Cultural Heritage Agency
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Nederlandse Oudheden 20

The Roman villa at Voerendaal-Ten Hove

Excavations of a Late Iron Age enclosure, a Roman villa complex, a Late Roman-Early Medieval settlement and burials

Part V - Appendices

H.A. Hiddink (ed.)

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provincie limburg

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Contents

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Part V - Appendices

Appendix I Research themes

D.S. Habermehl

Various research themes can be defined for the study and analysis of the Voerendaal-Ten Hove site. Prior to drafting the Action Plan (*Plan van Aanpak*), the RCE formulated three main themes: 'habitation', 'economy and infrastructure' and 'burial and other rituals'. Within these various sub-themes can be defined that are related to the various approaches to the site, partly in view of the multidimensional perspective introduced above.[3347]

1 Research questions

1.1 Basic analysis

As previously emphasised, the first, essential part of the study comprises the basic analysis of the features and structures, as well as a detailed phasing of the settlement. This is of great importance in order to be able to approach the more complex, substantive themes and questions in a well-informed manner and to carry out specialist analyses. The related research questions concern in particular the form, constructional and spatial structure, the dating and nature of features and structures, as well as the settlement(s) as a whole. The finds play a supporting role in this basic analysis, particularly with regard to dating (and with an explanatory value in terms of functions/activities).

- What structures can be reconstructed from the documented soil features?
- What can be said about their construction?
- What is the spatial coherence of these structures?
- How can the different structures be dated?
- Is it possible to make statements about the above-ground architecture of the different defined structures (without going into elaborate reconstructions)?
- Can statements be made about the function of the various defined structures on the basis of their form, structure or content/associated finds?
- How did the settlement develop over time? Which development phases can be distinguished and what was their absolute dating?

1.2 Formation and post-depositional processes

In the basic analysis, but especially in the interpretative study of the site, attention should be paid to the formation and post-depositional processes that played an important role in the way the archaeological soil archive was ultimately discovered. The aim is to obtain an overall picture of the factors that have 'distorted' the distribution of finds (including ecological material) and influenced the preservation of features, which can lead to an 'incorrect' understanding of dating, activity zones and so on.

- How are the features and finds conserved in the various parts of the site? How can any differences be explained?
- What are the main factors behind the distribution patterns of the various find categories?
- What formation processes played a role in the way finds has ended up in the various feature categories?
- What role did erosion play in the preservation of the archaeological features and the distribution of the finds?
- Did substantial erosion already occur during the settlement period at the Ten Hove site or was this mainly a phenomenon that only occurred after the abandonment of the site?
- How extensive was the erosion of the terrain during the various occupation and use periods (see also earlier calculations by Kooistra).
- How extensive was the erosion of the terrain after the terrain was not used for habitation any longer but as arable instead in the Late Middle Ages and Early Modern times?

1.3 Physical landscape

Study of the physical landscape in which the settlement is located and the changes in that landscape and the physical conditions over time; soil types, relief, hydrology, erosion, fertility, natural resources, vegetation, etc. This includes the relationship between the settlement, the human activities within it and the physical landscape.

[3347] In chapter 5 of the Action Plan.

- What did the landscape look like prior to the first structural occupation of the site?
- What were the uses of the immediate surroundings; which different landscape zones can be distinguished and what were their respective characteristics?
- Are there differences in the preservation of the site as encountered during the research campaigns of Habets, Holwerda, Braat and Willems that have a physical-landscape background?
- How is the site situated in relation to the relief?
- Why was the site chosen for the settlement and the construction of the monumental complex, seen from a landscape perspective?
- What is the relationship between the precise location and orientation of the building complex and the landscape conditions?
- What did the natural landscape in the vicinity of the villa look like (type of vegetation, openness etc.)?
- What did the physical landscape in the immediate vicinity of the site change in the period between the earliest Roman settlement and the final phase of the monumental villa (between c. the beginning of the era and the later third century AD)?
- Was reforestation already going on during or did it start after the Roman period?
- How did the landscape look like during the Early Medieval occupation phase?
- Are there indications that a terrace was formed on the site before the construction of the villa?

1.4 Cultural landscape

Study of the man-made landscape in which and within which the settlement is located and the changes to that landscape over time.
This includes the size and (symbolic) design of the 'villa territory', the location and size of the arable fields and the relationship between the Ten Hove settlement and other settlements, roads, graves, central places, etc.

- How is the settlement embedded in the contemporary cultural landscape in the different settlement phases; what was the (spatial) relation to other settlements (both simple traditional settlements and other villas), roads, *vicus*, cities, cult places, military bases etc.?
- What were the boundaries of the villa's territory and what data and arguments can be used for the reconstruction of this territory?
- How were the liminal zones of the settlement used?
- How was the villa of Voerendaal connected to the infrastructure? How was the villa situated in relation to secondary roads and the 'Via Belgica' between Boulogne and Köln?
- How did the access road to the villa settlement run?
- Where did this road come from and where did it go (connection primary Roman routes in this area?)
- What was the relationship of the Ten Hove villa to other villas? How far from the Voerendaal villa was the next villa located and were these or other villas visible from the Voerendaal villa?
- How was the villa's visibility in the landscape? From which points was the villa visible and from what distance?
- Was the villa visible from any of the roads crossing the area?
- Did the architectural choices that were made have anything to do with the (improvement of the) visibility in the landscape?
- Were there also simple, traditional settlements at a short distance from the villa Voerendaal?
- How was the relation between the villa settlement and the nearby (monumental) graves: visibility, accessibility etc.?
- To which *civitas* can the villa at Voerendaal be attributed, and on what basis?
- In what way could the (physical and cultural) landscape at and around the site of Ten Hove have been given meaning by the inhabitants and in what way are meaning and organisation related to each other (think of the meaning of landscape zones, like brooks, wet spots and especially high locations, the location of graves, the demarcation of zones of habitation and fields etc.)?

1.5 Structure and interpretation of the habitation

Study of the nature and (spatial) structure of the settlement, both from a functional-economic and a social perspective. This includes the relationship between the various buildings, the coherence of courtyards, the spatial delimitation of the settlement and the way in which social relationships were shaped in the spatial structure of settlements.

- How was the site laid out in the different periods?
- To which phases did the different buildings belong?
- What was the character of the (habitation) activities with which the flint artefacts can (possibly) be associated?
- How was the enclosed area (ditch 308) from the Late Iron Age or Early Roman period ordered and arranged and what was the character of the occupation of this area?
- Did the enclosure have a defensive function and was there an earthen wall next to the ditch?
- Was the pre-villa settlement divided into several plots? How were they laid out and how do they relate to each other?
- What is the reason that building 403 is not at the same level as building 401?
- How can the subtle change in orientation between the earliest fenced settlements and the villa settlement be explained?
- What functions did the land behind the main building have?
- What were the geometrical principles underlying the settlement structure: the enclosure ditches, the arrangement of the buildings etc.?
- How were the flows of movement of residents and visitors controlled within the settlement and how did that determine the experience of these people?
- Can it indeed be assumed that a path ran between the southern entrance of the settlement and the entrance of the main building?
- Do outbuilding 402 and 405 [and the later discovered 401 and 403 as well] belong to the second stone villa (period 3), as Braat suggests?
- Are there indications of a garden in the enclosed forecourt next to basin 319?
- How can foundation 414, situated centrally in front of the villa, be interpreted; are there concrete indications for an interpretation as foundation for a Iuppiter column, as suggested by Willems?
- Why was the south side of the villa site equipped with a stone wall (416) as boundary and the rest of the site not?
- Are there indications for the presence of buildings south of Steinweg?
- The regularly ordered features on the inside of trench 302 have been interpreted by Willems as planting holes: is this interpretation tenable and what arguments support it? How can this enclosure be reconstructed?
- Can a distinction be made, based on the pottery assemblage or other finds, between the main living quarters and the secondary houses/buildings on the site?
- How was the Late Roman and Early Medieval settlement spatially structured?
- What role did the remains of the monumental villa buildings play in the spatial arrangement of the Late Roman and Early Medieval settlement?

