Track Ten are caused when flooding in the Gippsland Lakes creates a hydraulic gradient that leads to flow towards the southwest, along Lake Reeve from Trapper Point toward Golden Beach⁶. The distance from Trapper Point, where Lake Reeve connects to Lake Victoria, and Track Ten, is about 20 km. Therefore, there will be a time delay as water flows along Lake Reeve, before water levels equalise between Lake Victoria and the lake at Track Ten. This travel time will also be affected by the wind strength and direction.

When water flows along Lake Reeve from Lake Victoria (from Trapper Point toward Golden Beach), there is the potential for Track Ten to raise the water level on the upstream side of the causeway (Loch Sport side). The water level must be higher on the upstream side to force water through the culverts, or to flow over the causeway. Engineers refer to this increase in water level upstream as afflux. Afflux occurs whenever there is flow through culverts, under bridges or over weirs. Generally, higher flows are associated with higher afflux.

At normal low water levels in Lake Reeve, there will be a small amount of afflux associated with tidal or wind driven flow through the Track Ten culverts. This does not contribute to flood risk because under normal low flow conditions, the water levels are below any vulnerable infrastructure, and the amount of afflux is insignificant.

In the early stages of a large Gippsland Lakes flood, when there are larger flows along Lake Reeve, originating from Lake Victoria, the afflux caused by Track Ten will increase because of the increased flow rates through the culverts.

As water levels increase further, the Track Ten causeway is overtopped. Once the water level is the same on either side of Track Ten, then there is 'no afflux' and the track does not influence water levels on either side of the causeway.

In summary, flow through/over Track Ten occurs in three phases:

- Below the causeway crest, flow is mainly through the culverts, so a head difference is needed;
- Near the causeway crest: overtopping begins and conveyance increases sharply;
- Well above the crest the structure is drowned, and any residual head difference is small.

Then as flooding recedes, water will flow out of Lake Reeve and the water level at Track Ten will decrease.

This was the pattern of behaviour observed in the large flood of June 2007, which is discussed in more detail in the next section.

The speed of water movement from Lake Victoria into Lake Reeve and toward Track Ten will depend on the size of the flood. Larger floods in the Gippsland Lakes will result in greater hydraulic gradients and more rapid flow. Larger floods also cause longer periods of elevated water levels in

⁵ Gippsland Lakes Ramsar site. Ecological Character Description. Australian Government. Department of Sustainability, Environment, Water, Population and Communities. March 2010.

⁶ High water levels in Lake Reeve could also occur because of flood flow in Lake Reeve from the west, from Merriman Creek, Carr Creek, local runoff or a breach in the foredune. However, Track Ten would increase flood levels at Loch Sport caused by flood flows from the west, so this situation is not considered further in this report.

the Gippsland Lakes which mean there is more time for water to flow into Lake Reeve, and it is more likely there will be sufficient time for the water levels on both sides of Loch Sport (the Lake Victoria side and the Lake Reeve side) to equalise.

It is likely that the greatest afflux occurs when flow along Lake Reeve (to the west during a large Gippsland Lakes flood) is sufficient to increase water levels to just below the road crest of the causeway, that is about 0.8 m. Once the causeway overtops, the greatly increased flow rate will rapidly lead to increased water levels on the downstream (Golden Beach side) of Track Ten. A further increase in Lake Reeve water levels result in Track Ten being “drowned” i.e. completely submerged. Once this occurs, the effect of Track Ten on flood levels at Loch Sport will be negligible.

Therefore, although the level of afflux caused by Track Ten could be reduced through engineering interventions such as bridging the causeway, the only benefit achieved with such works would be a small reduction in the afflux when flood levels were at about 0.8 m and only for the brief period in a flood until Track Ten was overtopped. It is questionable if any benefit would be achieved at Loch Sport given the distance from Track Ten to Loch Sport is about 5 km and elevated levels from afflux decay in the upstream direction⁷.

3. Historical flood levels in the Gippsland Lakes and at Track Ten

In this section, a review of historical floods has been undertaken to analyse the interaction of floodwaters and Track Ten. The floods of June/July 2007 and June 2012 are addressed in detail as more information is available from these recent events. Information from older floods is also reviewed.

2007 Flood

The Gippsland Lakes flood of 2007 was a large event, probably the largest since 1978, that inundated parts of Loch Sport, Paynesville, Lakes Entrance and other areas around the Gippsland Lakes. The flood occurred between 29 June and 6 July 2007.

Recorded water levels are available from three locations in the Gippsland Lakes (Figure 5):

- **Lake Wellington** (Bull Bay) (gauge 226041);
- **Paynesville** where flood level observations were made intermittently from 1400 on 29 June to 0850 on 5 July 2007;
- **Bullock Island**, where flood level observations were made intermittently from 1510 on 1 July 2007 to 2400 on 4 July 2007.

There are also observed peak water levels at Loch Sport adjacent to Lake Victoria and Lake Reeve. These were compiled by the East and West Gippsland CMAs (Table 1; Figure 6).

⁷ Samuels (1989).

