Investigation and remediation of the Kendall Bay sediments

The blue line defines the EPA regulated area. There is currently an EPA order that prohibits the disturbance of the sediment within the EPA regulated area without EPA prior approval.

Red dots indicate sampling points.
Why are sections of Kendall Bay being remediated?

Kendall Bay was contaminated with gasworks waste as a result of the operation of the AGL Mortlake Gasworks (now the Breakfast Point residential area). Historically the tar waste from the gasworks found its way into the bay through dumping stormwater drains and seepage during the 100-year operation of the gasworks. Two sections of the bay will be subject to active remediation:

- **The bay area near the former wharf along the western side of the bay**
  This will address the presence of intermittent hydrocarbon sheens, which is an indication of concentrated gasworks waste.

- **The beach and mangrove areas at the southern end of the bay**
  This will substantially reduce the total loading of gasworks waste in this area, which in turn will allow the beach to be used for recreational purposes.
What are the toxic elements in the designated areas?

The primary contaminant is coal tar. The chemical compositions of weathered coal tar found in the bay include polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and naphthalene. Naphthalene gives the distinctive "gasworks" smell and TPHs give the "oily" appearance of tar.
What are the levels of toxicity for each element?

PAHs, TPHs and naphthalene are toxic to humans if exposure exceeds health limits.

PAHs contain 16 different types of chemicals including benzo(a)pyrene, which is a confirmed human carcinogen. The overall average benzo(a)pyrene concentrations in the beach and mangroves areas at the southern end of Kendall Bay are 36.6 milligrams per kilogram (mg/kg) for the 0.0 - 0.1 metre sediment depth and 54 mg/kg for the 0.1 - 0.2 metre sediment depth. The national health-based investigation level for benzo(a)pyrene in a recreational setting is 3 mg/kg. Therefore, in some locations where the level of benzo(a)pyrene is as high as 83.4 mg/kg, the contamination in the surface sediment is up to 27 times higher than the health investigation level.

More detailed analysis of contaminant concentrations can be found in the human health risk assessment report prepared by URS Australia Pty Ltd in 2007 (the URS Report), which Jemena has published on its website.
Levels of benzo(a)pyrene in the beach sediments
(Extracts from Figure 5A in the URS Report)

Red boxes show benzo(a)pyrene exceeds the health investigation level. Almost all sampling points show exceedance.

Benzo(a)pyrene is **83.4 mg/kg** at 0.1 - 0.2 metre depth. Health-based investigation level is **3 mg/kg**.

Benzo(a)pyrene is **70.2 mg/kg**.
There is not much clean sediment at the beach and former wharf area. This implies that the natural deposition of clean sediment has been slow. It also means that the public can easily access the contaminated sediment.

Blue dots show thickness of clean sediment = 0 – 0.05 metre (i.e., 5 cm). This implies that this former wharf area is only covered by very little clean sediment.

Yellow dots show thickness of clean sediment = 0.05 – 0.1 metre (i.e., 5 – 10 cm).

Blue dots. This shows the beach has not much clean sediment.
Why is only a small section of the area being remediated?

- The remediation is designed to protect human health and improve environmental outcomes.

- The principal risk is the health hazard for people coming into contact with high concentrations of contaminants. This is most likely in the shore areas, where there is the greatest concentration of contaminants. It is on this basis that those areas are designated for active remediation (refer to previous slides).

- The disturbance of sediment in a greater area is likely to result in the mobilisation of contaminants. This would cause greater and more dispersed harm to Sydney Harbour than leaving the less accessible, stable contaminated sediments in place to accumulate further clean sediments on top.
Have the levels of toxicity increased, decreased or stayed the same over the period of investigation?

The initial sediment investigation was completed in 2006. Jemena has advised there is no noticeable reduction in contaminant concentrations since that time. Based on the properties of the chemicals in question, the EPA believes that without remediation, the level of toxicity will stay the same over a long period of time.
In 2007, URS, on behalf of AGL/Jemena, carried out a human health risk assessment, which modelled how people of different ages undertaking recreational activities in the area may be affected by the contaminated sediments.