1.6 Architecture

Study of the construction, structure and appearance of the buildings within the settlement. This includes architectural aspects, building practice, use of materials, the cultural and social significance of architectural traditions, the functional and socio-spatial structure of buildings and the process of monumentalization ('*aggrandizement*').

1.6.1 Stone buildings

- Can the building that Braat calls the first main building indeed be interpreted as such?
- Had this possible first stone main building indeed been demolished, as Braat suggests?
- How did the main buildings evolve over time?
- How can the spatial structure of the stone

main buildings be interpreted, both from a functional and social perspective, and how did it change over time as the building expanded?
- How was the central space of the main building (separately for each phase) arranged? Was there a central hearth, a paved floor, or was the space possibly still divided into separate rooms?
- What was the layout of other important rooms?
- How were social relations spatially and architecturally expressed within the different main buildings? For example, what was the spatial arrangement of different rooms, what were the restrictions on access, the presence of wall paintings, interior decoration, etc.?
- What was the function of the rooms where murals were found? Were these rooms added later?
- What was the function of the cellar in the second main building?
- In what way is there the so-called 'aggrandizement' of the main building over time (aggrandizement is increasing the monumentality, making a building more impressive).
- Are there any connections based on concrete similarities between the architecture of the villa of Voerendaal and other villas in the vicinity (also Germany and Belgium)?
- Is there any form of standardisation in the architecture of main villa buildings within the region?
- Can the above-ground architecture be reconstructed of in particular the main building and possibly the larger outbuildings?
- Was there standardisation with regard to the stone outbuildings of the villa?
- How can the foundations of structure 407 (formerly known as G) be interpreted? Is an interpretation as a tower indeed tenable? Is this structure comparable to other Late Roman towers in for instance the *burgi* along the Via Belgica?
- What is the structural relationship between tower 407 and the village building in which it was constructed? Were these buildings in ruins at this stage, were only the foundations reused or was more of the buildings used for the construction of this tower?
- Was building material from the villa reused in the construction of (the foundations of) tower 407?
- How did the baths develop over time?
- What is the functional structure of the baths in the different phases? Are Braat's interpretations correct? (compare also Dodt 2003).
- Can the earliest baths indeed be dated contemporaneously with the first phase of the second stone main building?
- For what reason were the secondary buildings provided with 'buttresses'; what was their function?
- Were the stone outbuildings used exclusively for economic/agricultural activities, or were they also lived in?
- Why did building 401 have a portico and building 403 did not?
- Is the portico of building 401 a later addition or an original element of the building?
- How were the foundations of the stone buildings constructed and how does this construction technique compare to that of other villas in the area?
- What types of stone were used in the construction of the stone foundations and walls?
- How high were the stone walls? Was it a low wall with wooden frame construction or were completely stone walls perhaps also used?
- What spatial and geometrical concepts may underlie the monumental villa complex of the second/third century?
- What are the geometrical principles that underlie the structure of the various buildings?
- Where could the architectural knowledge and skills have been acquired that were needed for the construction of the stone villa buildings and the specialized installations like the bath building and the water pipes?
- What types of mortar were used for what purposes?
- What was the composition of the different mortars?

1.6.2 Timber buildings

- To which building tradition do the earliest wooden structures belong and where can parallels for these structures be found?

- Are there also buildings of the Alphen Ekeren type present at Voerendaal, as is known from e.g. the villa settlement Kerkrade-Holzkuil? If not, how can the absence of such buildings be explained?
- What types of buildings were present within the earliest enclosure ditches (ditch 308), what was their function and how can they be dated?
- What types of buildings were present within the earliest enclosure ditches (301, 303) and what were their functions?
- Are these early wooden buildings (also) byre-houses/longhouses?
- How can the rectangular wooden building 418 underneath building 403 be reconstructed; was it a timber frame construction?
- How can the sunken-floored huts/*Grubenhäuser* (*hutkommen*) be reconstructed and how does their form/structure relate to their function?
- What is the cultural significance of the pit dwellings (are they linked to specific population groups) and how does the appearance of these structures relate to other sites in the region?
- Were larger buildings present in the Late Roman and Early Middle Ages in addition to the pit dwellings and to what types can they be attributed?
- How were the wooden houses internally arranged?

1.7 Development of the settlement

Study of the development of the settlement through time and the relationships between the various settlement phases. This involves both short-term developments and the longer-term processes, in which the theme of 'continuity and discontinuity' is of great importance.

- In what ways was the villa complex monumentalised over time and what did this mean for the appearance and visibility of the complex?
- How did the use of space within the settlement develop, especially during the first two centuries of our era?
- Was there an increasing functional-spatial 'specialisation' and separation of functions?
- How did the enclosure of the settlement develop over time? Is the phasing of the enclosure ditches drawn up by Willems correct?
- When did (parts of) the monumental complex fall into disuse and how?
- Was the first *horreum* already connected to the (second) main building by a portico?
- Was there a total abandonment of the settlement in the period between c. AD 275 and 350/375, or are there indications for some form of continuity?
- What did the settlement look like after c. AD 275, when the villa possibly fell out of use as an operational agricultural business?
- Did some buildings remain in use after c. AD 275? Consider Willems' interpretation that building 401/A remained in use until c. AD 400.
- To what extent were buildings after c. AD 275 still present in the landscape as ruins and how were these ruins used?
- When was material from the building ruins reused?
- Are there any *spolia* known in the vicinity of the site that could have originated from the villa in question?
- How did the enclosure/boundary of the settlement develop over time (for example ditches, palisades, vegetation, walls)?
- When did the first enclosed settlement fall into disuse and how? Is there perhaps a relationship with Caesar's campaigns?
- In what way were the second/third century (outhouse) buildings used in the Late Roman period and Early Middle Ages?
- How did the inhabitants of the site deal with the remains of the past that they encountered (the past in the past)?
- Is there an occupation continuity between the earliest activity within the site enclosed by ditch H and the first settlement enclosed by ditches?
- To what period dates this first settlement enclosed by ditches?
- Are the glass bracelets found indications of habitation or activity in the Late Iron Age or can they also be assigned to the Early Roman period?
- Is there continuity or discontinuity in the period between c. AD 275 and 350/375?

Which archaeological arguments can be put forward for this?
- Is there any activity on the site or in the vicinity between the early eighth century and the eleventh century? Is there continuity or discontinuity?
- How did the 'de-Romanisation' and 'Germanisation' in the fourth and fifth century phase of habitation of the site develop?
- How can the remarkably long occupation history of the site be explained when compared it to other sites in the vicinity?
- What does the long history of occupation tell us about the significance of the Ten Hove site? Why was it inhabited for so long; purely physical/landscape, or also mental, significance, continuity?
- Is there a social/ethnic continuity between the second/third century villa settlement and the Late Roman settlement?
- Why did these (new) inhabitants choose to live on the former villa site?
- How did the monumental villa complex develop? Was there a coherent spatial concept, as Willems suspects, or is there a phased development from a small, simple, to a very monumental complex?
- How can the absence of coins from the period of the late 3rd and early 4th centuries be explained?