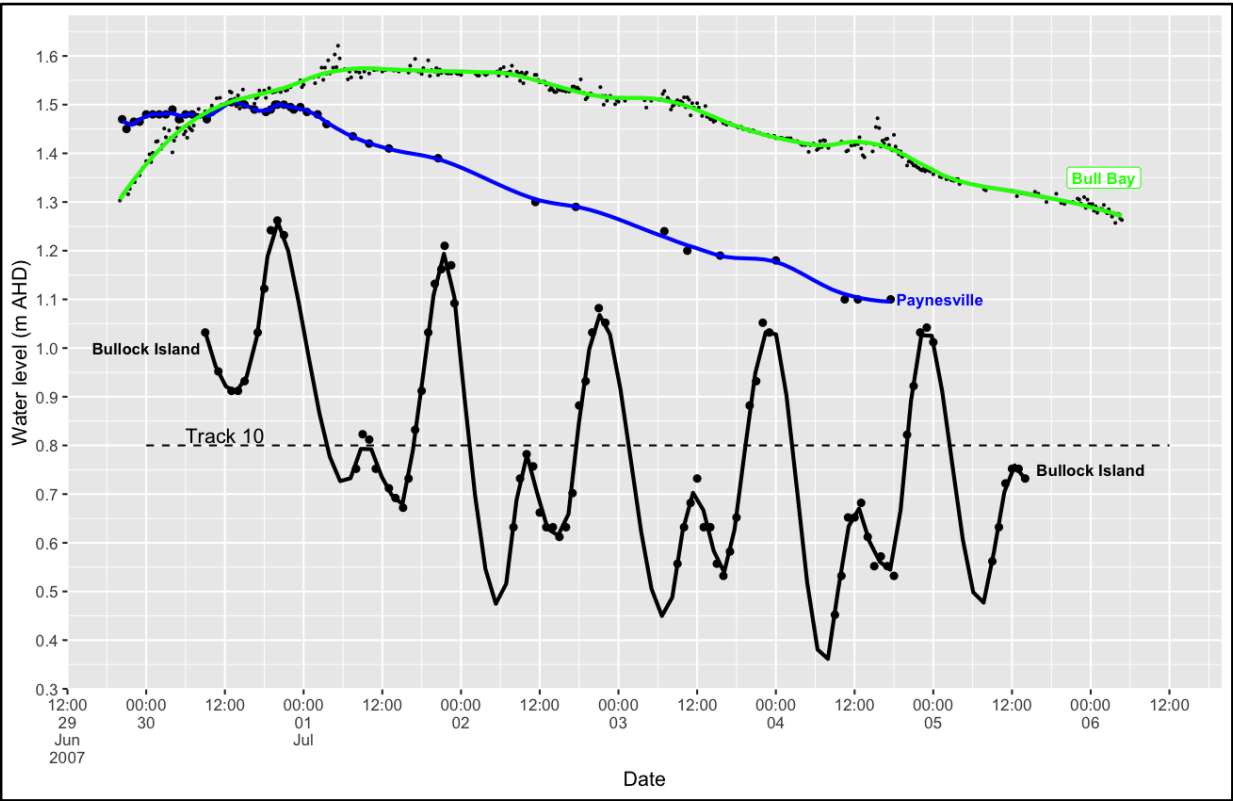


Figure 5: Measured flood levels at Bullock Island, Paynesville and Bull Bay (Lake Wellington), during the July 2007 flood



Figure 6: Recorded peak flood levels at Loch Sport, July 2007 flood

Table 1: 2007 flood levels in Loch Sport adjacent to Lake Reeve

No	Location (Loch Sport) (Figure 6)	Approximate Peak flood level (m AHD)	Distance (km)
1	Cnr Wallaby St and Stockyard Hill Causeway	1.34	0
2	Cnr Camerons Rd and Davies St	1.18	1.9
3	Cnr Sanctuary St and Second St	1.12	3.0
4	Centre Rd between Stevenson St and Charlies St	1.04	4.0
	Track Ten	1.0 (estimated)	8.5

To summarise, Figure 5 shows peak levels at Paynesville of about 1.5 m for about 24 hours from late on 29 June 2007 to the early hours of 1 July, declining to about 1 m at midday on 4 July. This is still well above normal water levels which vary tidally from about 0 m to 0.4 m. The peak water levels at Paynesville of about 1.5 m are similar to those recorded at Loch Sport on the Lake Victoria side (as shown in Figure 6). Community observations (Appendix D) show Lake Victoria peaking at Loch Sport around 29 June which is consistent with the data in Figure 5.

Lake Wellington peaks later, at about midday on 1 July with water levels remaining above 1.55 m for about 36 hours. At Bullock Island water levels are elevated but there is also a significant tidal component. The highest water levels were recorded late on the afternoon of 30 June at about 1.28 m.

Early in the 2007 flood, the water level in Lake Reeve increased in response to high water levels in Lake Victoria and water ponded against the eastern (Loch Sport) side of Track Ten (Figure 7). This event is captured on a photograph (Figure 7), reported to have been taken on 25 June 2007 which is 5 days before the flood peaked. This is also consistent with community observations (Appendix D). It is likely there was substantial flow through the Track Ten culverts which would be associated with a difference in water levels from upstream (Loch Sport side) to downstream (Golden Beach side) of the track. As discussed earlier, this is known as Afflux.

Track Ten would have contributed to higher water levels at this time but the effect at Loch Sport would be limited and below the peak flood levels recorded in Table 1. Based on Figure 7, the water level appears to be approximately 0.6 to 0.7 m (based on a causeway height of about 0.8 m).

As the Gippsland Lakes flood progressed, the water level at Track Ten increased to above 0.8 m and the track was overtopped. Figure 8 shows the track completely inundated, water levels are the same on either side of Track Ten which means the track was not affecting the water level at Loch Sport.

Community observations indicate that some Lake Reeve-frontage areas experienced inundation before or around the time Track Ten overtopped. That observation is relevant to flood onset and timing, but by itself does not demonstrate that Track Ten materially increased the peak flood level in Loch Sport. The community observations are also consistent with the Loch Sport Local Flood Guide⁸ which shows that at a floodwater height of 0.9 m AHD, 29 properties surrounding Lake Victoria are affected by flood water and 26 are isolated.

There were no recorded levels at Track Ten during the 2007 flood, but I estimate that the water depth over the road, when the photo, Figure 8, was taken, was about 200 mm. This implies the water level at the Track Ten Causeway was approximately 1 m (based on a causeway height of 0.8 m).

