Legally Privileged Multidisciplinary Expert Report

# McCrae Landslip Project

Prepared for: Thomson Geer
5 May 2025
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# Executive Summary

This report provides information and assessment of the likelihood of impact and contribution of the South East Water (SEW) assets on the McCrae landslide that occurred on 14 January 2025, located within the properties of 10-12 View Point Road, and 3 Penny Lane (the subject site).

SEW assets in the locality (that is, within 500 m) of the subject site comprise buried pressurised water mains, gravity sewerage mains, and mains water tanks. Buried water mains and sewerage mains are located along View Point Road. The nearest water tank is off Waller Place, some 300 m south east of the subject site.

SMEC understands that a landslide occurred previously within the subject site on the evening of 5 January 2025.

SMEC also understands that a leak, located approximately 460 m south east of the site was located on 30 December 2024, and repaired on 1 January 2025. No mains leaks have been located or notified within the vicinity of the subject site since 26 November 2024 (that is, leaks within 100 m of the subject site).

The site is within an area classified as having a 'high landslide susceptibility' by the council in 2012.

The likely mechanisms of SEW assets impacting on the subject site are limited to the increase in water into the subject site, leading to slope instability. Additionally, it is likely that the 5 January 2025 landslide changed the slope profile and the geotechnical and hydrological characteristics within the site, to an extent where the slope had nominal stability, therefore making a further landslide inevitable. This further landslide occurred on 14 January 2025.

Mechanisms proposed to understand how SEW assets could have impacted on the subject site were:

- That a leak occurred within SEW assets in the vicinity of the subject site (that is, within 100 m of the subject site),
- That groundwater or mains water from a leak flowed along SEW asset trenches
- That groundwater levels within the subject site increased due to water from SEW asset leaks, and not private water usage.

The preliminary assessment within this report is that each mechanism is considered not feasible based on the evidence that:

- No recent leaks had been detected in the vicinity of the subject site:
  - Records of leaks provided by SEW, going back to 2022, have been assessed. Upwelling, reporting of leaks or other observances suggesting asset defects, or localised elevation of groundwater located within the vicinity of the subject site (that is, within 100 m), were recorded on 26 November 2024 only.
- There has been no historical precedent within the vicinity of the site, to suggest that a leak can affect the ground surface 30 m away, without defects being evident at distances closer to the source of water:
  - the most likely location for observing surface distress or other effects downhill of the Bayview Road water mains leak would be at the toe of the cut slope of the M11 Mornington Peninsular Freeway. We are not aware of any records of water flow observations within the cut slope due to the Bayview Road leak. It is considered reasonable that a leaking main that lasted for at least two months that did not generate observable distress in, or a change in the condition of the nearby cut slope, is unlikely to have impacted the subject site 465 m away.
  - localised defects along Charlesworth St and Waller Place may have been caused by the Bayview Road Leak. However, these defects are characterised by upwelling directly above the buried service trench and cannot be considered similar to a slope movement 30 m from a SEW asset trench.
- There are possible routes for water to flow through the trenches of SEW assets to the subject site. However, it is not feasible for such water:
  - to leave the trench specifically at View Point Road, but not at other locations within the network, or

  - cause only a slope failure, but not other defects associated with local saturation of soil, such as pavement and structural deformation.
  - To cause a slope failure along the possible route with only localised defects along Charlesworth St and Waller Place being apparent over a time period that could be associated with a known SEW asset leak.
- Sources of water outside rainfall, groundwater and mains water include private water usage, such as irrigating of garden and car washing. Private water usage is likely to occur closer or within to the subject site, and therefore should be considered more likely to impact on the stability of the escarpment, than SEW assets 30 m away.
- Laboratory and onsite tests from water samples over the locality (within 500 m) of the site available to date, do not indicate water at locations of defects (including the landslide) has chemical properties similar to the average properties for mains water. However, results received are inconclusive and we cannot confidently attribute sources of the water of these samples. We do not have reliable data showing typical groundwater chemical properties within the locality of the site. We strongly recommend that investigations are carried out to improve the knowledge of groundwater chemical properties.

Based on current information available, other sources of impact such as vegetation clearance and structural work within the subject site, and private water usage within and adjacent to the subject site are more likely to have impacted on the McCrae landslide.

# 1. Introduction

This report provides information and assessment of the likelihood of impact and contribution of the South East Water (SEW) assets on the McCrae landslide that occurred on 14 January 2025, located within the properties of 10-12 View Point Road, and 3 Penny Lane (see Drawings 001, 002 and 003) (the subject site).

Following a receipt of the brief dated 18 February 2025 from Thomson Geer, under instruction from South East Water (SEW), SMEC was engaged to analyse available information and assessment of the likelihood of impact and contribution of the SEW assets on the McCrae landslide.

Reference to a slope failure that occurred approximately 50 m from the subject site, within No. 14 View Point Road, is referred to in this report. However, the impact of SEW assets on that slope failure is not within the scope of this report.

It is understood that it is likely this report shall form evidence likely to be used during an Inquiry into the McCrae Landslide.

# 2. Definitions and background information

## 2.1 Glossary

A glossary of terms used in this report, with their definitions, is provided below:

| | |
|---|---|
| **Escarpment:** | Terminology referring to the steep hillside that dips towards the sea, from a point west of Coburn Avenue, to the T-Junction of Latrobe Parade and Point Nepean Road (see Drawing 001 for road names and contours indicating topography). The escarpment as defined, is approximately 2.3 km long. It is likely that it forms the lower slopes of Arthurs Seat. The nature and alignment of the escarpment is likely to be associated with the Selwyn Geotechnical Fault, that crosses northeast to south west beneath McCrae. |
| **Feasibility:** | For the purposes of this report, a possible event is described as feasible or not feasible based on the overall conclusion of facts to hand. The term does not refer to the likelihood of the event happening. |
| **Flowpath:** | The route taken of water from source, to outfall. This can be above or below ground |
| **Leak, Pipe burst:** | At its final length, an approximately 100 mm long, longitudinal fracture within the water main located within public land between Bayview Road, Outlook Road and the M11 Mornington Peninsula Freeway. It is estimated that 37ML of water flowed through the leak between November 2024 and repair on 1 January 2025. |
| **Likelihood:** | The chance that a possible **and** feasible event might happen. For the purposes of this report, the qualitative hierarchy of terms of likelihood, from 'least likely' to 'most likely' are:<br>Highly unlikely<br>Unlikely<br>Moderately likely<br>Likely<br>Highly Likely |
| **Locality of the subject site:** | A report specific definition which describes an area between 100 m and 500 m from No 10 – 12 View Point Road and 3 Penny Lane (the subject site), includes the leak at Bayview Road and upwelling features at Coburn Avenue. |
| **'Near-by' or 'in the area of' the subject site:** | A report specific definition which describes a location which is further than 500 m from the subject site, but is relevant to the subject site. This includes select stretches of the freeway. |
| **Possibility:** | For the purposes of this report, possibility is referred as whether an event 'could have' or 'could not' have occurred. The term does not refer to the likelihood, or the feasibility of the event. |
| **Private water usage:** | The use of mains water (or stored rainwater) for private use on private land, that is not removed via household drainage, for |

| | |
|---|---|
| | example: car washing, garden irrigation, or watering, fishponds or swimming pools. |
| **SEW Assets:** | Buried water mains, sewer mains and storage facilities (tanks) currently owned and operated by SEW, and recorded on 'Before You Dig Australia' information sources |
| **Site, Subject Site:** | The landslide that occurred on 14 January 2025, within the property of 10 – 12 View Point Road, and damaging 3 Penny Lane. |
| **Slope failure, slope movement, Landslide:** | The movement of soil downslope. For the purposes of this report, three slope failures are noted. In November 2022, at a location approximately 50m west of the subject site, within the same escarpment. On 5 January 2025, a landslide occurred within the subject site. On the 14 January 2025, drone footage suggests that this landslide destabilised further material affected by the 5 January landslide, and adjacent material. |
| **Runoff** | Flow of water on ground |
| **Spring** | A source of water flowing out from the ground |
| **Spur** | Depending on the context,<br>1. a branch of the stormwater or sewer network<br>2. the description of the topography of View Point Road which is located between the escarpment and the valley associated with Margaret Street, creating an inland promontory or spur. |
| **Time of interest:** | For the purposes of this report, 'time of interest' is taken as between 26 November 2024, and 14 January 2024. This period is chosen to reflect the starting point of the 'initial SEW area investigation' (see Table 16), as well as notification from residents of Waller Place and Charlesworth Street. |
| **Vicinity of the subject site:** | A report specific definition which describes an area approximately within than 100 m from the subject site, includes Prospect Hill Road. |

All times and dates provided within this report are local, that is Australian Eastern Daylight Time.

## 2.2 Factors affecting slope stability

Slopes, hillsides, and escarpments form from geological vertical movement of material raising land above surroundings. This can be abrupt and stark. They can also be gentler, over wider areas, for example the basaltic plains around western Victoria.

Hillsides and slopes move and deform towards an equilibrium. This tendency is evidenced in the reduction of the gradient until the properties of the soil or rock that hold the geology together, are greater than gravitational force acting on the soil or rock.

The ongoing stability of the slope can be reduced by activities, including the following:

- Steepening the overall slope batter (e.g. by excavation)
- Removing material from the toe or foot of the slope. This can be via:
  - erosion (e.g. a river eroding a bank, or the sea eroding the foot of a cliff, or by a slip failure lower down the slope), or

  - human activity, for example the excavation of material, steepening of a batter to increase the area of usable land at the toe, or
  - Removal of mature vegetation which was providing stabilisation by binding the slope materials together
- Increasing the load at the crest:
  - Building structures at the crest of the slope
  - Extending the crest outwards
  - Changing land usage in the vicinity of the site, e.g. a road, extension of hardstanding, or construction works).
- Changing the hydraulic characteristics of the slope:
  - Climate variation
  - Installing drainage, leading to the drying out of the crest, creating tension cracking.
  - Allowing the moisture content of near surface material to rise.
  - Groundwater from a spring, creating a zone of weakness within the slope, at the point where water daylights.

  All these disturb the balance between the driving forces and the restoring forces acting on the slope, and the properties of the geology.

The type and scale of any slope failure can be due to a combination of factors as listed above, as well as the scale of these factors, and the homogeneity of the slope and the geology. Slopes where rock is near or at the surface, will tend to fail in a different way to slopes comprising sandy or clayey soils.

# 3. Scope of works

The McCrae landslide is the slope failure that occurred on 14 January 2025, located within the properties of 10-12 View Point Road, and 3 Penny Lane, McCrae. It is known that a slope failure previously occurred within the subject site, several days earlier, on 5 January 2025. Due to the location of the slope failure, and the likelihood that the 5 January 2025 slope failure increased the likelihood of the 14 January 2025 slope failure occurring, the impact of SEW asset on the former slope failure is included in the scope.

The slope failure that occurred 15 November 2022, approximately 50 m west of the subject site is not included in the scope of works, but is referred to.

SMEC's scope of works includes a:

- desktop study of
  - data, information and analysis supplied by SEW,
  - readily available publicly accessible information obtained by SMEC
  - academic papers available to SMEC
- site visit of the area, with photographic survey and opportunistic walkover activities.
- The writing of this report, to include an assessment of the likelihood of impact and contribution of the SEW assets on the McCrae landslide

The report does not consider or evaluate the likelihood of impact and contribution of the following:

- The impact of private water usage such as:
  - washing cars,
  - irrigating gardens,
  - watering vegetable patches.
- Damaged, poorly maintained, aged, poorly installed or inefficient private water supplies or storages such as:
  - swimming pools,
  - fishponds,
  - rooftop drainage storage tanks
  - grey water systems,
  - irrigation systems,
  - water supplies from water meters to the residential properties
  - drainage systems behind retaining structures.
- Public stormwater drainage condition, or trenching including:
  - Kerb and gullies
  - Grated pits and their condition
  - Connector pipes
- Buried non – SEW utilities
- The driveway and hard standing areas including:
  - Level areas recently worked on
- Vegetation and its management including:
  - The watering schedule of plant boxes, vegetable gardens etc.

  - The pollarding, removal of existing vegetation via earthworks or general maintenance of the slope or by ground movement
  - The vegetating of the slopes and adjacent ground surfaces.
- The impact of atmospheric fluctuations and tidal influences on groundwater levels.

# 4. Proposed hypotheses

## 4.1 Principal events

Our understanding of the recent site activity highlights five significant events.

1. A landslide, reported in 1952 by the Herald occurred, 'crushing the backs of eight holiday homes and a milk bar', at 'the foot of Arthur's Seat at McCrae.
2. A landslide occurred on 15 November 2022, at No. 14 View Point Road (refer to Drawing 002).
3. A longitudinal fracture, approximately 100 mm long (width not known, but is not a critical dimension as it expands and contracts based on the pressure of the water flowing through the pipe), in the water main located beneath public land between Bayview Road, Outlook Road and the M11 Mornington Peninsula Freeway occurred at a time that is not known but was located at 1300 on 30 December 2024 and repaired in the early hours of 1 January 2025 (refer to Drawing 002).
4. A landslide within the subject site was reported to SEW by SES at 2038 on 5 January 2025.
5. A landslide within the subject site occurred around 0900 on 14 January 2025.

It is noted that there have been no significant rainfall events recorded by near-by weather stations during the period of time of interest (Table 16, Appendix A, from 26 November 2024). The heaviest rainfall event appears to have taken place between 27 and 28 November 2024, where 38.4 mm fell over a 48 hour period. This should be compared to the heaviest rainfall recorded at Rosebud Community Club for 2024, which was on 2 April, where 48.8 mm was recorded over 24 hours (Table 9).

In SMECs experience of slope failure projects where we have been informed of the time scale, where rainfall is identified as a primary cause of failure, the landslip happens within approximately 24 hours of a rainfall event.

It is therefore considered not feasible that rainfall directly on the subject site is the primary cause of the 5 January 2025 slope failure, but that rainfall occurring prior to the 14 January 2025 slope failure may have contributed to that slope failure.

## 4.2 Site factors

### 4.2.1 SEW Assets contributing to slope instability

SEW assets in the locality of the McCrae landslide are limited to water storage facilities, buried mains water pipes, and buried sewer mains. The likelihood of the asset impacting on slope instability is directly linked to the proximity of the asset to the slope.

Records of known storage facilities, or buried pipelines show that (see Drawing 002, Figure 35 and Figure 36):

- The nearest storage facilities are adjacent to Waller Place 300 m south south-east of the site.
- The nearest fresh water main and sewers are located
  - beneath the eastbound lane of View Point Road (i.e. slope side of the road), approximately 27 m south of the backscarp of the current failure.
- A sewer main is located beneath Penny Lane, along the front of No. 3 Penny Lane.

Based on the distance from the landslide, it is not considered possible that the presence of SEW assets have directly impacted on the slope stability.

It is possible but **not** feasible for SEW buried assets to transport water from sources remote to the landslide, due to the lack of evidence:

- indicating how water would leave the trench and enter the surrounding geology, and
- such as pavement or structural deformation observed between the SEW assets and the slope failure within the subject site.

### 4.2.2 5 January 2025 instability lead to 14 January 2025 landslides

It is considered that the 14 January 2025 landslide occurred as a result of the 5 January 2025 landslide. The 5 January 2025 landslide is expected to have led to some, or all, of the following:

- A change in the cross-sectional topography of the slope,
- Exposure of a suspected existing shallow ground water table, via the removal of vegetation and soils, leading to an increase in moisture content, and seepage through the slope.
- A reduction in the capacity of the slope to manage increases in groundwater levels, or rainfall run off due to the removal of mature trees and ground cover.

Factors that would not impact on the stability of the slope prior to 5 January 2025, including stationary items like the vertical load of fill, or irrigation pipes, are thought to have impacted on the stability of the slope following the 5 January 2025 slope failure. It is reasonable to conclude that after the 5 January 2025 slope failure had occurred, any one of the following was likely to trigger further slope movement;

- Rainfall direct onto the exposed slip material, saturating, and lowering the effective strength of the material, whilst also eroding it during runoff
- Rainfall raising groundwater levels,
- Rainfall charging newly formed spring points, leading to erosion of displaced material
- Localised slipping of unstable vegetation or surface material due to loss of soil strength.
- The irrigation of gardens
- The dead load of retained fill

## 4.3 Specific hypotheses

Our works are focused on the assessment of the likelihood of impact and contribution of the SEW assets on the 5 January 2025 landslide.

Based on the factors identified in Section 4.2, the following mechanisms specifically regarding SEW assets contributing to the landslide have been investigated:

- That a leak within SEW assets in the vicinity of the subject site
- That groundwater or mains water from a leak flowed along SEW Asset trenches
- That groundwater levels within the subject site increased due to SEW asset leaks, and not private water usage.

## 4.4 Methodology of analysis

A description of our understanding of the site, known activities, weather events and records from SEW personnel is provided in Section 7.6.

Based on this understanding, and observations from the site visit and desk study sources, our assessment of each hypothesis proposed discusses:

- the feasible mechanism of how each hypothesis would occur, and the impact and contribution to the landslide of this mechanism. Both the 5 January 2025 and 14 January 2025 slope movements shall be considered.
- for each mechanism, the required realities, and signs of proof shall be put forward, followed by statements to suggest whether observations, data, or other evidence is available to support the likelihood of each mechanism with respect of alternative feasible scenarios.

SMEC emphasises that the analyses are based on a data set which may not be complete and is considered smaller than what standard practice would indicate to be robust. It is emphasised that SMEC has not:

- had direct access to the subject site,

- had access to any site specific geotechnical factual data or information
- been able to scope, direct or supervise sampling of groundwater, drainage or other sources of water within the subject site, or area of the subject site.

# 5. Available Information

## 5.1 Client supplied

The following table details documents, and website resources issued to SMEC by SEW, which were not requested by Request for Information.

Table 1: Sources of Information volunteered by the client

| Type of document | Title of Document | Owner/ Author | Date of publication/ access | Date of issue to SMEC | Comment |
|---|---|---|---|---|---|
| Audio recording | 6 Jan2025 Landslide Face | SEW | 6/1/2025 | 24/2/2025 | Indicates freely running surface water |
| Photograph | 6 Jan2025 water surfacing Charlesworth St.JPG | SEW | 6/1/2025 | 24/2/2025 | Select photo showing upwelling water through pavement construction approx. 300m SSE of site |
| | Photos 7 March 2025 leak | | 7/3/2025 | 11/3/2025 | 6 photographs documenting the locating and repairing of a leak near Bayview Road |
| | Dec 2024 Burst photos for SMEC | | 7/2/2025 | 22/4/2025 | 25 photographs documenting repair works at Bayview Road leak between 31/12/2024 and 1/1/2025. |
| | 2024_12_30_T1298016_001_IMG_8687[1]_3... | SEW | 30/12/2024 | 28/4/2025 | Photo of stormwater pit at Waller Place showing flowing water |
| | IMG_5885 and 5086 | SEW | 5/3/2024 | 28/4/2025 | 2 Photos of stormwater pit at Waller Place showing flowing water |
| | IMG_5823, 5824 and 5825 | SEW | January 2025 | 28/4/2025 | 3 Photos of excavation at sewer |
| Text | 28 January 2025 McCrae landslide - timeline | SEW | - | 24/2/2025 | Select chronology of events |
| Newspaper cutting | 1962 Herald Sun | Herald Sun | 1952 | 24/2/2025 | Report of a landslide, that crushed the backs of 8 holiday homes and a Milk Bar at the foot of Arthur's Seat. Three bridges also swept away. |
| Landslide Risk Assessment Draft | View Point Road Landslide, McCrae, Landslide Risk Assessment | Victorian SES Authority/ GHD | 22/1/2025 | 24/2/2025 | A draft report providing factual data, and assessment of risk to road users etc. |
| Annotated map | Council Wet Areas | Mornington Shire Council | - | 24/2/2025 | A map showing the location of the leak near Bayview Road, in relation to known 'wet areas' off Waller Place, Charlesworth Street and Coburn Avenue |
| | Historic map with street overlay | | | 19/3/2025 | SMEC consider this to be slightly inaccurate, and at present should not be relied on. |
| | Overview Map showing December 2024 burst | SEW | - | 24/2/2025 | - |
| | Annotated map of locality of site showing dates of historic leaks | | - | 10/4/2025 | - |
| Email | McCrae Landslip | Melbourne Water | 6/2/2025 | 24/2/2025 | Old plans and aerial imagery from Melbourne Water |
| | Customer enquiry Water main burst near 23 Coburn Avenue McCrae | SEW | 22/11/22 | 24/4/2025 | Email documenting concerns of landowner of voids beneath house. |

| Type of document | Title of Document | Owner/ Author | Date of publication/ access | Date of issue to SMEC | Comment |
|---|---|---|---|---|---|
| Excel Spreadsheet | Lab Sampling results summary | SEW | - | 24/2/2025<br>13/3/2025 | Table of test results of water samples taken at several locations between 24 December 2024 and 3 February 2025 |
| | | | 13/3/25 | 10/4/2025 | Laboratory test certificates from opportunistic soil samples taken from excavation associated with mains leak 10 m from Bayview Road leak. |
| | | | - | 24/4/2025 | Laboratory test result summary, with accompanying annotated map, showing 10 locations where water samples were taken and tested. All locations along water courses south and south west of subject site, within catchment area adjacent to Coburn Creek catchment area. |
| Laboratory test certificates | Drinking water lab results | SEW | | 28/4/2025 | Lab test results of drinking water from SEW sample points |
| Schematic diagram | McCrae Water Supply Schematic | SEW | - | 24/2/2025 | - |
| Photographs and record | SewerExcvationJan2025. | SEW | 24/1/2025 | 05/3/2025 | 30 photos and recorded text documenting the excavation works at T-Junction of Waller Place and Charlesworth Street. |
| Drone footage | McCrae Landslip Screenshots | SEW | 4/3/2025 | 11/3/25 | Photographs and stills showing topography and aerial imagery of the site. |
| Graphs | Community Update Monitoring 28 Feb | Mornington Shire Council | - | 19/3/2025 | Charts showing recorded movement from GPS sensors. Conclusion stated 'Creep of the landslide headscarp is ongoing, indicating the landslide is active' |
| Annotated aerial photograph | Sand survey Dec 2024 burst | SEW | - | 22/4/2025 | Annotations showing extent of sand staining of hillside surface between Bayview Road leak and Mornington Peninsular Freeway, indicating path of runoff from leak to nearby stormwater pit. |
| SEW personnel site records | 'Montage' Extracts | SEW | | Various | Records of SEW personnel following site visits including on 14 – 15 November 2022, December 2024 – January 2025. |

The following Requests for Information (RFI) from SEW have been requested by SMEC to inform this report:

