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## CONNECTIONS TO THE POMPEII WATER SUPPLY NETWORK: ARTISANAL AND COMMERCIAL ESTABLISHMENTS AS PLACES THAT CONSUME WATER

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*Summary. Analyses of the urban distribution of the water supplied from aqueducts have generally focused on those elements directly referred to by Vitruvius (De Arch. 8.6.2): fountains, baths and houses. However, excavations in Pompeii, which has one of the best-preserved water supply networks from antiquity, have revealed that other places also benefited from these connections, including those with an artisanal or commercial purpose.*

*This paper compiles the available information related to water supply in Pompeii and complementary data from new field documentation. It analyses the distribution of these artisanal and commercial establishments in the town and draws attention to their significance and impact on the design and operation of its water supply network.*

### INTRODUCTION

In 2000, A. Wilson argued that ‘most craft production in the ancient world required water for some purpose’, regretting then that ‘despite the ubiquitous use of water in ancient manufacturing, almost no comprehensive study has been made of the subject’ (Wilson 2000, 127). Only now, more than twenty years later, is the position beginning to change.

In this context, this paper is part of a research focused on the analysis of water supply and its uses and management in artisanal and commercial spaces in Roman towns. Faced with the fact that some of those places were connected to the urban water network for their supply, a question is raised immediately. Were those connections numerous enough and was the amount of water actually consumed by those premises enough to have influenced the design of the network? Or, expressed in another way, should our attempts to understand the functioning of the water supply networks also take into account those consumers, and not only the public fountains, baths and some houses? Sadly, such an approach has proved to be difficult, due mostly to conservation issues. In most Roman towns it is difficult or almost impossible to define the functions of the facilities. Therefore, most of the time it is not possible to identify the actual economic activity carried out on the premises. Moreover, most of the pipes that connected the workshops to the distribution network are missing. Faced with this situation, Pompeii presents a useful case study as there is some consensus about the functions of the spaces and a large number of pipes are still in place.

Starting from this proposition, the *AQUA et TABERNA* project collected information about Pompeian facilities linked, according to the published literature, to economic activities. All the data related to the water supply of those spaces were managed through Q-GIS. The raw data are also accessible at [https://3dscanner.es/dev/web\\_pompeya/visor.php](https://3dscanner.es/dev/web_pompeya/visor.php), where the web viewer allows one to search by economic activity or a specific workshop or shop. Both the database and this paper address the different spaces in Pompeii using the traditional system that refers to each facility according to its location in the town, citing the *regio* (neighbourhood), *insula* (block) and *civico* (house number).

In the specific case of Pompeii, the objectives of the project were twofold: firstly, to attempt to determine whether, according to the number of connections that could be identified, a general analysis of the town's water network also needed to take into account *tabernae* and workshops; and secondly whether some kind of pattern could be identified. The aim was to determine whether or not there were economic activities that were more likely to have been connected to the urban network; whether that connection depended on the location of the workshop in the town plan, or whether it was related to a decision of the owners, depending perhaps on their wealth.

However and inevitably, such a project has to remain a work in progress, as the excavations in Pompeii are still on-going, and there are still large areas of the town that have not been excavated, and others need to be revisited with modern methodologies and new questions. As a result, the database will continue to grow in the future as new data become available.

#### STATE OF KNOWLEDGE OF THE POMPEIAN URBAN NETWORK

Pompeii initially appears to have drawn its water from wells that took advantage of the groundwater levels, as well as from rainwater storage cisterns. Most of the 22 wells identified (Schmölder-Veit 2009, 118–19) are believed to have been dug in the second century BC or earlier (Jansen 2002, 71). Although they were still in use at the time of the Vesuvius eruption, some appear to have been repurposed over the centuries, going from being located in public areas to private settings<sup>1</sup> (Schmölder-Veit 2009, 118–19). It also appears that the use of cisterns was more common, at least in private spaces.<sup>2</sup>

Nevertheless, it is assumed that from the Augustan period the most significant element in Pompeii's water supply was the *Aqua Augusta*,<sup>3</sup> which had a branch that served the *castellum aquae* of *Porta Vesuvio*.<sup>4</sup> However, the connection between the main pipeline of the Serino aqueduct and the short section (about 100 m) of conduit flowing into the distributor located at the highest point of

<sup>1</sup> Of the 22 listed wells, 10 appear to have been clearly in private properties from the outset, while the rest are associated, at least when they were first dug, with public spaces.

<sup>2</sup> According to Jansen (2002, 71), due to the difficulty posed by the depth of the water table (25–30 m).

<sup>3</sup> Also known as the Serino aqueduct, it reached as far as Misenum and supplied, according to a late inscription, the towns of Puteoli, Naples, Nola, Atella, Cuma, Acerra, Baia and Miseno (Merlin and Gagé 1939, 51).

<sup>4</sup> Although it has been proposed that Pompeii already received water via an aqueduct at an earlier time. Analysis of calcareous concretions in the entrance channel to the town led Ohlig (2001) to establish two phases in the water supply. According to his hypothesis, the pipeline that, according to the poem composed by Paulino de Nolla in AD 407, supplied Abella and Nolla from the mountains to the north-east of Abella, would also have reached Pompeii in the time of Sulla. Later, under Augustus, the new connection with the Serino aqueduct would have been added. The existence of an urban network prior to the Augustan period is supported by the public fountains dated prior to that time and by a possible *labrum* from the time of Sulla in the House of the Faun (Dessales 2013, 218).

the town has never been documented (Ohlig 2001; Keenan Jones 2010). Shortly before connecting to the *castellum*, the conduit had two branches, probably linked to the supply of peri-urban areas.<sup>5</sup>

The network of lead pipes that would have facilitated the urban distribution of water would have begun at the *castellum divisorium* of the aqueduct.<sup>6</sup> In the Pompeian case, this network had an unusual technical feature: a system of towers distributed throughout the town. They had a twin function: to permit the gradual reduction of pressure and to establish network connection points (Dybkjaer Larsen 1982; Peleg 1996; Wiggers 1996; Monteleone *et al.* 2007).

