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Chapter 6: Diachronic Discussion

6.0: Introduction

Detailed information on the distribution and chronology of the hydraulic systems of individual buildings in each *insula* were presented into Chapters 3, 4, and 5. Together with each of these data chapters came a section (3.1, 4.1, 5.1) that aggregated this data chronologically, presenting the total hydraulic biography of each insula over its entire life. These latter sections applied the Roman Water Footprint method to integrate the hydraulic systems of each insula into the wider environmental and cultural landscape of Ostia in each time period. In this chapter, the contextualized understanding of each insula is compared to the other case studies from a chronological perspective. In this way, similarities and differences between the insulae can be identified in each time period. This also acts as a final litmus test to determine how representative the data from any one insula is when compared with the available evidence for the wider city.

6.1: Roman Water Footprint #1 (4th century BC- 50 AD) in insulae III, i; IV, ii; V, ii

The earliest evidence for hydraulic infrastructure is lowest in this period (4th century B.C.- AD 50) across all insulae (Table 6.64). Although this may be a result of the minimal Republican structures excavated in the case studies and the wider city, it may equally indicate a real evidence of absence.

In terms of water supply, insula V, ii has the most number of features, excelling especially in terms of rain water collection (Figure 6.298). This is in stark relief to insula III, i, which has no evidence for rain harvesting in this phase or throughout its entire history. As this period is defined as the pre-aqueduct phase, no aqueduct supply systems are therefore present. This makes the presence of wells no surprise, yet one would expect there to be *more* wells present. This low number of wells must then imply that water was obtained at wells in the forum, or acquired from the Tiber river. The number of water usage features is very low, with only two known water usage features identified across all three insulae. Known usage features are all located within domestic contexts. A similar situation is present for the drainage systems, with only five identified features. Other than a handful of scattered drains in V, ii there are minimal traces of these features in any of the case studies. When comparing the total hydraulic infrastructure of all three insulae in this time period, very few parts of the system are identifiable (Figure 6.299). What is clear, however, is that the hydraulic systems are only present in domestic circumstances (IV, ii and V, ii), and that in these domestic buildings there is a desire to use both rain and ground water resources. The fragmented drainage system present in blocks III, i and V, ii paint the same picture of individual actions resulting from small-scale, mostly domestic concerns.

Roman Water Footprint # 1 (4th century BC- AD 50)					
Indicator	Sub-Indicator	Data	III, i	IV, ii	V, ii
Infrastructure	Supply Systems	Rain Water	0	2	6
		Ground Water	3	4	3
		Aqueduct	0	0	0
		Total # of Supply Features	3	6	9
	Usage Systems	Number of Leisure Water Features	0	0	0
		Number of Industrial/Economic Water Features	0	0	0
		Number of Domestic Water Features	0	1	1
		Total # of Usage Features	0	1	1
	Drainage Systems	Sewer	1	0	0
		Downshaft	0	0	0
		Drains	0	0	4
		Total # of Drainage Features	1	0	4
	System Resilience	Number of Types of Supply	1	2	2
		Number of Types of Usage	0	1	1
		Number of Types of Drainage	1	0	1
		Total System Complexity	2	3	4
		Total # of Features	4	7	14
Culture	Private Oriented-insula	Total # of Features	4	7	14
	Public Oriented-insula	Total # of Features	0	0	0
	Private Oriented-Ostia	Total # of Features	36	36	36
	Public Oriented-Ostia	Total # of Features	17	17	17
Nature	External	Tiber River Floods	21	21	21
	Internal	Urban Garbage	1	1	1
		Urban Health (# of Baths)	3	3	3

Table 6.64: Roman Water Footprint # 1, with data from insulae III, i, IV, ii, V, ii.

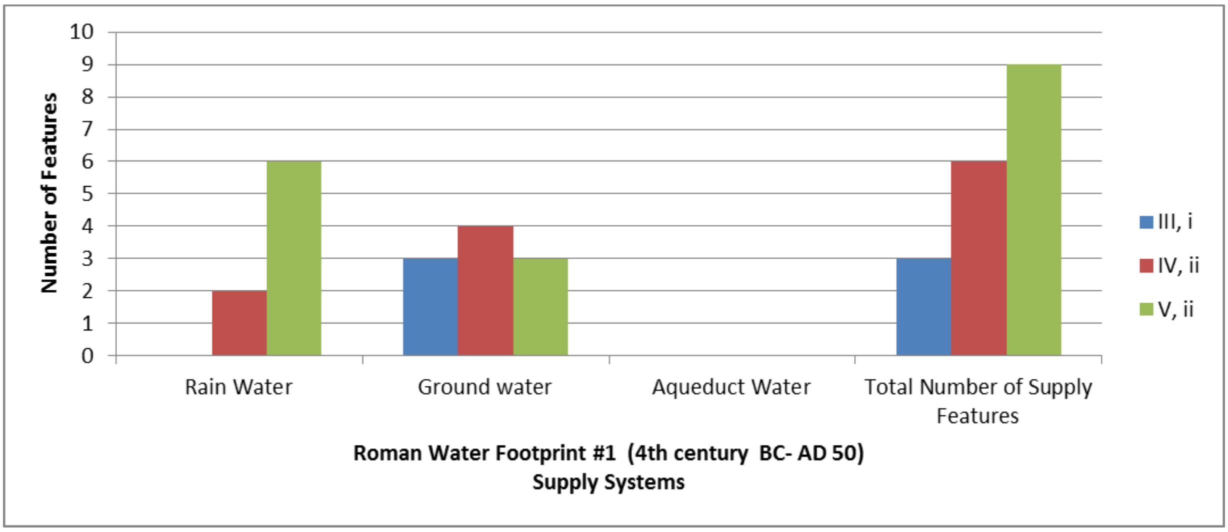

Figure 6.298: Supply systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #1 (4th century B.C.- AD 50).

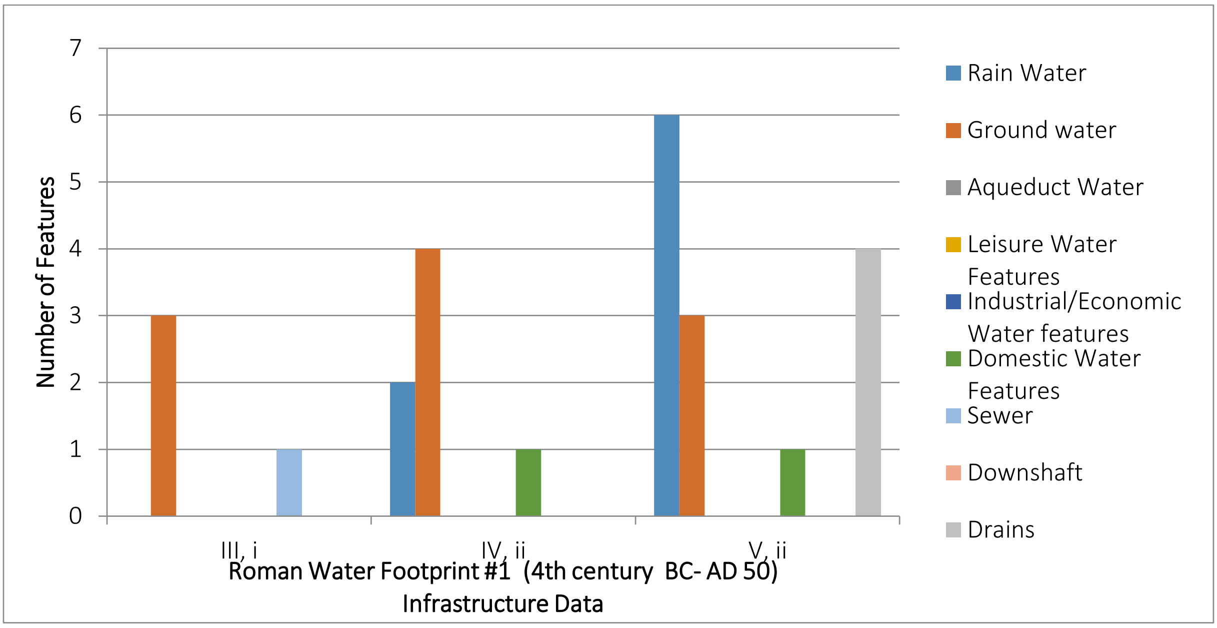

Figure 6.299: Infrastructure Data for insulae III, i, IV, ii, and V, ii in Roman Water Footprint #1 (4th century B.C.- AD 50).

By condensing the infrastructure data in the previous chart, a more clear picture emerges of the difference between the three insulae in this period (Figure 6.300). Insula V, ii has the highest number of water features compared to the other two insulae, yet all three city blocks have many more water features relating to supply than to usage or drainage. This suggests that there was a focus just on obtaining water in this early period, with less emphasis given to constructing lasting water features for using or draining that water.

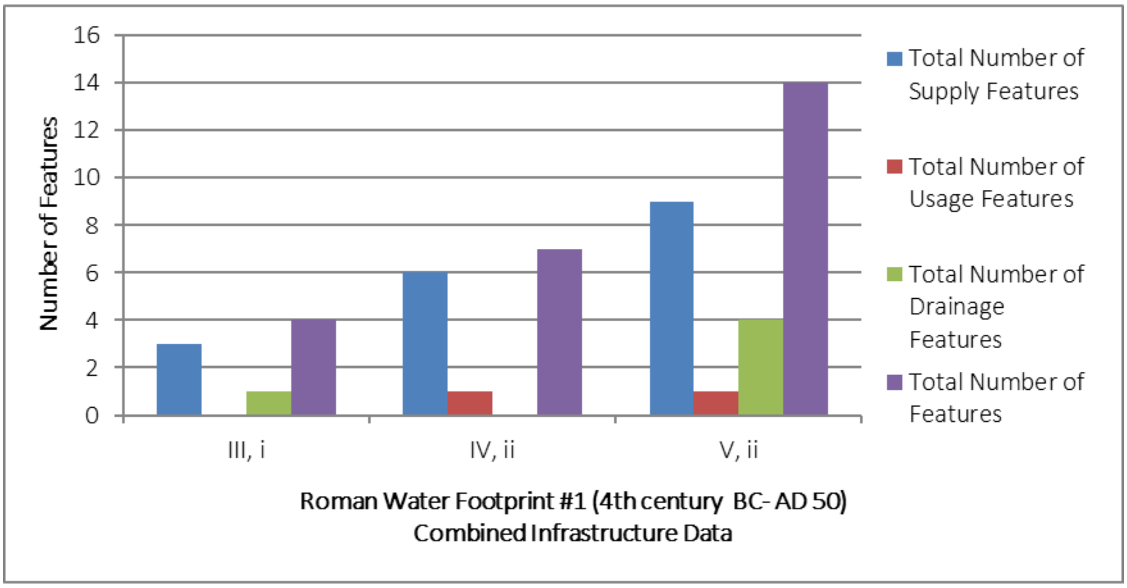

Figure 6.300: Combined Infrastructure data for insulae III, i, IV, ii, and V, ii Roman Water Footprint #1 (4th century B.C.- AD 50).

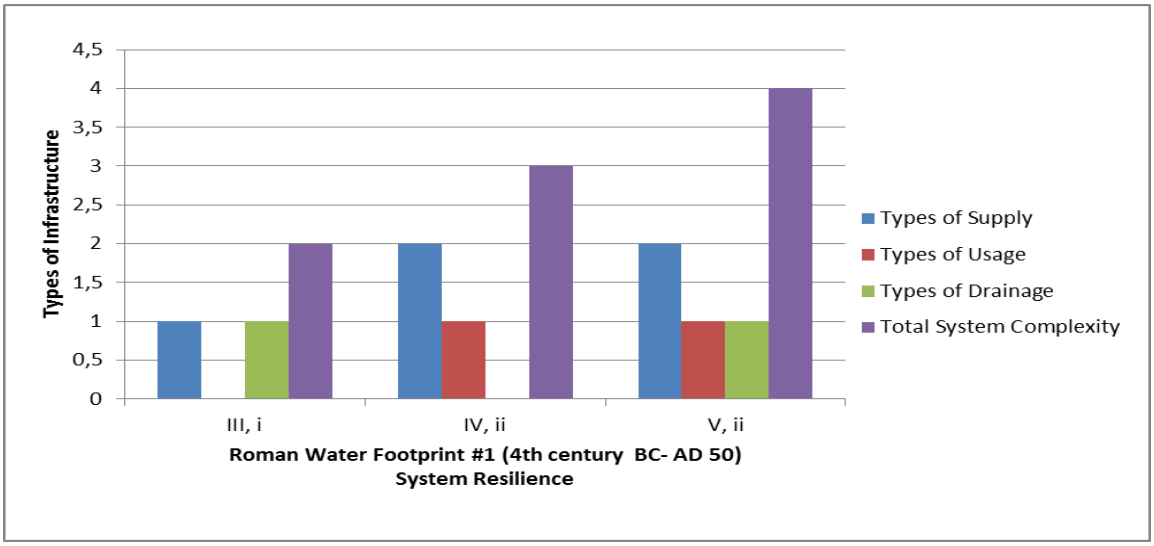

Figure 6.301: System resilience compared between insulae III, i, IV, ii, and V, ii in Roman Water Footprint #1 (4th century B.C.- AD 50).

