

Water Usage and the Disrupted Water Distribution System in Pompeii in the Aftermath of the 62 CE Earthquake

I intend to examine the disruption to Pompeii's water distribution system in the aftermath of the 62 CE earthquake, to determine how water usage differed before and after the earthquake. I will be discussing the damage, reconstruction efforts, and examining how the community's responses to the disrupted water supply varied. I will also explore potential secondary effects of water shortages such as health risks and social unrest, to understand more about the lived experiences of post-earthquake Pompeii.

Seventeen years before the 79 eruption, the wealthy, densely populated Bay of Naples on the southwest coast of Italy suffered its largest seismic event in Antiquity. The date of the earthquake is still debated, and while further seismic activity probably occurred in the run up to the eruption, I will be referring to the earthquake as occurring in February 62, as most contemporary scholars do.¹ Pompeii, near the epicentre of the earthquake, sustained the worst of the damage, and therefore has been assigned a historically-reconstructed Modified Mercalli Intensity Scale rating of IX, meaning the earthquake was considered violent, underground pipes were damaged, and substantial infrastructural damage and liquefaction occurred.² Scholars have also suggested a magnitude of approximately 5.8, but estimates vary.³ According to Seneca, the earthquake 'laid low' Pompeii, and 'also disturbed all the adjacent districts', and while neither Seneca or Tacitus give any indication of the death toll, scholars believe the earthquake caused 'extensive' injuries and deaths.⁴ Damage on this level would have displaced many people in the community. Seneca suggests some Pompeians, presumably members of the elite who had the economic means to do so, emigrated in response, taking their funding with them, which may have resulted in some domestic properties turning into businesses.⁵ In the aftermath of the earthquake the community would have been dealing with many pressures, and responding and adapting to them in a variety of different ways. One of these pressures would be the water shortages caused by ongoing disruption to Pompeii's water distribution system.

¹ Comastri *et al.* 1994: 199, Cubellis and Marturano 2013: 9.

² Cubellis and Marturano 2013: 1.

³ Cubellis *et al.* 2007:140-142, Guidoboni *et al.* 2019.

⁴ Seneca *Naturales Quaestiones* 6.1.1-15, Trincity 2019: 93.

⁵ Seneca *NQ* 6.1.1-15, Curtis 1980: 100.

Prior to the earthquake, the water distribution system in Pompeii was an efficient Augustan-era network which brought water to Pompeii along the Serino aqueduct and into the *castellum aquae*, a reservoir found near the Porto Vesuvio, from which water was distributed through the town.⁶ Three lead mains pipes filled up at least 14 water towers in different parts of the city, from which water was directly piped to at least 43 public fountains on street corners, at least four public bath complexes and into some private properties.⁷ The main purpose of this system was to provide clean running water directly to the street fountains for public consumption, and 88% of properties had fountains within 80m of their front door.⁸ The overflow from the street fountains, alongside rainwater and wastewater from buildings, was drained down the streets and played an important part in the city's sanitation by helping clean the streets, preventing build-up of waste and dirt.⁹ Around 6-12% of excavated properties were fortunate enough to be connected to the water distribution system with pipes designed to allow private users to turn their supplies on and off without disturbing the flow to other users.¹⁰ The whole water system was carefully engineered and relied on gravity to create the necessary pressure for distribution. The steep gradient of 35m between the *castellum aquae* and the lowest part of the city was 'more than adequate to ensure a steady flow' according to Roger Ling.¹¹ Earthquake damage to the water towers, properties, and likely the pipes and aqueduct, disrupted this carefully calculated system, changing the pressure, and preventing water from reaching certain areas.

Pompeii's water system would have been largely imperially funded and managed, with some costs recouped through expensive rates for private use, as Vitruvius writes, 'those who bring water into their own homes can [do so] through taxes'.¹² Taxes likely funded the maintenance and construction of public water usage, including the street fountains, markets, temples, public toilets, and the public bath complexes. Evidence of the latter can be seen in an inscription from a marble basin in the Forum Baths, dating to 4 CE, which was commissioned and overseen by the *duumviri*, and funded 'at public expense'.¹³ Further material evidence of water system management comes from pipe fragments which were found in the open trenches

⁶ Monteleone *et al.* 2023: 1, Ling 2005: 149.

⁷ Monteleone *et al.* 2023: 3.

⁸ Ling 2005: 149-150, Notarian 2023: 111.