⁸ Loch Sport Local Flood Guide. Victoria State Emergency Service, 2007.
<https://www.ses.vic.gov.au/documents/8655930/9320214/Loch%2BSport%2BLocal%2BFlood%2BGuide.pdf/a65c1864-12f4-2886-4305-bfe1080caaff?t=1620861025128> (accessed 27 March 2026)

All the peak levels recorded in Loch Sport adjacent to Lake Reeve in the 2007 flood (Figure 6; Table 1) would have occurred while Track Ten was completely inundated. That is, the peak levels occurred at a time when Track Ten had no material influence on water level or flow, as can be seen in Figure 8.

Any large Gippsland Lakes flood will result in inundation of Track Ten, in which case Track Ten, once it is hydraulically drowned, will not have any adverse influence on flood levels at Loch Sport. In particular, Track Ten would be well submerged in the 1% AEP flood, so any effect on peak flood levels would likely not be material. The declared 1% AEP flood level at Loch Sport is 1.9 m (see Appendix E) which is about 400 mm higher than the flood level recorded in June 2007.

Some members of the community have expressed concern that recent work to upgrade a bridge on the Stockyard Hill causeway may have increased flow toward Track Ten. Changes to the Stockyard Hill Causeway have not been separately assessed or hydraulically quantified in this study, however, the Stockyard Hill Causeway is also overtopped during floods, so culvert/bridge flows are likely a small portion of the total flow in this section of Lake Reeve during large floods. The Stockyard Hill causeway was overtopped in 2007 (Figure 9) and would probably be completely inundated in the declared 1% AEP flood.



Figure 7: Track Ten causeway during the 25 June 2007 flood⁹

⁹ Scene from a video provided by that the video was taken on 25 June 2007.

Available at <https://youtu.be/KQuuyZ1oZ80>.

reported



Figure 8: Track Ten causeway 1 July 2007¹⁰. Water depth is approximately 200 mm deep at the white posts



Figure 9: Overtopping of Stockyard Hill causeway¹¹

¹⁰ Photo from West Gippsland CMA taken on 1 July 2007, I have estimated the water depth by scaling the height of the white posts with and without partial inundation of flood water.

¹¹ Photo credit: West Gippsland CMA 30 June 2007, 9 am to 12 pm.

2012 Flood

The most recent large flood in the Gippsland Lakes occurred in June 2012. Regular water level measurements at Loch Sport (Lake Victoria) (gauge 226606) commenced on 25 November 2010 and the recorded water levels during June 2012 are the highest, since then, up to September 2025 (Figure 10). The maximum recorded level at the Loch Sport gauge during the 2012 flood was 0.995 m on 8 June 2012, which corresponds to a flood of 14.8% AEP (about 1 in 7). The 2012 flood is the only occasion, since records began, that water levels measured in Lake Victoria (at Loch Sport) have exceeded the elevation of the Track Ten causeway of 0.8 m (Figure 10). Figure 10 also shows the designated 1%, 2% and 5% AEP flood levels for Loch Sport (see Appendix E and F).

Figure 11 highlights the water levels during the 2012 flood (2 June to 20 June 2012) at Loch Sport and four other gauge sites: Bull Bay (Lake Wellington), Hollands Landing, Paynesville, and Bullock Island. This shows that the water level in Lake Victoria, at Loch Sport, exceeded 0.95 m for about 36 hours and exceeded 0.8 m (the Track Ten causeway level) for about 4 days (In the 2007 flood the water level in Lake Victoria exceeded 0.8 m for about 13 days)¹².

There are two other aspects to consider when reviewing these figures:

- The peak level at Loch Sport (from Lake Victoria) during the 2007 flood was about 1.5 m, that is, much higher than the peak 2012 flood level of about 1 m;
- The higher levels of the Track Ten causeway are about 0.8 m; this is lower than peak 2012 level as measured at the Loch Sport gauge.

There are no recorded water levels in Lake Reeve during the 2012 flood, and no photos have been located.

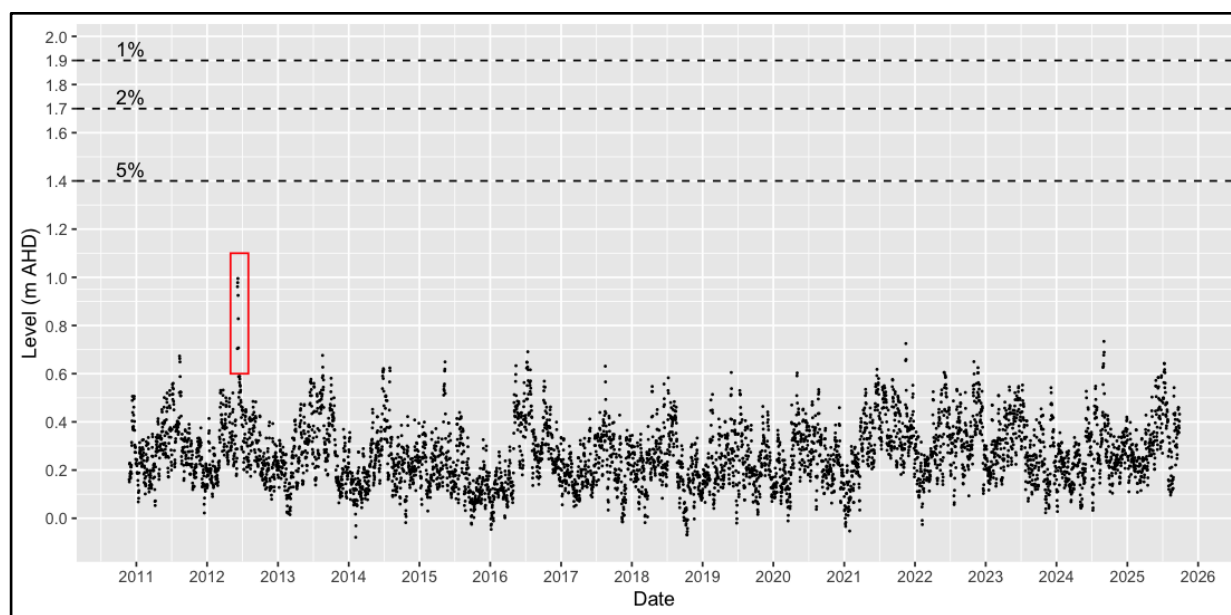


Figure 10: Maximum daily level at Loch Sport (Nov 2010 to Sep 2025). Flood levels in June 2012 are highlighted

¹² I have estimated 13 days from the data at Bull Bay (Lake Wellington) if a water level of 0.85 m at Lake Wellington corresponds to a level of 0.8 m in Lake Victoria.