Table 2: Requests for Information from publicly available resources or sources readily available by SEW

| Item | Request | Received status as of 30 April 2025 |
|---|---|---|
| 1 | Easement boundaries affecting, or within 10-12 View Point Rd, 16 View Point Rd, 3 Penny Lane. | Provided. They appear to show easements behind 3 Penny Lane, and down the escarpment within 14 View Point Road |
| 2 | Photos of the water leak at Waller Place on 1, 16, and/or 17 December 2024. | Not provided |
| 3 | Any data, measurements, sketches of the visit to the landslide of 5 January 2025, indicating the presence of trees, vegetable boxes etc between the post and panel retaining wall, and the backscarp (top extent) of the slip, observed on that date. | Only photos, estimations of location of 5 January 2025 landslide based on publicly available aerial photos. |
| 4 | Any indication of the distance between the retaining wall and the backscarp, and if the grass between the wall and slip was walked on and any observations? | Not available |
| 5 | Are there any photos, design drawings, planning applications, construction records to determine what were the drainage measures included in the construction of the retaining wall at No. 10-12 View Point Road. | Not available |

| Item | Request | Received status as of 30 April 2025 |
|---|---|---|
| 6 | Council drainage information. | Plan alignments and pit locations. Invert levels and diameters provided on 17/4/25. |
| 7 | Invert levels of SEW assets, both fresh water and sewer, particularly from Charlesworth to Prospect Hill Rd to View Point Road, and from Cornell Street to View Point Road. | The depth of mains tends to be consistent, less than 1.5m deep.<br>Data on sewer inverts at pit locations from Bayview Road to Coburn Avenue, and Prospect Hill Road to View Point Road |
| 8 | Between December 2024 and February 2025, have the levels or flows of the Mornington Peninsula Shire drain near the pipe burst been recorded, and where does the drain outfall? | One photo of stormwater flow in drain at Waller Place before Bayview burst repaired. No other information. |
| 9 | Locations of "springs" in the area that SEW know about. This could be customer reported and detail reported seeps that have been discovered | Discussed during site visit |
| 10 | Location of SEW property assets that may be available to field testing, to ascertain local geology and water table elevation. | Visited during site visit |
| 11 | Any customer complaints or notes for properties regarding drop in pressure, complaints about excessive water bills etc. that would lead you to believe that there was burst or leaking pipe(s) either on customer side or SEW side or customer meter within 6 months prior to latest initial landslide. | Quarterly meter readings provided for approx. 90 customers in locality of View Point Road |
| 12 | A comparison of water use for customers to identify any high-water use customers. Interested to see if 10-12 Viewpoint and surrounding neighbours (both on the same side and other side of road) had unusually high-water use. Would be interested to have this on a month by month basis for the most recent year before customers were excluded from their houses. | |
| 13 | Does SEW have on record the reason why the stormwater drain in front of 6 View Point Road was tested on 30 December 2024, as well as the Pothole at the T-Junction of Waller Place and Charlesworth? | Suspected water was tested at View Point Road was because water was heard in pit. Waller/ Charlesworth requested by the Council |
| 14 | Request for reminder of SMEC of the chronology of the pipe burst? That is, when was it suspected, when it was found, when any water was turned off from the pipe burst, when it was mended. | Timeline has some information. Burst was repaired on 30 December 2024. |
| 15 | Is there any evidence on Nos 10-12, and 6 View Point Road, of rooftop or grey water collection/storage on site? | Not provided |
| 16 | Does SEW have knowledge of the locations of the legal point of discharge for Nos 10-12, and 6 View Point Road and 3 Penny Lane, and if they have been connected to any household pipe works installed since construction? | Not available |
| 17 | Freedom of Information request from Council | Stormwater drainage invert levels provided on 17/4/25 |
| 18 | Request to provide photographs between January 2022 and today, of the slope, with particular reference to an area of bare ground, below the retaining wall withing 10 -12 View Point Road. In both the January and February 2024, this area suggests a patch of bare ground which doesn't seem to get vegetated to the same extent as either side of it. | Not provided |
| 19 | Historical radar images available from Weather Chaser for January 2025 | Select images of radar prior to landslides of 5 January 2025 and 14 January 2025 |
| 19A | Radar images for 5 January 2025 at 1800, 1900, 2000, 2100 | |
| 20 | Photos and details from 5 January 2025 landslide | Photographs show surficial vegetation and topsoil material slumping against 3 Penny Lane. |
| 21 | Updated lab sample results | Provided |
| 22 | Montage date stamp | Provided, data provided in Chronology |
| 23 | Were the mains turned off at No 10 View Point Rd on 5/1/25? | Suspect that it was, but awaiting confirmation at time of writing. |
| 24 | Estimated leak at time of writing is 50ML over one month is approx. 20 L/s. Is this figure realistic? | As of 31/3/25, SEW advised that following inhouse calculations the volume loss to 40 ML. |
| 25 | Are reading days for the quarterly meter readings provided within 24 Hrs of each other? | Usually meter reader covers many streets per day, so likely they were read in one day |

| Item | Request | Received status as of 30 April 2025 |
|---|---|---|
| 26 | Request to ask SEW personnel more about the statement that retaining walls were toppling | SEW personnel has left organisation so difficult to obtain information. At the time of writing, not provided. |
| 27 | Sewer long section from 2 Prospect Hill Road to 613 Point Nepean Road | Provided |

## 5.2 Requests for Information from third parties

The following requests for information were put forward for the client's consideration on 6 March 2025:

Table 3: Requests to the client to obtain Information from third parties

| Anticipated type of document | Summarising description of expected information | Received (Yes/ No) |
|---|---|---|
| Text or copies of notification forms | Any notification of leaking/ seeping from residents around Penny Lane, View Point Lane between 25 December 2024 and 5 January 2025 | No |
| Geotechnical Factual Reports | Any borehole logs, groundwater monitoring or testing, geophysics surveying and hydrological site investigation works (and related factual reporting) or other information of excavations drilled within or adjacent to View Point Lane in the last 10 years | No |
| Design drawings or planning application submissions | Any planning applications or documentation relating to the investigation, design and/or construction of retaining walls AND/OR Irrigation systems within 10-12 View Point Road, or 3 Penny Lane | No |
| Maps | Historic (between 2000 and 2025) and current maps showing the depth and/or location of buried council assets down Coburn Avenue, Prospect Hill Road ad View Point Road | No |
| Planning application submissions | Any planning applications or notifications of vegetation clearance within 10-12 View Point Road and/or 3 Penny Lane | No |
| Maps or LiDAR survey information | Any Lidar or topographic files both current and historical and any drone footage in 2017 or 2022, photographs or video associated with Penny Lane or View Point Road (the GHD report suggests a Lidar survey was carried out in 2017 Lidar may also have been carried out after the 2022 failure) | No |

## 5.3 Internet Sourced Information

The following data sources have been accessed by SMEC as part of the research to this report

Table 4: Sources of Information obtained by SMEC

| Type of document | Information source | Owner/ Author | Date of publication/ access |
|---|---|---|---|
| Environmental Audit Report | 611-615 Point Nepean Road McCrae, VIC | Lane Consulting | August 2003 |
| Environmental site assessment and remediation action plan | 611-615 Point Nepean Road McCrae, VIC | Environmental and Earth Sciences Pty. Ltd. | July 2002 |
| Report | Port Phillip and Westernport Groundwater Flow Systems | State Government of Victoria, Port Phillip and Westernport Catchment Management Authority | October 2003 |
| Paper | GIS Assessment of Regional Landslide Susceptibility, Mornington Peninsular Shire | Piper, J. P., Slade D. B, International Society for Soil Mechanics and Geotechnical Engineering | ANZ 2012 Conference Proceedings pp 943 -948 |
| Website | Maximum temperature Data from Frankston Ballam Park weather station | Australian Government Bureau of Meteorology (www.bom.gov.au) | March 2025 |
| Website | Daily rainfall from Rosebud (Country Club) weather station | | March 2025 |
| Website | 9 am and 3 pm daily pressure readings at Moorabin Weather Station | | March 2025 |
| Website | Geological Survey of Victoria 1:63360 Scale Map Sorrento | Resources Victoria | 1965 |
| | Surface Geology (GeoVic - Resources Victoria) | Resources Victoria | March 2025 |
| | Historical summaries of boreholes (GeoVic - Resources Victoria) | Resources Victoria | Date of drilling 1960, Accessed March 2025 |
| Website | Historical aerial photographs | NearMap | March 2025 |
| Website | Historical street view photographs | Google | April 2023 |

Historical aerial photos from NearMap indicate the vegetation within table drain along Point Nepean Road close to Penny Lane, is lusher than elsewhere. However, we do not have confidence in the date stamp of the photos and therefore cannot attribute anything to this observation.

# 6. SEW Site Visit of 3 March 2025

A drive through site visit was carried out by SEW personnel. Due to the sensitivity of the project, and the exclusion zone surrounding the subject site and adjacent properties, we did not carry out a walkover survey of the subject site. During the site visit, walkover survey works were kept to areas to the south of the Mornington Peninsula Freeway, and north of Point Nepean Road.

Appendix A, Drawing 001 shows the route and photographs taken at specific points.

The following observations were made:

## 6.1 The site of the leak at Bayview Road leak (Location 1 (Drawing 001))

The Bayview Road leak was located at 1300 30 December 2024 and repaired in the early hours of 1 January 2025, was visited. The Bayview Road leak is close to a shallow natural gully flowing northwest.

The head of the gully is located within 'The Boulevard', and the mouth is in the vicinity of Margaret Street. It is crossed by Waller Place where the road pavement falls and rises at a gradient of approximately 1v:15h, and at the junction of Coburns Avenue and Cornell Street where the side slopes of the gully are not easily observed against the general downwards slope of Coburns Avenue. At Margaret Street, the gully is a cleft with natural side slopes of approximately 1v:1.3h.

Observations of the surface and subsurface were made, the surface geology, (beneath topsoil appears to have a fine granular characteristic to it.

## 6.2 M11 Mornington Peninsula Freeway (Location 2 (Drawing 001))

A cut slope close to the location of the pipe burst of December 2024 was visited. The cut slope is adjacent to the southbound carriageway and is vegetated by trees and shrubs with a batter angle of approximately 1v:2.5h in places. The slopes of the shallow natural gully observed at Bayview Road, within the cut slopes are approximately 1v:11h, but steepen towards the southbound carriageway of the freeway, possibly due to the adjacent cut earthworks.

Other gullies crossed by the freeway, near-by the site include:

- the valley watered by Coburns Creek, located some 100 m west of the site, the head of which is assumed to be beneath a freeway embankment due to the presence of a culvert at the base of gully slopes with gradients of up to 1v:1.15h. This gully is approximately 500 m long and flows north west, outfalling near the T-junction of Point Nepean Road and Coburn Avenue.
- The valley that flows north west, to the east of Wonga Grove (Drawing 001). Side slopes typically as steep as 1v:1.6h. The head of the valley is to the south east of the Freeway, bounded by Bayview Road. The length of the valley is approximately 650 m long, flowing north west.

The pavement surface of both carriageways of the freeway was observed to be in a reasonable condition at the approximate location of the pipe burst. A 1 m wide by 2 m long approximate area of Crocodile Cracking was noted within the southbound carriageway. Evidence of possible sand piping was noted to the south of where the SEW assets crosses beneath the road.

## 6.3 Charlesworth Street (Location 3 (Drawing 001))

Observations were made of grass within the verges adjacent to Charlesworth Street noted to have variations in lushness. The causes are thought to include a variation in moisture content due to:

1. ponding from surface run off, indicating long term seepage from a location uphill.

2. The presence of a spring or upwelling at that location.
3. Localised elevated groundwater.

It is possible that all three options may be due to leaks within SEW assets. However, it is not considered feasible that such leaks have not been previously identified and repaired, as evidence such as deterioration within the pavement construction, and discolouration from runoff was not observed.

The variation of vegetation may be a lagging indicator of previously repaired leaks. This is likely, but as these leaks have been observed and repaired, the impact on this project of the remnant 'lushness' of vegetation is considered negligible.

The variation in vegetation 'lushness' may be due to natural groundwater spring points, i.e. option 2. This is considered feasible, but further studies are required to confirm likelihood.

Based on current information, it is considered more likely that the cause is localised private water usage.

## 6.4 Coburn Avenue (Location 4 (Drawing 001))

Crocodile cracking and spalling was noted throughout the pavement surface at the T-Junction of Coburn Avenue and Cornell Street.

At the junction with Prospect Hill Road, Coburn Avenue grades down towards the north west, with the turn to Prospect Hill Road, traversing the slope. Prospect Hill Road itself dips towards the bend approximately 100 m north of the junction with Coburn Avenue.

The cleft between View Point Road and Coburn Avenue is hidden from view by trees and houses. However, looking up from Margaret Street, the vegetated, and steep sides of the valley could be discerned.

## 6.5 Prospect Hill Road and The Eyrie (Location 5 (Drawing 001))

Evidence of intermittent kerb renewal and pavement patching works was noted along both roads. Analysis of Google Street View photographs taken in April 2023, indicates the works were completed prior to April 2023. However, the repair of the Prospect Hill Road pavement does not appear to have included remediating historical crocodile cracking, which is apparent within the Google Street View photographs taken in April 2023 and was observed during the site visit.

# 7. Site conditions

## 7.1 Surface conditions

Please refer to Appendix A, Drawing 002 which provides annotated aerial photos of site relevant characteristics.

### 7.1.1 Geology

The surface geology of the site is illustrated in Figure 1, an excerpt of published Geotechnical mapping available from the online data base: GeoVic- maintained by Resources Victoria.

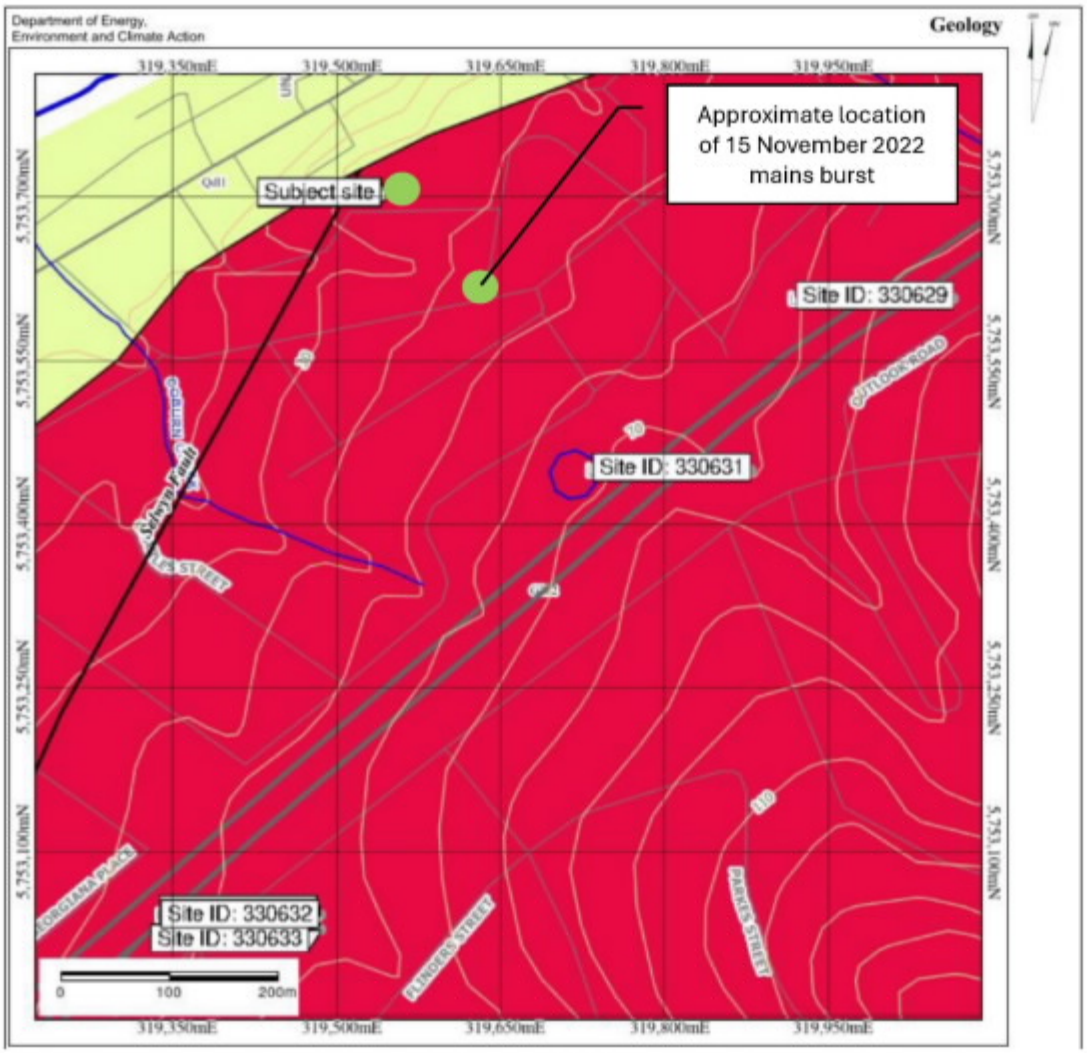



Figure 1: Surface Geology of the locality of the subject site (Geological information from1:250,000 original source)

Legend:

Qdl1: Coastal dune deposits: Sand, silt, clay

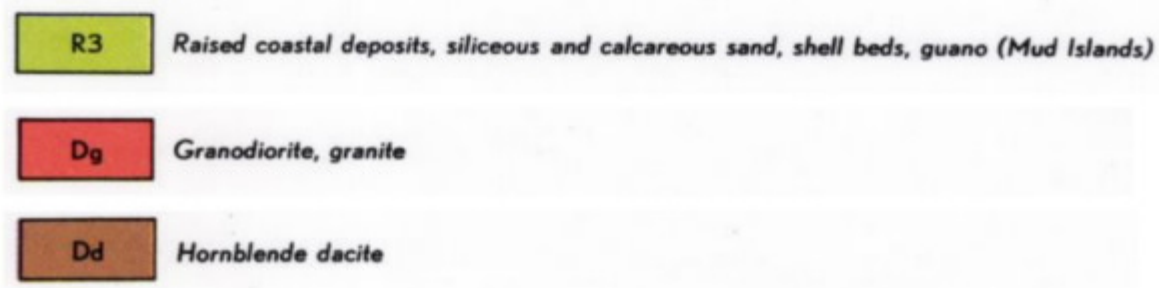
G262: Dromanda Granite: Biotite Granite.

Subject Site

An excerpt of the Geological Map of Sorento published in 1965 is provided in Figure 2 under a Creative Commons Attribution 4.0 international licence. The excerpt is not to scale. It is included as it provides greater detail of the known topographical features within, as well as indication of the surface geology of, the area of the subject site. In particular, the water course that flows west of the Bayview Road leak, and west of the subject site. This water course included in the 1862 survey map of the locality of the site (Figure 20). It should be noted that the contours, street map and water course layers of Figure 2 appear to be offset from one another, and the accuracy of each at small scales should not be relied upon.


Figure 2: Excerpt from Geological Survey of Victoria, Sorrento No. 867 Zone 7, Scale 1:63360 1965

Legend for Figure 2.




The summary logs of historical boreholes (from GeoVic), the locations of which are presented in Figure 1, are tableted below in Table 6. All borehole logs are dated 1960.

Table 5: Summary of historical borehole logs

| Material | Site ID: 330631 | Site ID: 330629 | Site ID: 330632 | Site ID: 330633 |
|---|---|---|---|---|
| Unconsolidated clastic sediment: surface soil/ sand | 0.00 – 0.61 | 0.00 – 0.457 | 0.00 – 0.305 | |
| Unconsolidated grey mottled gritty clay | | | | 0.00 – 1.219 |
| Unconsolidated brown gritty clay | | | 0.305 – 1.829 | |
| Unconsolidated grey and yellow/grey/ yellow gritty clay | 0.61 – 4.877 | 0.457 – 2.438 | 1.829 – 6.706 | 1.219 – 6.096 |
| Unconsolidated grey/ yellow and grey granite sand | 4.877 – 7.315 | 2.438 – 4.877 | | |
| Distinctly weathered, decomposed granite | 7.315 – 9.448 | 4.877 – 9.448 | 6.706 – 7.924 | 6.096 – 7.924 |

The geological characteristics of the locality of the subject site can be summarised as residual soils comprising sandy clay grading to sand, overlying distinctly weathered granite. The depth to the sand may vary between 2.4 m and 6.7 m depth. It is not known whether the stratigraphy mirrors the natural ground level, and therefore it is not known if the subject site and the slope within it, comprises up to 6.7 m of sand, or if the thickness of residual soils reduces as ground level falls within the subject site.

Significant earthworks have been undertaken during the construction of the Freeway, both in the road corridor and in the surrounding area. The elevation of the ground level is not provided in the log summaries available online. Therefore, it is not possible to confidently attribute geological descriptions within the table to the cut slope geology or the freeway pavement subgrade. However, based on the contours of the cut slope illustrated in Drawing 003, it is reasonable to estimate that the depth of cut at the location of the crossing of buried services beneath the Freeway is approximately 5 m.

Taking that assumption, the toe of the cut slope at the freeway alignment could be 'just within' the distinctly weathered, decomposed granite. However, based on the available information, it is more likely to be within the residual soils. It is feasible that water infiltration from a leak is accommodated by the granular soils to a significant extent before surface distress or water flows are observable within the cut slope. With no record of seepage, ponding or other water flow observations adjacent to the freeway carriageway known, this is feasible. Based on the duration of the leak from the asset (at least November 2024 to 1 January 2025 according to SEW) (Refer to Glossary Section 2.1), it is expected that some surface distress would occur. For comparison there was observable surface distress adjacent to 23 Coburn Road, for a leak that was of a much shorter duration (One day between leak initiation and repair) ( Section 7.6.3.1).

It is considered reasonable that a water main leak that lasted for at least two months that did not generate observable distress in a nearby cut slope, is unlikely to have impact the subject site 465 m away.

We consider that a slope failure within the cut slope of the freeway, caused by the leak is considered unlikely due to the slope gradient. The slope gradient within the subject site is steeper than the cut slope of the freeway, therefore having a higher likelihood of instability. However, the subject site is 465 m away from the Bayview Road leak, and the likelihood of the leak impacting on the subject site 465 m away, and yet not create a slope failure on shallower slope gradient closer to the mains leak, is considered highly unlikely.

Two isolated samples were taken of natural superficial deposits by SEW on 7 March 2025 and tested at a NATA accredited laboratory. The location of the sampling was 10 m away from the Bayview Road leak, close to Bayview Road. The depth of both samples was approximately 1 m below ground level. It is reasonable to assume the material sampled is representative of some of the residual soils in the Bayview Road area. The results of the tests are provided in Table 6.

Table 6: Laboratory test results of samples taken by SEW 7 March 2025.

| Sample Reference | Approximate depth (m) | Moisture Content (%) | Particle Size Distribution (%) | | | |
|---|---|---|---|---|---|---|
| 10929485 | 1.0 | 12 | 6 | 17 | 72 | 5 |
| 10929486 | 1.0 | 9 | 8 | 14 | 65 | 13 |

The samples suggest the material is a silty SAND, with gravel, or with trace gravel.

The paper 'Ground water control, design and practice', published by CIRIA, Funders Report FR/CP/50, 1997 provides a method for estimating the permeability coefficients of granular material with uniformity coefficients of less than 10. However, as noted in Table 7, the material sampled has uniformity coefficients indicating a gap graded material and therefore permeability is not possible to be empirically assessed based on this method.

Table 7: Analysis of particle size distribution with reference to relationship with permeability, based on Laboratory test results of samples taken by SEW 7 March 2025

| Sample Reference | 10929485 | 10929486 |
|---|---|---|
| $D_{50}$ (grain size where 50% of material is greater) (mm) | 0.250 | 0.342 |
| $D_{60}$ (grain size where 60% of material is finer) (mm) | 0.363 | 0.513 |
| $D_{10}$ (grain size where 10% of material is finer) (mm) | 0.013 | 0.003 |
| Uniformity coefficient ($D_{60}$ /$D_{10}$) | 28 | 171 |

### 7.1.2 Landslide susceptibility

A GIS based assessment of the Mornington Peninsula Shire local authority area was carried out and presented in the ANZ 2012 conference proceedings of the International Society for Soil Mechanics and Geotechnical Engineering. All parts of the local authority area were classified as low, medium or high landslide susceptibility. The figure embedded within the report indicates that the subject site, and the adjacent slopes have a 'high' landslide susceptibility. The land below the subject site has a 'low susceptibility'. To the south and east of the subject site, the landslide susceptibility is 'low to 'medium.

The definition of each susceptibility level is as follows:

*'The limit between 'low' and 'medium' susceptibility has been defined as the point beyond which creep or minor slope movement is likely to occur, but not necessarily a significant slope failure, for the natural topography, excluding any site modifications.'*

*'The limit between 'medium' and 'high' susceptibility has been defined as the slope for a particular geology beyond which slope failures have either previously occurred or are considered possible based on previous studies and aerial photography.'*

### 7.1.3 Hydrogeology

Hydrogeology is study of the water bearing and flowing properties of soils and rocks.

According to the Port Phillip and Westernport Groundwater Flow Systems Report written by the State Government of Victoria and the Port Phillip and Westernport Catchment Management Authority, the naturally occurring materials within the subject site have the following hydrogeological properties:

Table 8: Hydrogeological characteristics of the geological material within the subject site

| Property | Comment |
|---|---|
| Aquafer type (porosity) | Fractured rock, saprock (slightly weathered rock) and saprolite (chemically weathered rock) (secondary porosity), soil and grus (residual soils) (primary porosity) |
| Aquifer type (conditions) | Unconfined where it is exposed in outcrop and semi confined in sub-crop |
| Hydraulic Conductivity (lateral permeability) | Highly variable. Estimates for each component are:<br>- saprolite varies from approximately $10^{-6}$ m/d to $10^{-1}$ m/d,<br>- grus varies from $10^{-3}$ m/d to $10^{-1}$ m/d,<br>- rock varies from $10^{-10}$ m/d to $10^{-2}$ m/d, although can be considerably higher in fractured zones |
| Aquifer Transmissivity | Generally low, but may be up to 10 $m^2$/d |
| Aquifer Storativity (the storage coefficient, the capacity to store or release water defined as the volume of water released per unit surface area per unit change in hydraulic head). | Variable. Estimated to be less than < 0.05 for saprolite and grus and <0.01 for the fractured rock |
| Hydraulic gradient | Generally low to moderate but may be locally steep. |
| Flow length | Generally, less than 5 km but individual pathways may be much longer |
| Catchment size | Small (<500ha) to moderate (>1000 ha) |
| Recharge estimate | Unknown and variable with location. Possibly up to 25 mm/yr or more in wetter landscapes |
| Temporal distribution of recharge | Seasonal (winter and spring), with more recharge in wetter years |
| Spatial distribution of recharge | Catchment wide but varies with the depth of regolith, slope and waterlogged areas in the landscape |
| Groundwater salinity (TDS) | Generally, in the range of 500 mg/L to 10,000 mg/L. |

It should be noted that salinity recorded in 'Total Dissolved Solids' (TDS) relates to salinity recorded in Electrical Conductivity (EC) (which is what is used on site by SEW personnel) by a factor (k) which is determined based on the ions in the water. i.e.:

EC (µS/cm) = TDS (mg/l)/k

The value of the factor is between 0.5 to 0.8, typically 0.64.