Although insula V, ii has the highest degree of overall system complexity, this is still low, scoring 4/9 (Figure 6.301). Despite the wider knowledge about capturing rain water, this was not done equally in the three insulae. This low degree of system complexity in all of the insulae makes them likely vulnerable to seasonal and annual variations in ground water and rain water availability. The role of wells is especially important here, since marble-decorated wells from this early period often doubled as individual cisterns: numerous ceramic pipes set within these wells directed rain water into the well, coming from upper floor downshafts. Differences in water supply would be even more pronounced between those living in domus buildings and the remainder of the population, who would need to look to alternative sources of water for drinking and other activities. Despite the easily accessible ground water level, there are few known wells across Ostia in this period, suggesting that the creation of wells was either not as easy, or as widely practiced as would seem doable. In the time before the creation of the first aqueduct, perhaps the possession of multiple sources of water within a wealthier domus also carried social prestige, in the form of water resilience and security. Buildings that are more resilient are also more sustainable and can operate independently of external hydraulic systems.

As outlined in Chapter 2, every water feature is labelled either as Public or Private, based on the identifiable orientation of the room in which it is present, and as far as the evidence permits. In a situation where tabernae were built as part of a domus: the water features in the tabernae would be designated Public, and the water features within the domus would be designated Private. The author acknowledges the on-going debate between these two labels, especially regarding the social permeability of Roman houses.

However, it is hoped that such an approach is valuable to researchers interested in diverse aspects of Roman cities and water usage.[828] When examining the difference between private and public water usage, a similar trend emerges for both the three studied insulae and for Ostia

Figure 6.302). While the number of water features is low in the three insulae, the majority of evidence lies in the private domain. Only in insula V, ii is there evidence for a handful of public water features. The lack of architectural evidence for the earliest periods of Ostia's life may also be a result of the high frequency of flooding, which is the highest in the city's entire history. The 21 known floods for Rome in this period include mytho-historical floods.[829] Yet, based on the frequency of floods from better documented periods, this number is likely within an acceptable range. The low ground level of Ostia in

[828] The contributions in Tuori & Nisson (ed.) 2015 provide an update on this debate; see Dessales 2011 and Flohr 2011 for the interaction between industrial and domestic activities in domus houses of Pompeii.
[829] Aldrete 2007, 242 for floods in Rome in this period.

this period, coupled with a very high water table and the presence of neighboring marshes, would certainly exacerbate even minor flooding from the Tiber. While these floods may not have been disaster-level events, frequent flooding would have much larger effects on the early structures and health of the people in early Ostia.

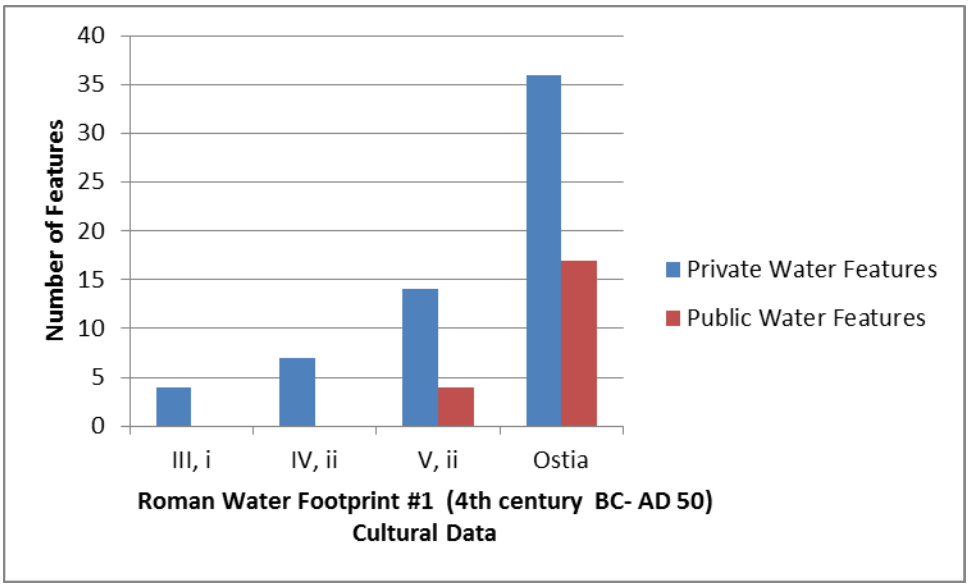

Figure 6.302: Cultural Indicator Data for insulae III, i, IV, ii, and V, ii in Roman Water Footprint #1 (4th century B.C.- AD 50).

Urban health across the city is difficult to assess given the few sewer systems known for this period, and the minimal evidence of accumulated faunal remains.[830] The three bath buildings known to exist from this period are the fewest in the city's history, and their small size suggests that not all people could be accommodated by them.[831] Subsequently, this means that fewer people would be at risk of swapping and contracting water-borne diseases in early Ostia.

6.2: Roman Water Footprint #2 (50-200 AD) in insulae III, i; IV, ii; V, ii

All hydraulic systems in the three insulae increase exponentially in this period when compared to the previous Roman Water Footprint phase (4th century B.C.- AD 50) (Table 6.65). The introduction of the urban aqueduct lines provide new opportunities especially for supply and usage systems. Lead pipes were installed in all insulae for the local distribution of aqueduct water (Figure 6.303). Together with this type of water comes the first development of sinter, or calcium carbonate, upon some walls and pipes in the city. The presence of this material acts as a helpful proxy in detecting where aqueduct based water flowed. Across the three insulae studied in this thesis there is evidence for inverted siphons pressurizing water well above the ground level. The identification of calcium carbonate within vertical downshafts implies the presence of flowing aqueduct water on at least the first floor of a building. If this is not the case, the only way continually flowing water would run down these channels is if people (i.e. slaves) repeatedly carried massive amounts of aqueduct water from courtyard fountains to upper floors for domestic usage.

830 MacKinnon 2014, 187-189 for faunal evidence in Ostia

831 Medri & Di Cola 2013, 101 for a concise chart of known baths in Ostia. Although little is known of these baths, they were likely small to medium in size, certainly not as large as the later Terme di Nettuno (II, iv, 2) or Terme di Faro (I, xii, 6).

Roman Water Footprint # 2 (AD 50-200)					
Indicator	Sub-Indicator	Data	III, i	IV, ii	V, ii
Infrastructure	Supply Systems	Rain Water	0	2	17
		Ground Water	4	4	6
		Aqueduct	7	11	5
		Total # of Supply Features	11	17	28
	Usage Systems	Number of Leisure Water Features	5	5	2
		Number of Industrial/Economic Water Features	3	2	10
		Number of Domestic Water Features	1	1	1
		Total # of Usage Features	9	8	13
	Drainage Systems	Sewer	22	16	10
		Downshaft	11	13	8
		Drains	6	4	13
		Total # of Drainage Features	39	33	31
	System Resilience	Number of Types of Supply	2	3	3
		Number of Types of Usage	3	3	3
		Number of Types of Drainage	3	3	3
		Total System Complexity	8	9	9
		Total # of Features	59	58	72
Culture	Private Oriented-insula	Total # of Features	20	35	42
	Public Oriented-insula	Total # of Features	39	23	30
	Private Oriented-Ostia	Total # of Features	122	122	122
	Public Oriented-Ostia	Total # of Features	72	72	72
Nature	External	Tiber River Floods	6	6	6
	Internal	Urban Garbage	3	3	3
		Urban Health (# of Baths)	21	21	21

Table 6.65: Roman Water Footprint # 2 in insulae III, i, IV, ii, V, ii.

This solution does not seem tenable, and forces us to reconsider our understanding of urban water distribution. While we do lack the vertically running lead pipes, the accumulation of calcium carbonate acts as a direct proxy to identify where aqueduct water once ran. In this period, rain water collection jumps dramatically in insula V, ii, but remains otherwise unchanged in blocks III, i, and IV, ii. This preference in water collection strategies may explain the paucity of aqueduct features in insula V, ii in comparison with the other two insulae. Ground water systems are present at roughly the same concentration in all of the insulae in this period. As with Supply, the highest number of Usage features in this period are present in insula V, ii (Figure 6.304). This insula also has the highest number of industrial/economic features, which is part of a wider trend across all three insulae that show an increase in industrial/economic, and leisure features, and a decline in domestic water features. This matches what is known of Ostia in this AD 50-200 period, when numerous *collegia* and tabernae were created across the city, expanding the number of businesses and places of production.[832]

[832] Hermansen 1982, 55-88 remains fundamental to the study of *collegia* and tabernae in Ostia; see Heinzelmann 2002 for an updated position on the "bauboom" of 2nd century Ostia.

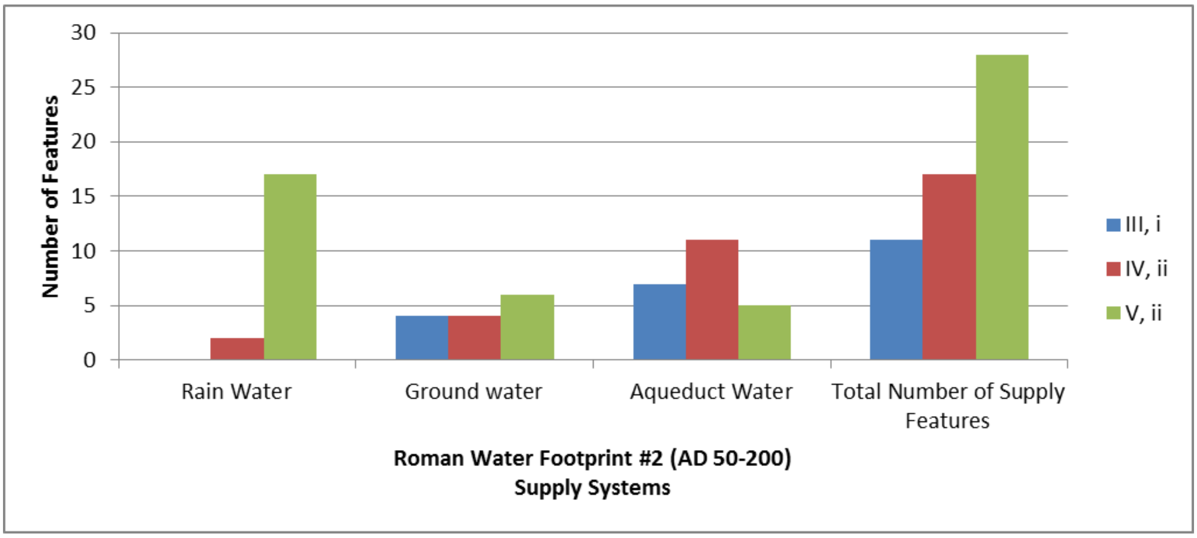

Figure 6.303: Supply systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #2 (AD 50-200).