The height difference between the base of the *castellum* and the lowest part of the town is some 34 m.<sup>7</sup> In the case of a direct connection between the two points, this difference in level would have caused high water pressure in the pipe and excessive force at the destination (especially in the fountains located in the lower sectors of the town). This could have damaged the pipes. Moreover, as it was a continuous flow system (there were no stopcocks in the connections or taps in the public fountains), without dividing the system into sections (by means of the towers and the secondary *castella* located on its peak), the upper parts of the town would have been left without a supply (Peleg 1996).

On the other hand, according to Frontinus, the connections to the urban network would have been from the *castella* and not directly from perforations in the pipes (*De Aq.* CVI, 1). This rule seems to have been largely respected in Pompeii. Most of the towers have deep grooves on one or more of their façades through which the pipes of the main network would have gone up and down, interconnecting the lead tanks in the upper part of the towers. However, smaller diameter pipes would also have emerged from these tanks, their water flowing downwards, and still attached to the tower's fabric (the traces in the concretions left by the water leaks in the upper tanks are still visible). These served for the individualized distribution of water (Jansen 2002, 35; Olsson 2015). Consequently, each permit to draw water would have corresponded to a connection and a pipeline.<sup>8</sup>

Concerning the route of the pipeline network throughout the town, the *castellum aquae* presents three exits that would have connected to individual pipes and which have been related to the probable existence of three main distribution lines.<sup>9</sup> However, the excavations in this northern sector of the town have only identified evidence of two of these main pipelines (Fig 1). The first connected the terminal deposit with Towers 1 and 7, i.e. those located respectively at VI, 16 (with a conduit that would have run below the right-hand side of the *Via del Vesuvio* until it crossed the *Viccolo di Mercurio*). The other was at VI, 13 (running down *Viccolo dei Vetii* until it crossed *Viccolo di Mercurio*). However, there is no agreement on the route followed by the third main distribution line. Some believe the pipeline would have connected directly to Tower 13 (in the small

<sup>5</sup> The *erogationes extra urbem* are cited by Frontinus (*De Aq.* III.2) and are a phenomenon well-known to scholars who research the Roman period (Wilson 1999; Bannon 2009; Kamash 2010; Sánchez 2015).

<sup>6</sup> Although currently ruled out, some proposals (mainly defended by Eschebach 1996) suggested that the *Porta Vesuvio castellum* was not the only one and that there were at least two more in the northern sector of the town, one to the west, in *Insula* 1 of Regio VI, and another towards the east.

<sup>7</sup> According to Eschebach and Müller-Trollius (1993, plan), the base of the *Porta Vesuvio castellum* is at a height of 42.6 m, while the lowest level of the town, at Porta Stabia, is 8.8 m.

<sup>8</sup> Although there appear to be exceptions, perhaps frequent if we observe the need to repeatedly legislate against it – see Frontinus (*De Aq.* CVI, 1) and the Digestus (*Dig.* 43.20.1) – as shown by the pipeline (it seems to be the main one due to its diameter) with a smaller diameter branch found by Maiuri (1942 [2002] pl. XXVII) in the vicinity of the *Casa degli Amorini Dorati*, and which seems to have been heading towards the *fullonica* located at VI 16, 4.

<sup>9</sup> Three lines that we can therefore link to a distribution through the different neighbourhoods of the town (as Eschebach 1983 had already pointed out) and not to a Vitruvian model of functionality.

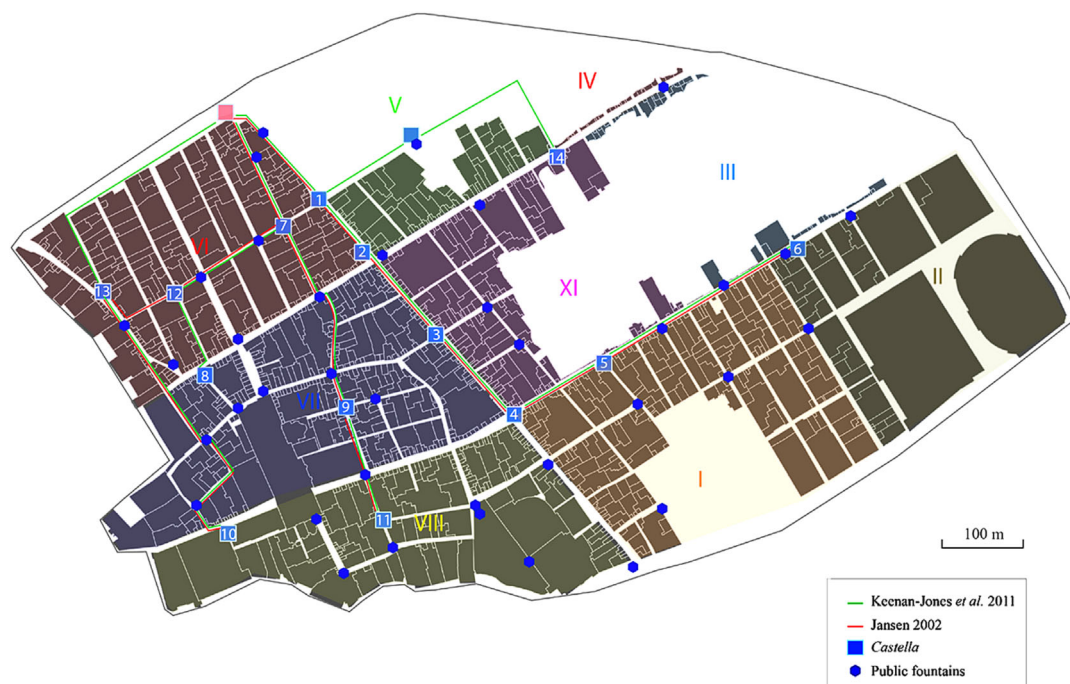


FIGURE 1

Proposals for the reconstruction of Pompeii's water supply network connecting the towers.