We do not have site specific data on the ions within ground water and therefore to understand the relation between the regionally based groundwater salinity character, against those tests carried out by SEW, an assumed factor of 0.64 is applied.

The Groundwater Salinity within the subject site area is calculated as having an Electrical Conductivity of at least 780µS/cm, based on the above calculation.

It should be noted that properties are attributed to material covered as indicated in the Figure below. Therefore, the chemical properties may be typical of geology encountered at the subject site, but should not be considered as site specific.

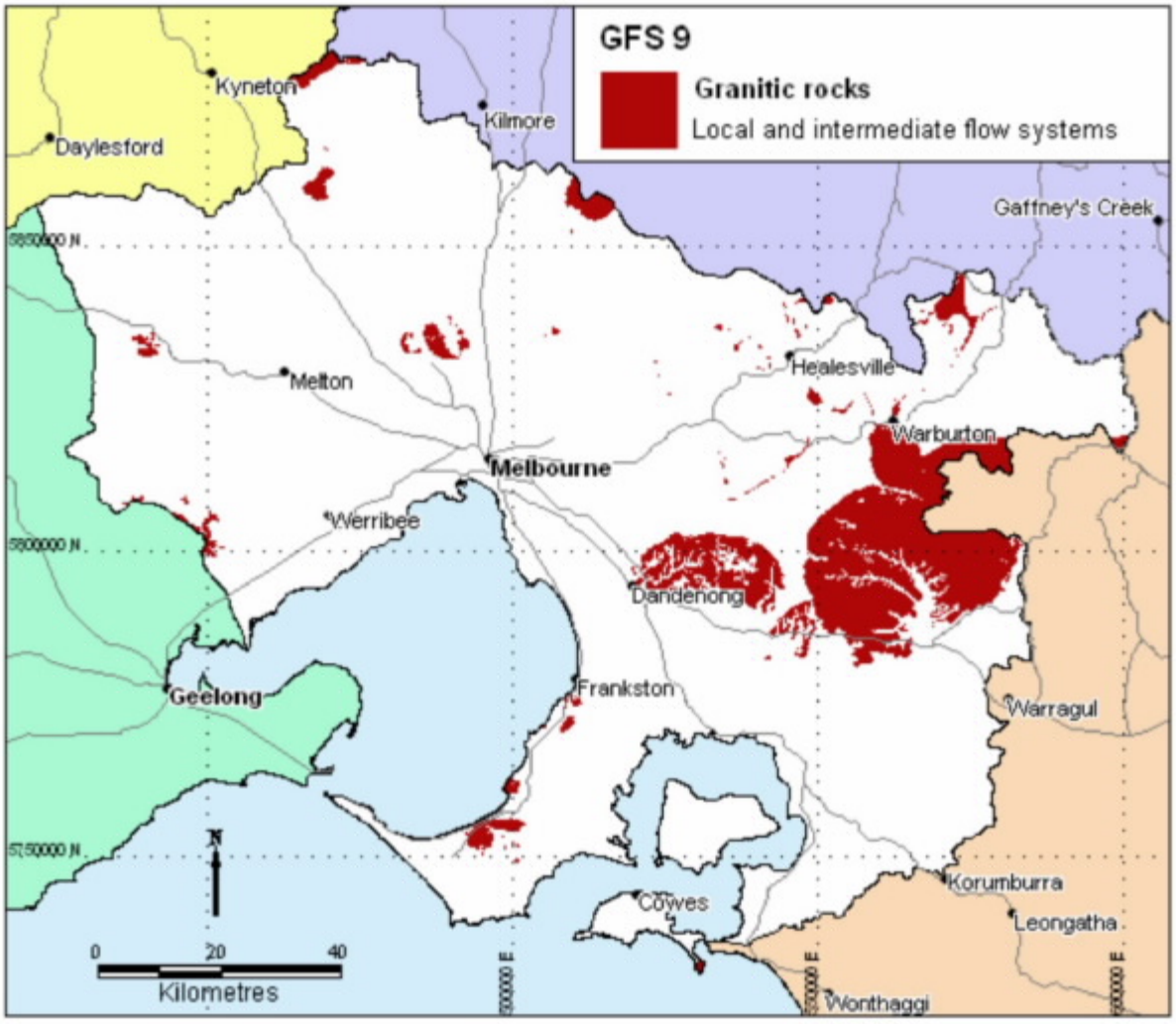



Figure 3: Excerpt from Port Phillip Groundwater Flow Systems Report, indicating the areas of land which characteristics listed in Table 6 are attributed.

## 7.2 Topography

Publicly available photographs suggest stormwater upgrade works took place during Autumn 2023 (that is, after the November 2022 landslide) (see Figure 4).


Figure 4: Google Streetview image from April 2023 looking east from outside No. 3 View Point Road. Note the stored pipes on the verge.

Figure 5, Figure 6 and Figure 7 provide an indication of the condition of View Point Road. The condition of the pavement is characterised by numerous longitudinal cracks (Figure 5) and areas of crocodile cracking and spalling. Such evidence can indicate pavement fatigue or aging, or weak subgrade. Water is noted to be flowing down the eastbound kerb within the photographs. The precise date of the photographs is not known. But we note the greenish tinge of the kerb and channel, compared to the south side, which could indicate vegetation build up due to high levels of moisture content.


Figure 5: Google Streetview image from April 2023 looking west from outside No. 3 View Point Road.


Figure 6: Google Streetview image from April 2023 looking west from outside No. 6 View Point Road. Note the localised spalling and crocodile cracking of the pavement adjacent to the driveway of No. 6.


Figure 7: Google Streetview image from April 2023 looking east from outside No. 10-12 View Point Road.

The following images are taken from drone footage collected on 16 January 2025 by SES.

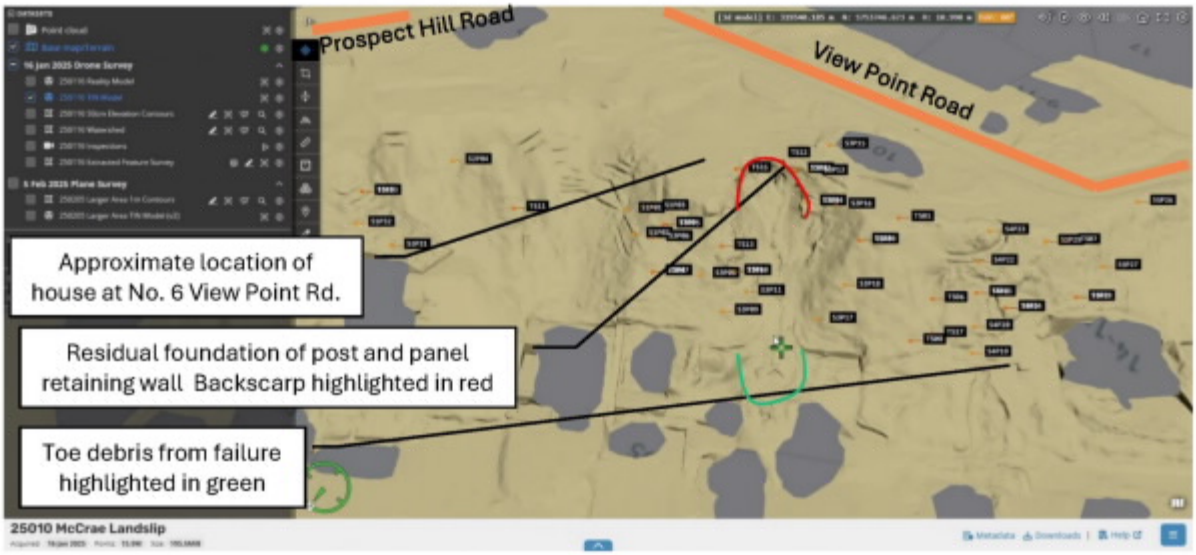



Figure 8: Imagery showing the subject site and adjacent slopes looking south west.

Figure 8 shows an overview of the site topography. The backscarp toe debris of the 14 January 2025 failure is highlighted. Note that the failure is within a clearly defined gully, which is a characteristic of the escarpment within the vicinity of the subject site.


Figure 9: Oblique image showing approximate contours of the site.

Figure 9 provides imagery showing the height of the slope around the subject site. From this image, SMEC has been able to estimate the elevation of springs noted during drone footage.

Figure 10: Drone footage taken from toe of slope failure showing the gully, denuded by slipping debris from upslope.

Figure 11: Drone footage taken from toe of failure, illustrating the 'bowl' shaped failure within the upper slope.


Figure 12: Drone footage illustrating surface conditions on site, the blue line showing the location of the cross section in Figure 13.


Figure 13: Cross section based on information from drone footage

Although Figure 13 is not scaled, the variation of the slope gradient is clear. Note that between points 1 and 2, the cross-section cuts through undisturbed slope. Point 3 shows the location of the backscarp of the failure, with point 4 the slip surface. The geometry of the topography shown in Figure 8, Figure 10 and Figure 11, suggest that the slip surface of the failure daylighted at an elevation similar to point 1. The toe debris has funnelled down a narrow gully throat before spilling out as illustrated in Figure 8 and Figure 11.


Figure 14: Drone footage showing detail of the failure.

Figure 14 shows the debris field of the failure. We note that a retaining wall at the crest of the site, and the retained platform behind, has been undermined by the slope movement, revealing geotextile layers. Fence panels are also seen in the debris. The varying colouration of the exposed soils suggest varying moisture content, and perhaps running water.


Figure 15: Detail of the presumed slip area with the red line an annotation of possible running water at the time of drone footage.

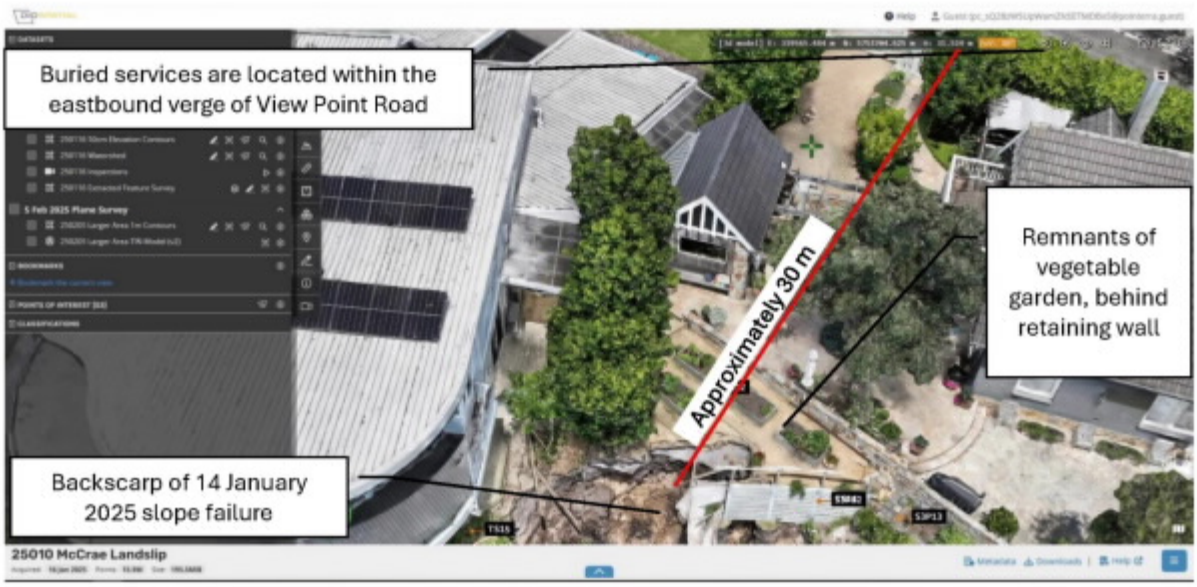



Figure 16: Drone footage showing the infrastructure, buildings vegetation and distance between View Point Road and the failure

The distance between the verge of View Point Road, the location of known SEW assets, and the failure, is approximately 30 m. Figure 16 includes View Point Road and the retaining wall, illustrating the approximate distance. Figure 16 also shows the vegetable garden behind the retaining wall, and mature tree.


Figure 17: Drone footage looking directly at retaining wall

Figure 17 shows the condition of the retaining wall. The remaining posts have soil still surrounding them, with 'unretained' soil having slipped through the gaps. The dry nature of the remaining backscarp material is of interest. Considering the 30 m distance between SEW asset and the backscarp, the highly localised nature of the inferred wetter material does not indicate that the source of water is the SEW assets.


Figure 18: Drone footage, showing the toe debris.

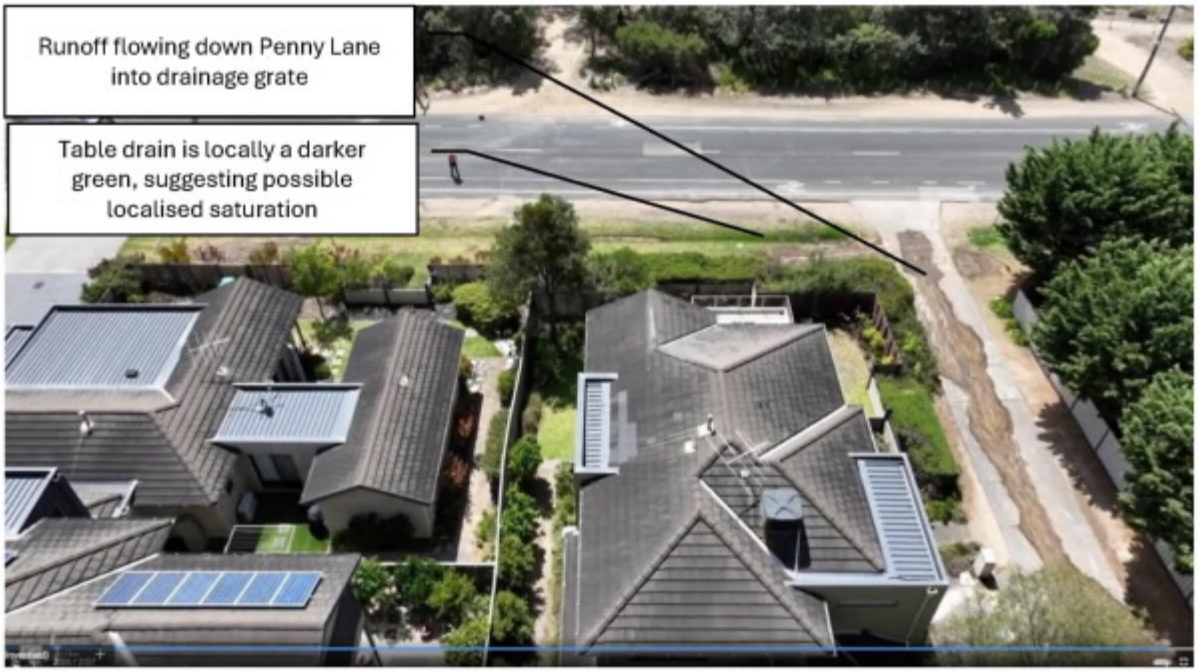



Figure 19: Drone footage from near the toe of the failure, looking towards Point Nepean Road.

Figure 19 shows water flowing down Penny Lane, and into a drainage grate, then flowing into a table drain. The surface area near the grate, is greener than the remaining length of drain.

# 7.3 Geomorphology

## 7.3.1 Site characteristics prior to development

Prior to development of the area, the steep slopes cut through with intermittent gullies, with streams, had been surveyed as indicated by the 1862 Coastal Survey – Port Phillip Martha Cliff to South Channel map available from the Public Records Office of Victoria (see Figure 20).

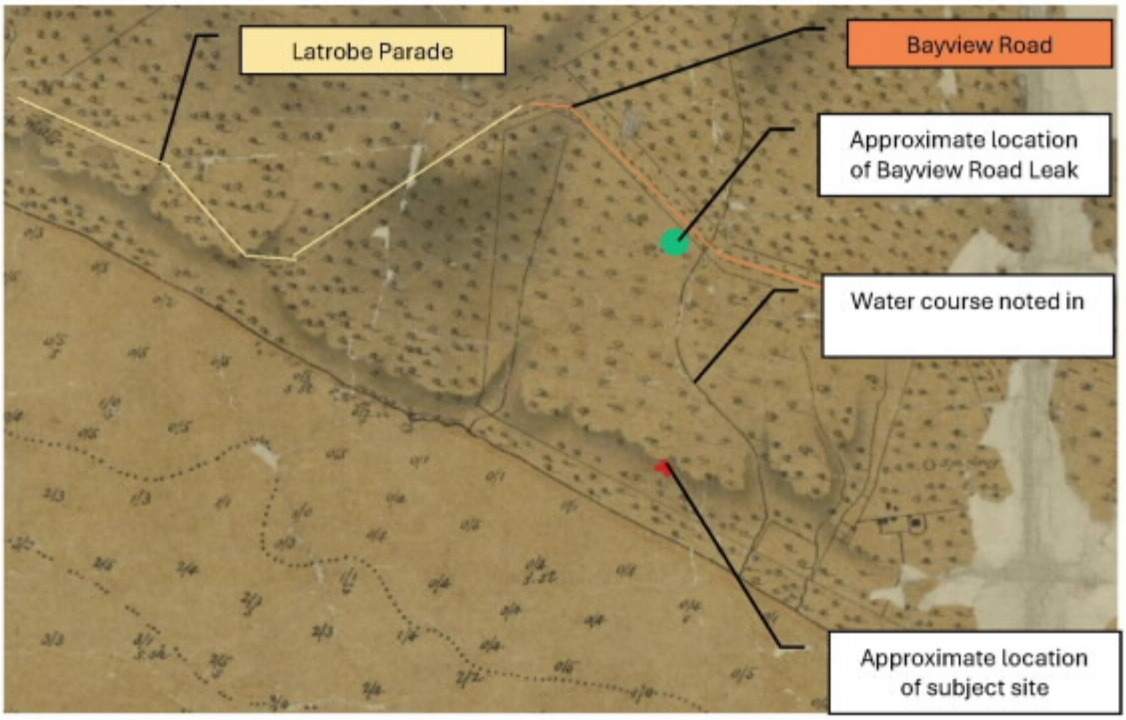



Figure 20: Annotated excerpt of the 1862 Coastal Survey (Public Records Office of Victoria)

The gradual development of McCrae, clearing of vegetation and building at the crest and the toe of the escarpment is outside the scope of this report.

## 7.3.2 14 and 15 November 2022: a pipe burst at 23 Coburn Avenue, and slope failure along View Point Road

### 7.3.2.1 Records

SEW advises that a slope failure within No. 14 View Point Road occurred on 15 November 2022, 50 m west of the subject site of this report. Table 15 in Appendix A documents SEW personnel records, and weather details between 13 October and 15 November 2022. Between 0900 on 13 November and 0900 on 14 November 2022, 80.6 mm of rainfall was recorded at the nearby weather station. According to historical records (since 1927) from the weather station, this was the wettest November date on record.

On the same day 14 November 2022, a mains burst in front to the driveway at 23 Coburn Avenue was reported. Records taken at the time state that

*'Investigation finds all water entered stormwater drain which discharged at the beach.'*

Figure 21: Photograph from SEW taken on 14 November 2022, looking west along Coburn Avenue from junction with Prospect Hill Road showing site conditions.

Figure 22: Photograph from SEW taken on 15 November 2022 (approximately), showing detail of water beneath concrete pavement construction prior to repair, being pumped out.

Repair works were carried out on 15 November 2022.


Figure 23: Photograph from SEW taken on 15 November 2022 (approximately), looking west along Coburn Avenue from junction with Prospect Hill Road showing completed mains repair works

The photographs provided within this section and recollections from SEW suggest the following:

- That the leak or upwelling visible at the surface was 5 m from the leak itself.
- Sinkholes appeared in the private property of 23 Coburn Avenue after the burst was repaired according to SEW.
- SEW advises SMEC that written records available to SEW indicated buried abandoned stormwater drains in the immediate vicinity of the site, and that the 'sink holes' relate to the abandoned pipes.

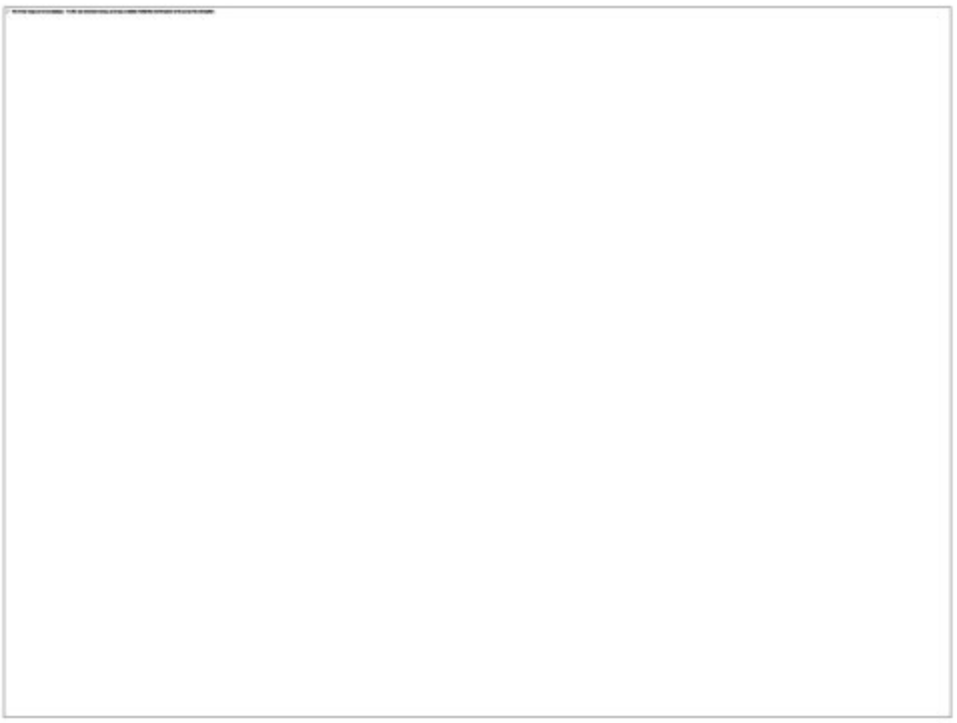


Figure 24: Photograph from email of 22 November 2022, looking north from Coburn Avenue towards Prospect Hill Road showing undulating concrete pavement construction.

Figure 25: Photograph from email of 22 November 2022, showing detail of sinkhole repair within private land.

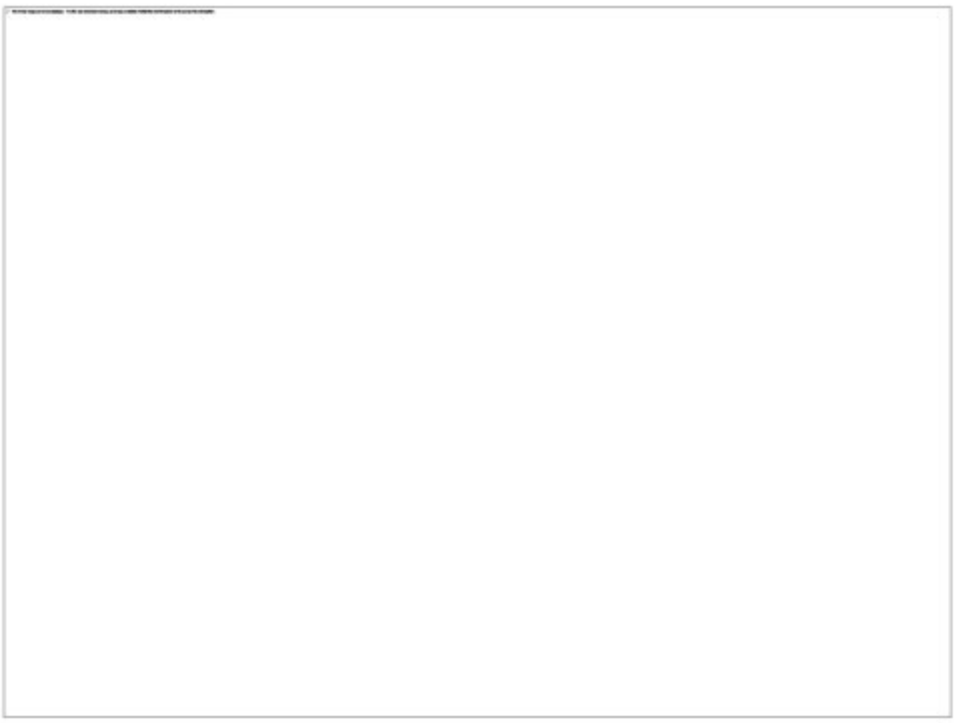


Figure 26: Photograph from email of 22 November 2022, showing detail of sinkhole repair adjacent to a kerb.

Figure 27: Photograph from SEW taken on 15 November 2022 (approximately), looking west along Coburn Avenue from junction with Prospect Hill Road showing completed mains repair works.