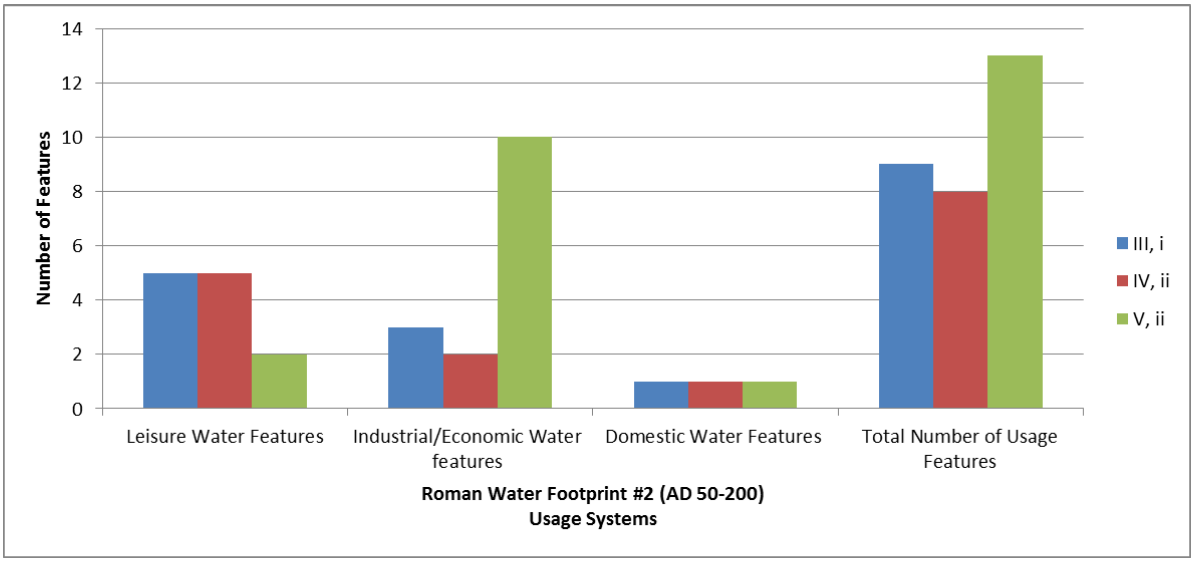

Figure 6.304: Usage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint # 2 (AD 50-200).

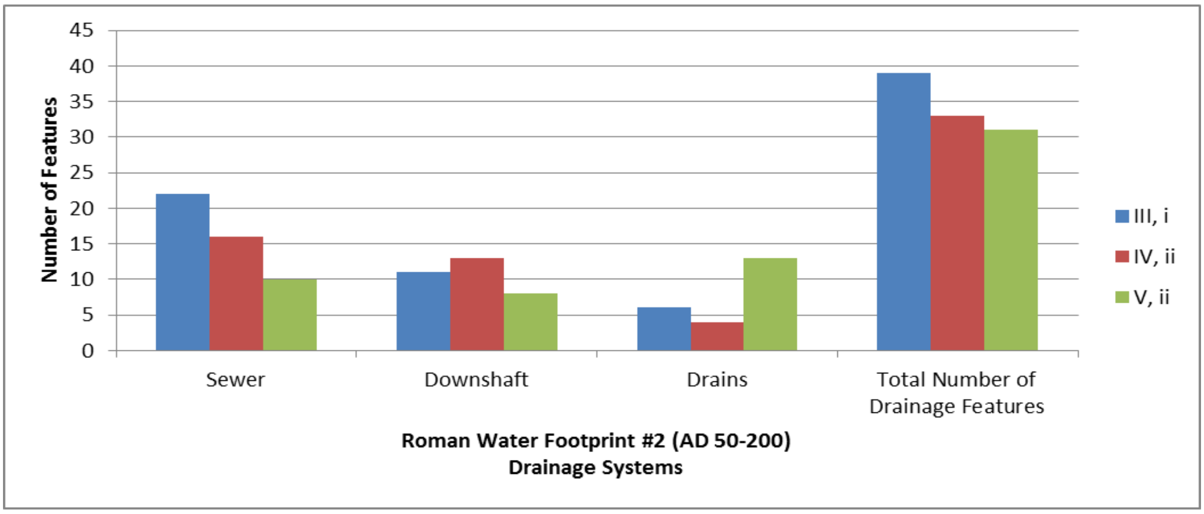

Figure 6.305: Drainage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint # 2 (AD 50-200).

The number of drainage features increases in all three insulae, resulting from the diffusion of smaller sewer sections and different types of downshafts (Figure 6.305). These sewer lines are contemporary with wider 1st century sewers known under the major streets of Ostia, such as the one under the Via della Foce or the *cardo maximus*.[833] Major sections of sewer lines are often roofed in the cappucina style, in which two obliquely leaning *bipedales* cover a rectangular channel. Many of these major lines are fed by smaller secondary sewer lines, which often have a flat roof made of a horizontal roof tile or single *bipedalis*. Together with drains from individual basins and downshafts directing different types of water toward the sewer, the city gains a hierarchy of drainage infrastructure. Several of these major and minor sewers were unknown before the current research project, but can now be identified with certainty. Insula III, i has the most number of drainage features, due in large part to the Trajanic phase of the Terme della Basilica Cristiana (III, i, 3). However, the number of drainage features is roughly equivalent in all of the insulae. As the city is at is maximum population, issues of local, neighbourhood, and urban drainage are crucial, especially given the city's low-lying position next to the sea and Tiber river.[834]

By comparing the hydraulic systems of all three insulae against each other, it is evident that insulae III, i and IV, ii are more similar to each other than compared with insula V, ii in certain aspects (Figure 6.306). This is most clear in the Rain Water category, which in insula V, ii is much higher than in insula IV, ii, and this category is not present at all in insula III, i. Equally, insulae III, i and IV, ii have similar quantities and proportions of water features. Condensing the infrastructure data from Fig. 6.9 brings the relationship between all three insulae into better relief (Figure 6.307). Insula V, ii has the highest overall number of water features (n=72), and there is a close correlation between III, i and IV, ii in how many water features are present in this period. But amongst all three insulae there is a similar trend of system hierarchy: all insulae have less Usage features than Supply features, and all have many more Drainage features than Supply or Usage. So while the insulae differ in their specific number and composition of water features, they all present a similar relationship between different parts of the hydraulic system. The creation of these drainage features indicates that all parts of the hydraulic system were valued and that while not as visually appealing as marble-clad fountains and pools, were vital to the successful habitation of a city.[835] Despite being invisible for the most part, these Drainage features are an important part of the entire functioning of the system.

833 For the sewer under the Via della Foce see Chapter 3 (III, i, 14, feature 73); for the sewer under the *cardo maximus* see Chapter 4 (IV, ii, 1, feature 114).

834 Meiggs 1973, 78 estimates 50,000 inhabitants at the death of Antoninus Pius.

835 Pliny the Elder (XXXVI, 24, 104-106) is rightly amazed at the sewer systems of Rome, calling it a hanging city (*urbe pensilis*) since it is underpinned by the network of drains and sewers.

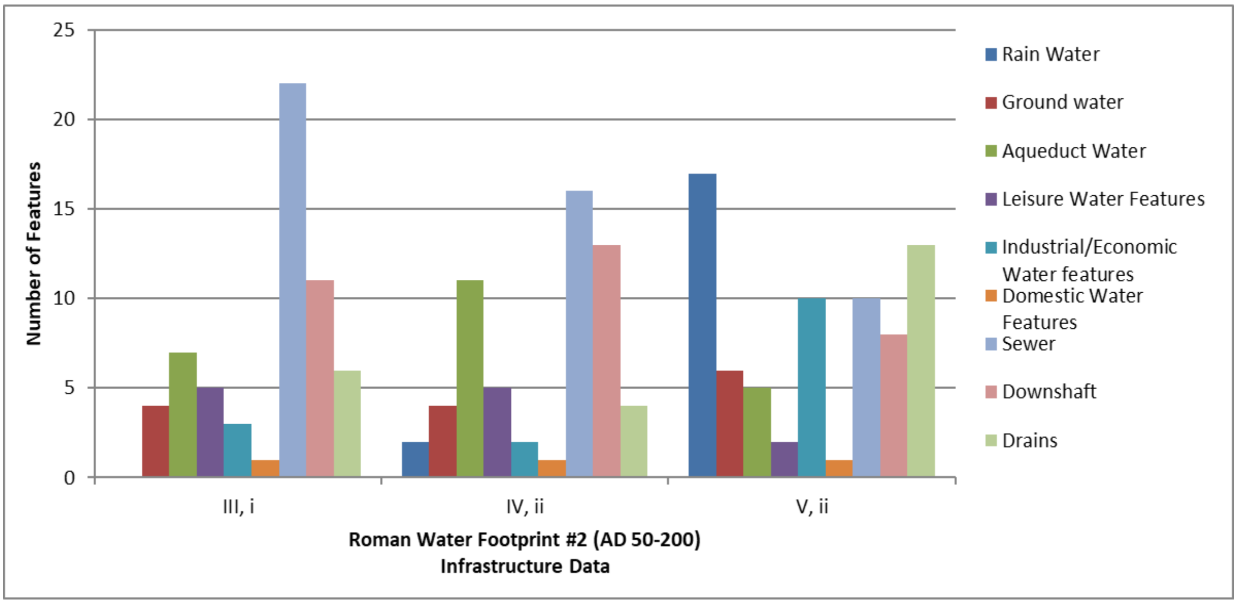

Figure 6.306: Combined Infrastructure data comparing insulae III, i, IV, ii, and V, ii in Roman Water Footprint #2 (AD 50-200).

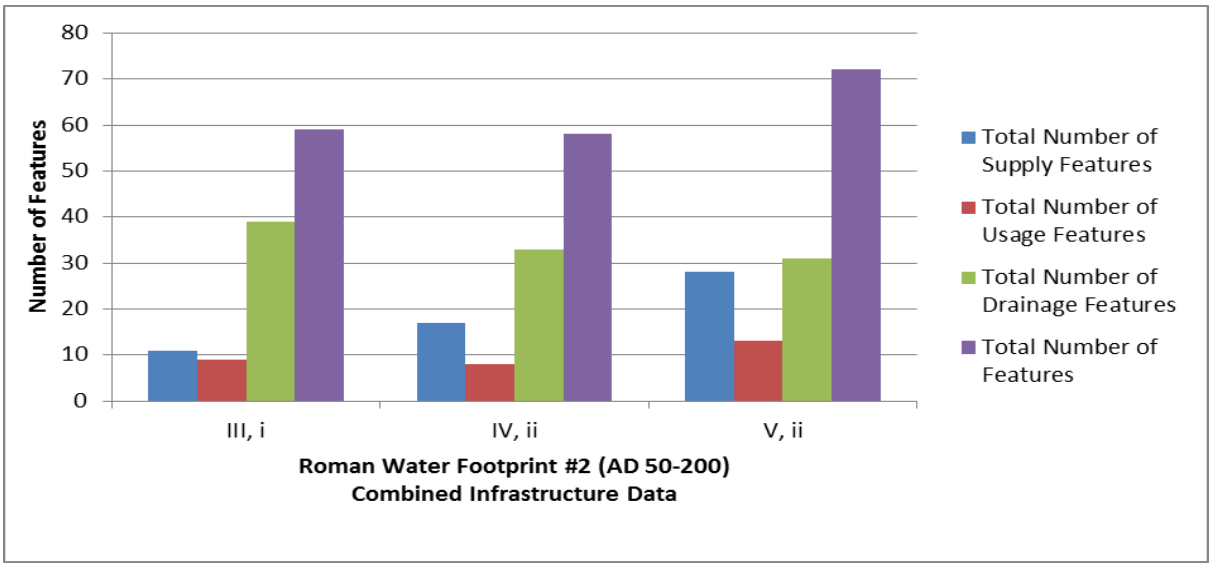

Figure 6.307: Combined Infrastructure data for insulae III, i, IV, ii, and V, ii in Roman Water Footprint #2 (AD 50-200).

When the system's resilience in this period is graphed, the diversity of the system reaches values that will be maintained throughout the subsequent Roman Water Footprint phases #3 and #4 (Figure 6.308). In all three categories of Infrastructure (Supply, Usage, Drainage), the system reaches its maximum level of diversity; only insula III, i does not reach maximum system diversity as it does not possess rain water collection systems. This means that in all three categories, the systems are highly diversified. In terms of infrastructure, this means that all of the *insulae* are relying on a mix of systems at all levels of hydraulic system, and can flexibly react to seasonal variations, or those caused by maintenance concerns. This diversity of supply, usage, and drainage in the three insulae accords well with the wider historical narrative of Ostia in the first and second centuries: a busy and growing city with a mixture of hydraulic activities and needs.