⁹ Ling 2005: 152.

¹⁰ Olsson 2015: 73, 10, Jones and Robinson 2005: 699.

¹¹ Ling 2005: 149.

¹² Vitruvius *De Architectura* 8.6.2.

¹³ CIL 10.817, Cooley and Cooley 2014: 113-115.

on Via del Vesuvio where pipes were being replaced in 79. Stamps on these pipes indicated they ‘belonged to the town of Pompeii’, suggesting this work was managed at a local political level.¹⁴ The water distribution system was integrally tied to the political and socio-economic world of Pompeii. Due to the high cost of private water, many wealthy properties built water features, garden fountains and pools as an ‘expression of luxury’.¹⁵ The Augustan-era renovation of the House of the Vestals (VI.1.6-8, 24-26) was built around its newly-installed private water supply designed as a status symbol, which fed a bath suite, an open-air swimming pool, as well as a ‘complex system of water features’ through the public parts of the house including the atrium, the large peristyle and the *triclinia*.¹⁶ The owners collected rainwater for domestic use, further showing piped water was a display of status more than a necessity.¹⁷ The post-earthquake disruption to private water supplies spoiled the Pompeian elites’ property-centred expression of wealth and status, so this property underwent another renovation in response to the reduced flow, which I discuss further on p.9.

Properties which had no private water supply collected rainwater and fetched water from the street fountains. This labour-intensive task of collecting fresh water would largely be undertaken by enslaved people. Matthew Notarian notes, through comparative study of water collection in impoverished areas of the modern world, the stresses of water collection, including pain, musculoskeletal disorders and higher levels of anxiety, can be ‘exacerbated’ by ‘periodic supply shortages’.¹⁸ The repair of fountains was prioritised over private water supplies in post-earthquake Pompeii which likely meant enslaved people were taking more frequent trips to collect water for houses which had previously relied on a piped supply, and therefore their health and quality of life may have suffered. Water collection sites may have become social hubs due to the community’s shared reliance on the facilities. This ‘social geography of water collection’, as Duncan Keenan-Jones puts it, may explain why fountains were frequently constructed on the sites of older wells; to preserve established patterns of community behaviour.¹⁹ Post-earthquake water shortages which disrupted Pompeii’s ‘social geography’, damaged a key aspect of status expression, and worsened quality of life for enslaved people, may have exacerbated existing social tensions. Comparative evidence, such

¹⁴ *Ibid.*

¹⁵ Jones and Robinson 2005: 695.

¹⁶ *Ibid.* 699-701.

¹⁷ *Ibid.* 702.

¹⁸ Notarian 2023: 98-99.

¹⁹ Keenan-Jones 2015: 196.

as the drought in 6th century Constantinople which caused fighting to occur over the street fountains, gives us reason to believe post-earthquake water disruption in Pompeii ‘could well have produced similar outbreaks of social unrest’ as Notarian argues.²⁰

Earthquake damage caused the water distribution system in Pompeii to malfunction, and between 62-79 there appears to have been ongoing water supply issues.²¹ These issues were likely caused by damage to the water system within Pompeii, as well as both bradyseism and direct damage affecting the aqueducts outside the city. The MMI assigned to Pompeii suggests there would have been significant infrastructural damage including damage to water towers and underground pipe damage, both of which would clearly have disrupted the water supplies. Water towers 3-7, and 10 all show evidence of being repaired or rebuilt, and two of the water towers, 12 and 13, were also damaged, but were not repaired.²² This would have disrupted the water distribution because the loss of, or damage to, the towers would have changed the pressure in different areas of the city. A relief from the House of Caecilius Iuncundus (V.1.26) depicts the earthquake damage which occurred in 62. The second panel shows the *castellum aquae*, which remains unaffected, but the leaning buildings depicted around it are illustrative of the extensive destruction, suggesting the *castellum aquae* made a lucky escape in comparison to other parts of the city and the water system.²³ Seneca records an eyewitness account of the earthquake damage to Pompeii’s water system; a man ‘taking a bath’ during the earthquake ‘saw the [bath] tiles [...] separate [...] and come back together again, and that when the floor opened up water was taken into the joints and when it closed back together the water [...] was forced out’.²⁴ This is illustrative of common earthquake damage; cracks caused by buildings moving, which in Pompeii are easily identifiable as they were often repaired with salvaged material.²⁵ Damage from the earthquake is also evident in the Forum baths where ‘the *caldarium* had lost much of its decoration, its bath basin, its heating apparatus and all but the base of its *labrum*’, according to Ann Koloski-Ostrow.²⁶ Further evidence of earthquake damage is found in the Stabian Baths, where the vaulted ceilings had ‘completely collapsed’, rendering the men’s *tepidarium* and *caldarium* unusable,

²⁰ Notarian 2023: 95.