The assessment found that the risks associated with the recreational use of the area and the consumption of fish and oysters caught in that area exceed the target risk level, which is an increase in mortality of 1 chance in 100,000 (1x10^{-5}). The calculated risk is in the range between 1 chance in 10,000 (1x10^{-4}) and 1x10^{-5}. These levels are considered unacceptable and therefore support the case for remediation. See next slide for the calculated risks shown in the URS Report.
Non-Threshold Risk applies to chemicals that do not have a “safe dose” below which it poses no harmful effect to people. (See Section 7 of the URS Report for details)

HI means Hazard Index. It is used to quantify harmful effect for exposure to chemicals that show a threshold below which no harmful effect is observed. HI shows the cumulative effect of multiple sub-threshold exposures to several chemicals. If HI is less than 1, cumulative exposure to these chemicals is unlikely to result in harmful effect. (See Section 7 of the URS Report for details)

### Table 7.6 Calculated Risks - Recreational Young Children Reasonable Maximum Exposure (RME) for AGL Mortlake

<table>
<thead>
<tr>
<th>Exposure Pathway</th>
<th>Calculated Non-Threshold Risk (RME)</th>
<th>Calculated HI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingestion of fish</td>
<td>7.9x10^-5</td>
<td>0.20</td>
</tr>
<tr>
<td>Ingestion of oysters</td>
<td>4.8x10^-6</td>
<td>0.013</td>
</tr>
<tr>
<td>Total Exposure from Fish/Shellfish/Oysters</td>
<td>8 x10^-5</td>
<td>0.2</td>
</tr>
<tr>
<td>Beach Areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingestion of sediments in beach areas while wading</td>
<td>4.7x10^-5</td>
<td>0.20</td>
</tr>
<tr>
<td>Dermal contact with sediments in beach areas while wading</td>
<td>1.9x10^-4</td>
<td>0.046</td>
</tr>
<tr>
<td>Total Exposure from Beach Areas</td>
<td>2 x10^-4</td>
<td>0.2</td>
</tr>
<tr>
<td>Mangroves Areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingestion of sediments in mangrove areas while wading</td>
<td>1.1x10^-5</td>
<td>0.57</td>
</tr>
<tr>
<td>Dermal contact with sediments in mangrove areas while wading</td>
<td>3.6x10^-4</td>
<td>0.10</td>
</tr>
<tr>
<td>Inhalation of volatile COPC in mangrove area</td>
<td>NA</td>
<td>0.00074</td>
</tr>
<tr>
<td>Total Exposure from Mangroves</td>
<td>4 x10^-4</td>
<td>0.6</td>
</tr>
</tbody>
</table>
What are the health risks for people who have used the area in the past?

Advice from NSW Health and the NSW EPA is that no-one should use the bay. The risk of health impacts is proportional to the amount of time a person spends in close proximity of the contaminated areas.

If children have been playing in the bay area for the time periods specified in the Health Risk Assessment, there is the potential for health effects to occur. The time period used to derive calculated risks shown in the previous slide is based on young children playing in the beach for 195 days per year. Section 6 of the URS report provides detailed exposure parameters for the risk calculations.

The EPA has directed that signs be used in the area to alert community members to the health risks.
What risks are associated with eating fish from this area?

Advice from NSW Department of Primary Industries is that no fish or crustaceans caught west of the Sydney Harbour Bridge should be consumed. Additional information is available on the Department of Primary Industries' website at: www.dpi.nsw.gov.au/fisheries/recreational/info/sydney-closure.

The level of risk depends on how much seafood from this area is consumed. The risk assessment carried out by URS calculated the risk for recreational adults associated with the ingestion of fish and oysters caught in Kendall Bay to be $6 \times 10^{-5}$ (Table 7.2 of the URS Report), which exceeds the target risk of $1 \times 10^{-5}$. The calculation is based on fish caught and consumed 104 times per year and oyster 52 times per year. See Section 6 of the URS report for details.
Will this remediation remove all risks associated with the contaminants?