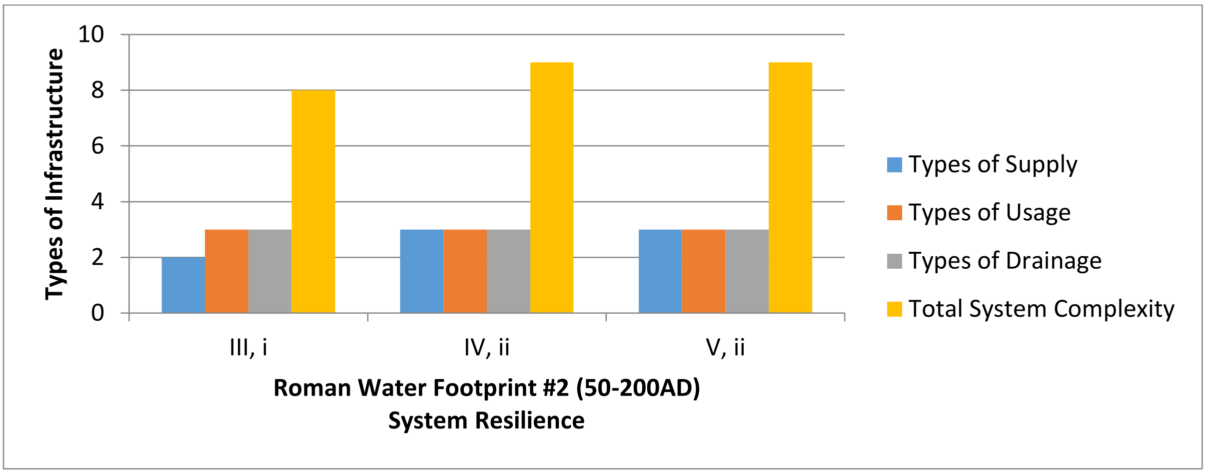

Figure 6.308: System Resilience for insulae III, i, IV, ii, and V, ii in Roman Water Footprint #2 (AD 50-200).

The relationship between the insulae and the city changes when examining the presence of water in publicly and privately oriented spaces (Fig. 6.309). Ostia's wider trend has more private than public water features in this period, similar to the preceding period. Only insula III, i has more public than private water features, with the opposite trend in the other two insulae. This is a result of insula III, i having many more tabernae and entire buildings dedicated to public usage.

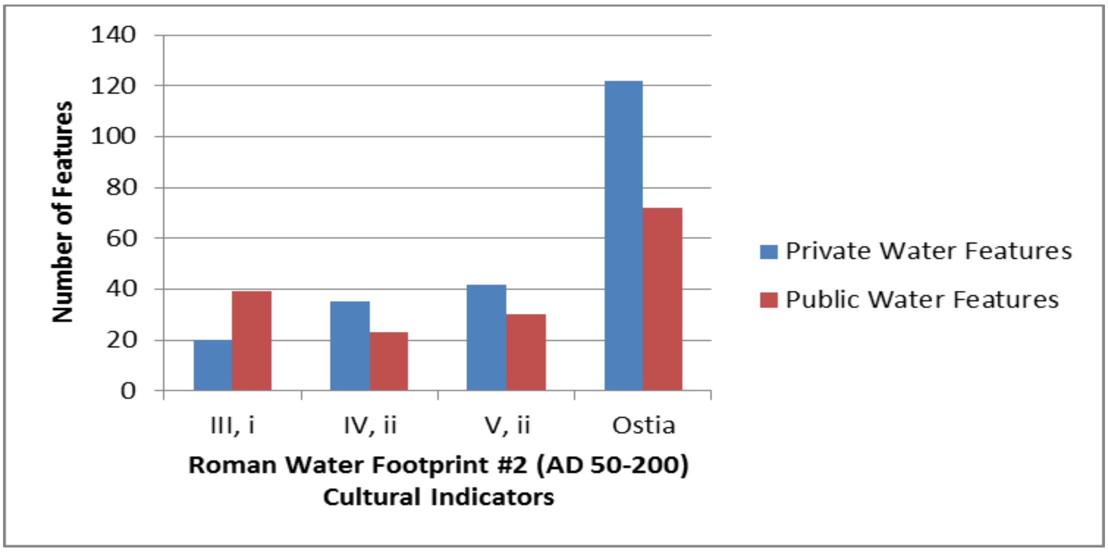

Figure 6.309: Cultural Indicators of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #2 (AD 50-200).

Environmentally speaking, there are fewer floods in this period than previously, with only six recorded flood events.[836] The widespread raising of many parts of the city in the 2nd century, must have reduced the impact, or at least the reach of flood waters. Yet, the insertion of sewer lines under many more streets and within nearly every building implies a host of post-flooding problems in almost all parts of the city, such as blockage by flood debris.[837] This is the boom period in Ostia's urban history, and even a relatively minor flood of 1 or 2 meters would have had a visible impact on the city's functioning. The presence of several internal garbage dumps across the city in this period would have increased the negative health impact of any floods.[838] This period also witnessed the maximum number of functioning bath buildings, with 21 known operational baths. Well-distributed across the city, the number and

[836] Aldrete 2007, 142-143 for floods recorded in this time period in Rome.
[837] Aldrete 2007, 144-158 elaborates on the delayed effects of floods, such as the rapid spread of disease and parasites resulting from standing water full of sewage waste, street garbage, and polluted upstream water.
[838] MacKinnon 2014, 189-192 for the faunal evidence from Ostia.

diversity of these baths made them available to the entire population of Ostia. Although the city's role as a harbour for Rome began to change with the creation and development of Portus, Ostia still remained a multicultural city, with people and goods arriving from across the Roman Empire. Given these factors, the waters of the bath buildings would have acted as excellent vectors for the transmission of a variety of water-borne diseases. While there are certainly many other ways for this to happen, the role of baths in this process cannot be overstated.

6.3: Roman Water Footprint #3 (AD 200-300) in insulae III, i; IV, ii; V, ii

The 3rd century continued to witness a great deal of hydraulic activity in the three case studies and in the wider city (Tab. 6.66). This change is largely a result of the doubling of aqueduct features in III, i and IV, ii (Figure 6.310), certainly reflecting the creation of a new aqueduct line in the Severan period. Insula IV, ii has the highest number of supply features in this period (34 features), as a result of the overhaul of the Terme del Faro (IV, ii, 1), and the cistern built in IV, ii, 5. As in the previous period, lead pipes with the same name were found in IV, ii and in V, ii, perhaps attesting to a favourite pipe maker (*plumbarius*) in this southern neighborhood of the city.[839] The number of supply features drops sharply in V, ii (from 28 to 13 features), but, as described in Chapter 5.2, this is a result of the inability to date the chronological duration of the rainwater supply systems. The presence of functioning ground water continues, although the overall number decreases slightly in comparison with the previous period.

Roman Water Footprint # 3 (AD 200-300)					
Indicator	Sub-Indicator	Data	III, i	IV, ii	V, ii
Infrastructure	Supply Systems	Rain Water	0	3	2
		Ground Water	2	4	5
		Aqueduct	14	27	6
		Total # of Supply Features	16	34	13
	Usage Systems	Number of Leisure Water Features	8	15	10
		Number of Industrial/Economic Water Features	10	5	3
		Number of Domestic Water Features	4	1	7
		Total # of Usage Features	22	21	20
	Drainage Systems	Sewer	26	25	30
		Downshaft	12	10	13
		Drains	13	17	24
		Total # of Drainage Features	51	52	67
	System Resilience	Number of Types of Supply	2	3	3
		Number of Types of Usage	3	3	3
		Number of Types of Drainage	3	3	3
		Total System Complexity	8	9	9
		Total # of Features	89	107	100
Culture	Private Oriented-insula	Total # of Features	20	46	58
	Public Oriented-insula	Total # of Features	69	61	42
	Private Oriented-Ostia	Total # of Features	101	101	101
	Public Oriented-Ostia	Total # of Features	49	49	49
Nature	External	Tiber River Floods	2	2	2
	Internal	Urban Garbage	4	4	4
		Urban Health (# of Baths)	16	16	16

Table 6.66: Roman Water Footprint # 3 in insulae III, i, IV, ii, V, ii.

839 See for detailed information on these pipes, Chapter 4: IV, ii, 1 (feature 78); Chapter 5: V, ii, 3 (feature 190).

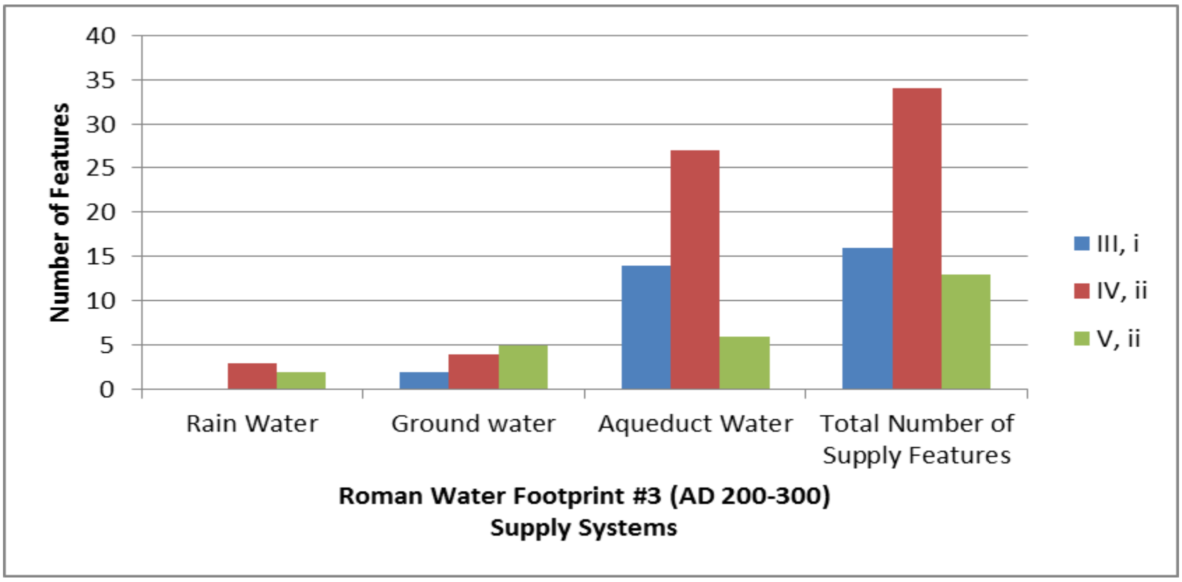

Figure 6.310: Supply systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

Usage increases across all the insulae, with more than double the values in III, i and IV, ii when compared to Roman Water Footprint #2 (AD 50-200) (Figure 6.311).[840] Insula V, ii also shows growth in the number of usage features, but in leisure and domestic water features, connected with the AD 250 building phase of the Domus del Protiro (V, ii, 4-5) and the Terme del Filosofo (V, ii, 6-7). In this period, insula III, i leads in the number of Economic/Industrial features, as well as in the total number of Usage features.[841]

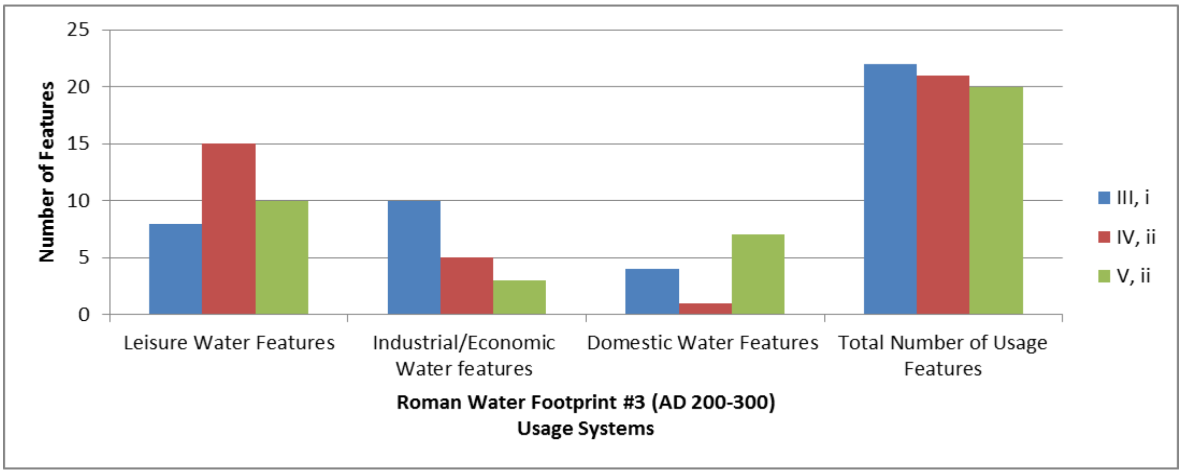

Figure 6.311: Usage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

All types of drainage increase in this period in every insula (Fig. 6. 312). This is partially a result of the widespread rise in urban ground levels in Ostia. Networks of sewer systems were created *ex novo* in IV, ii and V, ii in connection with the Severan rebuilding of the Terme del Faro (IV, ii, 1) and the Terme del Filosofo (V, ii, 6-7).[842]

Fewer sewer lines were created in III, i, but the number of sewer lines is roughly the same in all insulae. While the total length of these systems is no longer present, supporting evidence for these “floating sewers” is found in many parts of the insulae or wider city.[843] Support for the higher ground level comes from the height of the bonding course in brick support piers or walls, and in thresholds that now lie ca.