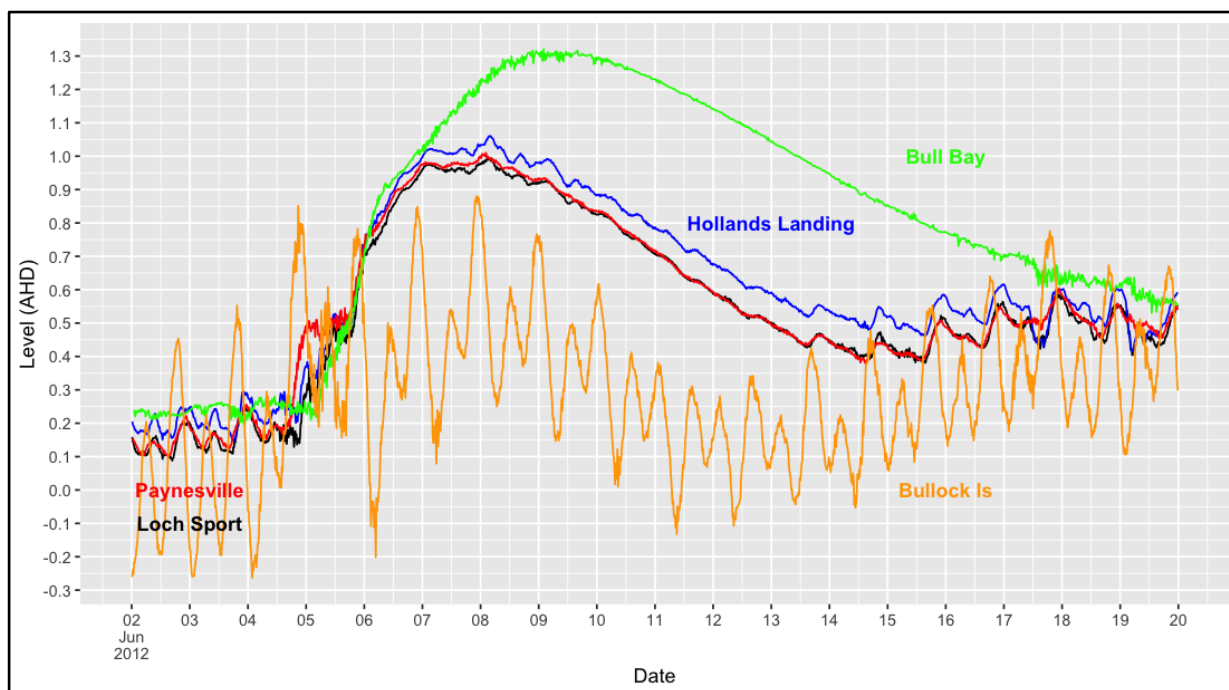


Figure 11: June 2012 flood. Water levels are shown for Bullock Is (orange), Bull Bay (Lake Wellington) (green), Hollands Landing (blue), Paynesville (red) and Loch Sport (black)

Other historical floods

Data on Gippsland Lakes floods from 1893 are summarised in Table 2. Based on measurements recorded at Paynesville, the largest floods occurred in 1893 and 1978. The July 2007 flood is the largest since June 1978 and similar to the 1952 flood in Lake Victoria, based on Paynesville measurements.

The 2007 flood was larger than the floods in 1993 and 1995. Photographs show that Track Ten was overtopped in both these floods (Figures 12 and 13). These photos appear to show similar flood conditions, but it is not known if they were taken at the peak.

The longest record of Gippsland Lakes water levels is available from Bull Bay (Lake Wellington)¹³. Taking levels above 1 m as indicative of large floods, means the data show a cluster of floods between 1975 and 1980; 1976, 1977, 1978 and 1979, then in 1990¹⁴, 1993, 1995, 1998, then a break to 2007 and 2012. This data also provides additional evidence that the 2007 flood was the largest since 1978 that is, it was larger than the floods of 1993 and 1995. Based on the water level measurements in Lake Wellington, the 1993 and 2012 floods were of similar size while the 1995 flood was smaller. All these floods have peak levels lower than the declared flood levels at Loch Sport for both Lake Victoria and Lake Reeve (see Appendix E).

¹³ Data from Lake Wellington (Bull Bay) is available from the Victoria Water Measurement Information System (WMIS) (data.water.vic.gov.au).

¹⁴ Data from Lake Wellington (Bull Bay) is missing from 3 July 1988 to 24 Feb 1991 but it is known from other sources there was a large flood in April 1990. See "Report on the Gippsland floods, April 1990", Bureau of Meteorology (1992).