square where the *Via Consolare* and the *Viccolo de Narcisso* meet; Wiggers 1996, 29, fig. 1; Keenan-Jones *et al.* 2011, 132, fig. 9.1), while for others the connection would have been with Tower 12 (the *Viccolo de Mercurio* and *Viccolo della Fullonica* crossroads) (Jansen 2002, 40, fig. II.40; Schmolder-Veit 2009, 122, fig. 13; Olsson 2015, fig. 6.1). From these main elements, the water was distributed through lead pipes buried below the pavements or flagstones of the streets, connecting the secondary *castella* of the towers and supplying the fountains and buildings connected to the network.

The divergences in the proposals for the reconstruction of the water distribution network are a direct consequence of its situation at the time of the eruption in AD 79. Traditionally it had been believed that the disappearance of elements linked to the urban network was due to several factors, among which were the salvaging of the pipes in antiquity after the Vesuvius eruption for melting to recover the lead, or their unrecorded removal during the early phases of the excavations (Eschbach 1979, footnote 74, and referred to by Nappo 1996; Jansen 2002, 27). However, Maiuri (1931, 557) had already shown that Pompeii's water supply network was being reformed at the time of the eruption. This was confirmed decades later by Nappo (1996; 2002) who, in digging up long stretches of pavement to install a new water distribution system at the archaeological site, was able to identify the earlier trenches dug to access and replace the pipes. These trenches had filled with volcanic material during the eruption, indicating that they were open at the time and that this was a work in progress.

Much has been debated and written about the reasons behind the major restructuring of the Pompeian water system that was in progress in AD 79 and how it was working at the time of the

eruption. It is generally assumed that the earthquake of AD 62 had affected the network, although opinions among researchers vary as to what extent. Maiuri (1931; 1942) suggests that after the earthquake a provisional network was put into operation to supply only a limited number of buildings, including certain main houses. However, subsequent researchers (Eschebach 1979; Nappo 1996; 2002; De Haan 2001, 46; Keenan Jones 2010, 81) seem to agree that, although the earthquake must have affected the network, it was repaired and returned into service (although perhaps only provisionally), as numerous premises were supplied with water in the years before the cataclysm. According to Nappo (1996; 2002), it would have been the earthquakes prior to the eruption that really damaged the system, requiring a systematic programme of repair that would have meant replacing a network in which the pipes were practically on the surface with another in which they were laid at a greater depth. However, Dessales (2013, 251) considered that this network very near the surface would have been that laid provisionally after the AD 62 earthquake.

#### URBAN SPACES CONNECTED TO THE DISTRIBUTION NETWORK

In general, the excavations at Pompeii have been limited to removing the volcanic fill and revealing the levels of use in AD 79. This, and the state of the distribution network at the time, have limited investigation of the lower levels and prevented the reconstruction of the entire water supply system. It is therefore difficult to identify all the areas that were connected to the system. Despite this, it can be inferred that the fountains distributed throughout the town undoubtedly received water from the urban network, as did some of the public buildings, including the bath complexes. Moreover, the archaeological excavations have made it possible to identify gradually many other buildings connected to the network, including some that were definitely of a private nature.

According to Eschebach (1979, fig. 32, footnote 75), 63 houses were connected to the Pompeian urban network, while Andersson (1994) believes the number would have been 160, since he assumes that all the houses in which a fountain has been documented were connected to the network. According to Jansen (2002, 82, footnote 204) there would have been 91 connected houses,<sup>10</sup> a number similar to that given in 2013 by Dessales. However, sometimes these lists of connections include artisanal or commercial premises in addition to homes.

Eschebach (1979, fig. 32) limited himself to pointing out on the same town plan the houses with a connection to the network and the businesses that would have consumed the most water,<sup>11</sup> (bakeries, laundries, dry cleaners, tanneries, etc.), giving a total of 72 establishments. While on her list, Jansen (2002, 82, footnote 204) includes premises such as the *Fullonica di Stephanus* (I 6, 7); the *pistrina* at I 12, 1.2, V 4, 1.2, VII 12, 11, IX 1, 22.29, IX 3, 19–20; the *officinae lanificariae* at VII 9, 41 or VII 12, 22–23; and catering establishments such as IX 7, 24.25. The same is true of the list offered by Dessales (2013), which includes *fullonicae* such as those at I 6, 7 and VII 14, 21–22 and the *pistrina* at VIII 6, 10 or IX 3, 20. The fact is that in many cases it is impossible to distinguish between domestic connections to the urban water distribution network and those related to productive uses, since the coexistence of different uses in the same space is common.

<sup>10</sup> Although she indicates having reconstructed 107 connections in the towers.

<sup>11</sup> It is not possible to rule out that sometimes the same space was designated as a house and an artisanal establishment, which led to it being counted twice.



The review (bibliographical and on the ground) carried as part of the AQUA et TABERNA project has made it possible to determine that the total number of known dwellings and artisanal and/or commercial premises connected to the urban network currently stands at 144<sup>12</sup> (Fig. 2). Their locations on a town plan, including some in the north-eastern area of *Regio VI*, also seem to suggest that the third pipeline that would have supplied the town from the *castellum aquae* would have connected with Tower 13 on a route parallel to the north-western face of the wall, as proposed by Keenan-Jones *et al.* (2011). Since the area remains mostly unexcavated, this possibility cannot be confirmed at the moment, nor can the presence of other water towers.