[840] In insula III, i, there is an increase from 9 to 22 features, and in insula IV, ii from 8 to 12 Usage features.
[841] This is mainly represented by the creation of large, often double-chambered basins.
[842] See Chapter 4.2, Roman Water Footprint #3 for IV, ii, and Chapter 5.2, RWF #3 for V, ii.
[843] See Chapter 4.2 for these “floating sewers” in insula IV, ii, and Chapter 5.1 for their presence in insula V, ii.

40 cm above the current ground level.[844] The insertion of several new downshafts in all of the insulae may appear innocuous enough, but they give an early indication of wider changes to come in the subsequent Late Antique period.

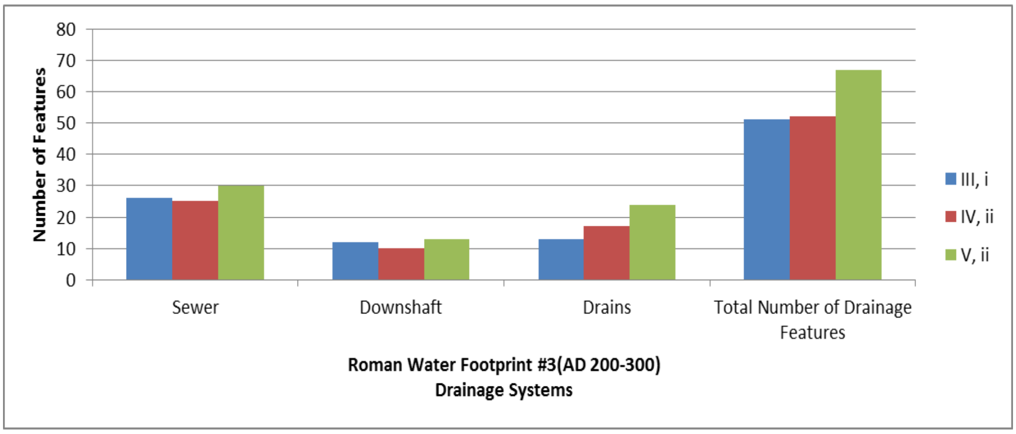

Figure 6.312: Drainage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

New downshafts mean that upper floors are being reconfigured in new ways to drain waste from upper floors, suggesting an increased subdividision of upper floor space into smaller apartments. The evidence for this phenomenon is much more present in the subsequent Roman Water Footprint phase (#4), and will be explored in greater detail in the following section. Looking at the complete hydraulic infrastructure of each insula in this period (Roman Water Footprint #3), they each have a unique combination of different elements (Figure 6.313). Whereas insula III, i and IV, ii had similar hydraulic profiles in RWF #2 (AD 50-200), and V, ii was the outlier, now all three differ in the number and type of water features present. The only element they do share is in the number and distribution of Drainage elements: in all three insulae, the proportional number of Sewers, Downshafts, and Drains is similar. As the other parts of the hydraulic system in each insula is widely different, this suggests that the same type of Drainage system can handle a diversity of activities.

When aggregating this data into the larger infrastructure categories of Supply, Usage, and Drainage, a similar trend emerges as from the previous Roman Water Footprint #2 period (AD 50-200) (Figure 6.314). There is the same proportional increase of number of features in different parts of the system: fewest supply, then more usage, then most drainage. Only IV, ii doesn't follow this trend, which may be a result of the supply features in its bath building (Terme del Faro: IV, ii, 1). The total number of water features increases in all of the investigated insulae, with 107 more features than in the previous period.[845] Roman Water Footprint #3 contains the maximum number of water features in insula III, i (89 features), and in IV, ii (107 features). The insulae maintain their degree of system complexity from the previous RWF #3 period (Figure 6.315). At first glance, this would suggest that nothing has changed from the previous period, however, this graph should be taken together with the other ones in this Roman Water Footprint #3 section. It is then possible to see that although the number of types of each class of infrastructure remained stable, there were clear changes to the number of water features in each category of infrastructure. The spatial distribution of the water features is an important point to raise here, since this micro-scale (i.e. single building) issue is not reflected in these aggregated graphs. Within every insula, although the quantitative number of water features increases, the distribution of these water features becomes concentrated and localized in individual buildings, or several buildings. This trend continues into the subsequent Late Antique period, but begins in the early 3rd century.

[844] Gering 2013, 258 gives numerous examples of this phenomenon in 3rd century Ostia.

[845] Total number of water features in all three *insulae*: 189 in Roman Water Footprint #2, and 296 in Roman Water Footprint #3.

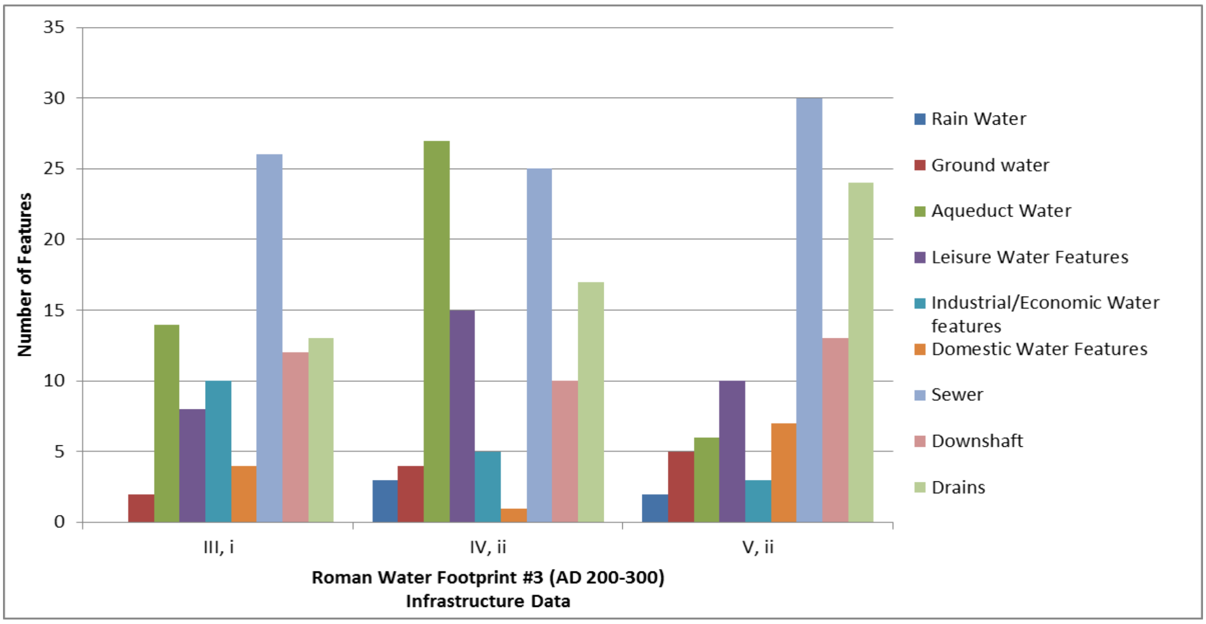

Figure 6.313: Combined Infrastructure data comparing insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

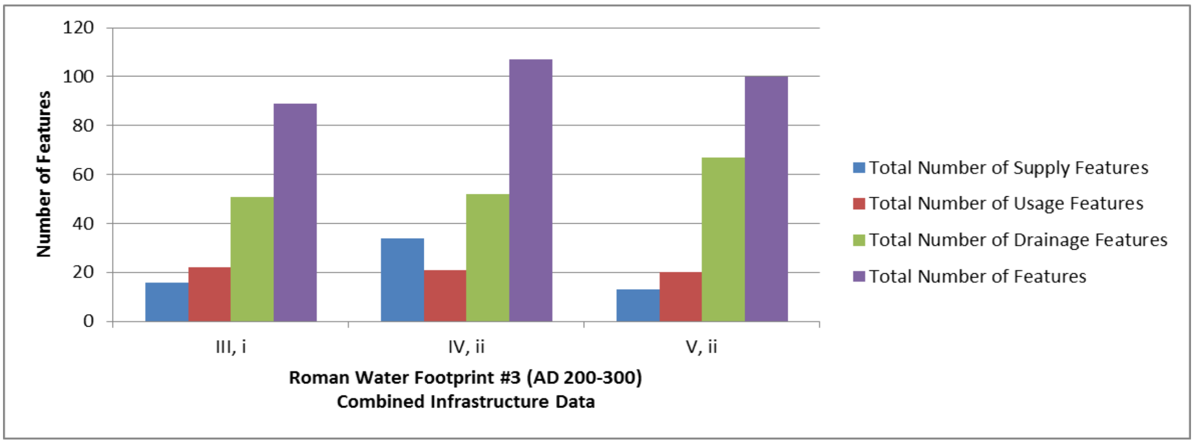

Figure 6.314: Combined Infrastructure data for insulae III,i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

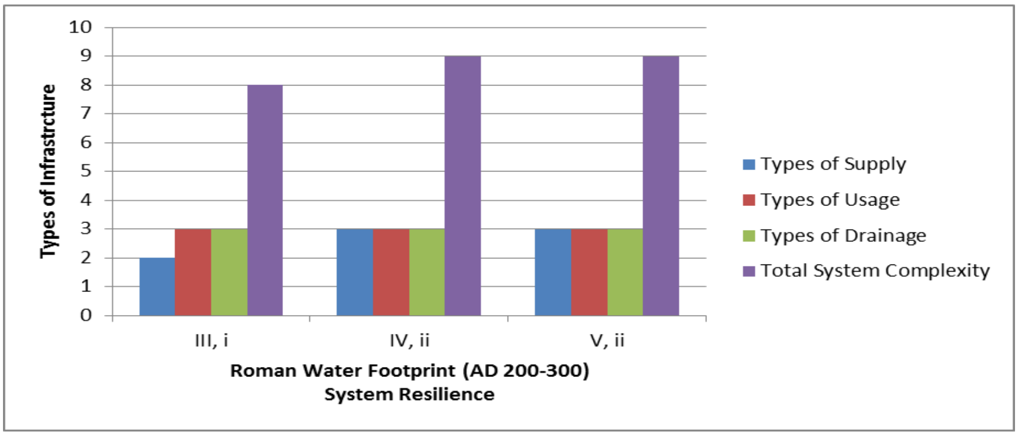

Figure 6.315: System Resilience of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

The number and relationship between publicly and privately oriented water features continues to change in this period. In Ostia, the wider trend shows double the number of private features compared to public ones (Figure 6.316). On an insula level, all three insulae reach their maximum values of private and public water features in this period. Insula III, i continues its previous trend of having more public than private features, but insula IV, ii flips its previous ratio, to also have more public than private features. Insula V, ii maintains its previous division, with more private than public.

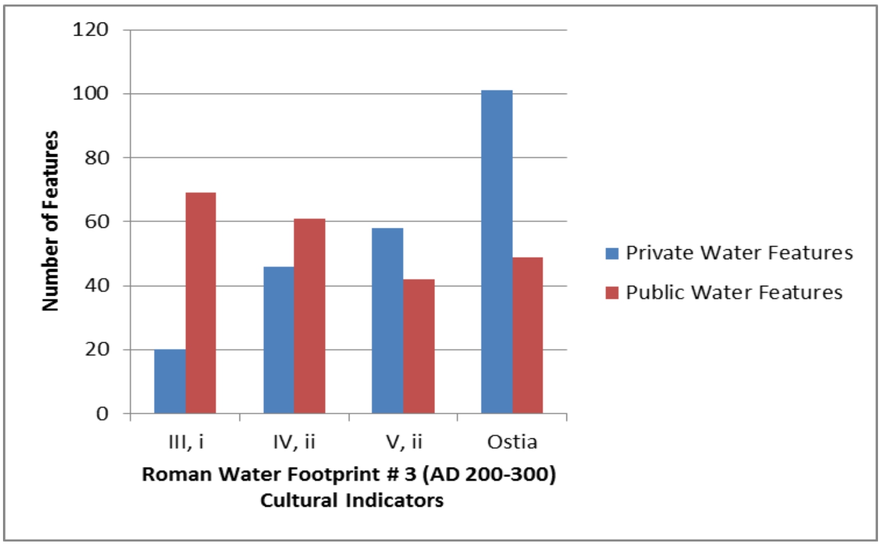

Figure 6.316: Cultural Indicators of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #3 (AD 200-300).