We understand that additional asphalt and concrete works to the pavement were carried out in November and December 2023, as illustrated below. It does not appear that significant deterioration of the site took place in the time between the immediate works and more permanent works.

Figure 28: Photograph from SEW taken on 29 November 2023 (approximately), looking west along Coburn Avenue from junction with Prospect Hill Road showing condition of pavement prior to repair works.

Figure 29: Photograph from SEW taken on 29 November 2023 (approximately), looking west along Coburn Avenue from junction with Prospect Hill Road showing asphalt pavement repair works.


Figure 30: Photograph from SEW taken on 21 December 2023, looking west along Coburn Avenue from junction with Prospect Hill Road showing concrete pavement repair works.

#### 7.3.2.2 Commentary on implication of what we know of the 15 November 2022 burst, on the subject site of this report

Figure 1 indicates that the geology of the subject site is likely to be similar to the geology at the pipe burst of 15 November 2022.

Factual data obtained by SEW from Mornington Peninsular Shire Council suggests that the stormwater drainage at the location of the 15 November 2022 burst, was installed in 1981. Redundant stormwater pipes may have been present near by the site, however at the time of the pipe burst, the functioning stormwater drains were already 40 years old. It is reasonable to suggest that ground deformations associated with the redundant drains should have already occurred.

The records suggest that the surface evidence of the leak was 5 m from the leak itself.

The observation of the leak and the sinkholes do provide evidence that defects can occur some distance away from any burst. They do not however change the likelihood of the hypothesis that water within a service trench can lead to a slope failure 30 m from the trench.

We understand that the 15 November 2022 slope failure is under current proceedings. It is not within the scope of the report to consider causes of this failure. However, Figure 31 illustrates that:

- the mains water for View Point Road, is linked to the mains water outside 23 Coburn Avenue. Leaked water could feasibly flow within the embedment material of the mains water.
- there is a bend in the mains water alignment at 14 View Point Road. This may have allowed water within the embedment material to seep out at that location and into 14 View Point Road. However, SMEC notes that there is no record of surface deformation between the mains trench and the slope failure.
- That the mains water system also links the site of the mains burst with a mains alignment down Coburn Avenue.
- Records suggest that the burst was repaired on the same date as it was observed, the volume of water lost is likely to be considerably less that the volume of water estimated for the Bayview Road leak located on 30 December 2024 and repaired on 1 January 2025.

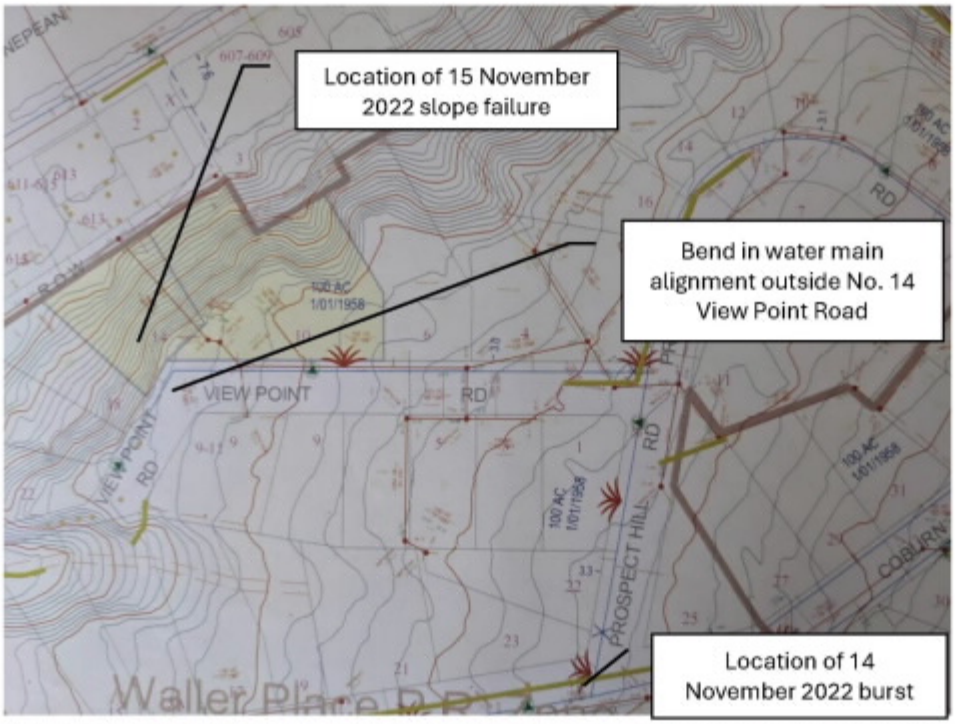



Figure 31: Excerpt of SEW map showing location of 23 Coburn Avenue, and the location of the 15 November 2022 slope failure, with annotations.

In conclusion, the evidence of 15 November 2022 suggests that pipe burst can cause defects which are most likely to occur within the proximity of the burst. It is considered not feasible that water can transport down buried service trenches and leave the trench without resulting in defects being observed close to (i.e. within 5m) of the burst.

## 7.4 Stormwater Drainage

### 7.4.1 Location

Figure 32 and Figure 33 illustrate the stormwater drainage network in the area. Drainage is located around the bend of Prospect Hill Road. Residents at 5, 6 and 7 Prospect Hill Road are uphill of this drain. Based on the information supplied, this stormwater drain flows into View Point Road.

Figure 33 indicates that stormwater drainage along View Point Road is incomplete (refer to annotation). SEW has advised SMEC, based on verbal conversations with Mornington Peninsular Shire Council, that the stormwater drainage flows from the front of No. 4 to No. 22 View Point Road. The works were completed in 2023. No as-built drawings or site records were available to SMEC at the time of writing.

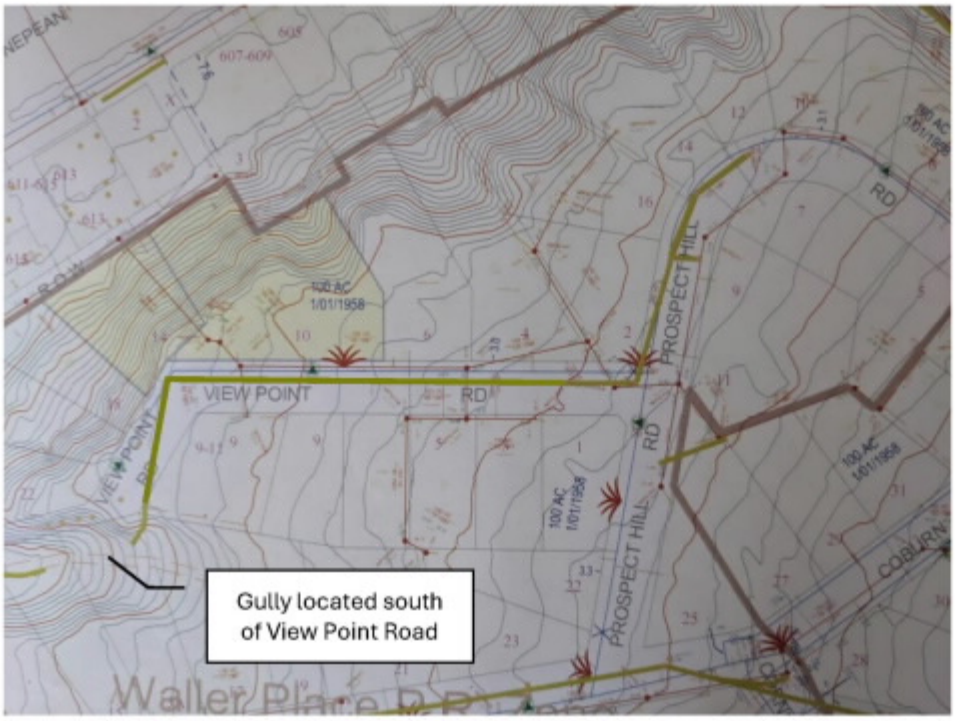



Figure 32: Excerpt of SEW map showing location of View Point Road and Prospect Hill Road.

Figure 32 also shows the topography of the locality. Note a gully that falls westwards, south of the turning circle of View Point Road. This is away from the subject site.


Figure 33: Map (not scaled) showing stormwater drainage network in the locality of the subject site.

SMEC has annotated Figure 33, to update it with the approximate locations of known buried stormwater drainage. The figure is derived from Before You Dig Australia maps, acknowledged to be incorrect by Mornington Peninsular Shire Council.

### 7.4.2 Depth

Figure 34 shows an annotated map showing locations where the depth to invert of stormwater drains has been provided by Mornington Peninsular Shire Council. The approximate locations of these invert levels, based on the address details provided by the Council, are annotated within the figure.

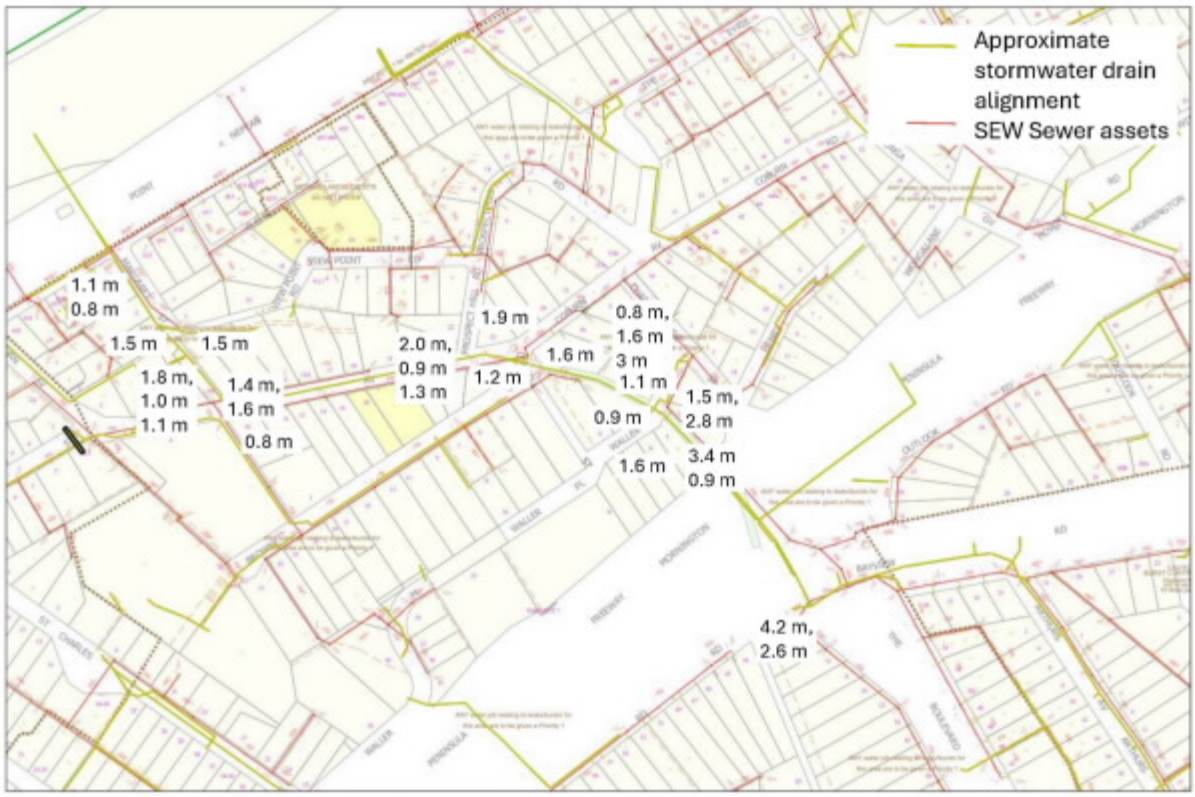



Figure 34: Annotated map showing locations of intrusive location works to be carried out by a third party.

The reason for why there are more than one depth recorded for several individual properties is not known but may be because several inlets fall into one stormwater pit.

# 7.5 SEW Assets

## 7.5.1 Location

SEW infrastructure assets are illustrated in Figure 35 and Figure 36 below.

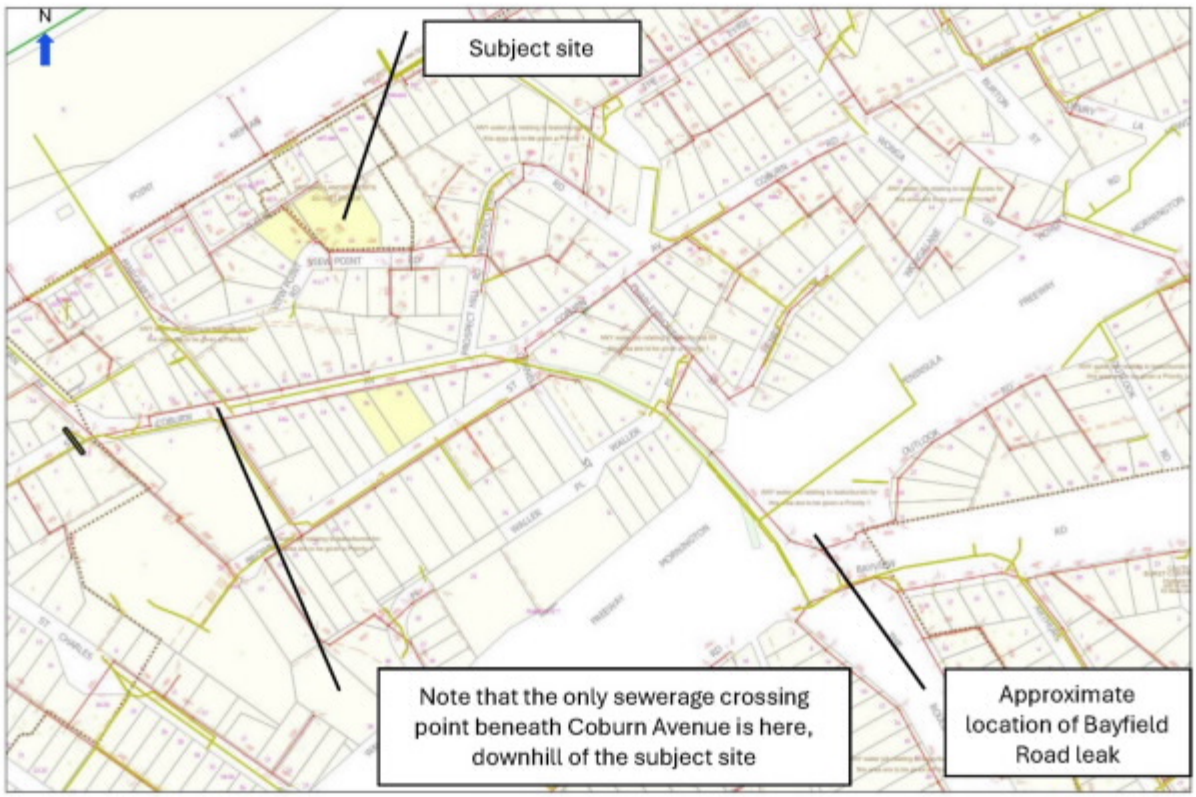



Figure 35: Plan showing sewerage network around locality of View Point Road. Note that the leak near Bayview Road is the south side of Mornington Freeway.

Figure 35 shows the location of buried sewer assets in the locality of View Point Road. It should be noted that the ground level tends to dip towards the northwest. There is no link between the sewer network of Prospect Hill Road and View Point Road, and the network south, or uphill from Coburn Avenue, as illustrated in Figure 58.

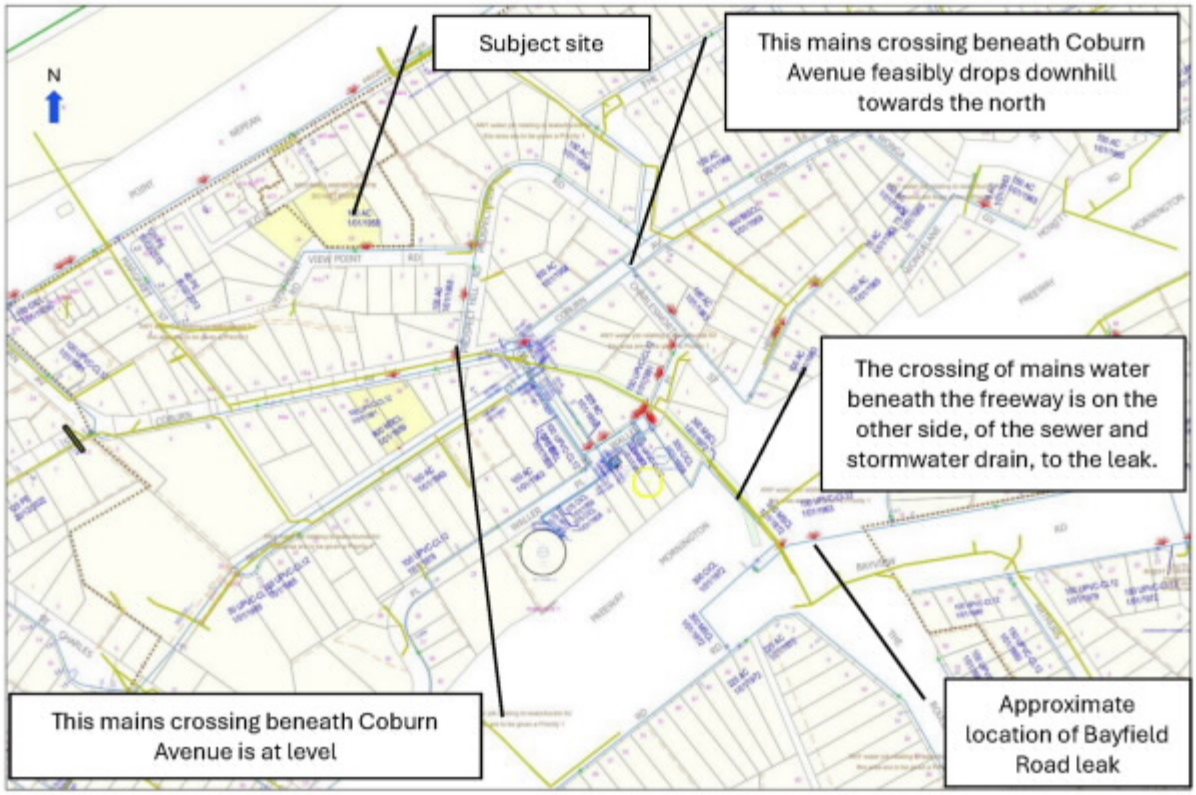



Figure 36: Plan showing water mains network around the locality of View Point Road.

Figure 36 illustrates that the link within the mains network at the T-junction of Prospect Hill and Coburn Avenue is level. This is not a concern for pumped water flow, but it indicates that the embedment material surrounding the mains, grades upwards towards Prospect Hill Road.

### 7.5.2 Depth


Figure 37: Map showing sewer network from Bayview Road and Point Nepean Road.

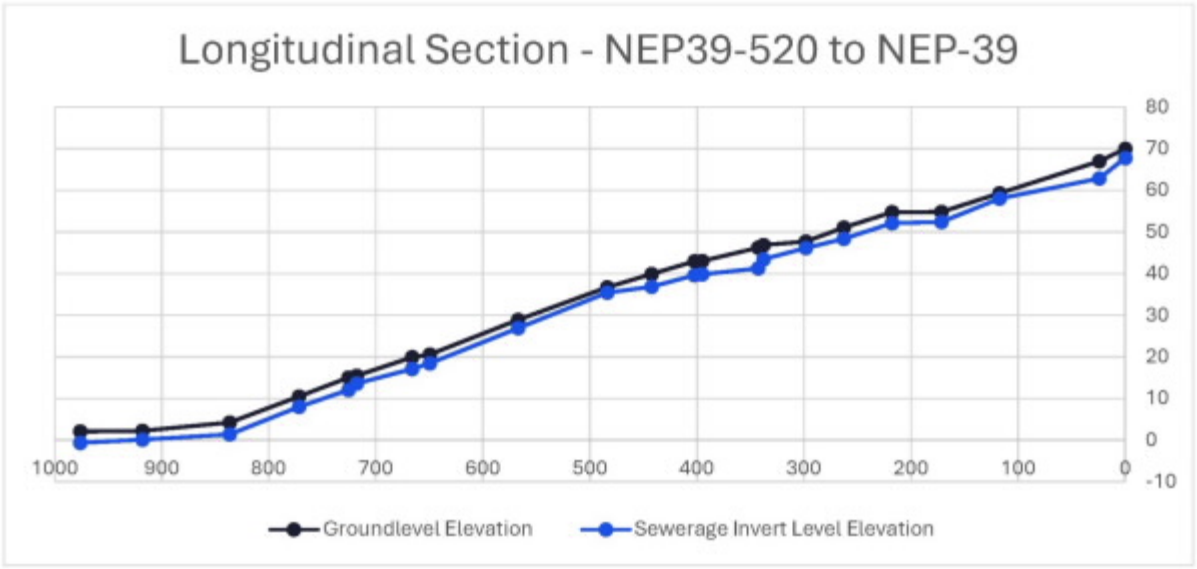



Figure 38: Graphical long section showing the ground level and invert levels of the sewer network between Bayview Road and Point Nepean Road

Figure 37 and Figure 38 illustrate the gradient through Bayview Hill Road into Point Nepean Road. Chainages 217.75 m to 298.25 m are located along Charlesworth Street, where upwelling was noted (Section 7.6.3.2). The depth to invert along Charlesworth Street varies from 2.69 m to 1.56 m. It is noted that the invert depths along Charlesworth Street are not the shallowest inverts along the alignment. It is therefore not certain that the depth to invert is solely related to the likelihood of upwelling.


Figure 39: Map showing sewer network from Prospect Hill Road and Point Nepean Road.

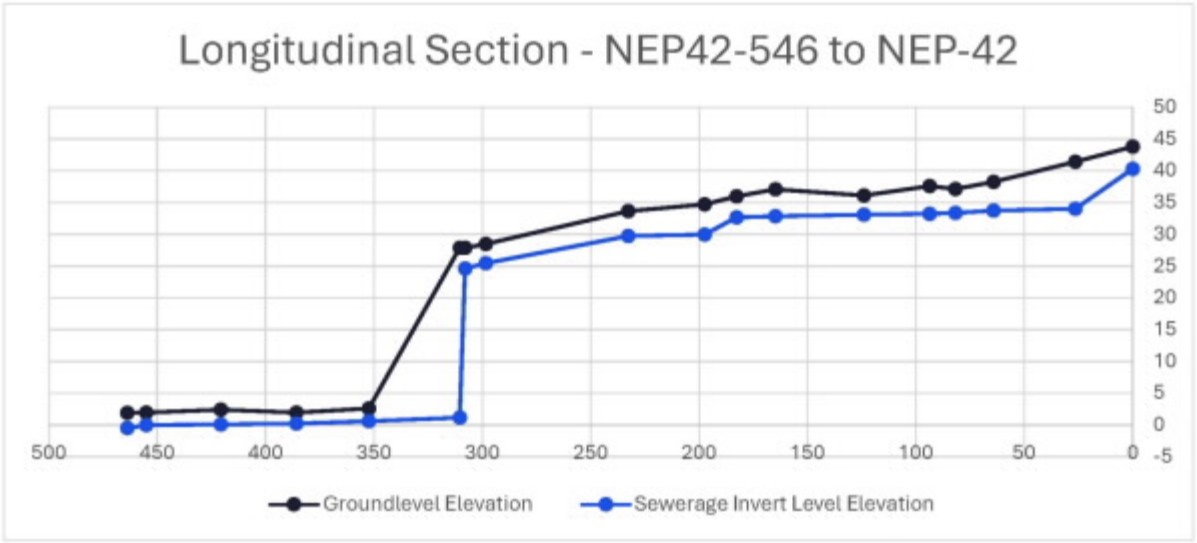



Figure 40: Graphical long section showing the ground level (CL) and invert levels (IL) of the sewer network between Prospect Hill Road and Point Nepean Road.

Figure 39 and Figure 40 illustrate the gradient through Prospect Hill Road into View Point Road. Note that the scales differ from Figure 37 and Figure 38. Note that 10 View Point Road is at chainage 298.4 m. The figures show a fall in invert level along the chainage, irrespective of the ground level. Note that Chainage 83.9m to 93.7m, is outside 10 Prospect Hill Place.

# 7.6 Event chronology

## 7.6.1 Leak at Bayview Road

It is known that a longitudinal fracture 100 mm long, at the base of a water main near Bayview Road, was located on 30 December 2024, and repaired in the early hours of 1 January 2025.

Analysis from SEW suggests that the cumulative volume of water between November 2024 and 1 January 2025 lost through the leak was 37 ML, with approximately 3ML lost before November. We understand that typically, flow rate linearly increases with time. This is attributed to erosion of soil around the burst pipe, with soil material washed out of the surface.

Therefore, it is possible to calculate, assuming flow rate through the leak was approximately 0 L/s on 1 November 2024, that by 1 January 2025 37 ML had been lost, with the final estimated flow rate through the leak was approximately **15 L/s.**

We know from resident statements to SEW personnel on 21 December 2024 of the high flow rate through the stormwater drain. As the investigations continued and the source of the leak was identified, runoff from the location of the leak to a stormwater grate was observed.