²¹ Keenan-Jones 2015: 211.

²² *Ibid.* 196.

²³ Cooley and Cooley 2014: 40-41.

²⁴ Seneca *NQ* 6.31.3.

²⁵ Comastri *et al.* 1994: 202, Fant *et al.* 2013: 201.

²⁶ Koloski-Ostrow 2009: 233.

and was still unrepaired by 79.²⁷ Baths were integral part of Roman life, and therefore the disruption to these facilities likely had a significant impact on the social world and lived experiences of Pompeians between 62-79.

The secondary effects of this extensive damage may include dirty streets, stagnant water, and water contamination, which increased the risk of disease. The presence of ongoing issues with water contamination in the region can be determined through epigraphic evidence from Herculaneum. Dating to the period after the earthquake, the inscription is a notice on the wall of the water distribution point, warning of beatings for enslaved people and heavy fines for freeborn people, if they were caught contaminating the water by dumping waste.²⁸ It is thought to be covering a similar notice from the 50s, suggesting this was an ongoing issue, but perhaps made worse by the earthquake, hence the need to replace the initial sign in the 60s.²⁹ While I have not found any scholarship on water contamination or disease outbreaks in Pompeii between 62-79, the risk of water contamination would have been high, and it is likely water shortages and disruption to the water supply will have affected the health of the city. The large-scale reconstruction work in Pompeii would have potentially impacted the community's health, because it meant the water supply's exposure to new lead piping dramatically increased, whereas normally the build-up of sinter on older sections of piping created a barrier between the lead and the water.³⁰ This may have created a 'spike' in the lead content of the water, potentially heightening the risk of lead poisoning in the community.³¹ Furthermore, disruption to the water pressure in the street fountains would have prevented the water from overflowing into the streets, therefore in the aftermath of the earthquake we can assume there was a build-up of dirt, debris, garbage and faecal matter in the streets. Diarrheal diseases which may have affected the Pompeians in the aftermath of the earthquake can cause severe dehydration, which would have been exacerbated by the water shortages. If street fountains were cut off from the water supply, the water left in them may have become stagnant, creating ideal breeding grounds for malaria-carrying mosquitos. The Romans appear to have been aware of water-borne diseases in stagnant water, as Pliny the Elder writes 'cistern water [...] is harmful to the bowels and throat because of its hardness, and no

²⁷ Comastri *et al.* 1994: 206.

²⁸ CIL 4.10488, Cooley 2014: 181.

²⁹ Cooley 2014: 181.

³⁰ Keenan-Jones *et al.* 2011: 144.

³¹ *Ibid.*

other water contains more slime or disgusting insects'.³² In the absence of direct evidence of disease following the 62 earthquake we can look at a modern comparison to get a sense of how disease may have occurred. The devastating 2010 Haiti earthquake created ideal breeding grounds for cholera, a 'bacterial disease [...] spread by ingestion of water contaminated by faecal matter', as the Haitians were using the contaminated Artibonite River as a water source, due to a disrupted water distribution system.³³ The subsequent cholera epidemic in Haiti killed around 10,000 people.³⁴ It is a preventable disease if 'clean drinking water and sanitary sewer system' are available, but the damage and displacement due to the earthquake meant the community was 'very susceptible to epidemic' when cholera was introduced.³⁵ While it is important to acknowledge the limitations of comparing case studies from different contexts, for example Pompeii was a wealthy region whereas Haiti was not, the Haiti cholera outbreak can still help us to understand the potentially devastating effects post-earthquake water disruption could have on a community's health.