The wider landscape of the city was changing in dynamic ways in the 3rd century, caused by a combination of uneven abandonment, a possible earthquake, and conscious levelling projects. Although this period experienced the fewest number of floods in the city's history, with only two recorded flood events, it also contains the highest amount of preserved osteological material.[846] This material comes from various points across the city and is primarily related to urban garbage dumps or larger ground-levelling projects. The osteological evidence fits well with the picture produced by the changing distribution of water features throughout all the insulae. The 3rd century is a turbulent time, but one of growth when many buildings take advantage of abandoned or destroyed property to expand or be completely rebuilt. The increase in water features in every insula in this period does not necessarily imply increased prosperity, rather that many *ex novo* systems were required, both in terms of supply and drainage. So, this suggests that earlier (e.g. Trajanic sewers) systems were not continuing to work, and while some buildings in each insula were renovated, others took advantage of derelict or collapsed properties to create new structures, such as the buildings along the east side of insula V, ii.[847] The 16 functioning bath buildings in this time period attest to their continued cultural importance, although the general decrease in the size of the bath buildings and basins reflects changing cultural attitudes of bathing. If the city has its maximum number of abandoned buildings and internal garbage piles, and the majority of the bath basins are small, then any person heading to the baths has likely come into contact with the maximum amount of urban waste. Taken together, this suggests that the 3rd century, especially the later part of it, would have been the unhealthiest period in the life of the city, when it would have been the easiest to catch water-borne diseases.

[846] Aldrete 2007, 242-243 for flooding data; MacKinnon 2014, 192-194 for faunal analyses.

[847] Buildings V, ii, 9-13; Gering 2013 suggested that 3rd century Ostia would be much more ruinous than Late Antique Ostia.

6.4: Roman Water Footprint 4 (AD 300-600) in insulae III, i; IV, ii; V, ii

The final several centuries of the city's life continued to offer a great diversity in hydraulic infrastructure, which reflects the wider changing dynamic of Ostia (Table 6.67).

Roman Water Footprint # 4 (AD 300-600)					
Indicator	**Sub-Indicator**	**Data**	**III, i**	**IV, ii**	**V, ii**
Infrastructure	Supply Systems	Rain Water	0	2	2
		Ground Water	2	2	5
		Aqueduct	15	20	8
		Total # of Supply Features	17	24	15
	Usage Systems	Number of Leisure Water Features	9	12	9
		Number of Industrial/Economic Water Features	8	3	3
		Number of Domestic Water Features	6	2	13
		Total # of Usage Features	23	17	25
	Drainage Systems	Sewer	22	20	25
		Downshaft	14	7	11
		Drains	13	17	36
		Total # of Drainage Features	49	44	73
	System Resilience	Number of Types of Supply	2	3	3
		Number of Types of Usage	3	3	3
		Number of Types of Drainage	3	3	3
		Total System Complexity	8	9	9
		Total # of Features	89	85	113
Culture	Private Oriented-insula	Total # of Features	20	40	74
	Public Oriented-insula	Total # of Features	69	45	39
	Private Oriented-Ostia	Total # of Features	63	63	63
	Public Oriented-Ostia	Total # of Features	36	36	36
Nature	External	Tiber River Floods	6	6	6
	Internal	Urban Garbage	3	3	3
		Urban Health (# of Baths)	14	14	14

Table 6.67: Roman Water Footprint # 4 in insulae III, i, IV, ii, V, ii.

Wells continued to be incorporated into Late Antique building projects, suggesting their continued operation from the Republican or early Imperial period (Figure 6.317). Their conscious preservation may reflect some kind of hydraulic prestige, whereby it was valuable, or at least desirable, to possess a diversity of water supply types, and further, to juxtapose Republican wells with cutting-edge fashionable domestic nymphaea. All three insulae continue to use a mix of rain and ground water, although the number of these features decreases compared to the previous Roman Water Footprint period (#3: AD 200-300). The marble-clad nymphaea and associated fountains constructed in insulae III, i (Domus Tigriniani, III, i, 4), and insula V, ii (Domus della Fortuna Annonaria, V, ii, 8; Domus del Protiro, V, ii, 4) often receive the bulk of research attention, but hydraulically speaking, they do not entail the creation of substantially more aqueduct supply features.

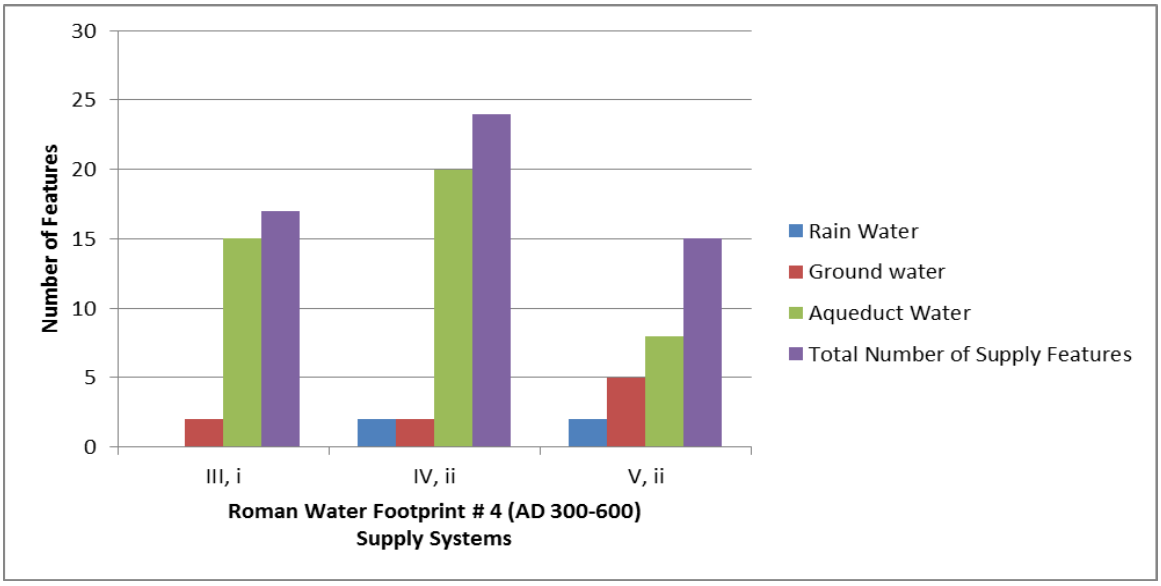

Figure 6.317: Supply systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

The aqueduct line continues to function into the 5th century, as indicated by a stamped *fistula* excavated near insula IV, ii.[848] Distribution of pressurized water is also known from the water tower identified in the Caseggiato dell'Ercole (IV, ii, 3).[849] The creation of a stand-alone pressure tower may also be a response to changing ground levels known across the city at this time, and the need to pressurize water to different places than before.

Water usage in this period differs between each of the three insulae (Figure 6.318). Insula III, i maintains its Industrial/Economic lead, but becomes more diversified with the insertion of several water features as part of the expansion of the Domus Tigriniani. While all the city blocks have different kinds of activities, in insula III, i, each of these activities have roughly the same number of Usage features.[850] The other two insulae favour other types of water usage: insula IV, ii has more Leisure features (in its bath building), and V, ii has more Domestic features (in V, ii, 6 and 8). The creation of Late Antique domus buildings in insulae III, i and V, ii are responsible for the majority of water features in this period. The drainage systems from the three insulae indicate that new hydraulic activities are occurring across the city (Figure 6.319). The higher ground level within the city blocks is known already from the Severan period, especially in insula IV, ii.[851]

However, by examining the sewer systems in and around insula V, ii, it also became clear that the ground level was higher than the current street level by ca. 50 cm.[852] Yet, there are also examples in all three insulae of Late Antique water features emptying into Trajanic or earlier sewer lines. Taken together, this suggests that the sewer system was not functioning to the same degree across all parts of the city.

[848] See Chapter 4.1, Terme del Faro (IV, ii, 1).
[849] See Chapter 4.1, Caseggiato e Portico dell'Ercole (IV, ii, 2-3) for this tower.
[850] Total usage features in III, i: 23 features; insula IV, ii: 17 features; insula V, ii: 25 features.
[851] SO 1, 162 already identified this during excavation: *"Lo scavo ha attestato estesi e spessi scarichi di cocciame, detriti di anfore, tegolozza su bari quartieri della città; e i pozzi molto tardi che rimangono…hanno l'imboccatura a un livello molto più alto del selciato del II secolo d. C., provando* ***un forte rialzamento stradale negli ultimi tempi****."* Emphasis added.
[852] See Chapter 5.1, Domus della Fortuna Annonaria (V, ii, 8), and Chapter 5.2, Roman Water Footprint #4 for supporting details; Gering 2013, 276 for similar kinds of drains exiting the Terme Piccole (I, xix, 5), well-above the current Via della Foce street level.

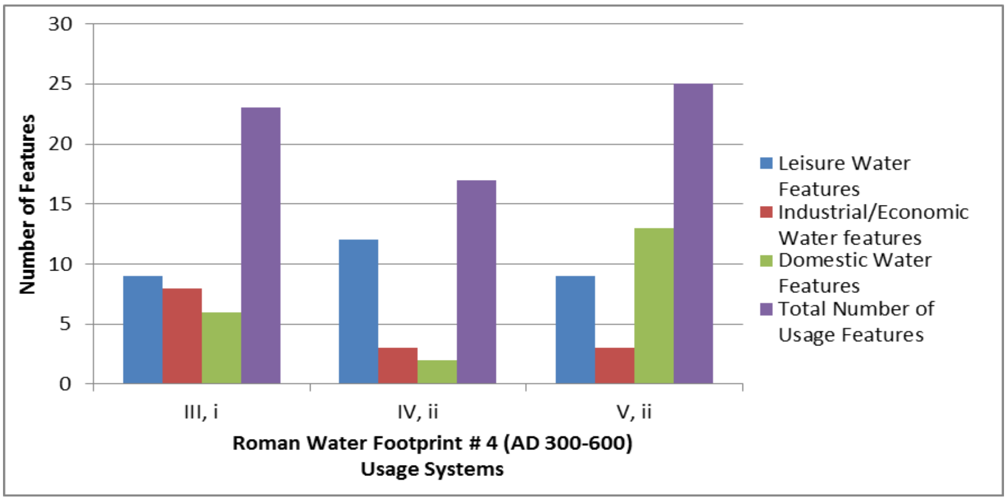

Figure 6.318: Usage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

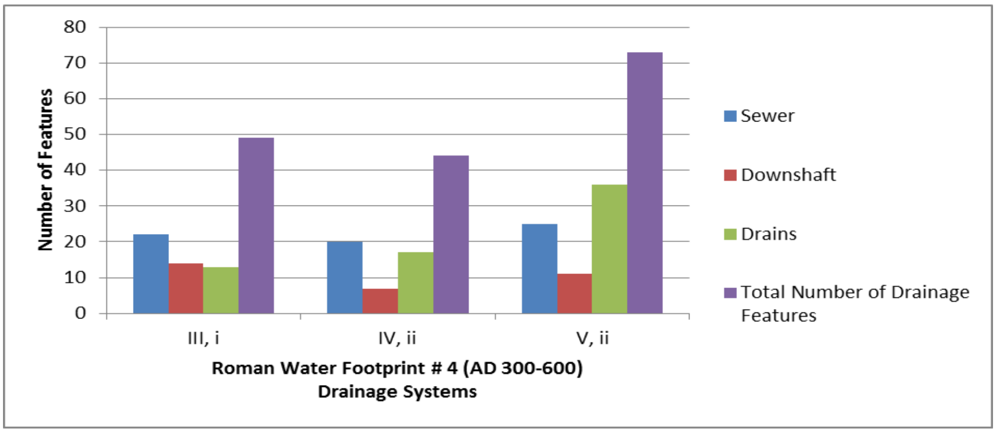

Figure 6.319:Drainage systems of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

Additionally, it means that in some parts of the city, there were superimposed sewer lines, with 3rd or 4th century sewer lines running above the Trajanic sewers known under the present street level of the city. The previous interpretation that the initial sewers in Ostia simply survived repeated ground-level raisings requires reinterpretation, as does our understanding of how these superimposed lines interacted with each other. These insula-specific sewer lines also indicate a degree of autonomy of each insula, or at least a kind of communal or neighbourhood discussion as to their placement, direction, and construction.[853] While these local sewer networks differ in each insula in their degree of interconnectivity, their presence indicates that drainage systems can provide new perspectives regarding urban social interaction, property ownership, and urban topography than has been fully appreciated.