1.8 Agrarian economy

Study of the production and consumption of food within and in the immediate vicinity of the settlement and its changes over time.
This includes the analysis of the plant and animal products produced and consumed, the role of food products from outside (imports), the use of land/the landscape for growing crops and keeping animals, the processing and storage of products/crops and the stabling of animals (in relation to the function of buildings and other structures), the techniques and activities related to food production, socio-economic relationships in relation to production, the marketing of any surplus, the extent of production and processes of specialisation and intensification.

- How did the food economy of the settlement develop over time?
- How did the economic orientation of the settlement change over time?
- Is there any specialisation, intensification and if so, how and when did this take place?
- What was the market for the products produced at the villa?
- What was the size of the surplus produced at the villa?
- Were products or live animals also brought in from outside?
- What function did the south-eastern annex have? Is the function of pasture land suggested by Willems tenable?
- Is there a (functional and spatial) relation between building 401 and the mentioned annex?
- Where was the livestock kept within the settlement, and where might it have grazed?
- What was the function of structure 413 outside the villa enclosure (horse pond?)
- What was the size and the shape of the livestock herd?
- What was the primary and secondary function of livestock?
- What crops were cultivated around the settlement in the course of time?
- Where were the best fields in the immediate surroundings of the villa?
- Were tools found related to agricultural activities or cattle breeding found and what do they tell us about the way of working?
- Were ditches present outside the settlement that can be related to a field system?
- How can the functional shifts in the various outbuildings be explained? What is the broader economic context of these shifts?
- Are Kooistra's calculations and assumptions about the economic carrying capacity of the (seven) villas in the Heerlen basin still correct? (Compare with new studies, such as Jeneson 2013).
- What was the function of the paved area (420) in front of building 401?
- What economic activities were carried out directly outside the villa's yard?
- How did the landscape influence the economic activities of the site's inhabitants during the Early Middle Ages? How does this picture differ from the Roman period?

- Are there indications of agricultural activities south of the Steinweg, in the valley of the Hoensbeek?

1.9 Artisanal economy

Study of the artisanal activities that have taken place in and around the settlement through time. This involves the analysis of the various craft techniques and products, the use or sale of these products and the relationship of these activities to habitation and the social structure within the settlement.

- The potter's kiln: which technique, which type of products, for local use or wider market? How does this kiln relate to the habitation in period 2/early 3?
- Was the artisanal activity in the first settlement with the stone building (second half of the first century AD) focused on production for local needs only or (also) for the external market?
- What products were produced in this phase of the artisanal activities?
- Did iron mining and processing occur during the settlement phase with the first stone building?
- For which artisanal activities were the village buildings re-used in the Late Roman period? In what way were these buildings reused? (many parallels in the German Rhineland).
- Building 403 functioned as a forge in a later phase, according to Willems. Which finds can be associated with such a function, can the activities be determined more precisely and do they indeed belong to this building and a later phase of its use?
- How can the 17 small, keyhole-shaped ovens from the Late Roman period be interpreted?
- In the northwest corner of the site, near building 411, some small ovens from the third (?) century AD were excavated; what was their function?
- What was the function of the four circular soil features with a charcoal fill, partly mixed with iron slag (structure 614-617)?
- What was the function of the narrow, elongated ground features with traces of fire (607-613, 649) under the later building 405?
- What techniques were used for the extraction of iron from iron ore and the further processing of the iron?
- What is the origin of the iron ore from which the iron was extracted?
- Were the raw materials used in the crafts brought in from elsewhere, or were they possibly mined within the territory of the villa itself?
- Was lime being burnt on the terrain, for instance for the production of mortar?

1.10 Exchange networks and trade

Study of the economic contacts and exchanges between the settlement residents and the outside world. This involves the reconstruction of the exchange networks in which the site operated, the origin of imported products/ materials and the marketing of produced food and other products.

- In which exchange networks did the settlement of Ten Hove operate with regard to agricultural products and food (sales and supply)?
- What were the important suppliers of pottery from the region and province? And do shifts occur in this respect through time?
- Which pottery entered the settlement as packaging material and which products were involved?
- What is the origin of the amphorae found in the settlement?
- How does the number of amphorae found (and their provenance) compare to similar villa settlements and what conclusions can be drawn?
- What pottery was imported from outside the province, and from where exactly?
- What was the economic significance of the different cities in the region for the settlement of Ten Hove: The larger centres Tongeren, Xanten and Köln, but also the secondary centres like Heerlen, Maastricht, Jülich and Aachen?

- What does the coinage tell us about the activities on the ground, the embedding of the villa in the wider economic system (relations with cities, military apparatus etc.)?
- In which exchange networks did the settlement of Voerendaal operate through time?
- Where was the building material used sourced or purchased?
- What do the building materials used tell us about the connections between the builder of the villa (a developer/architect) and the wider region?
- To what extent is there uniformity in the ceramic building material? Are the hypocaust tiles and *tubuli* made of the same fabric as the roof tiles?
- What do the coin assemblages from different periods tell us about the exchange networks within which the settlement operated in that period?

1.11 Raw material extraction

Study of the extraction or supply (see above) of raw materials associated with the settlement. These may include iron ore, clay, wood, natural stone, gravel, loam, etc.

- Can it be plausibly established that the Craubeek quarry lay within the territory of the Ten Hove villa?
- Is it possible to establish with certainty that stone was extracted from the Craubeek quarry in question for the construction of the stone buildings? And if so, can such stone also be found elsewhere in buildings from the Roman period (Heerlen?)? Or was stone from further away used for the construction of (parts of) buildings?
- What other raw materials were within reach of the villa, which may have lent themselves to exploitation and sale, or to processing in artisanal processes?
- Was peat extracted in the valley of the Hoensbeek during the Roman period, as suggested by Willems & Kooistra?

1.12 Funeral rites and other rituals

Study of the way in which deceased co-residents were treated through time, how they were buried and possibly how they remained part of the community. This includes the reconstruction of burial rituals, the handling of the body, grave goods and associated ideas, funerary monuments, the relationship to the living community (including the wider community), and social hierarchy.

1.12.1 Burials

- What is the spatial relationship between the different settlement phases and the contemporary graves?
- Who were buried in the graves found? (also physical-anthropological research)
- Were the interred individuals locals or did they come from elsewhere?
- What social relationships are reflected in the burials?
- Which individuals were interred in the graves and what was their social position?
- Were there (simple) burials in the periphery of the settlement (possibly around the enclosure ditches) during the Roman period, as was often found at other villa settlements in the German Rhineland?
- Where were individuals buried during the first two centuries AD?
- How can the grave goods from the different graves be interpreted; what do they tell about the individuals interred, their social environment and the themes and ideals communicated through these grave goods?
- Are there any graves known for the period of the large villa complex (2nd and 3rd centuries AD)? What was the spatial relationship of these graves to the villa settlement?
- Are there indications that building 411 and/or 412 functioned as grave monuments? What was the nature of the rituals performed there?
- Can the separately found lion sculptures (Voerendaal-Winthagen), gold coin and Bacchus bust be associated with graves and did a relationship of these finds with the villa complex at Ten Hove exist?