It is feasible and highly likely that some of the water also infiltrated surrounding geology. However, we consider it highly likely that only a small fraction of the leakage flow from the burst water main infiltrated the natural geology and therefore any embedment material. No records or observations received to date indicate saturation of verge side drainage, seepage, ponding, or other observations have occurred adjacent to the southbound carriageway of the freeway. One or more of these observations would be expected to be observed if significant volumes of water had infiltrated surrounding soils. We therefore consider it highly likely that most of any water that infiltrated the surrounding soils from the leak was accommodated by the geology.

It is considered moderately likely that water from the leak entered stormwater and sewerage embedment material. The seepage observations made along Waller Place and Charlesworth Street may be evidence of this. However, the lack of records of similar defects in the pavement of the Mornington Peninsular Freeway, significantly reduces any certainty.

Based on the information supplied, it is not possible to estimate the proportion of water accommodated by the geology, transported by embedment material, and taken by the stormwater drains.

Similarly, based on the information supplied, it is not possible to accurately determine the effect of distance from source of spreading of water across the vicinity of the site. The undulating nature of the site would indicate that the spread would be uneven.

### 7.6.2 Weather

SMEC has studied available data from nearby weather stations. The stations data provides a reasonable indication of site conditions.

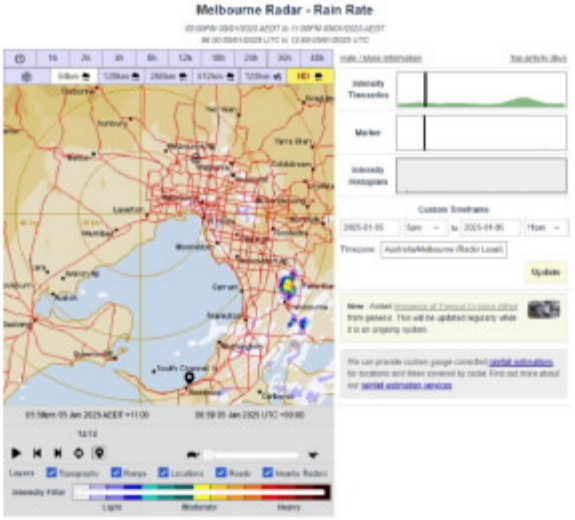
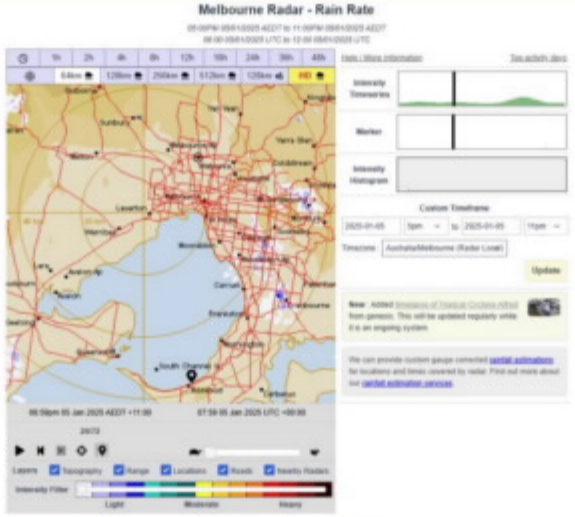
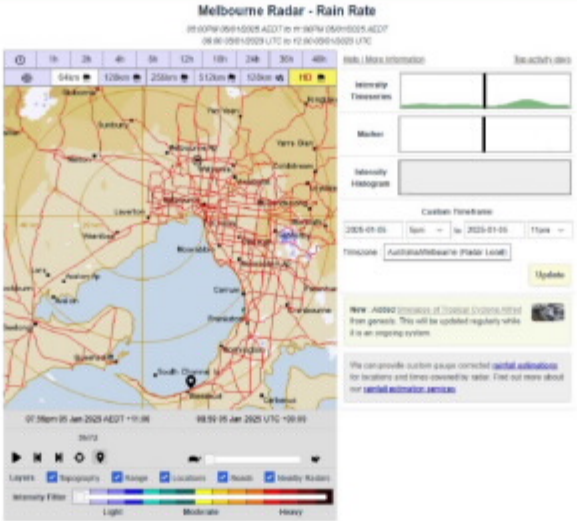
Annual rainfall data available from the Rosebud Country Club weather station operated by the Bureau of Meteorology is presented in Table 9.

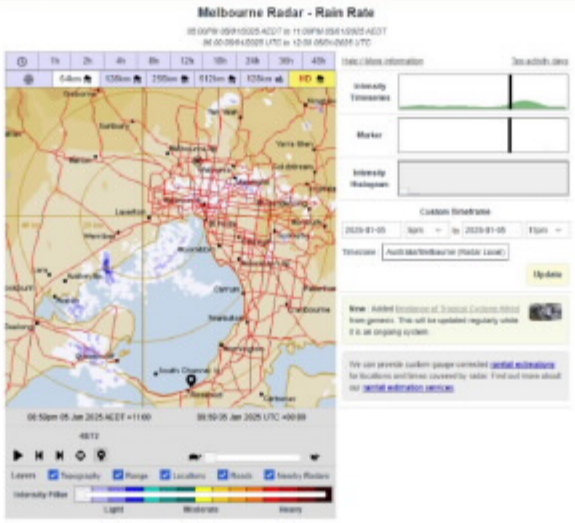
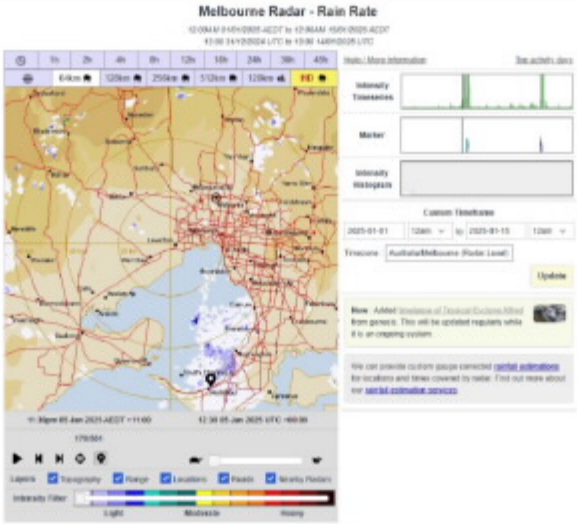
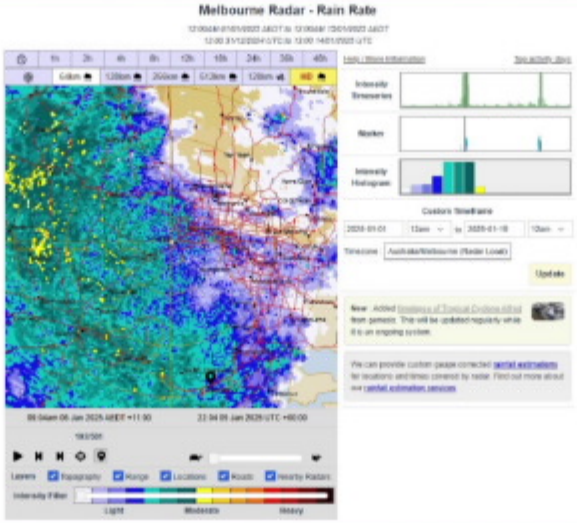
Table 9: Select rainfall data from Rosebud Country Club Weather Station

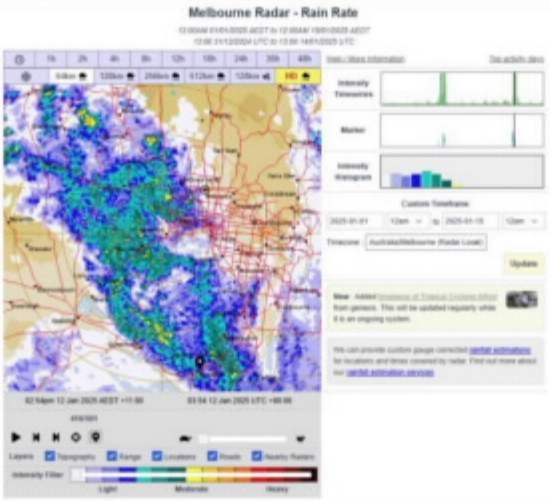
| Year | Annual cumulative total (mm) | Wettest day | | Wettest consecutive 2 months | |
|---|---|---|---|---|---|
| | | Date | Rainfall (mm) | Months | Rainfall (mm) |
| 2022 | 950.4 | 14 November | 80.6 | October - November | 271.4 |
| 2023 | 686.0 | 4 February | 32.0 | May - June | 206.0 |
| 2024 | 594.4 | 2 April | 48.8 | December 2023 – January 2024 | 162.2 |

In overview, little rain fell at the anticipated time of the 5 January 2025 failure as illustrated by the following hourly radar images. The daily rainfall readings for the days leading up to the event are tabulated in Appendix A:

Table 10: Select rainfall radar images illustrating rainfall over the Melbourne Region during the known times of the 5 January 2025 and 14 January 2025 landslides

| Date | Time | Image |
|---|---|---|
| 5 January 2025 | 1800 |  |
| | 1900 |  |
| | 2000 |  |

| Date | Time | Image |
|---|---|---|
| | 2100 |   |
| | 2349 |   |
| 6 January 2025 | 0904 |   |

| Date | Time | Image |
|---|---|---|
| 12 January 2025 | 1454 |  |



## 7.6.3 SEW Asset Maintenance

The timeline of construction of SEW asset has not been considered as part of the preparation of this report. The recent history of maintenance works, studies, and call outs following contact from residents, has been considered and is presented in Tables provided in Appendix A. These tables provide a chronological list of such actions. The tables present select weather data, and the locations of the activities, which are shown in Drawing 002.

### 7.6.3.1 14 November 2022, 23 Coburn Avenue

As noted in Section 7.3.2, the landslide of 15 November 2022 (Item No. 2022.3 Appendix A) occurred the day after 80.6 mm of rainfall was recorded at the nearest weather station. This failure is currently the subject of legal proceedings. However, SEW advise that SEW assets are not considered to be a contributory factor.

### 7.6.3.2 19 December 2024 onwards, Charlesworth Street and Waller Place

Following a call out request from concerned residents, discussions between SEW personnel and residents of Charlesworth Street and Waller Place on 19 and 21 December 2024, indicate that 'other areas of seepage stormwater in area and are used to it', and 'water in grated drain [the stormwater drain] is always running'.

On 24 December 2024, SEW reports:

*'Water is flowing up from the road at 10+ L/min (the road is damaged and getting worse, it has been barricaded off). The storm water drain is raging. There are other locations where the nature strip is extremely saturated with water running onto roadway.*

*'I sounded all SEW assets and spoke with residents, I was told there is an underground spring and water often flows into the storm water drain but is not usually this heavy.*

*'We found no leak noises on any SEW assets.'*

The comment that the sewer was 'raging' is illustrated by the photograph taken by SEW on 30 December 2024. At this time the leak at Bayview Road had not been located. Rainfall data presented in Table 18 in Appendix A indicates no significant rain had fallen on the site since 23 December 2024. Figure 41 is a photograph taken by SEW that we understand to be the pit where the stormwater drain crosses beneath Waller Place. The photograph shows one inlet with water pouring out, one with a slight amount of water flowing out, and the other dry. SMEC suggests that:

- the dry inlet (thought to be from the western half of Waller Place) indicates that the sources of water flowing from other inlets is not from rainfall.

- the low volume flowing water (thought to be from the eastern half of Waller Place) may be from the seepage issues raised by nearby residents.
- The high-volume flowing water would corroborate the 'raging' description.

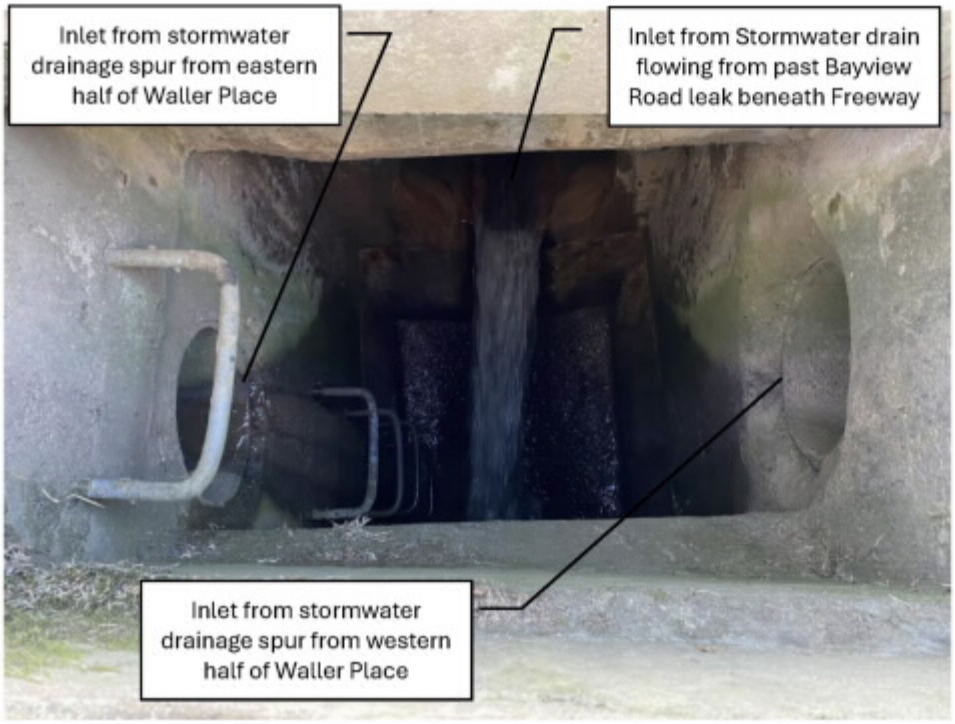



Figure 41: Photograph supplied by SEW, taken on 30 December 2024, showing water flowing into pit opposite 6 Waller Place

Figure 41 is contrasted with Figure 42, which shows the same pit on 5 March 2025. By this time, the Bayview Road leak had been repaired. Recent rainfall data is provided in the table below for the reader to consider.

Table 11: Rainfall data from 27 February to 5 March 2025 obtained from BOM online data.

| Date | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|
| 27/2/2025 | 0 |
| 28/2/2025 | 0 |
| 1/3/2025 | 0 |
| 2/3/2025 | 0 |
| 3/3/2025 | 0 |
| 4/3/2025 | 0 |
| 5/3/2025 | 0 |

Similar weather conditions for both photographs, lead to the conclusion that the Bayview Road leak had a significant impact on stormwater flow. It must be noted however that such a conclusion assumes similar private water usage patterns occurred during both time periods.

Figure 42: Photograph supplied by SEW, taken on 5 March 2025, showing water flowing into pit opposite 6 Waller Place.

#### 7.6.3.3 31 December 2024 to 1 January 2025 Bayview Road leak

Observations of 31 December 2024 state that during excavation the 'ground collapsing due to high exposure to water', and 'a burst underneath the pipe'. The water pressure through the leak was reduced during that afternoon via turning one of two valves.

The section of pipe that had leaked was replaced at around 0300 on 1 January 2025.

Figure 43: Provided by SEW, understood to have been taken on 31 December 2024, showing site condition upon arrival at the Bayview Road leak site. Note the ponded water, and flowing runoff into the background.

Figure 44: Provided by SEW, understood to have been taken on 31 December 2024, showing detail of ponded and flowing runoff at the Bayview Road leak site

Figure 45: Provided by SEW, understood to have been taken on 31 December 2024, showing the ground collapsing during water pumping at Bayview Road leak site. Hole assumed to have been excavated by small excavator on site at the time.

Figure 46: Provided by SEW, understood to have been taken on 31 December 2024, showing the Bayview Road leak site during pumping and excavation works.

Figure 47: Provided by SEW, understood to have been taken on 1 January 2025, at the Bayview Road leak site showing exposure of pipe. Indicating the fracture is at the bottom of the pipe.

Figure 48: Provided by SEW, understood to have been taken on 1 January 2025, at Bayview Road leak, showing repair.

Six hours after the leak was repaired, a walkover survey along Charlesworth St noted water continuing to flow up in the nature strip, and water was observed within the storm water drain. Twelve hours afterwards, the flow in the stormwater drain had 'slowed right down'.

#### 7.6.3.4 5 January 2025 onwards Slope Failure observations

##### 7.6.3.4.1 General

No rainfall was reported in the seven days before the landslide of 5 January 2024 (Item No. 2024.13).

A significant drop in maximum temperature over the preceding 24 hours (greater than 20°C) was recorded at the Frankston weather station.

The landslide of 14 January 2025 (Item No. 2024.14) occurred the day after 9 mm of rainfall was recorded at the nearest weather station.

Based on the occurrences of instability during periods of different weather conditions, it is considered unlikely that rainfall contributed directly to the recorded slope movements of 5 January 2025. However, it is considered likely that the rainfall of 14 January 2025 led directly to the failure of that date, given that the stability of the slope following 5 January 2025 failure is thought to have been reduced.

Appendix A lists seven service leaks were reported during 2023 in the vicinity of the subject site. Twelve service leaks or upwelling in pavements were reported in 2024. There appear to be an increase in reported leaks during 2024, compared to 2023.

We have viewed the records provided by SEW from their site personnel visiting the site on 5 and 6 January 2025. The following passages are select excerpts.

#### 7.6.3.4.2 5 January 2025

At 2036 on 5 January 2025, SES contacted SEW regarding the landslide at 10 View Point Road.

Select photographs of the site are provided below.

Figure 49: Photograph taken on the night of 5-6 January 2025, of a stormwater drainage pit outside what is thought to be No. 10 View Point Road

Figure 50: Photograph taken on the night of 5-6 January 2025, Showing flowing water within the stormwater drain shown in Figure 49.

Figure 49 shows a storm water pit with a grate. The accompanying records from SEW personnel do not explicitly say where this pit is. However, based on locations of fire hydrants and recognisable fences, SMEC believe it is outside No. 10 (see Figure 6).

Figure 51: Photograph taken on the night of 5-6 January 2025, looking south from behind 3 Penny Lane

Figure 52: Photograph taken on the night of 5-6 January 2025 showing landslide debris against rear wall of 3 Penny Lane

From the SEW notes: *'SES advised leak large leak to rear of No 10 and the meter wasn't ticking over so said there is water running down from Viewpoint Road to the back of 10 which has caused a landslide to 3 Penny Lane. SES trying to find cause of leak and location of leak. Coming from the higher side of this address. They can hear water from the fireplug at no 10 in View Point Rd.'*

Visiting site in the middle of the night, the SEW personnel noted:

*'Arrived to find SES onsite checked FP at #10 View Point Rd no noise. Tested water running down SW pit is not in mains range 286SL spoke to residents at #10 they advise this is the second land slide in the area and the water is a spring that continually runs regardless of the weather checked the backyard can see where the landslide has run down to 3 Penny Lane. Checked the 25mm meter at #10 no noise is not ticking over.'*

SEW standard analysis suggests that water in the stormwater pit is not within mains range. But as observed from weather reports, there had been little rain up until that time. The second landslide statement is thought to reference the November 2022 failure. The statement that a spring that continuously runs is of interest and may explain the variable vegetation cover in the publicly available photographs. It is unclear as to how long it has been that the 'spring' has been running continuously. Checking for leaks within water mains is carried out using an electronic microphone apparatus which when attached to the asset, such as a valve, can be used to identify leaks due to the sound the water makes flowing through the leak. Reference to noises, or sounds etc. within this text, and the table in the appendix relates to these tests., The record continues:

*'Valve for View Point Road #362909 was buried located with yellow wand marked and painted. Shut valve no noise opened valve no noise, drove down to Penny Lane inspected property and spoke with SES. Water running down the stairs is clean and clear EC test is in mains range. Sounded garden tap good noise located b/valve was buried shut off and noise stopped. Flow down the stairs eventually stopped the water line inside the house has been damaged by the landslide. Took sample from the rear of the house from land slide EC test is not in mains range 1400SL plus.'*

Another sample of the water springing from the landslide was taken and tested providing a similarly high EC number.

*'Residents advised me of a leak running from Charlesworth St drove up to find bollards in the middle of the road in two spots major potholes. EC test is 600SL plus other pothole is just before manhole id #430662... ...Resident advises the leak has been running for 8-9 months...'*

The statement that the failures have been around for eight to nine months, and that SEW were aware, correlates with the records of previous customer issues raised. A second SEW colleague, in his record stated, assumed to be referring to the Charlesworth Street and Coburn Avenue upwellings:

*'...the leaks have not changed... ...the leaks up the road on the other job number is still the same.'*

#### 7.6.3.4.3 6 January 2025

On the morning of 6 January 2025, SEW personnel visited site again. Select photos taken from the site are provided below.

Figure 53: Photograph taken on 6 January 2025 looking west across the backscarp of the failure.

Figure 53 indicates that the location of the 5 January 2025 landslide failure is downslope of the concrete retaining wall that was undermined by the 14 January 2025 landslide (e.g. Figure 14).

The record from an SEW representative includes the following:

On viewing the failure:

*'Water is running down the washed away embankment...'*

*'I visited the property above at 10 View Point Road McCrae, meeting the concerned homeowners... ...The residents are also having issues with retaining walls leaning, etc.'*

Figure 54: Photograph taken on 6 January 2025, looking downslope showing debris slide below the backscarp.

Figure 55: Photograph taken on 6 January 2025, showing slip debris of the 5 January 2025 landslide and water channel cutting through debris. The adjacent vegetation may indicate the original ground level and vegetation cover prior to the failure.

As shown in Figure 55, water continued flowing down the embankment on 6 January 2025. It is considered likely that this would continue to soften and erode material adjacent to the water flow, destabilising the slope.

The statements made during the site visits of 5 and 6 January 2025 referring to the retaining walls 'leaning' suggests a historical instability of the site. It is currently not known if the design or construction of the retaining walls was sufficient for the site characteristics. The wall instability may be because the site geology is poorer than the design of the wall allowed for. It is assessed that the age, location and design details of the retaining wall may inform us of any data regarding a long-term low level of slope stability on the site.

Figure 56: Photograph taken on 6 January 2025, looking up at the landslide, showing saturated debris flow surface with dry soil adjacent. Debris may include some boulders cobbles, but also anthropogenic and vegetation material

Further information about the wall is in an SEW record from the second Representative who reports they visited site with the property owners of 10-12 View Point Road. The following statements were written:

With regards to the escarpment affected by the landslide:

*We… …observed water still trickling down the hill. [The property owner] mentioned that there never used to be water coming from this point and it had only recently started.*

The statement that 'there never used to be water coming from 'this point'', may contradict a statement recorded in the middle of the night on 5 January 2025. It is possible that the statements came from different people.

The discussion of the retaining wall lacks specifics about which retaining wall. It is noted there is no record of 'toppling' retaining walls.

With regards to the November 2022 failure and works that took place in View Point Road:

*[The property owner] said the area [of the November 2022 landslide] was previously very wet but is now dry. And he suspected it has something to do with the construction of the stormwater drain on the north side of the View Point Rd [Refer to* Figure 4*].*

*[The property owner] mentioned that there was previously a very poor condition kerb and channel that experienced flow 24/7. He believed that prior to [the stormwater drain] being constructed, this water was infiltrating through cracks in the kerb and channel and discharged out of the ground on the eastern side of No. 14.*

Note that Figure 5, Figure 6 and Figure 7 indicate that continuous flow along the kerb, which may confirm this statement.

#### 7.6.3.4.4 5 Prospect Hill Road

With regards to Prospect Hill Road comments were made on 5 January 2025:

*Significant flow of water inside the stormwater drain [up Prospect Hill Road], [the property owner] mentioned that this water was from properties in Prospect Hill Road that had groundwater pumps. He mentioned that No. 7 was recently constructed and they had lots of groundwater issues and have a pump running 24/7 to remove the groundwater.*

*[The owner of No. 5 Prospect Hill Road] observed that the pump in his basement had started pumping more frequently as of around a month ago. The water from this pump discharges into the kerb and channel in front of the property which connected into a closed stormwater drain that connects to the drain in View Point Rd.*

*Whilst onsite I also observed a significant wet area in front of no. 6 Prospect Hill Road. this was surveyed multiple times by leak detection and no leak was found.*

On 17 January 2025, the following was noted by SEW personnel:

*The house at no-7 has a grated drainage pit near the meter & water is constantly following. I tested the water a few times & got readings of around 400. The water is to murky to do a powder test.*

It is noted that on that only 1.4 mm of rain had fallen since 14 January 2025. This would indicate that stormwater drainage is picking up water from sources other than rainfall.

SEW has advised SMEC that in January 2025, SEW advised the owner of 5 Prospect Hill Road that they had identified a leak in the property from leak detection activities. In April 2025, the owner found the leak and repaired it. The flow of water within the stormwater drain (Figure 49) is considered to be at least in part due to the pumping of groundwater from the basement.