Another example of individual actions reflecting wider changes comes from the downshafts in the three insulae studied.[854] As intimated in the previous section, the creation of downshafts on internal walls, either within hollow brick piers, or by simply covered in concrete in the corner of a room indicate a greater need for drainage on upper floors. As these downshafts are often of the circular kind, and placed within, rather than on the outside of buildings, they are here interpreted as belonging to domestic waste or upper floor toilets. While their contents can be debated, their presence cannot be, and their frequent connection with newly installed staircases indicates that there are more and smaller apartments being created on first or second floors. These downshafts may offer us a picture of Ostia with a class of people

[853] Stöger 2015 uses space syntax to identify possible neighborhoods in Ostia and also identified individual architectural choices that would have fostered neighborhoods.
[854] In III, i, 10, 14; IV, ii, 1; V, ii, 8, 13, 14.

that cannot afford to live in the large domus houses, but also cannot afford to rent out the larger apartments created in the past. This could suggest that there is a shrinking or absent middle class in Ostia, with only upper and lower class people inhabiting the city.

Taking this one step further, it could also mean that the upper class is not as wealthy as it used to be, and needed to create more apartments to maintain the same amount of rent. Whatever the case may be, these downshafts point to active choices being made regarding the removal of waste and water from buildings in Ostia in the Late Antique period. Other downshafts were resolutely blocked up in this period in the three insulae, suggesting that they were no longer needed. Perhaps the same issue is at work here as for the newly created downshafts, and that in some parts of the city blocks, there are no more tenants at all on upper floors, and as a result, they no longer require vertical drainage downshafts.[855] By comparing the total hydraulic systems of the three insulae, some more specific trends can be drawn out (Figure 6.320). Generally speaking, the systems of three insulae are increasingly different from each other, which results from the stronger role of the wealthy domus houses, especially in insula III, i and V, ii. This continues the trend from the previous period (RWF #3: AD 200-300), in which the domus house controls more area of the city block, and receives much more hydraulic attention than other buildings. Aqueduct supply features and sewer features are at high levels in this period, with the highest number of drains (36 features) known in insula V, ii. This is more than the combined number of drains in the other two insulae, and is connected to the increased number of water features created in the two large domus houses in this insula. When the Infrastructure data is distilled, the role of the domus houses becomes clear (Figure 6.321). With the creation of the elaborate domestic water features, the hydraulic system still maintains its hierarchy of features, with an increasing number of supply, usage, and drainage features, as in III, i and V, ii. No such single elaborate building is present in insula IV, ii, and it maintains its hydraulic diversity. In quantitative terms, only in this period does insula V, ii reach its maximum number of water features (113 features).

The degree of system resilience remains at the same level as the preceding period for all three insulae (Figure 6.322). This means that the system is complex, diversified, and flexible in all aspects. While the hydraulic systems are increasingly localized in fewer buildings in each insula, these continue to sustain themselves in a diversity of ways, especially in the domus buildings in insula V, ii (Domus del Protiro, Domus della Fortuna Annonaria). In terms of water in public and private spaces, each insula presents this relationship in a different way (Figure 6.323). The distribution between water in public and private spaces in insula V, ii mirrors the wider trend at Ostia, reflecting the boom of Late Antique luxury houses built across the city in this period. However, the other two insulae run directly opposite to this trend, especially insula III, i, which continues to display its resolutely outward facing public personality. While the respective values remain the same in this insula as in the previous RWF #3 period (20 private and 69 public water features), this continuity itself is the important point: despite its luxury domus, the rest of the city block continues to maintain its publicly oriented buildings, like the row of tabernae along the Via della Foce.[856] Much of the private investment comes from the creation of the private sewer and drainage systems outlined above in Figure 6.319.

[855] Downshafts blocked up in III, i, 4; IV, ii, 4; and V, ii, 4-5.

[856] See Figure 6.316 above for the Public-Private Water Usage in Roman Water Footprint #3; see Chapter 3.2 for detailed information on the role of tabernae in insula III, i, 4.

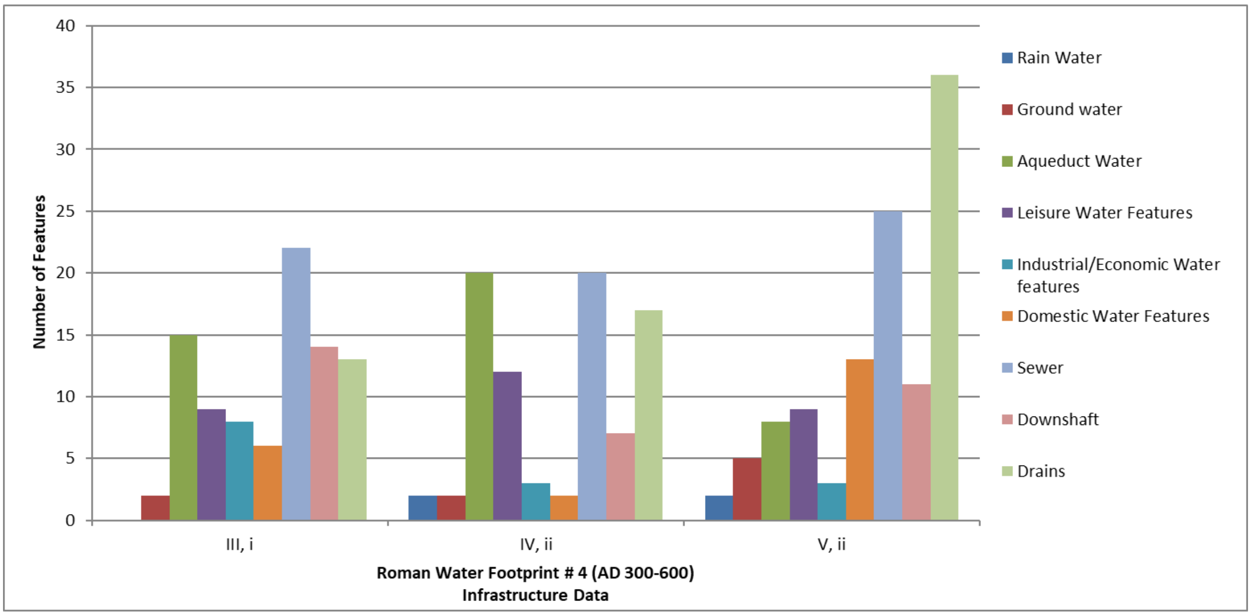

Figure 6.320: Infrastructure data comparing insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

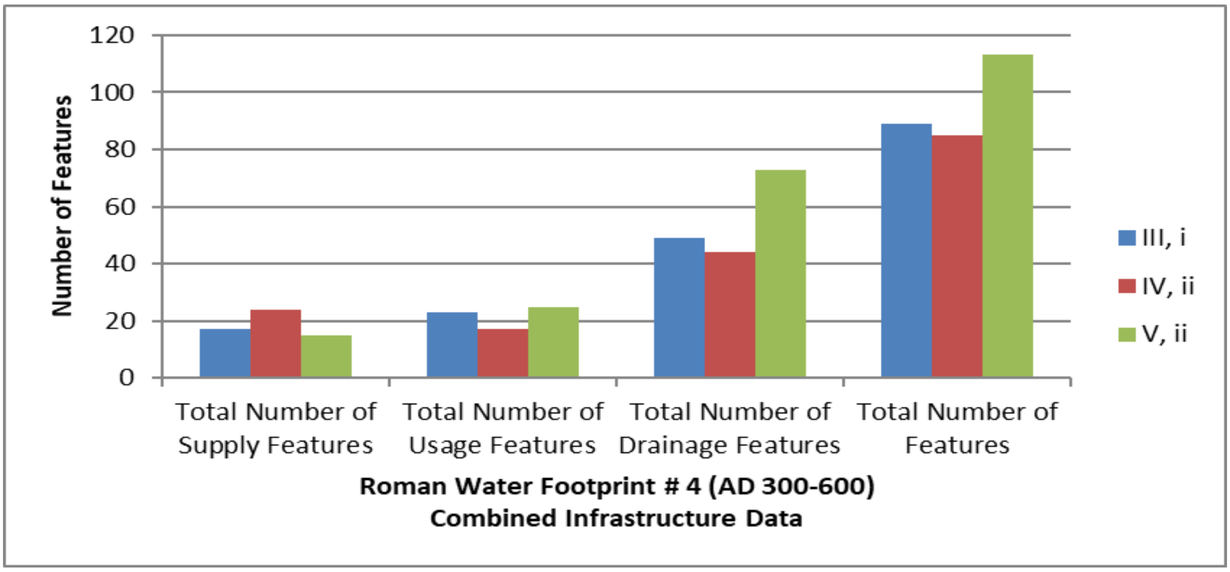

Figure 6.321: Combined Infrastructure data for insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

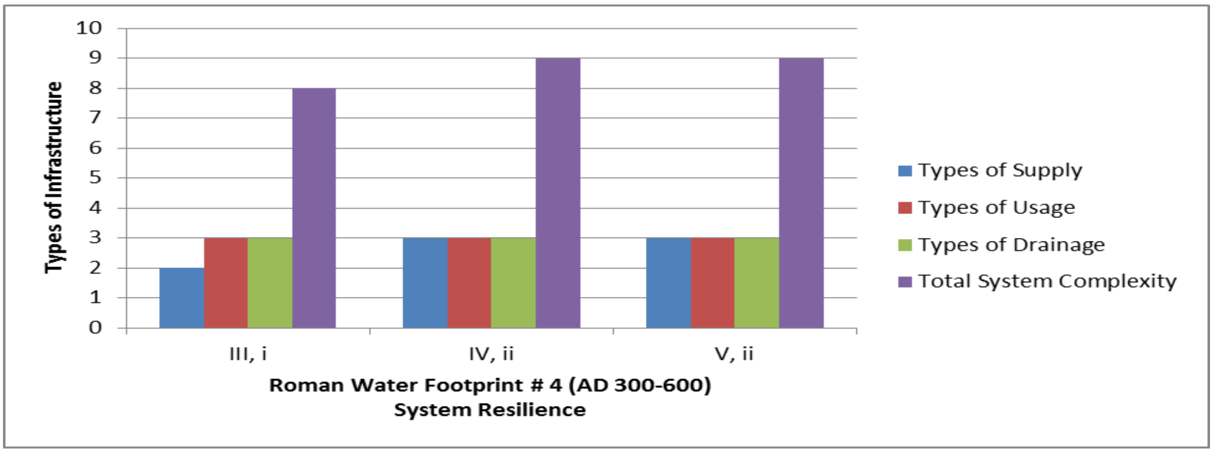

Figure 6.322: System Resilience of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

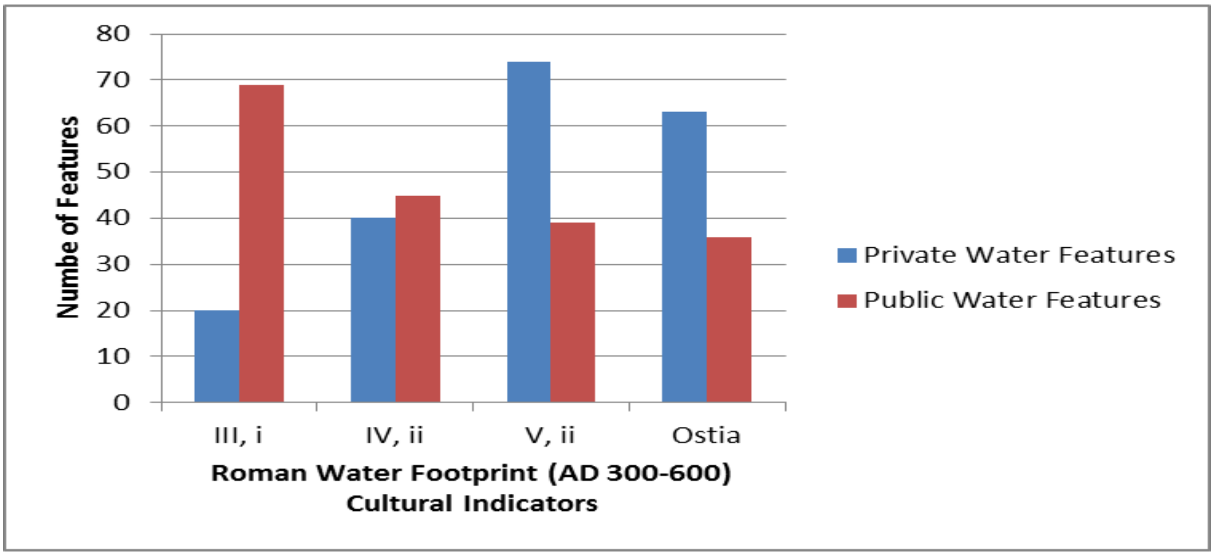

Figure 6.323: Cultural Indicators of insulae III, i, IV, ii, and V, ii in Roman Water Footprint #4 (AD 300-600).