- How can the grave monument to which the lions may have belonged be reconstructed and dated?
- What was the spatial relationship between the graves from around AD 300 (320, 321) and the contemporaneous occupation?
- What is the relationship between building 402 and the Early Medieval graves found at the site? Did the presence of the building play a role in the choice of location for the graves and in what way?
- Why were people buried in the ruins of the villa in the Early Middle Ages?

1.12.2 Religion/ritual practices

Study of the religious/ritual practices that took place within or in the immediate vicinity of the settlement. This involves the recognition and interpretation of ritual deposits, objects with ritual or religious significance, the possible presence of structures with ritual or religious functions, the social significance of ritual practices, the relationship of these practices to more institutionalised religions.

- Are there indications of rituals that were performed in the domestic sphere?
  For example, building sacrifices, abandonment sacrifices, ancestor worship, idols, altars, etc.
- Are there indications of rituals near the liminal zones of the settlement: in or near the enclosure ditches?
- How can the deposition of dog skeletons in the well be interpreted?
- Are there any deposits in the liminal zones of the settlement (in or near the enclosure trenches) which can be interpreted as ritual?

1.13 Water supply

Study of the way in which water was obtained within the settlement. This includes the role of the various streams in the vicinity, the use of the well(s), the possible collection of rainwater, the construction, function and course of the stone water pipes, gutters and drains.

- How was the water supply organised in the earliest settlement phases (first century AD); were there water wells or was water obtained from streams?
- Which stream is the source of aqueduct 316 that replaces well 314 in the second century?
- What is the possible further course of this aqueduct through the landscape?
- What buildings were supplied with water by the aqueduct in the far northwest of the site?
- How was aqueduct 316 constructed and during which period?
- Which structures were used for the drainage of water?

1.14 Social structure and society

Study of the social structure within the settlement and the settlement within the wider society. This involves the social position of the various residents, the mutual and wider (external) social relationships and the way in which these were shaped and communicated. In addition to informal social relations, it may also involve institutionalised social relations and functions.

- How can the occupants of the site during the Late Iron Age and the earliest Roman period be culturally interpreted, seen in the dynamic context of the period in question?
- In which tradition does the hand shaped pottery of the earliest settlement phases fit? Does the pottery fit into existing local traditions or are there indications of relationships with other traditions?
- In which social networks did the owner of the villa of Voerendaal operate?
- For which buildings are there suspicions/indications that they may have been inhabited? Was there a multifunctional/combined living/working function?
- How was the social structure of the settlement shaped in the spatial structure and architecture of the settlement?
- Focus on the non-elite: who lived in the villa grounds without being part of the villa owner's household? How did they live, what relationship did they possibly have with the villa owner?

- Can (asymmetrical) social relationships be assumed between the villa settlement and nearby settlements?
- Are there indications of unfree/enslaved people within the villa settlement of Ten Hove?
- How were the social relations within the settlement and within the household(s) shaped through the structuring of space? (social space; spatial as social metaphor).
- What was the social structure of the Early Medieval settlement? Was there a social hierarchy and if so, how was it expressed?

2 Synthesis

In the sections above, a multidimensional perspective has been described and various research themes and questions have subsequently been defined. An essential part of the chosen integral and multidimensional approach is the synthesis. In this synthesis, the various dimensions, themes and specialist sub-studies are confronted with each other in order to arrive at a more detailed, complete and subtle understanding of the site under investigation. How can the form, functioning and development of the Ten Hove site be understood within the region, the province and the state? How has the site been repeatedly reshaped, viewed within those broader frameworks?
In addition to the research themes already described, a number of themes can be defined for the synthesis. These synthesising themes are more abstract and theoretical in nature and often cover several research themes.

Romanisation. Integration into the Roman Empire
Processes of change within the settlement at ten Hove which are connected with the development of the Roman empire, with the development of new cultures and lifestyles and with the integration in Roman structures and networks. A broad view on developments in architecture, material culture, (social) economic relations, use of space, food economy, trade and religion.

De-romanization and Germanisation
The processes of change that took place in the period when the Roman Empire lost influence and finally ceased to exist in the region of the site. A broad view on developments in architecture, material culture, (social) economic relations, use of space, food economy, trade and religion.

Material culture
The role of material culture (both mobilia and architecture) in the lives of the inhabitants of Ten Hove. How did they actively shape their lives in an economic, social and cultural sense through this material culture?

Town-country relations
The economic, social and cultural relations between the settlement of Ten Hove and the central places in the vicinity and the wider region. What role did places like Heerlen, Maastricht, Tongeren, Aachen, Xanten and Köln play in relation to the Ten Hove settlement?

Elite and non-elite
Issues regarding the increasing social complexity in the Roman period and the lifestyle of and relations between the elite and non-elite. In the case of villa settlements in particular, attention is sometimes limited to the elite inhabitants, their houses and their material culture. For a good picture of such settlements, however, it is important to include those who do not belong to the elite in the analysis: their houses, material culture, graves.

Appendix II Calculating flow-rate and velocity

H.A. Hiddink

Flow-rate

The flow-rate of an open channel is calculated with the formula:

$Q = A . v$

with the elements;

- Q discharge (m^3/s)
- A cross-sectional area (height x width (m^2) of a channel with a simple rectangular cross-section)
- v flow velocity (m/s)

The result of the calculation is the flow-rate in m^3/s, to be multiplied by 1000 to obtain a value in l/s

Velocity according to the Chézy formula

The flow velocity (v) of water is calculated here with the Chézy formula:

$v= C . \sqrt{R} . S$

Here the latter two elements are the most obvious:

- S (or i) the slope or incline of the line (m/km); the 0.25 or 0.15% mentioned in chapter 10 expressed as 0.0025 and 0.0015
- R the hydraulic radius of the line = A/P; the latter being:
- P the wetted perimeter= twice the height * width of the channel (m^2) or in simple terms the part of the channel dragging the water down
- C the Chézy-coefficient; often calculated like we did with Manning's roughness coefficient (n):

$C= R^{1/6} / n$

Example

For a stone/clay channel of 24 cm wide with a water level of 10 cm, A = 0.24 * 0.1 = 0.024 m^2
The wetted perimeter P= 0.1 + 0.24 + 0.1= 0.44
With both numbers, the hydraulic radius R can be calculated: 0.024/0.44= 0.0545 m^2
The Chézy-coefficient = $(0.0545^{1/6} = 0.615828467) / 0.015 = 41.05523117$
All numbers to calculate the velocity are known:

$v= 41.055 * (\sqrt{(0.0545 * 0.0025 = 0.000136364)} = 0.011677) = 0.479$ m/s

Velocity according to Manning

Another way to calculate the flow-rate (Q) is by Manning's equation:

$Q= vA= (1.00/n) . A . R^{2/3} . \sqrt{S}$ (or i)

Another formula for calculating the flow-rate

And an quite simple alternative for the calculation of flow velocity (after Haberey 1972, 97; the roughness coefficient for concrete is here 0.35 (probably Kutter's), giving the same result as Manning's 0.015):

$v= (100 . \sqrt{R}) / (b + \sqrt{R}) . \sqrt{(R . S)}$

Appendix III Provenance of raw materials and labour-input for the aqueduct

P. Schut

In order to get an idea of the effort required to build the aqueduct, some of the construction activities are listed here, as well as the amount of materials required and their origin. Of course, the calculations are approximations that may deviate more or less from reality.