Table 2: Historical flood levels around the Gippsland Lakes¹⁵

Year	Location	Level (m)	Source
1893	Paynesville	1.67	EGCMA ¹⁶
1952	Paynesville and Raymond Island	1.476, 1.490, 1.402	SRWSC (1981) ¹⁷
	Metung-Bancroft Bay	1.552, 1.685	
	Lake Reeve	1.3161, 1.522	
	Lakes Entrance	1.844, 1.786, 1.424, 1.392, 1.474	
1978	Lakes Entrance	1.0 (at gauge) 1.45, 1.71 (in town)	EGCMA
	Lake Victoria (West)	1.13	
	Lake Wellington (west side)	1.1	
	Paynesville	1.66	
1990	Bullock Is	1.2	EGCMA
	Lakes Entrance (Highway Br.)	1.6	
1993	Lake Wellington (Bull Bay)	1.35	
1995	Lake Wellington (Bull Bay)	1.0	
1998	Bullock Is	1.3	
	Lakes Entrance (Town)	1.3	
2007	Bullock Is	1.3	
	Paynesville	1.5	
	Lake Reeve	1.0	
	Loch Sport	1.5	
	Lake Wellington (Bull Bay)	1.6	
2012	Bullock Is	0.9	
	Paynesville	1.0	
	Loch Sport	1.0	
	Lake Wellington (Bull Bay)	1.3	

¹⁵ Adapted from Tan (2004) PhD thesis, Chapter 10, Table 10.2, page 373.

¹⁶ EGCMA – East Gippsland CMA

¹⁷ SRWSC (1981a;b)



Figure 12: Inundation of Track Ten during the November 1995 flood¹⁸



Figure 13: High water level at Track Ten during the September 1993 flood¹⁹

¹⁸ Reproduced from Ethos NRM, 2008; SKM, 2004.

¹⁹ Photo credit, ..

4. Conclusion

During larger Gippsland Lakes floods, Track Ten is overtopped and hydraulically drowned, so any effect on peak flood levels at Loch Sport is likely small and not material based on the available evidence.

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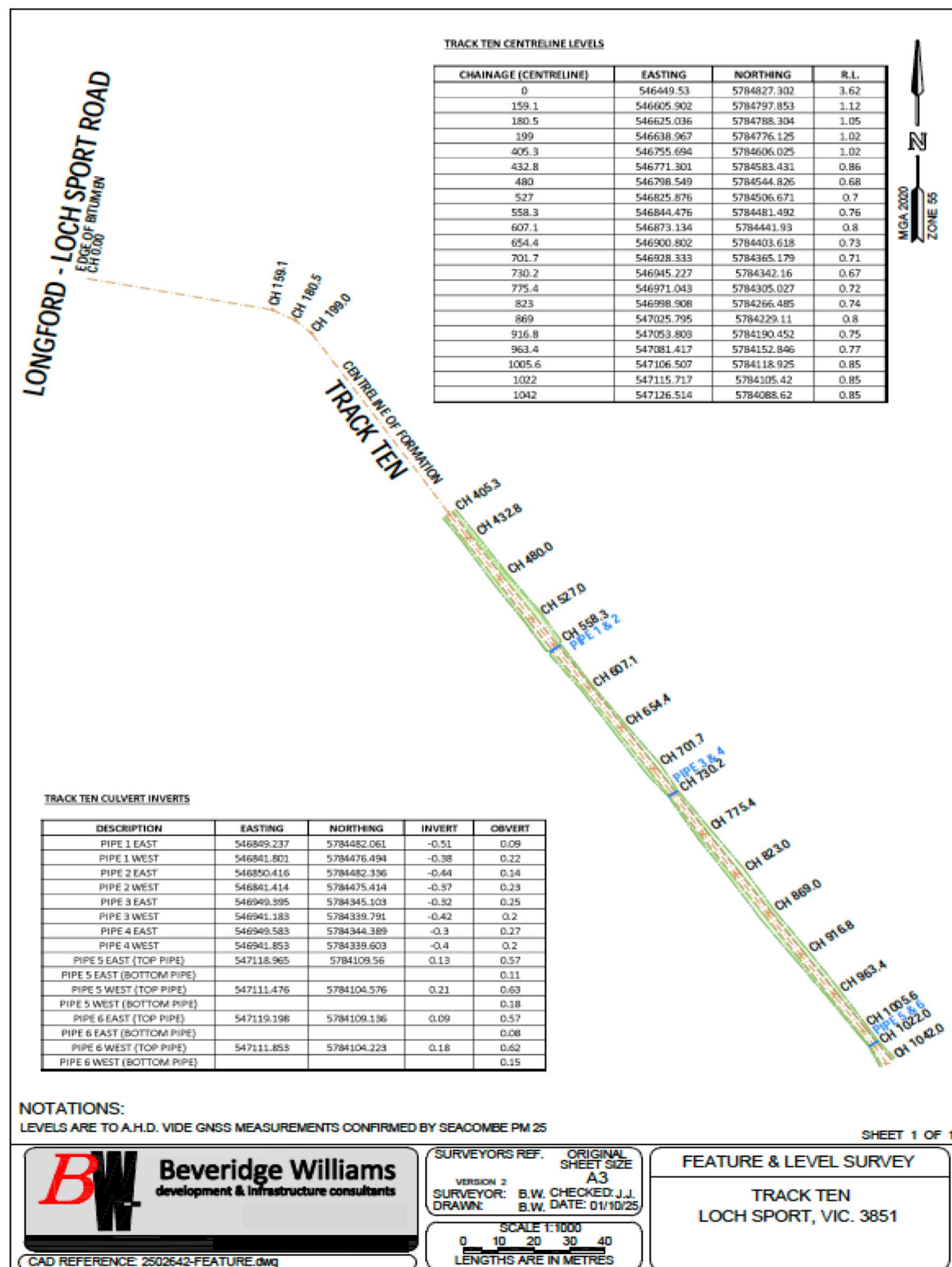
SRWSC (1981a) Flooding through Lake Reeve, Paynesville, Raymond Island, Metung and Lakes Entrance during 1952. Internal Memorandum from Crothers, S.J. to Weinmann, P.E., State Rivers & Water Supply Comm. of Victoria, Maffra, 16 Feb 1981. State Rivers and Water Supply Commission