Several factors likely elongated Pompeii's recovery, which was still ongoing in 79, including the unexpectedness of the earthquake, migration, and a potential lack of imperial aid. While Campania was vulnerable to seismic activity, as Seneca writes, the region 'had never been damaged' in earlier seismic events suggesting the severity of the 62 earthquake was unexpected, and thus ill-prepared for.³⁶ The turbulent last years of Nero, and the civil strife that followed his death, may have also affected the state's response to the disaster. There is no surviving evidence of imperial aid from Nero, with the earliest evidence of support for Campania being a Flavian inscription on the restored Temple of Mater Deum in Herculaneum, dated to 76.³⁷ While it would have taken time to complete this work, and the water supply likely took priority over religious infrastructure, it still suggests there was a significant delay in any imperial response to the earthquake, and therefore, as Comastri *et al* note, 'the people of Pompeii had to organise the rebuilding of the city and its life on their own'.³⁸ Imperial aid in the aftermath of a disaster was not unprecedented in the Roman world, as ancient writers have shown, imperial support was given to Rome following the 64

³² Pliny *HN* 31.34–35.

³³ Nicholson 2010: 38.

³⁴ Houston 2017: 299.

³⁵ Nicholson 2010: 38, Kurzban *et al.* 2015: 18.

³⁶ Seneca *NQ* 6.1.1–2.

³⁷ CIL 10.1406.

³⁸ Comastri 1994: 202.

fire, and Titus sent aid to Campania in 79.³⁹ Additionally, following a brawl at a gladiatorial event in 59, the Senate, in consultation with Nero, instated a ban on games held in Pompeii, which illustrates previous imperial interest in Pompeii, and perhaps shows a degree of animosity towards the region which may explain the lack of state aid after the earthquake.⁴⁰ This apparent lack of imperial funding may have impacted which post-earthquake repairs were prioritised, and potentially fuelled social unrest. It also might indicate that Pompeii was potentially fed by a secondary, much smaller, locally-funded water supply while the imperially-managed Serino aqueduct awaited delayed post-earthquake repairs, which could explain the long-term reduction of the water supply.⁴¹

In the aftermath of the earthquake, repair to the public water supply appears to have been ‘prioritised’, as ‘temporary pipes’ were laid along the pavements, which illustrates the community’s reliance on these street fountains.⁴² Notarian points out that while collecting water from fountains would ‘have been less convenient and more labour intensive than drawing from cistern wellheads inside a home’, especially when less fountains were functioning, and those which were, supplied a reduced amount of water, the ‘use-wear’ on the basins suggests the Pompeians preferred clean piped water to wells.⁴³ By 79 there were still a number of aspects of the water distribution system in varying states of disrepair. According to Keenan-Jones, water tower 8, which was likely constructed as a replacement for the damaged towers 12 and 13, had a much ‘lower elevation’ suggesting ‘that the supply of private properties in the higher land to the north [...] was no longer a priority’ for Pompeii.⁴⁴ Probably because the private supplies were no longer a priority, around a third of the sufficiently catalogued private baths were out of use at the time of the eruption.⁴⁵ Public baths were also out of use, for example the Sarno Baths were still in the process of being renovated.⁴⁶ Some street fountains, and new public toilets built in the Forum, had no supply pipes when excavated, either the result of post-eruption looting, or because they had been disconnected due to earthquake damage, or because they had been recently constructed and were incomplete.⁴⁷

³⁹ Cassius Dio *Historia Romana* 66.23.

⁴⁰ Griffin 1984: 56.

⁴¹ Jansen 2009: 260, Keenan-Jones 2015: 201-202, Comastri *et al.* 1994: 202.

⁴² Notarian 2023: 91.

⁴³ *Ibid.*

⁴⁴ Keenan-Jones 2015: 196-7.

⁴⁵ *Ibid.*

⁴⁶ Olsson 2015: 22.

⁴⁷ Keenan-Jones 2015: 197.

Despite the varying degrees of disrepair in Pompeii by 79, there is also evidence of ‘confidence’ in Pompeii about the future of their water distribution system, illustrated by the construction of the expensive, state-of-the-art Central Baths, which suggests there was an expectation of a return to normal water consumption.⁴⁸ There appeared to have been a lot of investment in re-establishing the water distribution system in Pompeii by 79. As Koloski-Ostrow notes, the damage from the earthquake may have encouraged ‘real-estate speculation in the heart of the city’, as the extensive damage and abandoned buildings would have opened up space needed for ambitious projects like the Central Baths.⁴⁹ There was also ‘substantial’ renovation work in progress at the Suburban Baths, which included the construction of a heated pool, with the expectation water would be provided for it.⁵⁰ Keenan-Jones notes if the Pompeians thought they would never have their pre-earthquake water supply back, they would have brought the ‘public wells [...] back into use’, which didn’t happen.⁵¹ This optimistic outlook for Pompeii’s future and an intention to return to being a wealthy commercial town with costly leisure facilities, contrasts with Seneca’s description of the immediate aftermath of the earthquake, in which people ‘say they will never visit that district again’, perhaps suggesting a shift in people’s attitudes occurred between 62-79.⁵²