#### ARTISANAL AND COMMERCIAL PREMISES IN POMPEII AND THEIR WATER SUPPLY SYSTEMS

Thanks to the state of conservation of the structures and the archaeological record, the functional identification of the artisanal and commercial premises in Pompeii is easier to elucidate than at most Roman-era archaeological sites.

There is general consensus regarding the identification of the numerous *pistrina* (bakeries),<sup>13</sup> *fullonicae* (fulleries or laundries), *tinctoriae* (for dyeing) and the so-called *officinae lanificariae* (wool-cleaning),<sup>14</sup> as their facilities are easy to recognize (La Torre 1988, 82; Flohr 2007, 130). The same is true of other less common but also identifiable cases in the archaeological record, such as the *officina coriariae* (tannery) (I 5, 2) (Leguilloux 2004; Brun and Leguilloux 2014), the pottery workshop (I 20, 2–3) (Peña and McCallum 2009) and the *bottega del garum* (the fish-sauce workshop) (I 12, 8) (Bernal and Cottica 2017). With the rest of the establishments, the graffiti on the walls (text or drawings), sometimes supported by the composition of the material record from the excavations, have led to the proposal of different functions (Della Corte 1965; Eschbach 1993; La Torre 1988; Monteix 2010a). They include *officinae coactiliariae* (felt manufacturers), *sutoriae* (shoemakers), *tegetariae* (basket-weavers), *vestiariae* (clothes shops), *fabri aerarii* and *ferrarii* (metal workers), *lignarii* or *lignarii plostratii* (wood workers); premises for the production of glass, dyes, perfumes, oil and wine; artisans' workshops specializing in mosaic manufacture, stonemasons and even urban allotment plots.

Another matter is the identification of commercial premises. Again, the graffiti refer to *tabernae argentariae* (banks), *pomariae* (fruit shops), *lusoriae* (gambling places), *lactariae* (dairies), bakeries and fishmongers (La Torre 1988, 81). To these we have to add the archaeological identification of a large number – 253 according to La Torre's calculations (1988, 77–8) – of *hospitia*, *cauponiae*, *popinae* and *thermopolia*.<sup>15</sup> The most recent proposals suggest using a

<sup>12</sup> As already pointed out, the complete database is accessible at [https://3dscanner.es/dev/web\\_pompeya/](https://3dscanner.es/dev/web_pompeya/), with a specific bibliography for each of the establishments. The consultation is carried out through a web viewer connected to a database generated in Q-GIS (Sánchez and González forthcoming).

<sup>13</sup> Although different typologies have been observed among the establishments related to the production of bread, Flohr (2007, 131) establishes a differentiation based on the existence of facilities with and without mills, which would have resulted in two different models, one in which the entire process was carried out (beginning with grinding the grain) and another devoted solely to baking. Monteix (2010b, 164–6) establishes a division between those that have space for sale to the public (whether or not they have mills) and those that do not.

<sup>14</sup> These establishments, characterized by the presence of truncated-conical receptacles lined with lead, associated with sinks and structures for heating water, are identified by most researchers with wool washing (Moeller 1966; Borgard and Puybaret 2003).

<sup>15</sup> About the origin and of this terminology in Pompeian archaeological literature, see Monteix 2010a, 89–92.

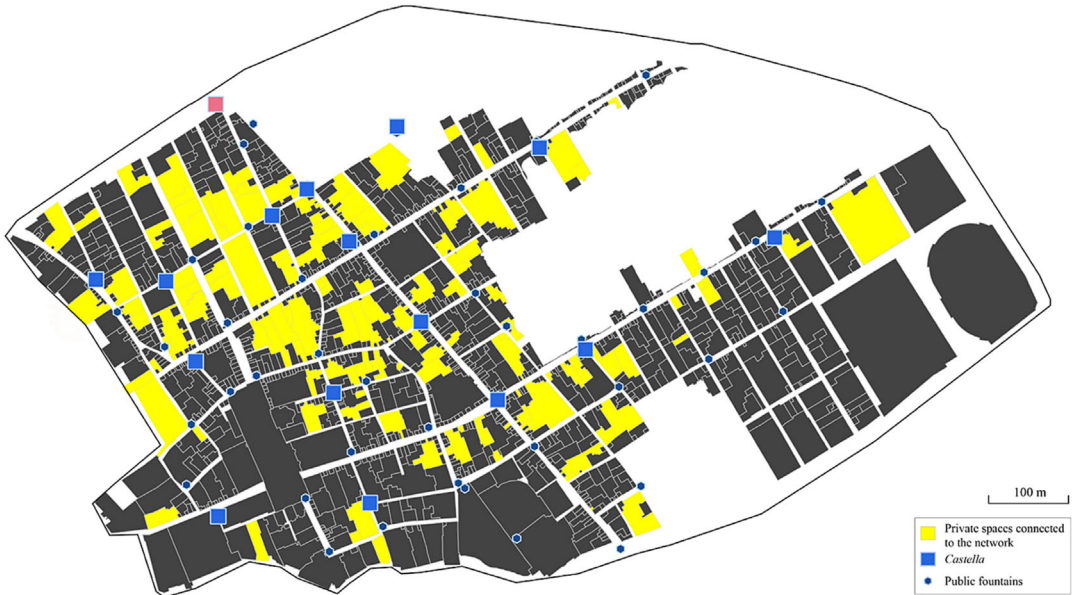


FIGURE 2

Plan of Pompeii with private spaces connected to the network.

simplified nomenclature for these last, defining them generically as food businesses, divided between catering establishments and those dedicated to retail sales (Monteix 2010a). We should not forget the town's commercial premises par excellence, the *macellum* (VII 9, X), the market devoted mainly to the sale of meat and fish and their derivatives (De Ruyt 1983; 2000; 2007).