### 7.6.3.5 Conclusions from SEW records

The differences between the statements of observation do not provide a clear indication of the potential causes or landslide mechanisms. There appears to be confirmation that water upwelling and stormwater flowing observations at Waller Place and Charlesworth Street have been noted since around May 2024. As recently advised by SEW, the Bayview Road leak is thought to have started before November 2024, as 3ML was estimated loss before that date. It is feasible and considered highly likely that references to flowing water within the drain relate to the time period between the leak appearing, and November 2024. It is not possible to come to a similar conclusion from the statement made during the night of 5 January 2025, of the '*spring that continually runs regardless of the weather*', due to lack of confidence of when this 'spring' appeared.

The statements regarding the recent history of 10-12 View Point Road, do not confirm each other. From the accounts provided, it is not possible to ascertain if seepage, or movement of retaining structures did occur prior to the 5 January 2025 landslide.

The flowing water within stormwater drains along Prospect Hill Road, which were observed irrespective of rainfall, and noted after the Bayview Road leak had been repaired is expected to be from groundwater pumping activities from 5 Prospect Hill Road. Any water transported to View Point Road via the SEW asset trenches therefore should reasonably be considered to include water from the same source as what was being collected within the stormwater drains after the Bayview Road leak was repaired.

### 7.6.3.6 On site and laboratory test results of water samples

Since 24 December 2024, SEW personnel have taken water samples from readily available sources of running water, to measure the chemical properties of the samples, with the objective of identifying the source of that water. The table below provides the results of the field tests. Appendix A, Drawing 002 presents the locations of each sample point.

The table includes laboratory test results of drinking water taken at three existing sample points from SEW.

The table includes commentary by SMEC about the results, with respect to test results that are the SEW network average. Laboratory Sample Numbers are not included for presentation reasons.

Table 12: Water sampling test results summary

| Sample Ref. | Location of sample | Sample Date | EC - (µS/cm) | Fluoride (mg/l) | Chloride (mg/l) | pH | $SO_4$ (mg/l) | $NH_3$ (mg/l) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | *SEW water network avg.* | - | *83* | *0.77* | 9 | | | | |
| 5 The Eyrie | 300 m ENE of subject site | 15/04/25 | 120 | 0.76 | 20 | 7.7 | 2 | <0.002 | |
| 16 Arthurs Avenue | 760 m SE of subject site | 15/04/25 | 120 | 0.81 | 19 | 7.7 | 2 | <0.002 | |
| 3 Flinders Street | 630 m SSE of subject site | 15/04/25 | 120 | 0.79 | 20 | 7.7 | 3 | <0.002 | |
| | *General range of salinity of aquifer* | | <780 | | | | | | |
| A | Upwelling within pothole at junction of Waller Pl and Charlesworth St | 24/12/24 | 670 | 0.29 | 120 | N/A | N/A | N/A | |
| | | 30/12/24 | 640 | 0.27 | 120 | N/A | N/A | N/A | |
| | | 6/01/25 | 570 | 0.14 | 110 | N/A | N/A | N/A | Following 5 January 2025 landslide |
| | | 16/01/25 | 1200 | 0.28 | 250 | N/A | N/A | N/A | After 14 January 2025 landslide and Council excavation at site |
| B | Within stormwater drain in front of 6 View Point Rd | 30/12/24 | 160 | 0.8 | 29 | N/A | N/A | N/A | |
| | | 8/01/25 | 570 | 0.13 | 82 | N/A | N/A | N/A | Following 5 January 2025 landslide |
| C | Seepage within landslide material | 6/01/25 | 1600 | 0.15 | 330 | N/A | N/A | N/A | Following 5 January 2025 landslide |
| D | Upwelling within pothole at junction of Coburn Ave and Charlesworth St | 6/01/25 | 750 | 0.3 | 140 | N/A | N/A | N/A | Following 5 January 2025 landslide |
| | | 22/01/25 | 1000 | 0.32 | 210 | 7.1 | <10 LINT | <0.1 | |
| D | Pavement around Coburn & Charlesworth | 22/01/25 | 1400 | 0.22 | 270 | 7.2 | 95 | 0.1 | |
| E | Verge in front of 34 Coburn Ave | 22/01/25 | 680 | 0.31 | 150 | 6.7 | <20 LINT | <0.1 | |
| F | Verge opposite 5 Waller Place | 22/01/25 | 600 | 0.18 | 120 | 8.2 | 29 | <0.1 | |
| G | Within stormwater drain in front of 11 Prospect Hill Rd | 3/02/25 | 400 | 0.14 | 83 | 7.1 | 14 | <0.1 | Investigating high result at Point B |
| H | Kerb in front of 5 Prospect Hill Rd | 3/02/25 | 140 | 0.86 | 20 | 7.7 | 5 | 0.1 | |
| 1 | Gutter of 5 Prospect Hill Rd 'storm pipe' | 25/3/25 | 120 | 0.71 | 17 | 7.1 | 2 | <0.1 | Taken on the same day, along the same 'stormwater flow' (Note location B is along the same flow). |
| 2 | 11 Prospect Hill Rd Stormwater Pit | 25/3/25 | 440 | 0.13 | 100 | 7.0 | 17 | <0.1 | |
| 3 | 10 View Point Rd Storm Pit | 25/3/25 | 450 | 0.16 | 99 | 7.6 | 22 | <0.1 | |

| Sample Ref. | Location of sample | Sample Date | EC - (µS/cm) | Fluoride (mg/l) | Chloride (mg/l) | pH | $SO_4$ (mg/l) | $NH_3$ (mg/l) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 11 Prospect Hill Road is 'halfway' along. |
| 4 | 29 Browne St Coburn Creek | 25/3/25 | 420 | 0.19 | 100 | 7.3 | <5 LINT | <0.1 | Along the same water course |
| 5 | 1-3 Burrell St | 25/3/25 | 630 | 0.15 | 88 | 6.8 | 43 | 0.6 | |

EC = Electrical Conductivity. $SO_4$ = Sulphate. $NH_3$ = Ammonia

Values in Blue are those less than half the network average. Values in Orange are those greater than double. Values in red are those EC readings that are greater than the calculated EC groundwater salinity value range for this geology as defined in the Port Phillip and Westernport Groundwater Flow Systems.

It should be noted that EC can be affected by the turbidity of the sample. Although EC is a favoured immediate method to indicate water sampled originated from mains, it is considered that fluoride levels are a more reliable indicator. It is noticeable that most of samples returned test results which indicate the water is not mains based. There are four samples that returned ECs of greater than 780µS/cm three from the pavement of Coburn Avenue, and adjacent road. The other, from the landslide on 6 January 2025. Fluoride tests show overall a lower level than the average mains network average.

Water samples returning EC values of > 780 µS/cm may be of water which has potentially higher salinity, i.e. groundwater. The source of this water, or the sources of this water and how and where the water is mixed up to produce water of properties which are not readily identifiable as either mains water, or groundwater, is not known.

Of interest is the flowing water within the stormwater drain at View Point Road on 30 December 2024, and at Prospect Hill Road on 3 February 2025. Both samples suggest the source of water is of potentially lower salinity such as stormwater drainage, or mains water or private water usage.

It is understood that pumping of basements of the houses within 5 -7 Prospect Hill Road was required due infiltration from the customer's own water pipe leak. The leak was identified and repaired in April 2025. The leak resulting in the need for pumping activities, was identified and repaired in April 2025.

From the accounts provided, it is not possible to ascertain that the source of water samples taken since 24 December 2024, come from mains water, private land usage, or groundwater.

# 8. Assessment of hypotheses

## 8.1 That a leak within SEW assets in the vicinity of the subject site

### 8.1.1 Proposed mechanism

A failure within the mains water network introduced water into the surrounding ground. Depending on where the leak was, the water either:

- saturated enough ground to destabilise the escarpment within 10-12 View Point Road, or
- the water flowed along a seepage path to the escarpment within 10-12 View Point Road.

### 8.1.2 Proposed impact and contribution

Water flowing into the escarpment, increases the mass of the soil, and decreases the strength (or ability for particles to physically or chemically bind). Both changes can reduce the stability of a slope.

Alternatively, water finding a subsurface flowpath daylights as a spring within the escarpment. The presence of a spring, results in localised erosion around the area of daylighting, leading to instability uphill. Immediately downhill, the material becomes saturated thus reducing in strength. Erosion downhill occurs as the runoff flows downhill.

### 8.1.3 Evidence required

For the hypothesis to be confirmed, and to fit with observations on site, mains water needs to leak and either saturate the ground, or find a subsurface flowpath in the vicinity of the site whilst:

- not saturating the surrounding slope or leading to additional springs on adjacent slopes, nor
- not saturate the ground to the extent where the ground and structures between the main and the site show signs of distress or damage (e.g. crocodile cracking of pavement).

It is considered **not** possible that a leak close to the site could create such conditions without other evidence of deterioration being observed at the surface.


Figure 57: Map illustrating the evidence needed to confirm the hypothesis that the McCrea Landslide was impacted by a leak within SEW assets in the vicinity of the subject site

Figure 16 and Figure 32 illustrate the distance between the landslide and the location of the water main (located within the verge of View Point Road) is approximately 30 m. The ground level tends to drop across the alignment of View Point Road (see the green arrow, Figure 57).

It is considered highly unlikely that a leak occurring outside View Point Road would cause the slope failure because:

- View Point Road runs along the centre line of a minor spur formed between the escarpment and the valley outfalling at Margaret Street (refer to the green lines indicating crest of escarpment, Figure 57),
- The alignment of the spur (the promontory between the two slopes highlighted in the figure above) is at an angle to the overall dip of the escarpment,
- The general dip of the slope towards the escarpment is oblique to the direction of the buried services along View Point Road.

The limited understanding of the presence of preferential pathways throughout the vicinity of the site, limits interpretation of subsurface flow to mirror ground surface profile, which may be oversimplistic.

It is considered more likely water flows down via Margaret Street (point A and blue arrow, Figure 57). Water from leaks at Charlesworth Street (point B and blue arrow, Figure 57), would flow downhill, westwards. The topography east of Cornells Street would suggest a fanning out of water, as opposed to a concentrated flow of water.

### 8.1.4 Observations

Based on data collected from the location and depth of buried services (Sections 7.4 and 7.5), Drawing 003 presents information relevant to determining a possible flowpath of water from the Bayview Road leak, to the subject site.

Several checks of buried infrastructure by SEW have not provided evidence of leaks nearby. The leaks identified are documented in Appendix A. The Bayview Road leak (reported on 30 December 2024, and repaired on 1 January 2025), is approximately 400 m from the landslip area as noted in Drawing 003.

We consider it likely that the cut slope associated with the Mornington Peninsular Freeway, near to the Bayview Road leak, comprises residual soils. The geotechnical properties of the cut slope are not known at present, but it is considered unlikely that saturation of the cut slope, would lead to a slope distress or failure due to shallow

gradient of the slope. However, it is considered much more likely that the Bayview Road leak would lead to water flow observations such as seepage and ponding at the toe of the cut slope, than impact on the subject site 465 m away.

No evidence of structural subsidence or deformation has been observed beyond the immediate footprint of the landslide.

Contradictory anecdotal evidence from residents in discussion with SEW (Section 7.6.3.4.3) suggests that water may have been flowing for 'some time' within the escarpment within the subject site. Tests carried out in-situ, and via laboratory since 24 December 2024, do not suggest that water at specific locations (Charlesworth Street) originated from water mains. However, it is possible that the chemical properties of mains water alter with time, exposure to soils and distance covered through soils. It is also possible and feasible that mains water mixes with other sources of water, diluting the chemical properties as a result. Where this would happen and whether it was a constant process is not known.

Springs and groundwater upwelling, on public roads along Charlesworth Street, (Drawing 003) may indicate variable and evolving groundwater flows in the locality of the site. Alternatively, they could be associated with the Bayview Road leak.

Further, the observation of free-flowing water within the stormwater pit, outside 6 View Point Road (point A Drawing 003) during the night after the 5 January 2025 landslide, had an EC of 286 µS/cm. Such a value is low to be solely groundwater, according to published documents. Other sources, such as the rain that had recently fallen that evening, mains water, private water usage, or the leak at 5 Prosper Hill Road in this instance, may contribute to this EC value.

Similarly, referring to Drawing 002 and Table 12, it is noted that water sampled from the landslip area the day after the first landslide, returned electrical conductivity results significantly different to results that would be expected from low salinity sources such as mains derived water.

Rainfall data does not suggest a rain event related to the observed water flow.

### 8.1.5 Conclusion

Based on the limited information obtained, it is considered not feasible that known and repaired leaks within SEW assets have impacted to the landslides of 5 January and 14 January 2025.

There are no laboratory tests which indicate water within the landslip, or within stormwater drains around the time of the 5 January 2025 landslip, is solely from mains supply or private water usage. Sampled water could be derived from a combination of both sources or other sources such as the leak at 5 Prospect Hill Road, or rainfall. It is noted that the water taken on 6 January 2025 at the subject site, had an EC level that was very high in comparison with other tests on water sampled in the locality of the site, but not unexpected on a state wide level, according to the published range for groundwater for the site.

It is observed that the slope failure, located within 50 m of the subject site, within the same escarpment occurred in November 2022. The slope failure is currently under separate proceedings. A day before the leak a mains burst was identified and repaired on the day of the slope failure (Section 7.3.2). Additionally, on the day before, over 80 mm rainfall was recorded. The leak led to several areas of surface damage including pavement distress, and sink holes within the adjacent private property. As detailed in Section 7.3.2.2, we conclude the evidence of 15 November 2022 suggests that defects are most likely to occur within the proximity of the burst. It is considered as not feasible that water can flow down buried service trenches and leave the trench without resulting in defects being observed close to (i.e. within 5 m) of the burst.

It is not considered feasible that saturation of soil surrounding a leak, and therefore transfer towards the escarpment could occur without distress of residential properties or pavement formation being observed.

# 8.2 That groundwater or mains water from a leak flowed along SEW Asset trenches

## 8.2.1 Proposed mechanism

The mechanism is that a source of water, either leak, private water use, perched water table, permanent water table, or combination of sources flowed along SEW asset trenches, backfilled with embedment sand or other granular material, outfalling in the vicinity of the site, leading to either:

- Enough saturated ground to destabilise the escarpment within 10-12 View Point Road, or
- the water found a natural buried seepage path that directed it to the escarpment within 10-12 View Point Road.

## 8.2.2 Proposed impact and contribution

For the hypothesis to be confirmed, and to fit with observations on site, water needs to flow through embedment material of either the water main or sewer main (see Figure 35 and Figure 36), from its source. The water would either saturate the ground or find a subsurface flowpath in the locality of the site whilst:

- not saturating the surrounding slope or leading to additional springs on adjacent slopes, or
- not saturating the ground to the extent where the ground, pavement, kerb and structures between the main and the site show signs of distress or damage (e.g. crocodile cracking).

## 8.2.3 Evidence required

The precise location of the source of water for this mechanism is not a key factor. A comprehensive understanding of the groundwater profile of the locality of the site is not available at the time of writing. It is known that the November 2022, 5 January 2025, and 14 January 2025 landslide events took place in summer which is anticipated to be a drier time of the year. As such, groundwater could reasonably be expected to be higher at some point in the past than the level assumed during these periods of time.

In determining the likelihood of the Bayview Road leak impacting on the subject site, SMEC has carried out preliminary calculations to assess the 'travel time' between the source of the leak and the landslide location for different soil types. The results are is presented in the table below. The assumptions for the 'travel time' assessment are:

- 465 m horizontal distance between leak, and subject site
- 45 m of head due to the difference in elevation between location of leak and landslide (leak at 70 m AHD, approximate level of seepage at subject site 25 m AHD).
- Effective porosity of bedding sand of 0.25

Table 13: Assessment of travel time of water between location of Bayview Road leak, and subject site

| Soil type | Assumed hydraulic conductivity (m/day) | Travel time (days over 465 m) |
|---|---|---|
| Clean fine sand | 1 | 1200 |
| Clean medium sand | 10 | 120 |
| Clean coarse sand | 100 | 12 |

It is not possible based on current information to compare these estimates with soil samples from site (Table 6 and Table 7). However, it is likely that surrounding natural material has lower permeabilities due to the fines content (clay/silt) of the material. This assumption leads to the conclusion that water within a trench grading downwards, would tend to flow in the direct of the drop.

The results of the 'travel time' assessment suggest for a time span of two months (the approximate time between the leak starting and 5 January 2025 landslide occurring), a coarse sand would have the required permeability. Such a description could describe the bedding material surrounding SEW assets.

However, based on the assumption that water will find the easiest way to flow downhill, it is considered more likely that the subsurface water flow would continue within the embedment material past No. 10 View Point Road, than stop and saturate ground at the subject site.

Analysis of Figure 35, Figure 36, Figure 39 and Figure 40, and show that the sewerage networks north and south of Coburn Avenue are not connected.

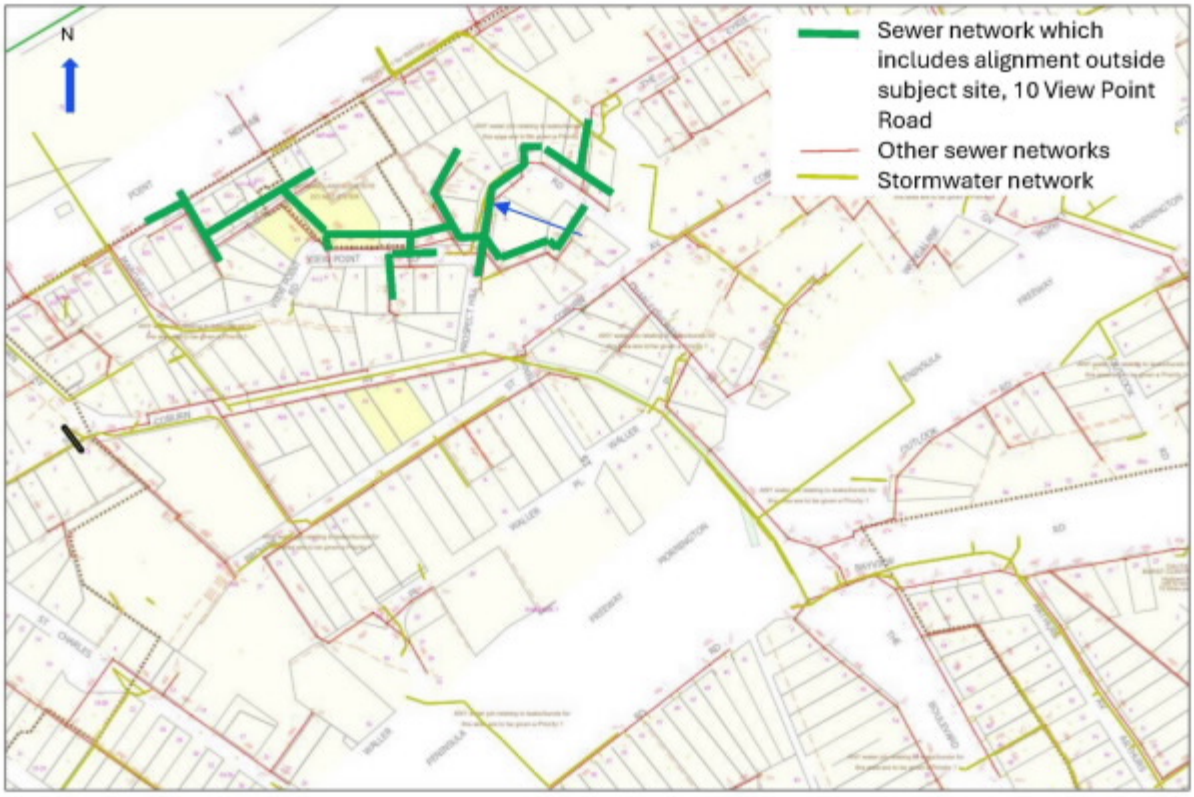



Figure 58: Map illustrating the evidence needed to confirm the hypothesis that the McCrea Landslide was impacted by a leak within SEW assets in the vicinity of the subject site

This means that there is no contiguous trenched network associated with the sewerage that could allow water from significantly uphill of the subject site to reach the site.

The network that connects View Point Road, taking account of gravity, is limited to the green annotated network in Figure 58.

SEW has advised that invert levels of water mains are not recorded, as they follow the ground level between 1.0m and 1.5m below ground level. Therefore, the base of reticulated water trench typically reflects the surface topography and slopes. The base of sewerage and stormwater trenches fall at a grade enabling the water within the pipes to flow under gravity.

A water source remote from the site, for example the Bayview Road leak, does not have a direct flowpath to View Point Road. A route is possible which uses a range of buried service trenches as indicated in Drawing No. 003, transferring between trenches at the T-junction of Charlesworth Street and Coburn Avenue, is feasible, but requires all water to be transferred via upwelling, and therefore it is reasonable to conclude that the majority of the water would continue within the sewer trench down Coburn Avenue.

For water either sourced from, or transported via SEW asset, to impact on the slope failures of 5 January 2025 or 14 January 2025, it is required to migrate from the SEW asset or trench to the slope within the subject site. Figure 57 illustrates the contours of the locality of site and the direction of ground level dip in the vicinity of the

site. Therefore, the migration path from SEW assets to the subject site could feasibly be from any point between in front of 2 View Point Road and 10 View Point Road. Flowing either parallel to the fall of ground level, or across the narrowest point between assets and escarpment, or at a location in between, (see orange alignment within Drawing 003). This is considered highly unlikely as the preferential flowpath for any water is to continue within the embedment material until an obstruction is encountered. The likelihood of just one obstruction along the network happening to be located along View Point Road, and not at any other location is considered to be highly unlikely.

Further, it is not considered feasible that this would occur without other defects (structural and pavement deformation, as observed on 14 November 2022 at 23 Coburn Avenue), being observed.

With reference to Figure 37, Figure 38, Figure 39 and Figure 40, it is reasonable to conclude that the Bayview Road leak did have an impact on the upwelling observations around Charlesworth Street and Waller Place. Further, it is reasonable to suggest that the upwelling is associated with the embedment material of the sewer network at that location. If this is the case, it is therefore reasonable to expect that under similar scenarios, such as pipe junctions, or bends, where water is flowing through the embedment material, that deterioration, not necessarily just upwelling, of the surface should be observed.

### 8.2.4 Observations

Observations indicating a leak at 8 Waller Place were noted since May 2024, which may be associated with the starting date of the leak. The date of the leak commencing is not known at the time of writing but is thought to be before November 2024.

Upwelling of water around Charlesworth Street and Waller Place (Section 7.6.3.2) (Drawing 003), was noted during 1 January 2025 some six hours after the repair of the leak at Bayview Road, but slowed 'right down' approximately 12 hours after the repair works (Appendix A). It is noted that leaks or water observations at that location were noted on 8 January 2025, over a week since the repair to the Bayview Leak. On 13 January, the SEW personnel noted that the ponding and seeping at No. 1 Waller Place had stopped. Although water was still 'coming out of the middle of the road' at No. 3 Charlesworth Street.

Water can feasibly cross Coburn Avenue within the embedment material of the mains close to the T-Junction with Charlesworth Street (Drawing No. 003). However, water would need to infiltrate the water main embedment material from upwelling only as the sewer invert at this location is 1.56 m. This is feasible and moderately likely. But it is more likely that most of the water within the sewer trench would continue within the sewer trench.

The network of sewerage that passes beneath View Point Road includes the stretch of Prospect Hill Road where groundwater issues (pumping needed to run 24/7 at No. 7, and pumping needed at No. 5) have been recorded. It is considered though that this pumping was required due to a leak at 5 Prospect Hill Road. (Section 7.6.3.4.2).

It is considered not feasible that water flows within SEW asset trenches around Prospect Hill Road because the scenario requires water to keep within the trench as it turns a sharp left, traversing contours in front of Nos. 12 to 16 Prospect Hill Road (Drawing 003), and yet migrate from the trench around Nos. 2 to 10 View Point Road.

If this scenario was to occur, it would be expected that pavement distress at this location, similar or less severe than the distress along Charlesworth Street would occur., due to the greater depth of the sewer along Prospect Hill Road, would be observed if water was flowing within the embedment material.

Further, the sewer in front of No 12 Prospect Hill Road is 40 m from the escarpment, and based on information available, topographically and geologically appear to be similar to the subject site. This location is considered to be at similar risk to the subject site, of slope failure, if such a failure was dependent of SEW assets being a significant or primary cause.

With reference to Table 12 and Drawing 002:

1. water samples were taken from the stormwater drain in front of 6 View Point Road (note this is linked to the stormwater drainage system for Prospect Hill Road).
    a. The sample on 30 December 2024, before the finding of the Bayview Road leak, returned electrical conductivity and fluoride results that were not significantly different from results that would be expected from low salinity sources such as mains derived water, water used for irrigation and other

private uses, or storm water. (please refer to Appendix A where rainfall data suggests no rainfall fell on that day).

b. The sample on 8 January 2025, a few days after the 5 January 2025 landslide, returned electrical conductivity and fluoride results that were higher than mains average, but below the published range for groundwater for the area. This water may be derived from mains, private water usage and/or stormwater, and groundwater sources.