1 Digging the construction trench

Of course, it is not known whether each section of the aqueduct was constructed in the same way, but in any case a construction ditch had to be dug everywhere. It is uncertain how deep the original trench exactly was, but to the 65 cm recorded during the excavation, 40 cm was added for the top soil and another 30 cm for the later (possibly) eroded part, resulting in a total of 1.35 m. Assuming a length of the aqueduct of 1,825 m, a width of 1.1 m and the depth just mentioned, it can be calculated that 2,710 m³ had to be excavated. With 3-4 m³ of earth displacement per worker per day, whereby the soil did not have to be moved away,[3348] between 678 and 903 man-days were required for construction (Table III.1). Presumably, several work teams were deployed simultaneously, working on different subsections based on the route marked by the surveyor. The speed is determined by the number of work teams and their staff. Closing the trench after installing the water pipe also required several days. Since only loose soil had to be pushed back, this would have been less work than digging the trench, despite the fact that the soil volume had increased due to its loose nature (factor 1.2). This is based on 4 m³ per person per day, making a total of 813 man-days. For that matter, the pipeline was covered by a layer of quarry stones, which will have left soil. This soil was probably used to create a frost-free cover in the form of a limited relief elevation.[3349] Rounding off, 1,500 to 2,000 man-days were needed for the earthwork. Assuming 20 excavation workers per day – a completely arbitrary assumption – the trench would have taken 75 to 100 days.

2 Cerithium clay

This grey-green clay, the possible origin of which is discussed in section 63.4.2, was used to make the last part of the construction trench watertight, also to prevent the infiltration of unwanted water. It is as yet uncertain whether this clay was used in the construction of the entire aqueduct, but it is likely. The bottom and walls of the last 64 m are covered with a layer of 14 cm and 20 cm of clay respectively. This clay also covers the walls and bottom of the sinkhole and the end basin. In order to realise this construction, 21 m³ of clay is required per 100 m.[3350] Assuming that the entire channel was filled with clay, it concerns 383 m³ over a length of 1,825 m. This does not take into account its use as 'mortar' for the wall stones and other applications on the villa site. Note that this is in a 'solid' state, where the material has been compacted to the desired bedding.[3351]

Excavating the cerithium clay will have required greater effort than the digging of the construction trench. Here, including loading, 2 m³ per person per day has been assumed, so that for this activity, approximately 191 man-days can be assumed.

Since the weight of the clay depends on the moisture content and varies between 1,600-2,000 kg/m³, this means that an average of 1,800 kg/m³ was moved. This means that 689,850 kg were needed for the construction of the pipeline, or 690 cartloads (assuming a four-wheeled wagon with 1,000 kg per load)

Table III.1. Estimated time investment for digging and filling of the ditch for the aqueduct.

Activity	Soil volume (m³)	Man-hours 3 m³ / per person/day	Man-hours 4 m³ / per person/day
Excavating	2710	903	678
Filling in	3252 (2710*1.2)	1084	813
Total		**1987**	**1491**

[3348] See for example Schut 2005, 49 ff; Driessen 2007, 55-56.

[3349] Compare Dorchester Putnam 1997, 364-369; 2002.

[3350] Per 100 m for the bottom 1.10 x 0.14 x 100 = 15.4 m³ and for the walls 2 x (0.14 x 0.2 x 100) = 5.6 m³.

[3351] During excavation in the quarry, the volume increases, estimated at 1.3 to 1.5. We have no figures for this specific clay, so that in general we have to reckon with a transport volume of 631 to 729 m³ for an aqueduct of 1825 m.

or double that 1,380 (for two-wheeled wagons).[3352] If the clay could be extracted in the vicinity of Ten Hove, then a journey of 800 m might take an hour (there and back).
For 690 cartloads, then 690 hours or 86 man-days were needed (or 172 for two-wheeled wagons). Of course, this is highly dependent on the number of carts and persons available. However, if the material had to be hauled from 4-5 km away, substantial larger time and labour input was required.

Unloading the clay will have taken about as long as loading, i.e. 191 man-days, making a total of 382 man-days. An important but uncertain factor is the application of the clay in the construction trench. Depending on the form in which it has been delivered (loose or as 'loaves'), the application and shaping takes more or less time. As this is a precise job, we have assumed 20 m per person per day, which is no more than an estimate. This would mean that this activity took 90 man-days.

3 Kunrade limestone

The Kunrade limestone, used in the walls and cover of the aqueduct, may have been extracted from various quarries in the area, the closest being around Craubeek.[3353]

The walls consist of one or two superimposed cut stones 0.16-0.2 m thick at a height of about 0.29 m. The hard layers of Kunrade limestone are located in a stratified package in which sandy limestone layers alternate with layers of stone. The latter vary in thickness from about 20-40 cm. This means that for the construction of 100 m of aqueduct, 10.4 m^3 of limestone was needed for the walls and 11.52 m^3 for the cover. [3354] This is a rough figure, as the gaps between the stones have not been counted and, moreover, the stones are not perfectly rectangular. To this should be added an estimated 25.6 m^3 for the quarry stone – a residual product of stone extraction – used for the cover. Based on an 1,825-m long line, this means that 867 m^3 of limestone was needed in gross.[3355] The volume to be transported is greater, by the way, because the broken limestone will have had a lot of unused space in between. In its solid form, a cubic metre of Kunrader limestone weighs about 2,300 kg, and as broken stone it weighs 1,600 kg. The weight of the broken stone has been used for transport. This amounts to an average weight of 1,600 kg per m^3 or 1,387,584 kg. Considering the transport of the clay, it is estimated that, depending on the type of cart, 1,388 or 2,776 cartloads or 225 man-days are involved.

The use of small boulders for the cover also indicates that the final stone processing was (largely?) done on site and not in the quarry. It is estimated that 0.5 m^3 of limestone can be processed per person per day. This implies that stone processing must have taken about 1,734 man-days. The work involved in mining and processing Kunrader limestone involves various aspects. A maximum of 781 m^3 of stone is needed, but in reality this will be less because of the gaps between the wall stones and cover stones. In this example, however, the maximum is assumed, from which 20% may be subtracted. The starting point is 0.5 m^3 per person per day for breaking loose a slab of Kunrader stone in the quarry and processing it into manageable blocks. Given the quarry stone used as a covering material, the latter was (largely?) done at the site of processing. This work would therefore take a maximum of 1,724 man-days including the loading of the carts.

Based on 3 m^3 of stone per man per day, unloading would have taken 261 man-days. The finishing and placing of the stones in the bed of the gully would require another 90 man-days, assuming two people working together (carrying, finishing and placing), at a length of 100 m per day. Finally, the whole thing would be covered with quarry stone and earth, considering a total layer of 1 m in thickness. Assuming 3 m^3 per man per day, this means an investment of 608 man-days.

4 Wood

If the aqueduct was lined with wooden planks, a rough calculation can be made of how much wood was needed for this. It should be emphasised that no evidence has been found for the use of wood in the aqueduct. Considering the

[3352] For the so-called 'Hessen roads', a maximum of 1,100 kg for four-wheeled carts was assumed in order to prevent damage to the road (https://nl.wikipedia.org/wiki/Hessenweg (accessed 7-4-2021)). For Roman two-wheeled carts, a maximum of 500 kg including the weight of the cart is usually assumed, while for four-wheeled carts, 1,500 kg including 500 kg for the cart is assumed.

[3353] With thanks to Bas Vervuurt from the Kunrader Steengroeve (Voerendaal) for the informative tour and additional information. See further section 63.2.1.