However, although their identification is still open to debate at times, the reality is that a water supply must have been important, if not essential, in many of the aforementioned activities. Water would have been essential for washing, preparing and dyeing wool and fabrics, curing leather, preparing bread dough or clay, retting vegetable fibres, cooling metal, irrigating market gardens and orchards, and cleaning facilities.<sup>16</sup> Some water needs have left evidence in the archaeological record through the presence of elements linked to its supply, use and drainage.

As in any other context, Pompeian artisanal and commercial premises could have taken their water from wells (taking advantage of the groundwater); from rainwater stored in cisterns; or, as already mentioned, aqueduct water, either via a connection to the urban network or transported manually from the nearest fountain.

As already noted, in AD 79 it appears that water was still being drawn from wells and many of those dug continued in use. Of the 22 wells on the list published by Schmölder-Veit (2009, 118–19), 10 were private and another two had been privatized over time. Some were in places that, at least in the last phase of the town, have been associated with artisanal or commercial activities, such as the one located in the *Casa della Regina d'Inghilterra* (VII 3, 25), where an *officina tintoria* has been documented. It must be taken into account, however, that all these wells appear

<sup>16</sup> For a more general reflection on the role of water in different craft processes in ancient times, see Sánchez 2020 and 2023.

to have been dug in previous phases of the premises in which they were located; therefore the function of the spaces might have been different in the second century BC when they were built (Jansen 2002, 71).

Much more frequent was the use of cisterns to guarantee a supply from stored rainwater. These are commonly documented in Pompeian artisanal and commercial premises, although only in a few cases have they been excavated and emptied, making it difficult to define their size, shape or even the entry point of the water. In general they are only identifiable from the location of the wellhead through which the stored water was accessed.

The AQUA et TABERNA project reviewed some 900 sites in Pompeii linked in the bibliography in some way to economic activities, visiting many of them during active fieldwork campaigns.<sup>17</sup> The result was the identification of cisterns in 145 of the premises related to a commercial or craft activity (Fig. 3). As such, cisterns can be linked to 16 establishments associated with textile work (among them 8 *fullonicae* and 5 *officinae tinctoriae*), 22 *pistrina*, 31 establishments identified in the bibliography as related to lodging or the sale of food, and 74 premises linked to other commercial or craft activities, including the *officina coriariorum*, the pot and the basketry workshops, the *garum officina*, and a whole series of workshops related to specific activities such as woodworking, marble, metals or perfume (Table 1).

The analysis also took into account the connection to the urban water network, yielding a result of 65 establishments, to which must be added 19 where such a connection is probable. Thus, connections to the public distribution network were proposed for 16 establishments associated with textile work (at least eight *fullonicae*, three *officinae tinctoriae* and three *lanificariae*), 23 *pistrina*, 31 establishments for the sale of food, and another 32 related other commercial or craft activities, including the *officina coriariorum* and other workshops (perfumery, blacksmith, a gem workshop).

Finally, there are numerous commercial or artisanal spaces in which the combination of autonomous supply systems (mainly cisterns) to the network is observed. This is the case in 41 establishments, to which must be added another six where this combination can be defined as probable, since the connection to the distribution network is also probable. Within this group, eight textile working establishments stand out (mainly *fullonicae* with six examples) and 16 *pistrina*, eight establishments for the sale of food, and artisanal premises of different types.

#### ARE THERE PATTERNS IN THE IDENTIFICATION OF ESTABLISHMENTS CONNECTED TO THE URBAN NETWORK?

The identification of an increasing number of places connected to the urban network raises the question as to whether or not there were patterns behind this phenomenon (Fig. 4). Beyond the difficulty in identifying the function of some establishments, or, in contrast, the existence of workshops for which the typology of the structures leaves little doubt about their functional attribution, it seems clear that some activities required access to a greater volume of water. This is the case, for example, of the workshops devoted to some of the processes in the textile cycle (*lanificariae*, *tinctoriae*, *fullonicae*). These are easily identifiable thanks to their sinks and basins of different types and sizes in which the wool and cloth was washed or the fibres were dyed. These are among those establishments in which the documentation of structures related to the water supply

<sup>17</sup> Campaigns authorized by the *Parco Archeologico di Pompei* and undertaken during the months of July-August 2021 and January-February 2022.





FIGURE 3  
Plan of Pompeii with artisanal and commercial places with a cistern.

is most frequent – not only the connections to the network, but also the structures for an autonomous supply or the combination of several elements.

Another of the easily identifiable establishments, especially thanks to the presence of ovens and mills, are the *pistrina*. Here again the elements related to water supply are defining. They have been documented in 30 of the almost 50 establishments identified: 15 had a cistern as well as a connection to the network; at least eight more were connected to the network and at least seven others had a cistern. The fact is that a large amount of water is necessary for baking bread, around 50% of the weight of the flour used.<sup>18</sup> In addition, the presence of these supply structures must be related to the water heaters installed in bakeries (Monteix 2010a, 98–9 and 157).

The third large group of establishments with a defined functionality, and for which a considerable number of connections to the network has been documented, are those related to the food sales. These elements must be linked to the water heating structures, generally made of lead, installed on the counters that characterize these spaces (Monteix 2010a, 97–8).

However, in addition to the activities most commonly connected to the network, the existence of some kind of geographical pattern could also be proposed. This possibility has already been raised in relation to the locations of the *fullonicae* along, or close to, the *Via Vesuvius* – *Via Stabiana* axis, considered the sector of the town with the best water supply, based on the number of *castella* identified (Monteix 2010b, 157).

<sup>18</sup> As can be seen from the proportions used by the chef Giorgio Locatelli to recreate Roman bread in collaboration with the British Museum (<https://www.britishmuseum.org/blog/making-2000-year-old-roman-bread>). For his part, Monteix (2010a, 148, footnote 80) proposes, based on a text by Pliny (*NH* 18, 67), 2.6 volumes of flour per one of water, or approx. 38.5%; although he does not mention the possible addition of sourdough and its consequent percentage of water.