It should be noted that some rain fell on the night of 5 January 2025. Whether the volume of rain can account for the description of stormwater flowing through the pipe as observed, is not certain.

2. water samples were taken on 3 February 2025, from the kerb gully, and from the stormwater drain.

   a. The sample from the stormwater drain returned electrical conductivity and fluoride results that were significantly different from results that would be expected from mains derived water, water used for irrigation and other private uses, or stormwater, but below the expected lower limit of groundwater salinity (as calculated for EC) in the area.

   b. The sample from the kerb returned electrical conductivity and fluoride results that were slightly higher than mains average, but significantly below the published range for groundwater in the area. It should be noted that fluoride levels in water do not increase due to natural processes. This water could be derived from mains water, private water usage or stormwater.

Table 13, as well as SEW personnel records, indicate that the samples taken along this route over time, appear to vary in chemical properties, irrespective of known rainfall events, or known leaks. It should be noted that the extent of private water usage is not known. These indicate that there appears no pattern with date, or location as to the chemical properties of samples taken. It is possible, that water samples over this time may be of water from mains or private water usage and/or stormwater and groundwater sources.

There are no comparable samples from elsewhere in the locality of the subject site to indicate a source for the groundwater characteristics of Prospect Hill Road, nor where this water outfalls.

With reference to Figure 37, Figure 38, Figure 39 and Figure 40, The depth to invert at 10 Prospect Hill Place is between 3.75m and 4.36 m depth. The depth to invert along View Point Road is 3.00 m to 3.89 m. The depth to sewer invert along this alignment compared to the alignment described in Figure 37 and Figure 38, is slightly greater. The lack of upwelling along the Prospect Hill Road- View Point Road alignment at locations of junctions or bends (i.e. at locations similar to those locations at Charlesworth Street where upwelling is noted), may be in part due to the depth of the trench. However, if the source of any water within embedment material was the Bayview Road leak, distress such as crocodile cracking and rutting and undulation would be expected at locations where water is saturating the trench backfill but not upwelling. There is no record of this along Prospect Hill Road or View Point Road. It is reasonable to conclude that water from Bayview Road leak did not enter the sewerage trench at Prospect Hill Road, in a similar nature to Charlesworth Street.

### 8.2.5 Conclusion

It is feasible, and moderately likely that the water observations at Charlesworth Street and Waller Place may be associated with the leak at Bayview Road. Table 11 indicates that a time lag between a repair, and the effects of the previous leak, could be days, which is in line with observations made on site.

It is considered not feasible that the cause of water at Charlesworth Street and Waller Place could transfer to the vicinity of the subject site in enough volume to cause a failure without additional defects (i.e. pavement and structural defects) being observed. It is noted the water mains are above sewer mains at this location, and therefore all water transferred between trenches would be via upwelling.

For similar reasons, it is considered not feasible that water from the Bayview Road was transported within SEW asset to the site.

It is moderately likely that water from Prospect Hill Road flowing through the bedding material of the sewerage network would leave the sewer trench in front of Nos. 12 – 16 Prospect Road where a bend in the sewer line, occurs within 40 m of a gully within the escarpment (see Figure 39) as well as leave the sewer trench at No. 10 View Point Road. It is considered not feasible that water would only leave the sewer trench where is passes in front of No. 10 View Point Road

It is considered feasible, but unlikely, assuming the bedding material has a higher permeability than the surrounding natural material, that water within the embedment material continues along View Point Road, down the easement through the land of No. 14 (Figure 40).

# 8.3 That groundwater levels increased within the subject site due to SEW Asset leak and not private water usage

## 8.3.1 Proposed mechanism

This mechanism is that due to the damage in an SEW asset, the volume of water leaked, intensity of flow, and period that the leak was active, locally raised the groundwater level or increased the horizontal flow of groundwater. The groundwater level increased to the elevation that it daylighted within the subject site. The private usage of water was negligible in comparison to the volume of water from the mains.

## 8.3.2 Proposed impact and contribution

For the mechanism to be confirmed, and to fit with observations on site, a volume of water needs to be such that it elevates groundwater or increases groundwater flow beyond which would be normally encountered during periods of high groundwater. This would result in the site experiencing hydrological and hydrogeological conditions that had previously not occurred.

To increase the likelihood of this hypothesis being the primary cause of the landslide, the impact of such a scenario would occur in conjunction with several other characteristics of the site. In combination, these would have created a set of circumstances which had not been experienced by the site. Such impacts may include:

- Change of vegetation cover of the slope, removal of trees, landscaping.
- Impacting the hydrological and hydrogeological environment (retaining wall with drainage measures).
- Change in stormwater or runoff and infiltration management.

Theoretically, works that have impacted on the surface, sub surface, and infiltration of groundwater flow that have elevated groundwater levels and flow could create a hydraulic condition previously not encountered. This is because works can both artificially lower ground water levels, by the channelling of rainwater into engineered drainage systems, and raise them.

## 8.3.3 Evidence required

The required volume, flow, and period during the leak was active, to cause an impact on the site reduces with lower distance between site and leak. As previously noted, the most recent leak was located off Bayview Road, approximately 465 m south south east from the site. Without site specific knowledge of geological conditions, and the variation in groundwater levels, the required volume to raise the ground water level, cannot be estimated.

It should be noted that current anecdotal evidence of continuous flow of water following both 5 January 2025 and 14 January 2025 failures, do not necessarily indicate a continuation of the hydraulic conditions that may have resulted in the failure. This is because the slope topography, and geology differ from prior to the failure.

Based on the event and observations presented, the mechanism to be considered requires a flow originated from:

- A single leak 465 m uphill from the landslide,
  - Creating water flow across a historic surface water channel that outfalled at Margaret Road (Figure 59),
  - but also, across a modern cut that takes the Mornington Peninsula Freeway past McCrae (Drawing 003), and

  - raised the groundwater locally to a site some 20 m wide.
- Seepage, distortion, settlement or failure or other ground movement has not been observed at any location in between the leak and the site. There are observations of welling of water at locations which anecdotally appear to have occurred since May 2024, but with more frequency between 24 November 2024 and 13 January 2025 (Waller Place and Charlesworth Road, Drawing 003).

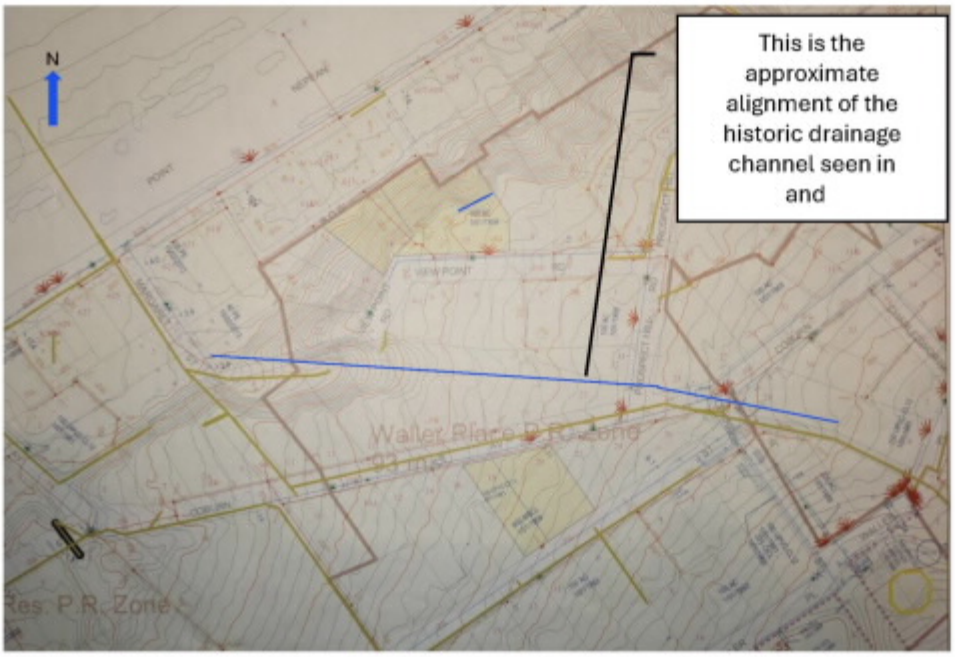



Figure 59: Map illustrating the historical drainage channel in the locality of the subject site, in the context of current development

It is noted that in addition to the possibility of leaks of mains pipes, water enters the subject site, and locality and vicinity of the subject site by:

- Groundwater flow
- Rainfall
- Private water usage

It is noted that all these sources are highly likely, but typically vary seasonally. It is also noted that the chemical properties of private usage water can be that of mains water, particularly for activities like car washing. The volume of private water usage is considered likely to be less than the volume of water from any leak. However, the proximity of water usage to the slope failure is likely to be closer than the proximity of an unreported leak within a buried SEW asset to the slope failure.

### 8.3.4 Observations

Evidence to confirm or dismiss the hypothesis is complicated by the assessment from the 2012 ANZ conference proceedings of the International Society for Soil Mechanics and Geotechnical Engineering allocating a 'high landslide susceptibility' to the subject site. that the assessment was the likelihood of landslides compared to other parts of the local authority area was high irrespective of changes to the conditions of the subject site.

SEW records indicate that the longitudinal crack at the location of the leak was at the bottom of the pipe. Based on current evidence, it is not possible to establish when water first started leaking into surrounds. Estimates of flow rates through the leak can be provided using empirical experience.

On site testing carried out during SEW personnel visits following calls from residents regarding defects (as listed in the appendix of this report) tend to suggest the water is groundwater. Similarly, laboratory tests from samples, listed in Table 12, suggest that the all samples have at least one result which is at variance to the average results for mains water. However, the majority are less than the range that published data suggest for

groundwater for the site. Therefore, we are unable to confidently identify the sources of the samples of water listed in the Table.

With regards to alternative sources, it is not possible, based on available information, to provide a reliable model of groundwater flow. We understand from rainfall data from nearby weather stations that the weather leading up to the 5 January 2025 did not include significant rainfall events (see Appendix A). There is no day by day data to indicate the water usage of individual properties. SEW have provided quarterly water usage of properties but advised that some properties in the vicinity of the site were holiday homes. Therefore, the variation of water usage that may be identified through any analysis of the figures could be caused by incremental living.

We consider it likely that, the toe of the cut slope of the Mornington Peninsular Freeway comprises residual soils. It is feasible that water from a leak is could be stored within the residual soil within the cut slope. With no record of seepage, ponding or other surface distress adjacent to the freeway carriageway known, this is feasible. However, considering the damage that was exhibited by the 23 Coburn Road, from a leak lasting one day ( Section 7.6.3.1), it is reasonable to conclude that an artificial increase in groundwater level is most likely close to the location of a leak.

Therefore, it is concluded that if there is no evidence of elevated groundwater level in cut slope near to a leak, that leak is highly unlikely to have caused an increase in groundwater level to affect the subject site 465 m away.

### 8.3.5 Conclusion

There is not enough evidence to confirm or dismiss the mechanism. However, the likelihood of the failure occurring, without other signs of ground movement, specific to the timeline of the leak, are assessed as highly unlikely.

It is considered more likely that sources other than a leak in the mains, would occur close enough to the subject site to impact on the stability of the escarpment.

# 9. Preliminary Assessment

This desktop assessment, based on current available information, has considered three mechanisms for water originating from SEW assets initiating the landslides at 10 – 12 View Point Road, McCrae. It is considered not feasible that the mechanisms caused the landslides based on the evidence that:

- The site is within an area classified as having a 'high landslide susceptibility by the council in 2012.
- No recent leaks had been detected in the vicinity of the subject site
  - Records of leaks provided by SEW, going back to 2022, has been assessed. Upwelling, reporting of leaks or other observances suggesting asset defects, or localised elevation of groundwater were recorded on 26 November 2024 only,
- There has been no historical precedent to suggest that a leak can affect the ground surface 30m away unless the ground is underlain by a service trench
- There are possible routes for water to flow through the trenches of SEW assets to the subject site.
  - However, it is not feasible for such water to leave the trench specifically at View Point Road, but not at other locations within the network, or
  - cause only a slope failure, but not other defects associated with local saturation of soil, such as pavement and structural deformation.
- Except for the localised defects along Charlesworth St and Waller Place, there have been no pavement or structural defects within the vicinity of the subject site to suggest that an SEW leak has affected local groundwater levels. These defects are characterised by upwelling directly above the buried service trench.
- Sources of water outside rainfall, groundwater and mains water include private water usage, such as irrigating of garden and car washing, are more be sourced closer to the subject site that water from SEW assets.
- Laboratory and onsite tests from samples over the locality (within 500 m) of the site do not indicate water at locations of defects (including the landslide) have chemical properties similar to the average properties for mains water. However, the results are at variance to typical published properties of groundwater for the geology of the area.

Based on current information available other sources of impact such as vegetation clearance and structural work within the subject site, and private water usage within and adjacent to the subject site are more likely to have impacted on the McCrae landslide.

This assessment is based on the evidence available, which does not include evidence of water originating from the SEW assets at, or upstream of, No. 10 View Point Road. It does include the chemical properties of samples taken in the locality of the site. However, we do not have reliable data showing typical groundwater chemical properties within the locality of the site. We strongly recommend that investigations are carried out to improve the knowledge of groundwater chemical properties.

Table 14 lists the factors increasing and decreasing the likelihood of each mechanism.

Table 14: A summary of factors impacting on the likelihood of each mechanism

| Mechanism | Factors increasing likelihood | Factors decreasing likelihood |
|---|---|---|
| That a leak within SEW assets in the vicinity of the subject site | | 'Soundings' or noise testing did not identify leak in mains<br>No leaks identified in sewerage around View Point Road<br>Chemical properties of water sampled from landslip of 5 January 2025 (taken on 6 January 2025) do not indicate mains derived water.<br>No clear reason for leaking water to leave SEW asset trench at, or upstream of the subject site |
| That groundwater or mains water from a leak flowed along SEW Asset trenches | The final flow rate, and the cumulative volume of water lost due to the leak at Bayview Road as greater than the estimated volume and flow rates that could be reasonably expected from natural rainfall events.<br>Water related defects present in Waller Place, Charlesworth Street, Coburn Avenue and Prospect Hill Road.<br>Chemical properties of water sampled from locality of the site, occasionally suggest the sampled water may be sourced from both mains/ private water usage and/or stormwater, and groundwater.<br>A soil of medium to coarse sand would have sufficient permeability for water to reach the subject site from the Bayview Road leak in the time periods suggested by records. | Bayview Road is south of Mornington Peninsula Freeway. For water to flow past the freeway using SEW assets requires following the sewer network, which is graded for the sewer to flow with gravity. However, the sewer network does not connect the trench beneath the freeway with subject site.<br>A link between the Bayview Road leak and View Point Road requires water to flow uphill from sewerage trench to mains water trench at Coburn Ave with Prospect Hill Road (depth to sewer invert is 3.02m) or at the junction of Charlesworth Street and Coburn Avenue (depth to sewer invert is 1.56m), indicating that water would have to flow up to a shallower trench, rather than continue within sewer trench.<br>There is no consistent pattern of chemical properties of water sampled in the locality of the site to suggest a consistent mains water source to the water within the defects.<br>It is more likely that defects similar to Charlesworth Street and Waller Place would occur outside 11 Prosper Hill Road, rather than the slope failure at the subject site.<br>Evidence of stormwater flow within View Point Road, was related to the leak at 7 Prosper Hill Road, indicates that this source is as likely to contribute to any instability, as another source using SEW asset trenches.<br>No clear mechanism for leaking water to leave SEW asset trench at, or upstream of the subject site. |
| That groundwater levels increased due to SEW asset leak and not private water usage | Water related defects within the asset trenches present in Waller Place, Charlesworth Street and Coburn Avenue. Other groundwater related issues noted at Prospect Hill Road.<br>Chemical properties of water sampled from locality of the site, occasionally suggest the sampled water may be sourced from both mains/ private water usage and/or stormwater, and groundwater. | Site has a high susceptibility of landslide risk.<br>Only isolated structural or pavement distress in proximity to asset trenches at Charlesworth Street, Waller Place, Coburn Avenue.<br>No deformation or seepage evident within freeway cut slope, or within pavement.<br>No deformation remote from services.<br>There is no consistent pattern of chemical properties of water sampled in the locality of the slope to suggest a consistent mains water source to the water within the defects.<br>No clear reason for leaking water to leave SEW asset trench at, or upstream of the subject site |

Results of further investigation may change the assessment of likelihoods.

Further investigation on the condition and extent of stormwater drainage embedment material and sewerage embedment material down View Point Road, is recommended. It is also recommended that the invert levels, gradient, condition and jointing details of the stormwater drainage network from No. 12 Prospect Hill Road, to the turning circle of View Point Road, is verified.

It is the expectation that further intrusive investigations will be carried out. The results of these investigations may impact on this assessment and may alter the assessed likelihood of the mechanisms occurring.

# Appendix A

## Chronological event tables

Table 15: Events recorded by SEW during 2022, with select weather data between 13 October 2022 and 5 December 2022

NB. Temperature and rainfall data is recorded from 0900 of previous day, to 0900 of the recorded day

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature ((Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 13/10/2022 | Thursday | | | | | 16.5 | 26 |
| | 14/10/2022 | Friday | | | | | 16.8 | 34 |
| | 15/10/2022 | Saturday | | | | | 17.8 | 0 |
| | 16/10/2022 | Sunday | | | | | 17 | 0 |
| | 17/10/2022 | Monday | | | | | 16.3 | 2.6 |
| | 18/10/2022 | Tuesday | | | | | 19.7 | 0 |
| 2022.1 | 19/10/2022 | Wednesday | 12 Prospect Hill Road | 130 | NE | Repairs to a service pipe leaking | 21.4 | 0 |
| | 20/10/2022 | Thursday | | | | | 21.7 | 0 |
| | 21/10/2022 | Friday | | | | | 25.3 | 0 |
| | 22/10/2022 | Saturday | | | | | 19.9 | 11 |
| | 23/10/2022 | Sunday | | | | | 21 | 0 |
| | 24/10/2022 | Monday | | | | | 19.6 | 0 |
| | 25/10/2022 | Tuesday | | | | | | 3.2 |
| | 26/10/2022 | Wednesday | | | | | 18.4 | 0 |
| | 27/10/2022 | Thursday | | | | | 16.4 | 0 |
| | 28/10/2022 | Friday | | | | | 14.6 | 3.4 |
| | 29/10/2022 | Saturday | | | | | 15.8 | |
| | 30/10/2022 | Sunday | | | | | 20.6 | 3 over 2 days |
| | 31/10/2022 | Monday | | | | | 20.5 | 2.6 |
| | 1/11/2022 | Tuesday | | | | | 13.8 | *0* |
| | 2/11/2022 | Wednesday | | | | | 14.5 | *14.4* |
| | 3/11/2022 | Thursday | | | | | 16.2 | 9 |
| | 4/11/2022 | Friday | | | | | 17.1 | *2.2* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature ((Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 5/11/2022 | Saturday | | | | | 21.5 | *0* |
| | 6/11/2022 | Sunday | | | | | 25.8 | *0* |
| | 7/11/2022 | Monday | | | | | 25.7 | *0* |
| | 8/11/2022 | Tuesday | | | | | 27.4 | *0* |
| | 9/11/2022 | Wednesday | | | | | 28.4 | *0* |
| | 10/11/2022 | Thursday | | | | | 27.1 | *0* |
| | 11/11/2022 | Friday | | | | | 20.9 | *0* |
| | 12/11/2022 | Saturday | | | | | 20.9 | *0* |
| | 13/11/2022 | Sunday | | | | | 25.3 | *0.8* |
| 2022.2 | 14/11/2022 | Monday | 23 Coburn Avenue | 125 | SSE | Responded to burst in front of driveway at 23 Coburn Avenue. Investigation finds all water entered stormwater drain which discharged at the beach.<br>SEW Reporting: [16:51] Burst watermain [100mm ac] in the road. Main on other side of the road so must be where main crosses the road from Prospect Hill Rd. | 16.8 | *80.6* |
| 2022.3 | 15/11/2022 | Tuesday | 14 View Point Road<br>23 Coburn Avenue | 35<br>125 | WSW | Landslip at McCrae. SEW investigates leak and issues red notice. No leak found on SEW assets.<br>SEW Report for Coburn Avenue [04:05] Arrive/set up, drill holes to locate burst, saw cut and remove concrete, shut main and found broken back next to collar, closer inspection revealed second broken back, cut in replace section, slow back charge/flush main, load spoil, fill hole sand/rock compact, pull up broken road water has undermined, more rock required road broke apart under machine tracks, pull up more road and compacted.<br>NB Road reinstatement works at site were completed between November and December 2023. | 13.9 | |
| | 16/11/2022 | Wednesday | | | | | 15.1 | 5 over 2 days |
| | 17/11/2022 | Thursday | | | | | 16.6 | *0* |
| | 18/11/2022 | Friday | | | | | 22.4 | *0* |
| | 19/11/2022 | Saturday | | | | | 21.2 | |
| | 20/11/2022 | Sunday | | | | | 18.2 | 22 over 2 days |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature ((Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 21/11/2022 | Monday | | | | | 13.2 | *6.2* |
| | 22/11/2022 | Tuesday | | | | | 16.9 | *15.2* |
| | 23/11/2022 | Wednesday | | | | | 17 | *0.4* |
| | 24/11/2022 | Thursday | | | | | 17.5 | *1.2* |
| | 25/11/2022 | Friday | | | | | 18.3 | *0* |
| | 26/11/2022 | Saturday | | | | | 27 | *0* |
| | 27/11/2022 | Sunday | | | | | 19.2 | *2* |
| | 28/11/2022 | Monday | | | | | 17.2 | *0.4* |
| | 29/11/2022 | Tuesday | | | | | 19.1 | *3.6* |
| | 30/11/2022 | Wednesday | | | | | 18.7 | |
| | 1/12/2022 | Thursday | | | | | 19 | 0 |
| | 2/12/2022 | Friday | | | | | 24 | 0 |
| | 3/12/2022 | Saturday | | | | | 30 | 0 |
| | 4/12/2022 | Sunday | | | | | 33.3 | 0 |
| | 5/12/2022 | Monday | | | | Customer report and account adjustment for leak | 18.4 | 0.6 |

**Table 16:** Events recorded by SEW during 2023, with select weather data on the relevant days

NB. Temperature and rainfall data is recorded from 0900 of previous day, to 0900 of the recorded day

| Item No. | Date | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|
| 2023.1 | 9/03/2023 | 25 Coburn Avenue | SE | 150 | Responded to a leak from fire hydrant | 22.2 | 2 |
| | 15/05/2023 | Not known | | | Third party damage to SEW service on 3 days, 14, 16 and 30 May. | 21.4 | 0 |
| 2023.2 | 23/06/2023 | 32 Coburn Avenue | ESE | 200 | Responded to a leak on stop tap | 11.1 | 6.6 |
| | 9/08/2023 | Not known | | | Responded to internal leak | 18.2 | 0 |
| 2023.3 | 25/08/2023 | 3 Viewpoint Road | SE | 65 | Responded to leak on stuffing box | 18.6 | 0 |
| 2023.4 | 5/09/2023 | 22 Viewpoint Road | SW | 100 | Responded to a leak from fire hydrant | 13 | 0 |

| Item No. | Date | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|
| 2023.5 | 6/12/2023 | 12 Coburn Avenue | SSW | 160 | Responded to a leak from service | 21.4 | 0 |
| 2023.6 | 6/12/2023 | 16 Waller Place | SSE | 265 | Leak detection, no issues found | 21.4 | 0 |

**Table 17:** Events recorded by SEW between January and July 2022, with select weather data between 13 April 2024 and 19 July 2024

NB. Temperature and rainfall data is recorded from 0900 of previous day, to 0900 of the recorded day