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Appendix A: Track Ten Survey



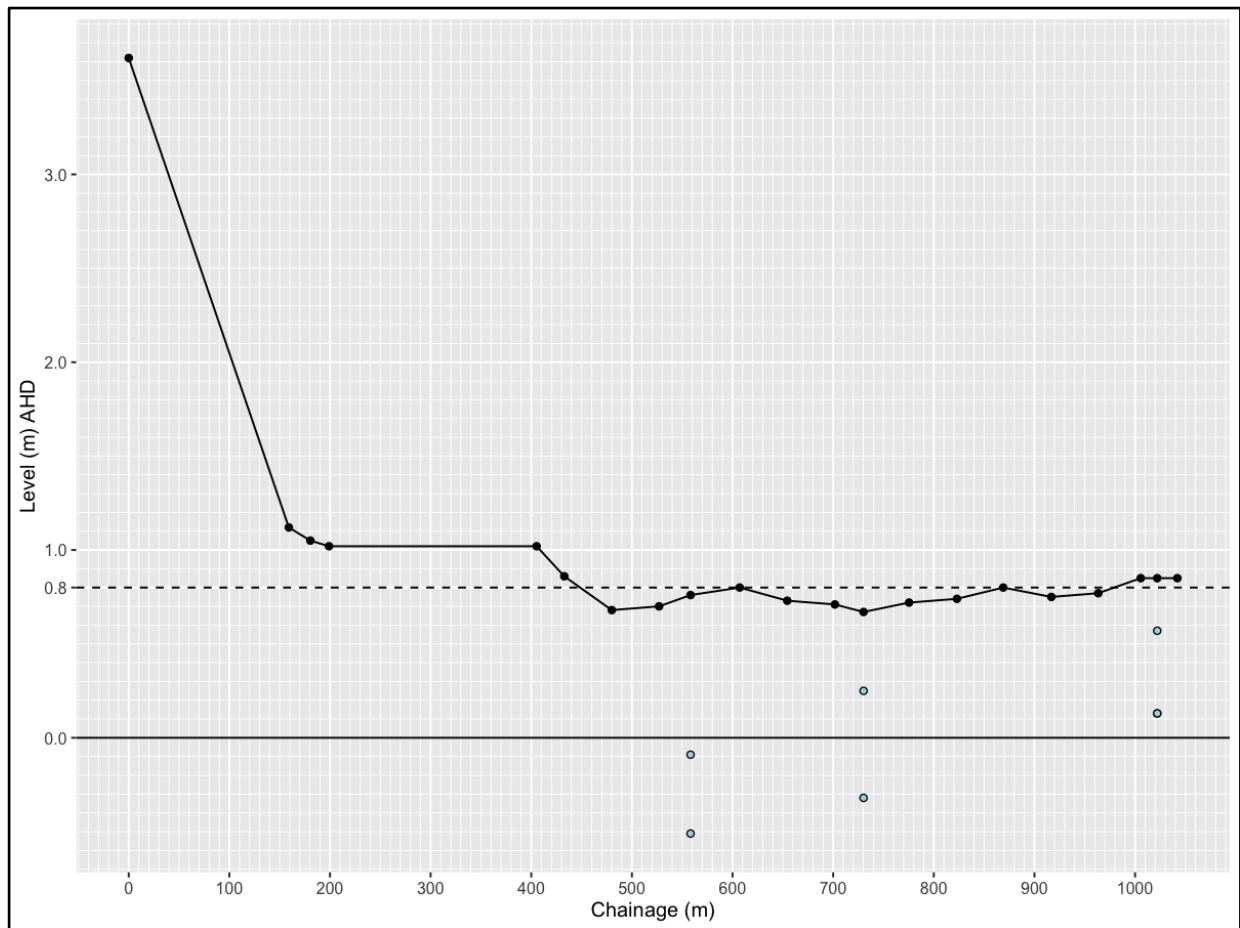


Figure 14: Track Ten long section (based on survey data from the previous page). Approximate culvert inverts and obverts are shown at 558 m, 730 m and 1,020 m. There are 4 culverts at 1,020 m, see Figure 4

Appendix B: Historical aerial photographs



Figure 15: Track Ten, 1967²⁰

²⁰ Aerial survey photography negatives of SJ55-11 Sale and SJ55-10 Warragul Vic 1:80000 CATEGORY: photograph FORMAT: b&w negative STATUS: preservation material. 18 April 1967.
<https://recordsearch.naa.gov.au/SearchNRRetrieve/Interface/DetailsReports/ItemDetail.aspx?Barcode=30900686&isAv=N>



Figure 16: Track Ten, November 1970²¹

²¹ Loch Sport [and] Langham [cartographic material] / photomap prepared by Department of Crown Lands and Survey from photographs taken in November 1970. Victoria. Department of Crown Lands and Survey, 1975.



Figure 17: Track Ten, 1989²²

²² TITLE: Aerial survey photography negatives of SJ55-11 Sale Vic 1:83200 CATEGORY: photograph FORMAT: b&w negative STATUS: preservation material.
<https://recordsearch.naa.gov.au/SearchNRRetrieve/Interface/DetailsReports/ItemDetail.aspx?Barcode=30883322&isAv=N>



Figure 18: Track Ten, February 2005 (Google Earth)

Appendix C: Culverts

Details of culverts

There is a total of eight culverts under Track Ten, in 3 banks (Figure 3). All culverts are relatively low capacity (Figure 4).

The first bank consists of two 500 mm diameter culverts at the northwest end of Track Ten causeway. The next bank is 132 m further southeast (two 550 mm diameter culverts). Approximately 270 m further southeast, are four smaller culverts, 430 mm diameter each. There are two upper culverts and two lower culverts.