While Pompeii seemed to anticipate a return to a pre-earthquake water supply, evidence of adaptation suggests some Pompeians intended to live with the new reduced water distribution system. A reduction in the volume of three street fountains (6, 24 and 37), can be interpreted as evidence of ‘reduced flowrate’ in these regions, and perhaps were intentionally adjusted as an adaptation to the water supply issues.⁵³ However reconnection of street fountains to the water supply was largely prioritised over private water use. This shows Pompeii had to choose between public and private water consumption to deal with their reduced supply, and existing wealth inequalities may have affected these decisions, as the poor would have struggled to fund rebuilding of their damaged homes at all, and certainly could not make major adaptations like the wealthy Pompeians could. As I mentioned earlier, VI.1.6-8, 24-26 underwent a major renovation in the Augustan period, with a private water

⁴⁸ *Ibid.*

⁴⁹ Koloski-Ostrow 2007: 225.

⁵⁰ Keenan-Jones 2015: 196-7.

⁵¹ *Ibid.*

⁵² Seneca *NQ* 6.31.3.

⁵³ Monteleone *et al.* 2023: 13.

supply installed and luxurious water features, pools and a bath suite built but later removed due to post-earthquake issues.⁵⁴ Although the house itself was not badly damaged by the earthquake, without a private water supply its water features were redundant, and were subsequently removed or adapted when the property underwent a post-earthquake renovation. The bath suite was abandoned, swimming pools turned into ponds and the pipe-fed fountains changed to passive water features. A coin minted in 72 found among the demolished bath suite might indicate the owners initially hoped their water would be reconnected, and delayed renovations for over a decade.⁵⁵ These renovations were consistent with the property's frequent redevelopments, to keep up with changing fashions. However, the owners response to the disrupted water supply, which included the complete removal of pipes and the infill of pipe trenches, is still useful as it shows the dramatic and permanent adaptations made due to post-earthquake water distribution issues, and contradicts the optimism narrative, again suggesting there were changing attitudes towards the water system during 62-79.⁵⁶ To provide the necessary water pressure for a fountain, which 'had previously been guaranteed by the piped system', many private properties, including VI.1.6-8, 24-26 and the House of Julia Felix (II.4.3-12) installed elevated cisterns filled with rainwater; an adaptation which illustrates how important fountains were for the Pompeiian elites' expression of status.⁵⁷ Pompeii also appeared to adapt its water distribution system to mitigate the risk of further seismic activity. Construction work on the pipe system appeared to be ongoing at the time of the eruption as ditches were discovered filled with lapilli and pipe fragments, indicating they were open for delayed repair work.⁵⁸ This work was intended to be a much deeper underground network of pipes, presumably as an attempt to protect against further earthquake damage. This risk mitigation can also be seen in the other 'strengthening interventions' employed by the Pompeiians, such as the erection of buttresses in the Villa of Diomedes, and the rebuilding of the columns at the Large Palaestra with lead bases to 'improve adhesion with the soil'.⁵⁹

Water shortages in Pompeii because of earthquake damage were still an issue seventeen years on, potentially due to further seismic activity and lack of imperial aid. The earthquake

⁵⁴ Jones and Robinson 2005: 699-701.

⁵⁵ *Ibid.* 704.

⁵⁶ *Ibid.* 704.

⁵⁷ *Ibid.* 705-6, Keenan-Jones 2015: 197-8.

⁵⁸ Olsson 2015: 17.

⁵⁹ Ruggieri 2016: 498.

significantly disrupted the water distribution system which played a vital role in Pompeii. It kept the streets clean, fed the bathing complexes which were necessary for both the health and social world of the city, supplied clean running water for public use in street fountains which were important socio-spatial locations for the community, and provided piped water into elite properties for status-illustrating water features. I argue that disruption to this system may have had significant social and health implications, especially for the poor or enslaved people. The contradictions between investment in the future of Pompeii's water system and the adaptations of public baths, street fountains and elite properties intending to live with this new normal, suggest Pompeiians had a variety of different experiences of the post-earthquake water distribution, and that their attitudes towards it may have changed over the course of the city's recovery.

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