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 13/04/2024 | Saturday | | | | | *17.9* | *2* |
| | 14/04/2024 | Sunday | | | | | *18.4* | *0* |
| | 15/04/2024 | Monday | | | | | *20* | *0* |
| | 16/04/2024 | Tuesday | | | | | *17.8* | *0* |
| | 17/04/2024 | Wednesday | | | | | *17.8* | *0* |
| | 18/04/2024 | Thursday | | | | | *16.5* | *5.2* |
| | 19/04/2024 | Friday | | | | | *18.5* | *0* |
| 2024.1 | 20/04/2024 | Saturday | 8 Waller Place | 260 | SE | Service Pipe leak repair | *17.3* | *0* |
| | 21/04/2024 | Sunday | | | | | *16.7* | *0* |
| | 22/04/2024 | Monday | | | | | *23.5* | *0* |
| | 23/04/2024 | Tuesday | | | | | *24.9* | *0* |
| | 24/04/2024 | Wednesday | | | | | *15.8* | *11.2* |
| | 25/04/2024 | Thursday | | | | | *16.2* | *0* |
| | 26/04/2024 | Friday | | | | | *15.2* | *2* |
| | 27/04/2024 | Saturday | | | | | *17.7* | *0* |
| | 28/04/2024 | Sunday | | | | | *21.8* | *0* |
| | 29/04/2024 | Monday | | | | | *16.5* | *0.8* |
| | 30/04/2024 | Tuesday | | | | | *15.5* | *1* |
| | 1/05/2024 | Wednesday | | | | | *17.9* | 0 |
| | 2/05/2024 | Thursday | | | | | *18.1* | 0 |
| | 3/05/2024 | Friday | | | | | *18.5* | 0 |
| | 4/05/2024 | Saturday | | | | | *17.8* | 0 |
| | 5/05/2024 | Sunday | | | | | *19.2* | 0 |
| | 6/05/2024 | Monday | | | | | *19* | 0 |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 7/05/2024 | Tuesday | | | | | *17.4* | 0 |
| | 8/05/2024 | Wednesday | | | | | *19.3* | 0 |
| 2024.2 | 9/05/2024 | Thursday | Coburn Avenue | 160 | SE | Customer report of road damage due to leak. Leak detection used. No issues found. Note little recent rain. | *18* | 0 |
| | 10/05/2024 | Friday | | | | | *17.5* | 10 |
| | 11/05/2024 | Saturday | | | | | *18.5* | 0 |
| | 12/05/2024 | Sunday | | | | | *18.6* | 0 |
| | 13/05/2024 | Monday | | | | | *16.4* | 0 |
| 2024.3 | 14/05/2024 | Tuesday | Coburn Avenue | 160 | SE | Customer report of road damage due to leak. Leak detection used. No issues found. Note little recent rain. | *15.9* | 0 |
| | 15/05/2024 | Wednesday | | | | | *16.3* | 0 |
| | 16/05/2024 | Thursday | | | | | *17* | 0 |
| | 17/05/2024 | Friday | | | | | *14.3* | 0 |
| | 18/05/2024 | Saturday | | | | | *13.7* | 0 |
| | 19/05/2024 | Sunday | | | | | *13.7* | 1 |
| | 20/05/2024 | Monday | | | | | *15.8* | 8.2 |
| | 21/05/2024 | Tuesday | | | | | *15.7* | 0.6 |
| | 22/05/2024 | Wednesday | | | | | *15* | 0 |
| | 23/05/2024 | Thursday | | | | | *15.6* | 0 |
| | 24/05/2024 | Friday | | | | | *15* | 0 |
| | 25/05/2024 | Saturday | | | | | *15.6* | 0 |
| | 26/05/2024 | Sunday | | | | | *15.1* | 0 |
| | 27/05/2024 | Monday | | | | | *18* | 0 |
| | 28/05/2024 | Tuesday | | | | | *19.9* | 0 |
| | 29/05/2024 | Wednesday | | | | | *19.5* | 0 |
| | 30/05/2024 | Thursday | | | | | *20.4* | 0 |
| | 31/05/2024 | Friday | | | | | *16.2* | 7.4 |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 1/06/2024 | Saturday | | | | | *13.4* | *1.4* |
| | 2/06/2024 | Sunday | | | | | *13.4* | *0* |
| | 3/06/2024 | Monday | | | | | *14.3* | *0* |
| | 4/06/2024 | Tuesday | | | | | *12.6* | *0* |
| | 5/06/2024 | Wednesday | | | | | *14.9* | *0* |
| | 6/06/2024 | Thursday | | | | | *16.5* | *0* |
| | 7/06/2024 | Friday | | | | | 16.3 | *0* |
| | 8/06/2024 | Saturday | | | | | *12.8* | *0* |
| | 9/06/2024 | Sunday | | | | | *14.9* | *0* |
| | 10/06/2024 | Monday | | | | | *14* | *0* |
| | 11/06/2024 | Tuesday | | | | | *14.8* | *5.6* |
| | 12/06/2024 | Wednesday | | | | | | *9.8* |
| | 13/06/2024 | Thursday | | | | | *11.2* | *0* |
| | 14/06/2024 | Friday | | | | | *13.4* | *0* |
| | 15/06/2024 | Saturday | | | | | | *0* |
| | 16/06/2024 | Sunday | | | | | *13.5* | *0* |
| | 17/06/2024 | Monday | | | | | *14.7* | *0.4* |
| | 18/06/2024 | Tuesday | | | | | *11.9* | *0* |
| | 19/06/2024 | Wednesday | | | | | *12.8* | *0* |
| | 20/06/2024 | Thursday | | | | | | *0* |
| | 21/06/2024 | Friday | | | | | 13.4 | *1* |
| | 22/06/2024 | Saturday | | | | | *13.2* | *0* |
| | 23/06/2024 | Sunday | | | | | *14.1* | *0* |
| | 24/06/2024 | Monday | | | | | *13.4* | *0* |
| | 25/06/2024 | Tuesday | | | | | *16.1* | *0* |
| | 26/06/2024 | Wednesday | | | | | *14.2* | *0* |
| | 27/06/2024 | Thursday | | | | | *14.6* | *0* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 28/06/2024 | Friday | | | | | *16.6* | *0* |
| | 29/06/2024 | Saturday | | | | | *13.7* | *0* |
| | 30/06/2024 | Sunday | | | | | *11.9* | *10.8* |
| | 1/07/2024 | Monday | | | | | *12.1* | *4* |
| | 2/07/2024 | Tuesday | | | | | *12.1* | *0* |
| | 3/07/2024 | Wednesday | | | | | *12.3* | *0* |
| | 4/07/2024 | Thursday | | | | | *14.1* | *0* |
| | 5/07/2024 | Friday | | | | | *12.2* | *0* |
| | 6/07/2024 | Saturday | | | | | *9.2* | *0* |
| | 7/07/2024 | Sunday | | | | | *14.2* | *0* |
| | 8/07/2024 | Monday | | | | | *16.6* | *0* |
| | 9/07/2024 | Tuesday | | | | | *13* | *6.4* |
| | 10/07/2024 | Wednesday | | | | | *12.1* | *23.4* |
| | 11/07/2024 | Thursday | | | | | *12.8* | *0* |
| | 12/07/2024 | Friday | | | | | *13.5* | *0* |
| | 13/07/2024 | Saturday | | | | | *12.9* | *0* |
| | 14/07/2024 | Sunday | | | | | 11.9 | *3* |
| | 15/07/2024 | Monday | | | | | *12.9* | *10.6* |
| | 16/07/2024 | Tuesday | | | | | *14.8* | *20.8* |
| | 17/07/2024 | Wednesday | | | | | *14.7* | *0* |
| | 18/07/2024 | Thursday | | | | | *12.9* | *0* |
| 2024.4 | 19/07/2024 | Friday | 8 Waller Place | 260 | SE | Another repair of service pipe leaking | *12.1* | *0.8* |

Please note that no records were received between 19 July and 25 November 2024.

**Table 18:** Events recorded by SEW between August 2024 and January 2025, with select weather data between 19 November 2024 and 25 January 2025

NB. Temperature and rainfall data is recorded from 0900 of previous day, to 0900 of the recorded day

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 19/11/2024 | Tuesday | | | | | *17.6* | *0* |
| | 20/11/2024 | Wednesday | | | | | *19.5* | *0* |
| | 21/11/2024 | Thursday | | | | | 30.2 | *0* |
| | 22/11/2024 | Friday | | | | | *35.7* | *0* |
| | 23/11/2024 | Saturday | | | | | *35.9* | *0* |
| | 24/11/2024 | Sunday | | | | | *22.5* | *5* |
| | 25/11/2024 | Monday | | | | | *19.5* | *3* |
| 2024.5 | 26/11/2024 | Tuesday | 9-11 Viewpoint Road | 0 | | Customer reported water leak; investigation concluded groundwater. Initial SEW area investigation begins | *26.7* | *0.8* |
| 2024.6 | 27/11/2024 | Wednesday | | | | | *29.9* | *23.8* |
| | 28/11/2024 | Thursday | 1 Charlesworth Street | 260 | ESE | Customer reported water leak; investigation concluded groundwater | *23.4* | *14.6* |
| | 29/11/2024 | Friday | | | | | *27.9* | *0* |
| | 30/11/2024 | Saturday | | | | | *22.3* | *0* |
| 2024.7 | 1/12/2024 | Sunday | 2 Waller Place | 260 | ESE | Customer reported water leak; investigation concluded groundwater | 23.7 | *13.6* |
| | 2/12/2024 | Monday | | | | | 30.3 | *3.8* |
| | 3/12/2024 | Tuesday | | | | | 29.3 | *4.4* |
| | 4/12/2024 | Wednesday | | | | | 22.2 | *0* |
| | 5/12/2024 | Thursday | | | | | 31.6 | *0* |
| | 6/12/2024 | Friday | | | | | 28.9 | *0* |
| | 7/12/2024 | Saturday | | | | | | *2.6* |
| | 8/12/2024 | Sunday | | | | | 20 | *0* |
| | 9/12/2024 | Monday | | | | | 20.9 | *0* |
| | 10/12/2024 | Tuesday | | | | | 21.8 | *0* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 11/12/2024 | Wednesday | | | | | 22.6 | *0* |
| | 12/12/2024 | Thursday | | | | | 25.7 | *0* |
| | 13/12/2024 | Friday | | | | | 22.6 | *0* |
| | 14/12/2024 | Saturday | | | | | 24.9 | *0* |
| | 15/12/2024 | Sunday | | | | | 29.1 | *0* |
| 2024.8<br>2024.9<br>2024.10 | 16/12/2024 | Monday | 1 Charlesworth Street;<br>34 Coburn Avenue;<br>The Boulevard | 260<br>22<br>470 | SE | SES and customer at 4 Waller Place reported water leak at 1 Charlesworth Street; investigation concluded groundwater.<br>SES reported water leak at 34 Coburn Avenue; investigation concluded groundwater.<br>Water main burst identified at The Boulevard and repaired. Water was flowing into stormwater drain | | *0* |
| 2024.11 | 17/12/2024 | Tuesday | 4 Waller Place | 270 | SE | Customer at 2 Waller Place reported water leak, investigation concluded groundwater.<br>SEW report: on site water seeping from nature main on other side of road. Gained access to no1 [Waller Place??] water sitting in front yard tested at 225 [EC] meter not turning raining on site. No indication of sew asset leak storm water<br>Later that day SEW report: Margaret Campbell, 4 Waller Pl, called with another report. [We] advised we have already attended and there doesn't seem to be any leaks from the main or nearby. She reports water bubbling up from the ground around No. 1 on the corner of Charlesworth St. | *22.6* | *0* |
| | 18/12/2024 | Wednesday | | | | | 20.9 | *1.6* |
| | 19/12/2024 | Thursday | | | | SEW visit Waller Place/ Charlesworth Street: on site tested water in gutter 352 [EC], stormwater area is beginning to *dry* spoke with resident at no 4 she explained she had not complained but stated this has occurred before as with other areas of seepage storm water in area and are used to it no leak as per previous notes | 29 | *0* |
| | 20/12/2024 | Friday | | | | Fulton Hogan to SEW - advised amount of pressurised water running they [FH] think it's not storm water they checked all the storm water assets on behalf of council & no storm water issues found. Said the road [Charlesworth St | 34.2 | *0* |

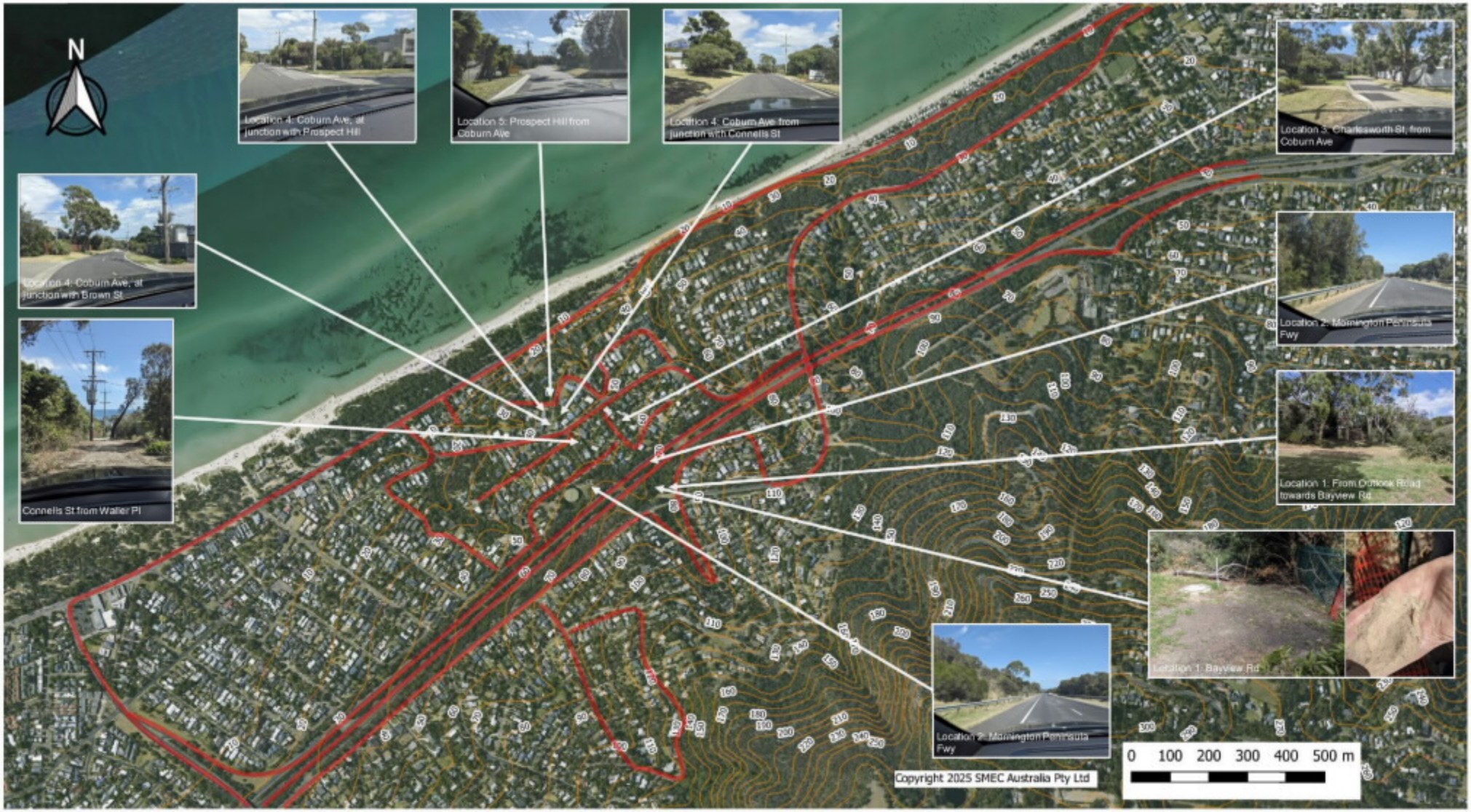
| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | perhaps] is getting bad & might have to close the road down due to water affecting condition of road. | | |
| | 21/12/2024 | Saturday | 3 Charlesworth St and 4 Waller St | | | SEW report: water coming out in 2 spots. 1 in the middle of the road that has bollards around it opp no-3 Charlesworth St & 2 water seeping from the n/strip & going over the road opp no-4 Waller Pl. [tests] have come back as well above mains range between 440 & 540 & the water. No sounds on any nearby service's or f/plugs. There is water pouring in a deep grated drain in the gutter at no-4 & it looks like that is coming from the other side of the freeway. There is a 300mm CICL 300mm MSCL main that runs from the back at no-5 Waller Pl & goes to the other side of the freeway. I then went around there & sounded f/plugs & valves & service's in The Boulevard & along Bayview Rd & was unable to pick up any sounds. The owner at no-5 Waller Pl told me that the water in the grated drain is always running. There is a good flow coming from the leak in the road in Charlesworth St. | 20.6 | *0* |
| | 22/12/2024 | Sunday | | | | | 21.8 | *0* |
| | 23/12/2024 | Monday | | | | | 17.9 | *7.8* |
| | 24/12/2024 | Tuesday | 4 Waller St | | | SEW conducted leak detection in area and water tests.<br>SEW reports: Water is flowing up from the road at 10+ L/min (the road is damaged and getting worse, it has been barricaded off).<br>The storm water drain is raging. There are other locations where the nature strip is extremely saturated with water running onto roadway.<br>I sounded all SEW assets and spoke with residents, I was told there is an underground spring and water often flows into the storm water drain, but is not usually this heavy.<br>We found no leak noises on any SEW assets. | 22.7 | *1.4* |
| | 25/12/2024 | Wednesday | | | | | 30.6 | *0* |
| | 26/12/2024 | Thursday | | | | | 35.6 | *0* |
| | 27/12/2024 | Friday | | | | | 21 | *1.6* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | 28/12/2024 | Saturday | | | | | 21.8 | *0.8* |
| 2024.12 | 29/12/2024 | Sunday | 34 Coburn Avenue<br>1 Waller Place | 160 | SE | Customer reported leak; investigation concluded GW.<br>SEW report of 1 Waller Place: the customer says her fence is underwater and the area is flooded and swampy, is unable to fully close doors | 25 | *0* |
| | 30/12/2024 | Monday | | | | SEW conducted leak detection in area and water tests. | 26.4 | *0* |
| | 31/12/2024 | Tuesday | 1 Waller Place<br>Bayview Road | | | Flooded house foundations and fence under water, unable to close their doors. Road is crumbling and 3 sink holes in the area.<br>SEW report on initial works to fix leak at Bayview Road found at 1300: Arrived on site [1550?]. Dug down and pumped out water to find the surrounding ground collapsing due to high exposure to water, deemed unsafe to complete job as the ground was undermining underneath 2 large trees that could fall at any point. Main approx. 1.6-1.7m to the top of the main with a burst underneath the pipe. Turn one of two valves back on so residents had water but low pressure due to needing to limit amount of water coming out of burst main. Moved approx. 100 m up to try and find the main to cut in valve which we could not find after digging about 2.5 m down which we then backfilled to make safe. | 24.4 | *0* |
| | 1/01/2025 | Wednesday | Charlesworth St<br>Waller Place<br>Bayview Road | | | Repair of pipe burst at Bayview Road:<br>Study of upwelling at Charlesworth Street and Coburn Avenue: Arrived on site [09:15]& water is still coming out of the road opp no-3 Charlesworth St & still coming out of the n/strip along Waller Pl also still running in the grated drain opp no-5 Waller PL I then went to where the burst was opp no-2 The Boulevard & all is dry there. I sounded the 2 valves & the f/plug in the scrub near the job & only picking up sounds from the freeway.<br>Arrived back on site [15:25] & the water flowing in the grated drain opp no-5 Waller Pl has slowed right down but the water flowing out of the pothole opp no-3 Charlesworth St is still the same. I then | *22.9* | *0* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | went inside the property at no-1 Waller Pl as was told water is getting in there. I found water is pooling along the fence line & going back towards the house for nearly 3 m. I then put the probe in the pothole & it went straight down. I spoke with the owners at no-1 Waller Pl & gave them a calling card. I tested the water in the property at no-1 Waller Pl a few times & got readings of around 500 [EC]. | | |
| | 2/01/2025 | Thursday | | | | Began regular leak detection in the area Monday through Friday. | *20.6* | *0* |
| | 3/01/2025 | Friday | | | | | *30* | *0* |
| | 4/01/2025 | Saturday | | | | | *36.6* | *0* |
| 2024.13 | 5/01/2025 | Sunday | 10-12 Viewpoint Road | 0 | | SES requested SEW investigate a leak after small landslip. | *39* | *0* |
| | 6/01/2025 | Monday | | | | Early hours: SEW Report: Arrived to find SES onsite checked FP at #10 View Point Rd no noise. Tested water running down SW pit is not in mains range 286SL spoke to residents at #10 they advise this is the second land slide in the area and the water is a spring that continually runs regardless of the weather checked the backyard can see where the landslide has run down to 3 Penny Lane. Checked the 25mm meter at #10 no noise is not ticking over. Valve for view point id #362909 was buried located with yellow wand marked and painted. Shut valve no noise opened valve no noise, drove down to Penny Lane inspected property and spoke with SES. Water running down the stairs is clean and clear EC test is in mains range. Sounded garden tap good noise located b/valve was buried shut off and noise stopped. Flow down the stairs eventually stopped the water line inside the house has been damaged by the landslide. Took sample from the rear of the house from land slide EC test is not in mains range 1400SL plus.<br>Charlesworth St two spots major pot holes. EC test is 600SL plus other pot hole is just before manhole id #430662. Resident advises the leak has been running for 8-9months. | *18.7* | *0* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | SEW undertook leak detection in the area and water tests.<br>Visited landslip in the daylight hours.<br>SEW Report: Visited 10 View Point Road McCrae, meeting the concerned homeowners. They also own next door (the property in dispute)<br>The residents are also having issues with retaining walls leaning, etc. | | |
| | 7/01/2025 | Tuesday | | | | | *23.2* | *14* |
| | 8/01/2025 | Wednesday | | | | SEW continued leak detection efforts in the area and conducted additional water tests | *29.2* | *0* |
| | 9/01/2025 | Thursday | | | | | *31.3* | *0* |
| | 10/01/2025 | Friday | | | | | *31.9* | *0* |
| | 11/01/2025 | Saturday | | | | | *33.7* | *0* |
| | 12/01/2025 | Sunday | | | | | *26* | *0* |
| | 13/01/2025 | Monday | | | | | *27* | *9.0* |
| 2024.14 | 14/01/2025 | Tuesday | 10-12 Viewpoint Road | 0 | | Primary McCrae landslip occurred.<br>SEW shut down the water supply to View Point Road and installed temporary water supply connections.<br>Reviewed pressure and flow data trends and analysed water quality results from three sites where water surfaced | *27.3* | *0* |
| | 15/01/2025 | Wednesday | | | | Began analysing night flows in the affected area, with crews on-site investigating. Extended water main shutdown and temporary water supply | *23.5* | *0* |
| | 16/01/2025 | Thursday | Western side of Penny Lane | 140 | W | Opened and checked manhole on the to ensure it was unaffected.<br>Isolated water tank at Cornell Street, to test for leaks—test showed no signs of leaks. | *21.1* | *1.4* |
| | 17/01/2025 | Friday | View Point Road | | | Conducted analysis of night flows for water storage tanks.<br>Installed ramps on Viewpoint Road to protect temporary water supply and ensure the area was safe for customers and the community.<br>Waller St storage tank returned to normal operation, no leak from tank or in the vicinity. | *22.4* | *0* |

| Item No. | Date | Day | Location | Distance from site (m) | Direction from site | Comment (derived in part from SEW records) | Max temperature (°C) (Frankston Ballam Park weather station) | Rainfall (mm) (Rosebud Country Club weather station) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Acoustic monitoring of 900MSCL transfer main shows no leak.<br>Arrived on site & picked up no sounds on services where the temp main is set up in View Point rd on the South side of the road. The North side has temp fencing right along it. I then walked along Prospect Hill rd & picked up no sounds. The house at no-7 has a grated drainage pit near the meter & water is constantly following. I tested the water a few times & got readings of around 400. The water is to murky to do a powder test. | | |
| | 18/01/2025 | Saturday | | | | Further leak detection shows no serious issues | *28.7* | *0* |
| | 19/01/2025 | Sunday | 3 Charlesworth St | | | Where the water was coming out of the middle of the road opp no-3 Charlesworth St has stopped. Looks like the council have put in a drainage pipe from the middle of the road to the grated drain in the gutter. The road has been reinstated. | *33.4* | *0* |
| | 20/01/2025 | Monday | | | | | *32* | *0* |
| | 21/01/2025 | Tuesday | | | | | *35* | *0* |
| | 22/01/2025 | Wednesday | | | | | 22.2 | *0* |
| | 23/01/2025 | Thursday | under driveway on Bayview Rd | | | Water main works after midnight to repair leak – part of regular maintenance | *20.7* | *0* |
| | 24/01/2025 | Friday | | | | Further surface water samples taken for laboratory testing | *23.7* | *0* |
| | 25/01/2025 | Saturday | Charlesworth St and Waller Place T-Junction | | | Water stop installed in reticulation sewer | 26.1 | *0* |




| | |
|---|---|
| FIGURE TITLE: | Drawing 001 - Aerial photograph of the locality of the subject site, showing roads driven during the site visit of 3 March 2025, and select photos taken during the site visit |
| PROJECT NO.: | 30043649 |
| PROJECT TITLE: | McCrae Landslip Project |
| CREATED BY: | J.H |
| DATE: | 28/03/2025 |



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|---|---|
| FIGURE TITLE | Drawing 002 - Aerial photograph of the locality of the subject site, showing locations of note |
| PROJECT NO.: | 30043649 |
| PROJECT TITLE | McCrae Landslip Project |
| CREATED BY: | J.H |
| DATE: | 28/03/2025 |



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*South East Water Corporation*

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| | | | | | | | | |

INFORMATION ONLY

SCALE

Not to scale

smec

Drawing title
Summary of observations and proposed modifications of sewer from Bayview Road sub

Drawing CC2 | Sheet 1 | Revision C


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