# CONNECTIONS TO THE POMPEII WATER SUPPLY NETWORK

TABLE 1

List of Pompeian premises related to commercial or craft activities with water supply infrastructures. Black = yes; Grey = probably; White = no/not documented

Location (main access)	Activity	Connection to the water network	Cisterns
I.6.7	Textile		
VI.8.20	Textile		
VI.13.6	Textile		
VI.14.22	Textile		
VI.16.3	Textile		
VI.16.7	Textile		
VII.3.25	Textile		
I.4.7	Textile		
VI.14.25	Textile		
VII.9.40	Textile		
VII.14.5	Textile		
VII.12.23	Textile		
VII.12.17	Textile		
VIII.4.13	Textile		
I.8.19	Textile		
V.1.5	Textile		
I.3.27	Bakery		
I.12.1	Bakery		
V.4.1	Bakery		
VI.3.3	Bakery		
VI.11.9	Bakery		
VI.14.30	Bakery		
VII.1.25	Bakery		
VII.1.36	Bakery		
VII.1.47	Bakery		
VII.2.3	Bakery		
VII.4.29	Bakery		
VII.12.11	Bakery		
IX.3.19	Bakery		
IX.1.22	Bakery		
I.3.1	Bakery		
I.12.2	Bakery		
VI.6.4	Bakery		
VI.6.21	Bakery		
VI.11.10	Bakery		
VII.12.13	Bakery		
VIII.6.1	Bakery		
VI.14.34	Bakery		
VII.2.22	Bakery		
I.11.1	Catering		
VI.2.4	Catering		
VII.9.33	Catering		
IX.7.25	Catering		
VI.1.5	Catering		
VI.14.28	Catering		
VII.3.1	Catering		
VIII.3.15	Catering		
I.12.3	Catering		
VI.10.1	Catering		
VIII.5.37	Catering		
I.4.27	Catering		

(Continues)

TABLE 1  
(Continued)

Location (main access)	Activity	Connection to the water network	Cisterns
I.9.4	Catering		
I.5.2	Other		
I.6.12	Other		
I.9.9	Other		
I.10.4	Other		
VI.10.6	Other		
VII.2.45	Other		
VII.4.24	Other		
VII.4.63	Other		
VIII.4.4	Other		
I.4.20	Other		
III.9.5	Other		
III.9.6	Other		
VI.1.8	Other		
VII.2.49	Other		
VII.3.3	Other		
VII.3.38	Other		
VII.10.12	Other		
VIII.4.2	Other		
VIII.4.7	Other		
VIII.4.14	Other		
VIII.4.22	Other		
VIII.4.48	Other		
IX.5.7	Other		
I.11.5	Other		
VII.2.48	Other		
VIII.5.24	Other		
VI.2.26	Other		
I.8.3	Other		
II.1.5	Other		
VII.2.44	Other		
IX.4.19	Other		
IX.4.20	Other		
I.7.3	Textile		
V.1.4	Textile		
VI.14.6	Textile		
VI.15.3	Textile		
VI.16.6	Textile		
VII.2.11	Textile		
VIII.5.1	Textile		
IX.3.2	Textile		
I.4.12	Bakery		
I.4.13	Bakery		
V.1.15	Bakery		
V.3.8	Bakery		
V.5.15	Bakery		
VI.5.15	Bakery		
IX.1.3	Bakery		
I.14.15	Catering		
I.2.18	Catering		
I.6.8	Catering		
I.8.9	Catering		

(Continues)

## CONNECTIONS TO THE POMPEII WATER SUPPLY NETWORK

TABLE 1  
(Continued)

Location (main access)	Activity	Connection to the water network	Cisterns
I.8.15	Catering		
I.12.5	Catering		
I.14.1	Catering		
I.21.2	Catering		
II.1.1	Catering		
II.2.3	Catering		
II.9.1	Catering		
V.1.13	Catering		
V.1.25	Catering		
V.4.7	Catering		
VI.1.4	Catering		
VI.4.1	Catering		
VI.4.8	Catering		
VI.8.9	Catering		
VII.2.33	Catering		
VII.13.20	Catering		
VII.15.4	Catering		
VIII.4.25	Catering		
IX.5.16	Catering		
IX.3.14	Catering		
I.6.15	Other		
I.8.13	Other		
I.11.15	Other		
I.12.4	Other		
I.12.12	Other		
I.12.8	Other		
I.14.2	Other		
I.14.11	Other		
I.20.2	Other		
I.21.4	Other		
II.8.4	Other		
V.1.19	Other		
V.1.20	Other		
V.1.27	Other		
V.1.31	Other		
V.2.9	Other		
VI.1.10	Other		
VI.1.14	Other		
VI.2.7	Other		
VI.3.10	Other		
VI.3.15	Other		
VI.4.5	Other		
VI.7.10	Other		
VI.7.20	Other		
VI.8.19	Other		
VI.10.10	Other		
VI.11.4	Other		
VI.12.3	Other		
VI.12.6	Other		
VI.13.1	Other		
VI.13.3	Other		
VI.14.11	Other		

(Continues)

TABLE 1  
(Continued)

Location (main access)	Activity	Connection to the water network	Cisterns
VI.14.10	Other		
VI.14.37	Other		
VI.15.13	Other		
VI.16.5	Other		
VI.17.8	Other		
VI.17.31	Other		
VII.1.28	Other		
VII.4.19	Other		
VII.5.23	Other		
VII.9.46	Other		
VII.9.59	Other		
VII.10.9	Other		
VII.11.10	Other		
VII.15.7	Other		
VII.15.8	Other		
VII.15.9	Other		
VII.15.14	Other		
VIII.5.4	Other		
VIII.5.7	Other		
VIII.5.10	Other		
VIII.5.11	Other		
VIII.5.21	Other		
VIII.5.22	Other		
VIII.7.5	Other		
VIII.7.14	Other		
IX.1.13	Others		
IX.2.5	Other		
VII.7.1	Other		
VII.6.21	Other		

When all the spaces for which there is evidence of a connection to the urban network are marked on a map, in general it appears that they are distributed more or less homogeneously throughout the excavated part of the town. Without taking into account the sectors occupied mainly by public buildings, which have not been included in this study, the number of connected spaces is substantially lower in the eastern half of *Regio* I and a large part of *Regio* VIII, particularly in its southern sector. However, it is difficult to determine whether this image is the result of the current state of research, or whether there really were fewer connections, given that in these sectors there are public fountains connected to the network, although there are fewer secondary *castella* than in other areas.