[3354] Per 100 m 2 x (0.18 x 0.29 x 100)= 10.4 m^3 for the walls and 0.64 x 0.18 x 100= 11.52 m^3 for the cover.

[3355] Because of the more compact packing, the wall stones and capstones actually weigh more per m^3 than the smaller boulders used for the cover. Due to the spaces between the wall stones that were filled with clay, an accurate estimate cannot be made.

width of the channel, the planks could not have been wider than 24 cm. Only the wall planks may have been slightly wider. I know of no experiments on manual sawing of planks that provide insight into the required working time. It is certain that when planks were used for the bottom, walls and cover, a total of 7,300 running metres of plank were needed to construct a wooden trough for the 1825 m mentioned here.

Although no wooden water line was used in the construction of the aqueduct, the more than 25 iron collars found show that it was used for the distribution of water or for drainage. The rings represent at least a pipe length of 50 to 100 m, as an unknown part has not been rediscovered. It is only possible to approximate the number of trees required for such a construction. If we assume that trees of a thickness corresponding to the final objective were used as much as possible, it is estimated that 2 or 3 parts of more or less equal thickness could be extracted from a tree. This means that 30 to 50 trees would be needed for a pipe of 100 m.

An experiment in Halsbach (D/BAY), in which a log of 4 m was drilled through with a historical drill comparable to the Roman drills, showed that it took 5-6 hours to complete the drilling. This would mean that for 100 m, roughly 150 man-hours were needed for the drilling. It should be noted that 2 or 3 woodworkers were probably involved in the work.

5 The total labour input

Despite all the uncertainties, a picture emerges of the labour input necessary for the construction of the aqueduct. The assumption was made in terms of man-days, without taking into account the turnaround time that ultimately determines the total duration of the project. After all, the number of available carts determines the progress of the workers in the quarry. Only by providing insight into the effort required for construction can we get an idea of the investment that was needed and that people were prepared to make. Naturally, the information presented here is highly model-based with large margins and expressed in man-days, leaving out a timeframe. In particular, the work involved in mining, transporting, processing and placing the limestone is uncertain. A minimum weight has been assumed here, i.e. the weight in its solid state. However, it has been transported in chunks, which means that the weight per m^3 is considerably lower, but the volume much greater. The figures shown are therefore mainly intended to give an indication with larger margins (of perhaps 25%; Table III.2).

Table III.2. Estimates of the time invested in the construction of the aqueduct (at a length of 1825 m).

Activity	Man days
Digging ditch (4 m3)	678
Quarrying and loading clay (383 m3 = 690 ton)	191
Transport (690-1380 carts) over 800 m	86-172
Unloading	100
Applying to ditch	146
Quarrying limestone (867 m3 = 1.803 ton)	434
Stone transport (1388-2776) over 800 m	173-347
Unloading	261
Construction stone aqueduct	90
Stone cover	150
Filling ditch with soil	350
Total	**2600-3000**

Appendix IV Estimated size of the group of net-consumers

H.A. Hiddink

1 Introduction

To get an idea of the 'societal format' of the province Germania inferior,[3356] a rough estimate was made of the group of consumers. Because it would be a research project on itself to estimate the size of the whole population,[3357] it was decided to take a shortcut. The group of consumers is defined as the people only consuming, not producing food: the Roman soldiers and their entourage, the camp-followers (living in army camps and 'military *vici*'), the inhabitants of the cities and 'civilian' *vici*. Obviously this is an oversimplification. Firstly, some inhabitants of the *vici* and probably even city dwellers produced part of their own food in allotments and by involvement as seasonal labourers in 'regular' agrarian production (Section 17.7). Secondly, the inhabitants of villas and other rural settlement were also consumers of food; a considerable part of them consuming more than producing. However, we assume that they were self-sufficient at least. A further group of consumers is ignored here: pack animals, (cavalry)horses, oxen etc. They did consume grain, but probably more widely available sorts, like oat and barley, combined with other kinds of fodder. Below, it is explained how the numbers in table IV.1 were calculated. It concerns only the numbers not in italics, because the latter are estimates mainly based on assumptions only.

2 The military population

The most reliable data are those concerning the number of soldiers, based on historical texts, epigraphic data and the size of *castra* and *canabae*. During the pre-Flavian period, from Tiberius onwards, some 42,000 *legionarii* and *auxiliarii* were stationed in Germania inferior.[3358] After the Batavian revolt, their number is steadily reduced, reaching a number of around 21,000 towards the end of the second and in the third century AD (Table IV.2). The size of the group of camp-followers, like merchants, artisans and the slaves or family members of soldiers is less easy to determine. One could look at the size of *canabae* and *vici* in the proximity of camps, but the examples in Germania inferior are less well known than those in other provinces. Rather than using the surface size, most researchers assume a certain ratio between the number of soldiers : camp-followers, like 1:1, 1:1.5 or 1:2.[3359] If the latter ratio is used, the total 'military community' had a size of over 125,000 persons in the 1st century and around 61,000-64,000 persons in the late second/third century AD (Table IV.2).

3 Proto-urban centres

Some places to become real cities in the course of the Roman period, already had a considerable size around the middle of the first century AD.

The surface of pre-Flavian Nijmegen, '*oppidum Batavorum*' is estimated as c. 20 ha, although perhaps only half of this was inhabited/used more intensive (Fig. 15.2-4).[3360] For translating this surface to a number of residents, one could for instance rely on detailed analysis for Pompeii, that resulted in an estimate of 16,615 people/km².[3361] For convenience sake,

Table IV.1. Estimates of the 'consumers' in the population of Germania inferior at three moments during the early and middle-Roman period.

Group / date	C. AD 15	C. AD 69	C. 175 AD
Military community	126000	126000	61500-64500
Population (proto-)towns	*10000**	16500-22000	53000-65500
Population civilian vici	*10000-18000**	*30000-50000†*	62750-104500
Total	**146000-154000**	**172500-198000**	**177250-234500**
Growth rate ca.		**120-130%**	**103-120%**

* 1/3 of next column; † 1/2 of next column.

[3356] The term 'societal format' was coined in anthropological literature concerning early state formation (e.g. Claessen 1988, 68ff.; 1991, 75ff.). Although we focus on the size of (part of) the population, the concept also includes population pressure and distribution.

[3357] Some attempts: Wendt & Zimmermann 2008 (Rhineland); Jeneson 2013, 147-154 (loess area); Hiddink 2015 (MDS-area); Willems 1984, 234-237 (Batavians/eastern river area); Kunow 1988 (size estimates vici Germania inferior); see further below.

[3358] Kunow 1987, fig. 32; Polak 2009.

[3359] About equal numbers (in later periods): Kooistra *et al.* 2013, 14; 150%: Wendt & Zimmermann 2008, 205; 'certainly' trice the number of soldiers: Roymans & Derks 2011, 16, n. 84.

[3360] Bloemers 1990, 76.; fig. 6.2. The number of graves at Ulpia Noviomagus was c. 30,000-40,000 (Koster 2010, 12, table 1), the result of c. 200 years of habitation. With a life expectancy at birth of 25 years, this leads to the number of people mentioned.

[3361] Storey 1997, esp. 973.

Table IV.2. Size of the army in Germania inferior at several moments and estimates of the number of camp followers in canabae and vici.