During these Late Antique centuries six recorded floods occurred.[857] This is the same number as occurred during the Roman Water Footprint #2 period (AD 50-200), but the impact on the city must have been reduced given the rise in street levels that had occurred since the 1st century AD. Although the magnitude of these (or any) floods in Ostia remains a question for further research, the impact of rising flood waters on sewer systems is well attested in Rome. Perhaps it was one or several of these floods that caused the destruction and blockage of earlier sewer systems, forcing the residents of the city to create their own.

Changes to the wider urban fabric were evident also in the design of bath buildings in this period. While 14 thermal complexes are known to be functioning, at least in the early part of this period, communal bathing continued into the 5th century, and perhaps in some rare cases continued after the collapse of the aqueduct in the 6th century. Several bath buildings had relied on norias or water wheels to supplement or even completely supply them with water already for centuries.[858] Bath buildings, just like what can be gleaned from upper floor apartments, also experienced more subdividing, with smaller hot

[857] Aldrete 2007, 243 for the flooding evidence in the 4th-7th centuries.
[858] Such as the Terme del Mitra (I, xvii, 2) and the Terme dei Cisiarii (II, ii, 3).

and cold basins created. An example of this comes from insula V, ii, where one of the hot pools in the Terme del Filosofo (V, ii, 6-7) was completely blocked up and removed in this Late Antique phase.[859]

Hydraulically speaking, it was not the collapse of the aqueduct line that "caused" the abandonment or reduction of population in Ostia. Early Imperial wells and rain water systems continued to be used, and new wells were even dug into the formerly-busy *decumanus* and Semita dei Cippi. While there is certainly much more to explore regarding the Late Antique landscape of Ostia, the other aspects of the city's decay must be equally borne in mind. Larger socio-political forces made the city less desirable a place to live in the 5th and 6th centuries, and its increasing move towards privately owned buildings could not maintain its urban functioning.

[859] See Chapter 5.1 for the Terme del Filosofo more detailed history.

6.5 Total Hydraulic Histories of insulae III, i; IV, ii; V, ii

The following charts outline the major hydraulic trends in all three of the insulae studied in this work (Figure 6.324, Figure 6.325, Figure 6.326).

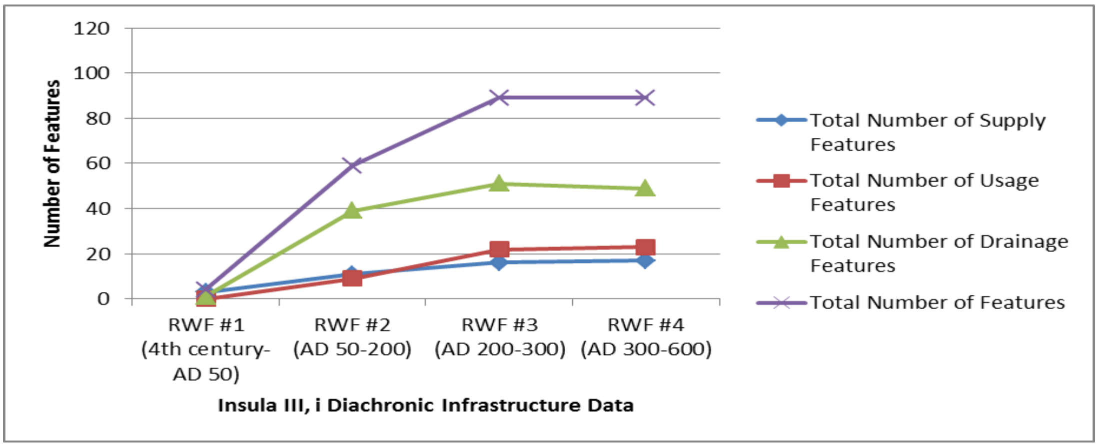

Figure 6.324: Combined infrastructure data for the entire history of insula III, i.

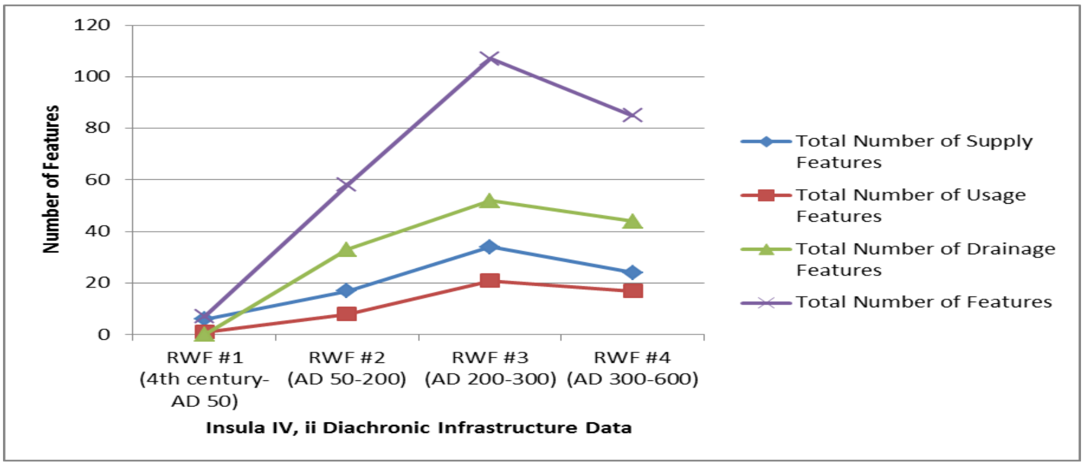

Figure 6.325: Combined infrastructure data for the entire history of insula IV, ii.

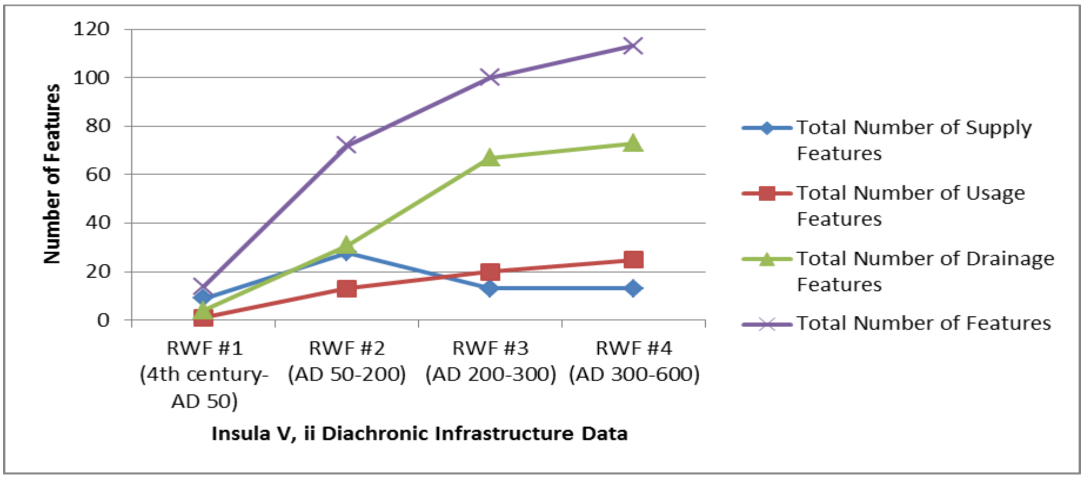

Figure 6.326: Combined infrastructure data for the entire history of insula V, ii.

By placing all three hydraulic biographies of the insulae next to each other, larger similarities and differences can be identified. The metaphor of a biography may be useful here: three children growing up in the same household will have much in common, but many crucial and intrinsic differences will distinguish them from each other. Right from the beginning (RWF #1: 4th century B.C.-AD 50), the blocks have different characters, especially in terms of what types of water supply resources they utilize. This is a direct reaction to the type of buildings created in each insula in the formative Republican and early Imperial period. Some of the city blocks maintain this diversity and self-sustainability throughout the rest of their existence (e.g. IV, ii, and V, ii), while others never choose to take advantage of other types of hydraulic systems (III, i). Just like a young child, the initial stage of Ostia's life is the one most replete with hydraulic incidents, namely with the highest number of flooding throughout its history. The repeated interaction with flood waters caused many sewer lines to be created across the city. Lacking the topography of Rome, these sewer lines directed drainage water in all directions away from the city centre: into the river harbor, out to the Mediterranean, and under an eastern city gate.[860] Perhaps this multi-directionality of drainage systems assisted flood waters to drain out in all possible directions of the otherwise flat and bumpy topography of Ostia. The city could then be seen to have discrete "catchment-basins" like rivers in a landscape, with different neighborhoods or city blocks channelling their waste water out in different directions.[861]

In all three city blocks the creation of the aqueduct lines in Roman Water Footprint #2 (AD 50-200) offered a wealth of hydraulic opportunities, and there is a clear growth in all aspects of the hydraulic system when compared to the previous period. This is the high Imperial period of Ostia, with massive urban investment especially during the Trajanic and Hadrianic periods. This is the city we are most familiar with, with a declining harbour function, but much prosperity as a result of Ostia's relationship with Portus. In all of the insulae, but especially insula IV, ii, the structural layout of the buildings in this period provided a framework to later development.

However, it is the transition from the Roman Water Footprint period #2 to #3 (AD 200-300) that appears to be much more hydraulically significant. Like teenagers developing into adults, the three city blocks continue to grow and develop while maintaining some deep structural similarities. The available hydraulic evidence supports the contention that the Severans, and more widely, 3rd century hydraulic systems, left a dramatic impression on Ostia. In all three insulae there is the structural relationship already elucidated in the previous sections, that of hydraulic hierarchies. The number of water features increases like a pyramid, with supply features at the top with the fewest number of features, then increasing to have more features dealing with the usage of the gathered waters. At the bottom of the pyramid comes the drainage features, most numerous. Only insula IV, ii goes against this model, but even then the number of supply and usage features is at no point dramatically divergent. While the top of this pyramid (Supply features), are most well studied, these rely heavily on the subsequent levels of hydraulic systems, most importantly the drainage systems.

Taking the metaphor to its final stage, the final phase of hydraulic life in the insulae is far from linear. Ostia is a very different city than its 2nd century heyday; the surrounding variables are all so different that comparing the two becomes increasingly anachronistic. Each insula reacts differently to the change from Roman Water Footprint # 3 into # 4 (AD 300-600). Insula III, i stays largely stable, maintaining its 2nd century character. Although it does gain a prestigious domus, this merely maintains the hydraulic situation of the insula, rather than dramatically changing it. Insula IV, ii witnesses a slight decline into Roman Water Footprint #4 in all its hydraulic categories. Its bath building, with its Severan rebuilding, continues to be the main novelty of this insula, with numerous smaller patches added to the various buildings, but with no dramatic changes. Insula V, ii thrives in its old age with its major investment in

[860] Bukowiecki 2008 *et al.* 92 for a sewer exiting the city gate directly south of the Porta Romana *castellum*; David *et al.* 2013 for the sewer draining *"direttamente in mare"* from the Terme del Sileno (IV, ix, 7); Heinzelmann-Martin 2002, 8 for the sewer emptying into the river harbor.
[861] Poehler 2012 modeled this idea for Pompeii, but in terms of rainwater drainage on the city streets.

250 AD bearing rich fruit in its later years. The creation of two luxury domus buildings and a bath building in the previous period allow this mercurial city block to continually invest in itself into its later years, when it gains its highest number of total water features.