If we begin with the *fullonicae*, although there are several examples of such premises connected to the network on the *Via Vesuvius* – *Via Stabiana* axis, there are also significant facilities outside of it, such as the *fullonicae* of *Stephanus* (I 6, 7) and *L. Veranius Hysaeus* (VI 8, 20). However, it can be observed that the textile activities connected to the network were mostly in *Regiones* VI and VII and supplied by two of the three main water distribution lines from the *castellum aquae*, where there was a large concentration of secondary *castella*, with seven examples.



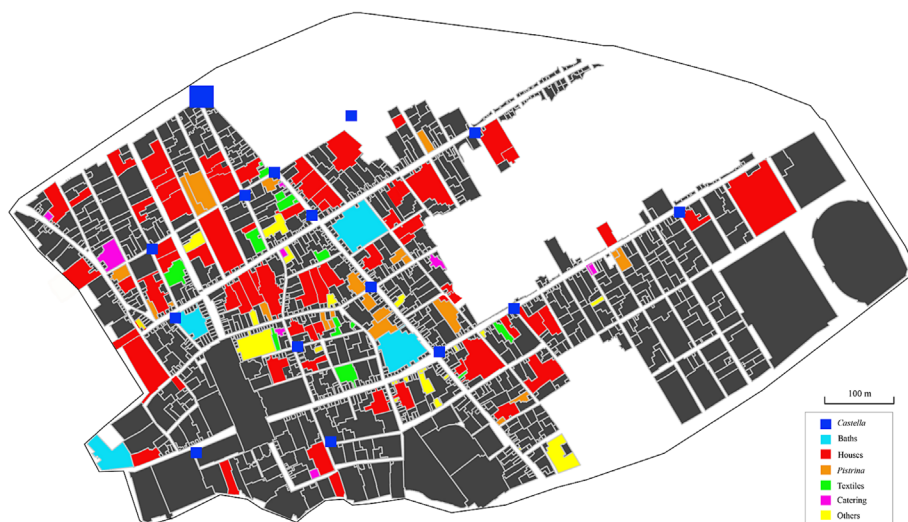


FIGURE 4

Plan of Pompeii with the premises connected to the water network, the *castellum aquae* and the secondary *castella*.

A similar situation, although perhaps not as extreme, is observed with the *pistrina*. However, in this case, more than a third of them are in *regiones* that have not been fully excavated (*Regiones* I, V and IX) and therefore the result is not conclusive. The same is true of catering establishments.

#### MULTIFUNCTIONAL SPACES AND SHARED WATER SUPPLIES

The state of conservation of the structures in Pompeii and the fact that in practice we have a snapshot of the situation at a very specific moment, without any subsequent interventions, allows us to observe issues that are difficult to address at other archaeological sites. In this respect, the aforementioned question of the coexistence of uses in the same space is important; in this case premises with a simultaneous domestic and artisanal/commercial function. This is a coexistence that Pompeian archaeological research has repeatedly highlighted and has led to very different interpretations. Maiuri (1942, 217) saw in the artisanal and commercial use of these domestic spaces a reflection of the town's decline in the years prior to the eruption as a consequence of the damage caused by the earthquakes. The most recent hypotheses (Flohr 2007; 2011) conclude however that the workshops were one more element of the urban landscape and were well integrated within the domestic environments (even in the case of some large *domus*) where, in most cases, they shared spaces.<sup>19</sup>

The multi-functionality of the spaces also raises questions in relation to the water supply, with the existence of supply structures potentially usable by the different activities – both of a domestic and an economic nature – carried out in those spaces. This is the case, for example, for

<sup>19</sup> According to Flohr's analysis (2007, 144), the archaeological reality would indicate that 79% of the Pompeian workshops were directly connected to a private residence.



FIGURE 5

Water pipes in the *Casa di Narciso* (VII 12, 17.21). Images published with the permission of Ministero della Cultura - Parco Archeologico di Pompei.

establishments such as the *fullonica di Vesonius Primus* (VI 14, 21–22), where the archaeological record has confirmed the coexistence of the working facilities and the domestic use of a large part of the dwelling (Flohr 2005, 59). In this case, in addition to the cistern in the peristyle, the sector of the house where the *fullonica* was located and the installation of the commercial facilities in the second half of the first century AD coincided with the establishment of a connection to the urban distribution network (Flohr 2005, 56–7). The pipeline previously identified by Jansen (2001, 32–3)<sup>20</sup> supplied water to both the workshop (reaching the farthest pool in the complex) and the fountain in the atrium.<sup>21</sup> A similar shared use, combining the ornamental function with a supply to the artisanal facilities (Monteix and Sánchez forthcoming), has also been observed at the *officina lanificaria* in the *Casa di Narciso* (VII 12, 17.21) (Fig. 5) and the *Casa di Siricus* (VII 1, 25.46–47), where there was a bakery.