Period	Years AD	Kunow 1987, fig. 32	Polak 2009	N vicani=soldiers	N vicani= soldiers * 2
Tiberius	14-37	42000		84000	126000
Claudius-Nero	41-68	42000		84000	126000
Vespasian-Domitian	70-83	37500	40000	75000-80000	112500-120000
Domitian	83-89/92	36500		73000	109500
Domitian-Traian	89/92-100	35000		70000	105000
Traian	100-104/106	27500		55000	82500
Traian-Hadrian	104/106-120	21000	22500	42000-45000	63000-67500
Hadrian	121-130	26500		53000	79500
Antonini	138-192	20500		41000	61500
Third century	192-270	21500		43000	64500

we will use this number here, although in literature somewhat lower and higher estimates are mentioned, between 6,000-25,000.[3362] For Nijmegen, the Pompeian figure results in a population between 1,600 and 3,300. This is much higher than calculations on basis of the number of graves found or the area of the Museum Kamstraat/Hunerberg cemetery, ranging from c. 535-1,205 inhabitants.[3363] Excavations in the 'proto-city' have attested strip-houses along a road,[3364] with a density of 17.7 houses/ha, or 1,062-1,770 persons per 10 ha. This number comes close to the lower end of the earlier estimation.

The area occupied by the 'oppidum Cugernorum' north of Xanten was c. 25 ha (c. 4,150 persons).[3365] The 'oppidum Ubiorum'/ Köln, shortly before it became a *colonia* in AD 50, measured perhaps 30 ha (nearly 5,000 persons; Fig. 15.2-3). The latter size is a rough estimate and a minimum, however. Köln had an area of 80-100 in total, of which c. 50 ha was an Augustan-Tiberian double *castra*, the *canabae/ oppidum* taking part of the remaining area.[3366]

Based on the results of a number of excavations in the last decades, traces of pre-Flavian occupation at Tongeren were found in an area of at least 35-40 ha (the street grid laid out in c. 45-50 ha).[3367] Part of the place could have had a relatively low population density, if some of the Alphen-Ekeren houses found were used as farms proper until AD 70 and not replaced by timber-framed 'urban' houses before. The population could have reached already some 6,000 persons, however.

4 Towns

The easiest way to estimate the population of the 'official' towns in the period after AD 70, is via the area inside the walls. It seems wise to use lower estimates for the population density, like the Pompeian number of 16,615, because everywhere parts of the walled area were not residential but used for the forum and cult places. At Tongeren, also a lower lying area, part of the Jeker valley, was included in the walled area (Fig. 15.2; Table IV.3). This area is counted, because there was at least some industry here, probably with craftsmen living alongside. Even if it was not densely populated, it compensates for the areas with activities/ habitation outside the walls,[3368] excluded from our estimate. At Xanten seven out of 40 *insulae* of the city seem not or less densely occupied.[3369] Therefore the lower rather than maximal surface inside the wall should be used. At Köln a large area outside the walls was used and occupied by craftsmen, adding some 50% to the size of the town. Regarding the importance of this town, the maximum surface is used. Towns like Forum Hadriani/Voorburg and Ulpia Noviomagus/ Nijmegen were quite small, with a size of 12 and 30-35 ha. The population implicated for the latter town, is of the same order of magnitude as

[3362] Bloemers 1978, 124 refers to estimates of 6,000-19,000/ km² for cities in Britain and 20,000-25,000/km² for cities in Gaul. Wendt/ Zimmermann (2008, 208) refer to an older estimate of 15,000-20,000/km².

[3363] These numbers are based on the 1,500-2,000 graves present, according to Bloemers (1988, 76). Assuming a period of use of 50 years and a life expectancy at birth of 25-30 years, the result is a population of 675-1205 (according to the well-known formula of Acsádi & Neméskeri 1970). A slightly longer use of 70 years (AD 1-70) and an life expectancy of 25 years, results in a number of only 536-714.

[3364] Van Enckevort & Heirbaut 2010, e.g. fig. 41; 64.

[3365] Müller *et al.* 2008, fig. 101; 128.

[3366] Bloemers 1990, 82-83; Caroll-Spillecke 1995 (with older reconstructions).

[3367] See e.g. Vanderhoeven 2002 (Kielenstraat; Hondsstraat; Sacramentsstraat); Vanderhoeven *et al.* 1992 (Kielenstraat); 1993 (Veemarkt); 1994 (Minderbroederstraat); 1997/98 (Zijdelingsestraat);

Table IV.3. Estimates of the size and population of the towns in Germania inferior.

Town	Surface (ha)		Population		
	min.	max.	min.	max.	probable size
Voorburg/ Forum Hadriani	12		1994	1994	1994
Nijmegen/Ulpia Noviomagus	30	35	4985	5815	4985
Xanten /Colonia Ulpia Traiana	63	73	10467	12129	10467
Köln/Col. Claud. Ara Agrippinensium	96	155	15950	25733	25733
Tongeren/Atuatuca Tungrorum	119		19772	19772	19772
Total			**53168**	**65443**	**62951**

estimates based on of the size of the cemeteries: c. 3,750-5000 persons.

5 Vici

For a part of the 'civilian' *vici* of the Middle Roman period, ranging from small roadside settlements of a few houses only to small towns, the surface is known. One must be aware however, that the size of *vici* as mentioned or illustrated in literature is often a maximum, or better: exaggerated. It is based on the scatter of surface finds and/or the inclusion of zones with industrial features rather than the actual inhabited area (see below).[3370] A good example is Coriovallum/Heerlen, for which the size can be measured by the area in which building remains are concentrated found or in that with all remains, in this particular case pottery kilns (Fig. 4.8; 15.4). Probably the truth lies somewhere between the extremes of 7.5 and 20 ha.

An estimate of the surface of 35 *vici* was made on the basis of several sources, among which the 30 year old inventory in my MA-thesis (Table IV.4).[3371] The average size of 35 places in this sample is 12 ha, which would result in a total of 780 ha for the c. 65 *vici* in the *civitas Tungrorum*, *Ubiorum*, *Cugernorum*, *Batavorum* and *Cananefatium*. This implicates a population of 7.8 x 16,615 = 129,597 persons. However, it is likely that the better known *vici* are the larger ones, implicating that smaller sites are underrepresented in the sample. To correct this, the total size could be in the range of: (35 * 12) = 410 ha + (30 x 7.5) = 225 = 635 ha or 6.35 x 16,615 = 105,505 persons.

Possibly even the last number is too high, considering the peculiar plan of many *vici*, with narrow plots, extending dozens of metres behind the strip houses. For sections of some *vici*, also outside Germania inferior, the number of houses per hectare can be calculated (Table IV.5). At an average of 15.9 houses/ha and a total of 657.7 ha taken in by *vici*, there would be 10,457 houses. If these houses were occupied by nuclear families of 6 persons on average, the population consisted of 62,742 persons. A higher number is perhaps more realistic, allowing for slaves and servants in some houses and compensating for workers in building, quarries etc. (not per se residents of *vici*). Reckoning with 10 persons/house, the population would be 104,570 persons.[3372]

2007a (Driekruisenstraat); 2007b (Momberstraat); 2007c (de Schaetzengaarde); 2020 (Hemelingenstraat); De Winter 2018 (Vermeulenstraat); Driesen 2018 (Museum site).