Table 3: Details of Track Ten culverts. Shading shows culvert banks

No	Description	Easting	Northing	Invert ²³ (m)	Obvert ²⁴ (m)
1	Pipe 1 east	546,849.237	5,784,482.061	-0.51	0.09
1	Pipe 1 west	546,841.801	5,784,476.494	-0.38	0.22
2	Pipe 2 east	546,850.416	5,784,482.336	-0.44	0.14
2	Pipe 2 west	546,841.414	5,784,475.414	-0.37	0.23
3	Pipe 3 east	546,949.395	5,784,345.103	-0.32	0.25
3	Pipe 3 west	546,941.183	5,784,339.791	-0.42	0.2
4	Pipe 4 east	546,941.583	5,784,344.389	-0.3	0.27
4	Pipe 4 west	546,941.853	5,784,339.603	-0.4	0.2
5	Pipe 5 east (top pipe)	547,118.965	5,784,109.560	0.13	0.57
5	Pipe 5 west (top pipe)	547,111.476	5,784,104.576	0.21	0.63
6	Pipe 5 east (bottom pipe)	547,118.965	5,784,109.560		0.11
6	Pipe 5 west (bottom pipe)	547,111.476	5,784,104.576		0.18
7	Pipe 6 east (top pipe)	547,119.198	5,784,109.136	0.09	0.57
7	Pipe 6 west (top pipe)	547,111.853	5,784,104.223	0.18	0.62
8	Pipe 6 east (bottom pipe)	547,119.198	5,784,109.136		0.08
8	Pipe 6 west (bottom pipe)	547,111.853	5,784,104.223		0.15

²³ The invert is the elevation of the bottom of the culvert.

²⁴ The obvert is the elevation of the top of the culvert.

Culvert terminology

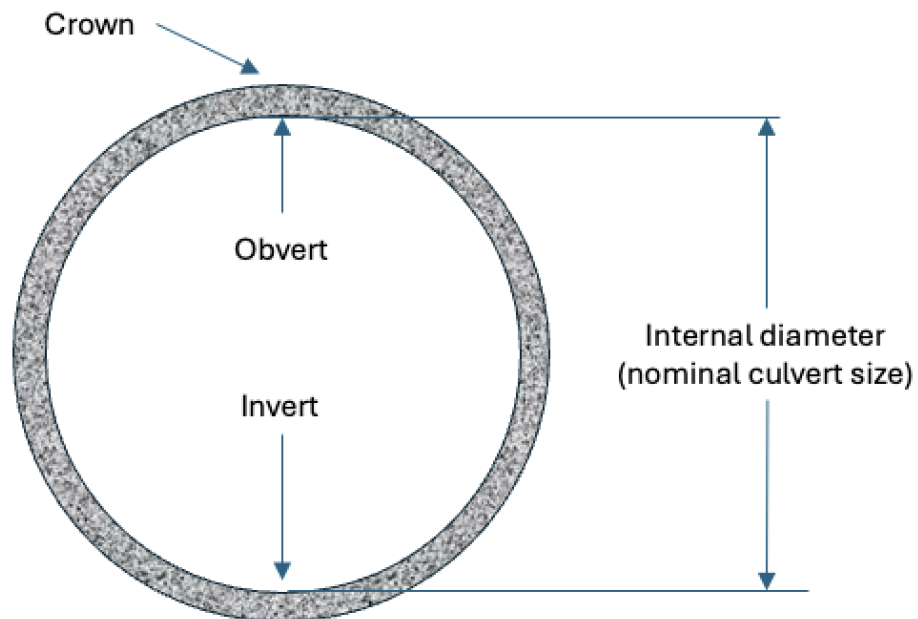


Figure 19: Terminology used to describe culverts

Appendix D: Community – observed flood chronology

Flood chronology provided by

Loch Sport resident.

Zone	Location	Date	Peak	Comment
Lake Victoria	Lake front	27 Jun 2007		Rising
		29 Jun 2007	1.4 m	Peaked
		30 Jun 2007		Ebbing
		1 Jul 2007		Ebbing
		2 Jul 2007		Ebbing
Lake Reeve	Track Ten	27 Jun 2007		Moderate – banked on Loch Sport side
		1 Jul 2007		Same – waiting for flood to come
		4 Jul 2007		Ditto
		15 Jul 2007		Private road passable
Lake Reeve	National Park Road (south side)	30 Jun 2007	0.3 m	Peaked at 300 mm – actual road not impacted
		1 Jul 2007		Ebbing
		2 Jul 2007		Almost zero