The circumstances in which this twin use of the *aqua publica* took place are, however, difficult to define. Frontinus only explicitly mentions the use of this water by one type of artisanal activity, the *fullonicae* (*De Aq.* XCIV, 3–4), and complains about the illegal connection of *tabernae* (*De Aq.* LXXVI, 2) and *negotiationes* (*De Aq.* CXV, 3). However, in other sections of the text he mentions the existence of *privatorum usibus* (private uses), to which a high percentage of the water consumed in Rome appears to have been devoted.<sup>22</sup> We have argued elsewhere (Sánchez 2023) that those private uses could also have included artisanal establishments. The question remains as to whether it could be precisely these shared uses (water used both for artisanal and domestic purposes within a premises) that Frontinus is referring to when denouncing the fraudulent connections to the

<sup>20</sup> And recognized again through the use of a metal detector during a fieldwork campaign carried out in April 2022 as part of the AQUAROLE Project (Monteix and Sánchez forthcoming).

<sup>21</sup> Flohr (2005, 57) mentions a fountain in the *impluvium*; while Jansen (2001, 33) mentions two (one on a pedestal and another in the middle of the *impluvium*).

<sup>22</sup> According to Bruun's (2000, 588) calculations based on data provided by Frontinus throughout his works, 38% of the water distributed by Rome's aqueducts would have been for private use. This we believe (Sánchez 2023) includes not only houses.





FIGURE 6

Access rim to a cistern located on the dividing wall between two establishments: I 8, 14 (*Casa di Epidius Primus*) and I 8, 15 (*caupona e officina di Fufidius Successus*). Image published with the permission of Ministero della Cultura - Parco Archologico di Pompei.

network. However, it seems unlikely that such a widespread phenomenon as the connection of these artisanal and commercial spaces to the urban distribution system was by definition illegal.

A different issue is that of the shared use of the water from the cisterns. In addition the use of this type of structure to supply both domestic and craft activities in a home, their shared use with neighbouring spaces has also been documented. Thus, excavations in *Insula I* of *Regio V* have revealed cisterns in V 1, 4 (*oficina infectoria*) and V 1, 31 (a catering establishment) supplied from the atrium *impluvium* of V 1, 3 (a house adjoining the *Casa del Torello di Bronzo*, V 1, 7) (Leander Touati 2010, 126). Another type identified is that of the cisterns whose access rims were located on the dividing wall between two establishments, making the water accessible from both. This situation has been observed between the premises at VIII 5, 10 and VIII 5, 11; VIII 5, 10 and VIII 5, 9; and I 8, 14 (*Casa di Epidius Primus*) and I 8, 15 (*caupona e officina di Fufidius Successus*) (Fig. 6). The aforementioned establishments in *Regio V* were not connected to the house from which the water that filled their cisterns came, at least not at the time Vesuvius erupted. Nor does it seem that, in the case of the listed cisterns accessible from two different establishments, there were further connections beyond that. However, the use of shared water supply structures may be indicative of a single owner who either directly operated or rented the establishments thus connected.

#### CONCLUSIONS

Traditionally, studies of urban water management in Roman times have taken into account as spaces connected to the public network those directly mentioned by Vitruvius (*De Arch.* 8.6.2): fountains, baths and houses. However, research carried out in Pompeii, which has one of the best-preserved water supply networks from antiquity, has long shown the existence of other places that also benefited from these connections. Nevertheless, these had only been the object of attention in very specific cases, especially in relation to workshops integrated into houses in which a domestic use was also maintained. No attempt to summarize the connection of artisan and commercial premises to the network has ever been made. The result of this first endeavour has been the identification of at least 65 such establishments connected to the urban water distribution system. This is a low figure in relation to the total number of shops/workshops (600 according to Monteix (2010b, 148) and probably more than 800 according to the results of this study). However, this figure is increasing as excavations using modern documentation systems progress and are published.

Consequently, the available data indicate that these places were also important consumers of water, which is why they must be taken into account when understanding the town's water distribution and consumption system. In fact, in addition to the public baths complexes, the 44 fountains distributed around the streets and the more than 80 houses connected to the network, at least 65 commercial or artisan establishments were also connected. This figure, compared to that of the rest of the connected spaces, makes them important consumers. In fact, their water requirements, although for more mundane purposes, must have influenced the design of the urban network in the same way, immersed as it was in a reform process at the time of the Vesuvius eruption. However, today it is difficult to gauge the actual water consumption of the different spaces connected to the network. Only detailed calculations of the water supply and a complete modelling of the network will allow us in the future to calibrate the true consumption of each of the connections and determine how each of the uses influenced the design and operation of the town's water supply network.

The current state of research does not allow us either to gauge the existence of any pattern in the connections to the water supply network, beyond the fact that some activities needed larger amounts of water, and were thus frequently connected to it. At least 16 of the more than 50 textile workshops known to date were connected; as were 23 of the 47 bakeries. However, no clear geographical pattern could be identified. A third factor that could also have played an important role in the connections to the network was the owner's wealth, given that they must have entailed some kind of payment (Sánchez 2023) that possibly not everyone could afford. In some cases, the workshops were inside or connected to large and richly decorated premises; features that can be considered an indication of the economic and social position of the owners. It is, for example, the case of the *fullonicae* of *Vesonius Primus* (VI 14, 21–22) and *Stephanus* (I 6, 7) where in both cases the workshops were located at the rear of the house. Another example is the *fullonica* of *Manius Salarius Crocus* (VI 16, 3–4), which is somehow related to the *casa degli Amorini Dorati* (VI 16, 7), as the pipe supplying water to the workshop was also connected to the neighbouring house (Monteix *et al.* 2019). In other cases, however, it is difficult to determine the relationship between the premises and the adjacent houses. Therefore, it is impossible to define the wealth of the owners and whether this was the reason that explained the connection to the network.

#### Acknowledgements

This paper is the result of the research project *AQUA et TABERNA. Abastecimiento de agua a establecimientos artesanales y comerciales en Pompeya* financed by the BBVA Foundation LOGOS programme of research grants in the area of Classical Studies. Funding for open access charge: Universidad de Granada / CBUA.

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doi: 10.1111/ojoa.12284

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