- Considerable effort and expense has gone into remediating the former Mortlake gasworks site, which was the source of the Kendall Bay contamination. Therefore there is now no ongoing source of contamination.

- The proposed remediation of the sediments is designed to remove concentrations of contaminants that have the potential to harm users of the bay. The risk assessment criteria are based on conservative exposure scenarios.

- Once the designated areas are remediated, the risks to human health will be reduced to within acceptable health levels. While residual contaminants will still exist in the bay sediment, the exposure pathways to humans will be minimised and the residual contaminants should pose no adverse impact to recreational users of the bay.

- Increases in river traffic could potentially create additional wave action, which may disturb residual contamination at depth in the bay. If such disturbance does occur it may have the potential to mobilise contamination at low concentrations into the harbour. Although this would not increase the level of risk to recreational users of the bay, the management of the bay activities as a whole needs to be addressed in an environmental management plan. See next slide for details.
Who will be responsible for monitoring pollution levels in the bay, post-remediation?

- Monitoring will be conducted during the remediation to ensure that the contaminated sediments are removed and proper pollution control measures are in place. Once the remediation work has been approved by the Contaminated Site Auditor and the EPA, the EPA will consider the need for monitoring the quality of the water and capping material for a period of time to verify the stability of the remediation outcomes.

- The EPA also anticipates that an environmental management plan (EMP) for Kendall Bay will be developed. This will ensure that no unacceptable disturbance of the bay sediment will occur in the future. It is likely that Jemena will fund the development of the EMP and that Roads and Maritime Services (RMS) will implement the EMP. The obligation to comply with the EMP will be embodied into the EPA regulation of the bay.
What is Jemena’s ongoing obligation if further toxicity is found in the future?

In the unlikely event that new information identifies further unacceptable contamination from gasworks waste in the bay, Jemena could be held responsible.
What are the arguments for and against the "do nothing" option?

The advantages of "do nothing" include:

- **It is the least cost option.**
- The remediation cost will be borne by the polluter, and not by the Government or the local community. Although the "do nothing" option would be welcomed by Jemena from a financial perspective, it does not present a sensible and equitable outcome for the Government or local community.

- **It creates no residential disruption**
  - The EPA considers that sediment remediation is no different to other major civil development works. The associated disruption to the local residents can be managed via proper planning and Government Regulations. The long term benefit derived from the active remediation of the bay sediment outweighs the temporary disruption that the remediation project may have to the local residents.

The arguments against the "do nothing" option include:

- **It does not address the risk identified in the human health risk assessment**
  - At present, advice to the community regarding the health risk associated with coming into contact with the contaminated bay sediment is through information signage erected in the beach area. However, much of this signage has been repeatedly removed and destroyed by members of the community who do not want the information warning on display. The EPA has replaced some of this information, but without long term success.

This strategy is not sustainable and leaving this risk in a densely populated residential area is not considered acceptable by either the EPA or NSW Health.
Why was the remediation not done sooner?

- The focus of the clean-up of the former Mortlake gasworks site was to enable the site (now known as Breakfast Point) to be redeveloped. The remediation was completed in 2002 and the site remediation and its subsequent development have been a success.

- Towards the end of the site remediation work, the EPA and AGL turned to the issue of sediment contamination. The information on which to assess the sediments and determine the scope of any remediation was not available at that time.

- The process of investigation, risk assessment, decision on scope of remediation and then the development of a remediation strategy and approval is complex and time consuming. It is understandable that there has been some criticism regarding the length of time to complete the remediation works; however, throughout this process the EPA has engaged with AGL/Jemena, key stakeholders and the community to ensure that the areas of the bay that are frequently used by the community are appropriately remediated.

- The remediation works at Kendall Bay has provided valuable knowledge for the EPA. This knowledge has been used to inform the management of other sediment remediation projects including:
  - Homebush Bay in front of the former Berger Paint site, completed six years after the site remediation.
  - Homebush Bay in front of the Union Carbide site completed concurrently with the site remediation.
  - Hunter River remediated somewhat after the major site remediation works.