Appendix E: Declared flood levels

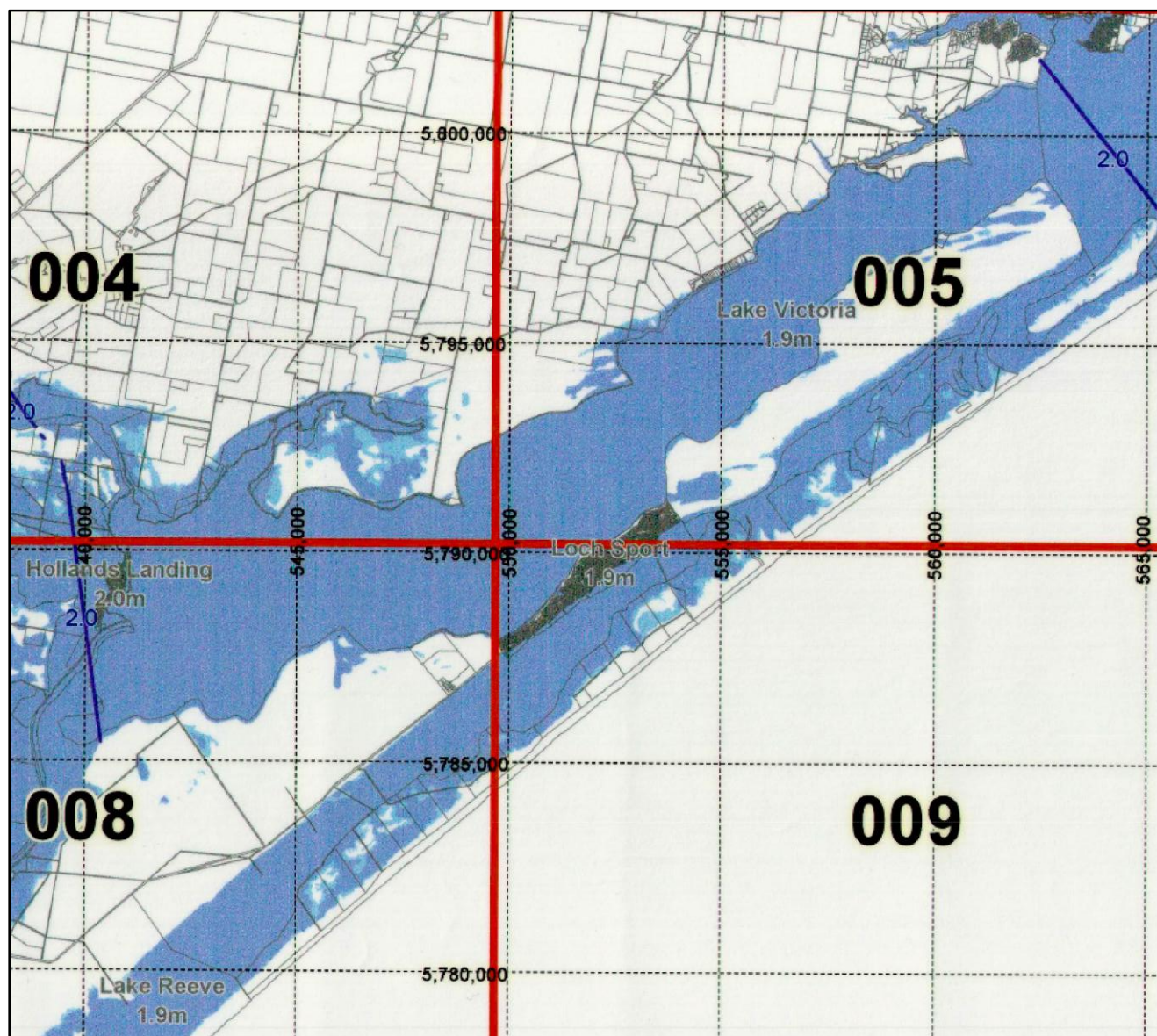


Figure 20: Declared flood levels at Loch Sport and surrounds²⁵

Table 4: Declared flood levels

AEP	Lake Wellington	Loch Sport (Lake Vic)	Mid Lake Victoria	Lake King (North)	Paynesville	Metung	Lakes Entrance
1%	2.2	1.9	1.9	2.0	2.0	2.1	1.8

Note that the 1.9 m flood level for Lake Reeve is consistent with the 2004 modelling report (Grayson et al., 2004) and later planning documents, however a limitation is that this was based on modelled flood levels in Lake Victoria and the assumption that levels would be the same on Lake the Lake Reeve side of Loch Sport.

²⁵ Flood Declaration Map. Gippsland Lakes System. Plan Number 500 492 001 Victorian Government Gazette, G4, 25 January 2006, 119-120

Appendix F: Flood frequency

The Gippsland Lakes Flood Level Modelling project (Grayson et al., 2004) developed design flood levels for the Gippsland Lakes at 7 locations:

1. Lake Wellington
2. Loch Sport (adjacent to Lake Victoria)
3. Mid Lake Victoria
4. Lake King (North)
5. Paynesville
6. Metung
7. Lakes Entrance.

Flood levels for three annual exceedance probabilities (AEPs) are shown in Table 5.

Table 5: Flood levels from the Gippsland Lakes flood level modelling project²⁶ (levels are in m AHD)

AEP	Lake Wellington	Loch Sport (Lake Vic)	Mid Lake Victoria	Lake King (North)	Paynesville	Metung	Lakes Entrance
1%	2.2	1.9	1.9	2.0	2.0	2.1	1.8
2%	2.0	1.7	1.7	1.8	1.7	1.8	1.6
5%	1.7	1.4	1.4	1.6	1.5	1.5	1.3

The Gippsland Lakes Flood Level Modelling project reports only list three annual exceedance probabilities (1%, 2% and 5%) and the corresponding flood levels.

To determine flood levels corresponding to other AEPs, I used the three AEPs and three flood levels shown in Table 5, to determine the mean, standard deviation and skew, that produced the values in Table 5 from a Log Pearson 3 distribution.

For example, for Loch Sport the relationship is:

$\text{Log}_e(\text{level})$ has a Log Pearson 3 distribution with:

- Mean = -0.946
- Standard deviation = 0.935
- Skew = -0.848

Using this relationship, a level of 1.5 m, which was the maximum observed level in Loch Sport during the 2007 flood, has an AEP of 3.7%, approximately equivalent to a probability of about a 1 in 27 year event.

The 18% AEP flood level is approximately 0.9 m. This is consistent with the analysis undertaken by Tan (2004)²⁷.

²⁶ Grayson et al. (2004), page 6.

²⁷ Tan, K. S. (2004) The estimated water level AEP curve for Paynesville is shown in Figure 10.1 (c) (page 374). I have assumed that the water level AEP curve for Loch Sport would be similar.

For Lake Wellington, the parameters of the Log Pearson distribution are:

- Mean = -0.480
- Standard deviation = 0.721
- Skew = -0.765

Using the parameters, the AEP that corresponds to the maximum flood level of about 1.5 m in 2007 is 6.6% AEP (1 in 15).