3368 Mertens & Vanvinckenroye 1975 (*horrea*); Vanvinckenroye 1975, map.

3369 Müller 2008, 272, fig. 159.

3370 Cf. Reddé 2018, 133.

3371 Hiddink 1990 and the article 1991 based on it, with many references. For a recent state of affairs, see Heising 2013, with a contribution by Ulbert (2013) with data on Germania inferior. Other estimates for this province in Kunow 1988, table 1. Many data on vici in the southern half of Belgium can be found in Brulet 2008.

3372 Estimates for *vici* like Köngen, Ladenburg, Euskirchen-Billig (Wendt & Zimmermann 2008, 208) are 70-140 persons ha. At 650.7 ha for all vici, the resulting population size is 44,549-91,098 souls.

Tabel IV.4. Data on the surface of vici in Germania inferior.

Vicus	Min.	Max.	Estimate/used size
Cananefates (2)			
Den Haag-Ockenburg			
Valkenburg-De Woerd	5	10	5
Batavi (5)			
Cuijk	12.5		12,5
Elst			
Halder			
Rossum			
Wijchen		9	
Cugerni (13)			
Blerick / Blariacum			4
Dilsen-Stokkum / Feresne	4	8	6
Heel / Catualium	4		4
Heerlen	7.5	20	15
Kleve-Rinderen - Arenatium	7		7
Melick / Mederiacum			4
Moers-Asberg	10	15	12,5
Mönchengladbach-Mülfort	11	50	12,5
Neuss / Novaesium	12		12
Pont / Mediolanum	4		4
Tüddern / Teudurum	9		9
Rimburg	3		4
Venlo / Sablones	4.5		4,5
Ubii (total ca. 20)			
Aachen / Aquae Granni	20		20
Aachen-Burtscheid	?		
Aachen-Kornelim. Vernenum	5		5
Baesweiler	17		12,5
Bergheim-Thorr/Tiberiacum			
Bonn	25	80	30
Bornheim-Sechtem			
Düren-Mariaw/Marcodurum			
Elsdorf	3.5		4
Euskirchen-Billig / Belgica	6.5	10	8
Jülich-Neubourheim	4.5		5
Jülich / Iuliacum	10	20	15
Stolberg-Breinigerberg			
Vettweiß-Soller			
Zülpich / Tolbiacum			

Vicus	Min.	Max.	Estimate/used size
Zülpich-Hoven			
Jünkerath / Icorigium			
Tungri (total ca. 20)			
Amay	9	18	15
Antwerpen?			
Braives / Perniciacum	25		25
Ciney			
Clavier-Vervoz	5	10	7.5
Fontaine-Valmont			
Grobbendonk	10	20	12,5
Huy	30	35	25
Maastricht/Traiectum	10	20	15
Kontich	4.5		5
Liberchies/Geminiacum	30		30
Namen	25	30	30
Rijsbergen			
Taviers	5		5
Theux			
Tienen	20	30	25

Table IV.5. Estimates of the population density of vici, based on the number of houses per ha in excavated samples.

Site	Length of street (m)	Plot depth	Surface (m²)	Houses	Houses/ha	References
oppidum Batavorum	90	94	8460	15	17.7	Van Enckevort 2010, 95, fig. 64
Walheim A	162.5	43.5	9606	18	18.7	Körtum 2005a, 162, fig. 173
Walheim B	74.4	83.8	6235	9	14.4	
Wederath / Belginum	407	80	32560	35	10.7	Cordie & König 2013, 103, fig. 2.
Wimpfen	147	57	8379	15	17.9	Körtum 2005b, 253, fig. 308
Valkenburg-De Woerd	174	90?	15660	22	14.0	Vos 2011, 127-128, fig. 6.19
Average					**15.9**	

Appendix V The surplus produced at Ten Hove

H.A. Hiddink

For the 'model-villa' in the Heerlen Basin, like represented by Ten Hove, Kooistra calculated the surplus production in a number of scenarios (lighter-heavier soil, percentage grain-meat in the diet, etc.).[3373] The result was that in the worst case scenario the surplus could sustain only 242 persons, at best 839 persons (200 ha of arable, diet with 75% grain or 137.3 kg/person/year). For further calculations, one could work with round numbers: 250, 500 or 750 persons.

The yields going with Kooistra's calculations seem well possible, for instance in the light of moderate yields of the nineteenth century (Section 17.6.3). For instance, for the historical average yield of 1,054 kg/ha only around 70 ha was needed to obtain 75,515 kg of grain. It is interesting to compare such a number to the capacity of the *horrea* at Ten Hove (Table V.1).[3374] The first small building contained less than this average yield, but was apparently too small because its capacity was doubled in phase 2. The 104.5 ton capacity of phase 2 is slightly less than the maximal yield, but the difference is not large.[3375]

If Voerendaal could produce the grain needed for 500-750 military and urban consumers, in total some 267-400 comparable villas were needed to feed a population of 200,000 net consumers (Table V.2; cf. Appendix 16). Obviously, in reality not all villas had the size of Voerendaal. A minority would have been much larger, perhaps some 500 ha, and a considerable number would have been much smaller, like the 50 ha often mentioned in literature. An example of a very crude calculation, in which the smaller villas were less productive, is shown in table V.3. To feed a population of 200,000 consumers, roughly between 600 and 950 villas would be needed, with some 60,000-90,000 ha of arable. Even if the number of net-consumers would be 300,000 persons, 900-1,425 villas were needed with some 90,000-135,000 ha of arable.

[3373] Kooistra 1996, 112, table 18.
[3374] Kooistra 1996, 109.
[3375] Obviously, it is a possibility that the *horreum* did not contain the total harvest, or more than that of a single year. The seed corn, grain for local consumption, an emergency supply and the grain for the market could be stored in different buildings.

Table V.1. Voerendaal-Ten Hove. Theoretical gross yields needed to feed different numbers of net-consumers and a fixed team of workers, in relation to the capacity of the horreum in phase 1 and 2.

Number of consumers	Surplus/year (kg)	Consumption of 50 labourers	Gross yield (kg)	Capacity horreum (kg)
250	34325	6865	41190	52250 (1)
500	68650	6865	75515	52250 (1)
750	102975	6865	109840	104500 (2)

Table V.2. Germania inferior. Number of villas comparable to Voerendaal to feed a population of 200.000.

Population	Surplus for n persons	Number of 200 ha villas needed	Hectares needed
200000	500	400	80000
200000	750	267	53400

Table V.3. Germania inferior. Indication of the number of villas of three size classes needed to feed a population of 200.000; sizes and areas in hectares.

Portion of villas	Mean size	% of consumers supplied	N consumers	N of persons fed per villa	Min. N of villas needed	Min. area needed	Max. N of villas needed	Max. area needed
65%	50	30	60000	87.5 (17.5%)			686	34300
				131.3 (17.5%)	457	22850		
25%	200	60	120000	500			240	48000
				750	160	32000		
10%	500	10	20000	1250			16	8000
				1875	10.7	5350		
Total					**627.7**	**60200**	**942**	**90300**

Appendix VI Income from agriculture

H.A. Hiddink

It is one thing to have an impression of the surplus produced at our villa, but one would like to know the worth of this surplus. How much money was earned by agriculture in the average year and how many years were needed to save the amount needed to build a villa? Obviously, questions like these are simplistic in the face of the complex reality of a past society, but it still seems relevant to bear them in mind.

A specific problem with income from agricultural produce is that prices are not fixed. Bad harvests result in higher prices and thus some compensation or even higher profits for some farmers, but in no income at all for those with minimal yields. On the other hand, the number of villas in the Middle Roman period is so large, that one wonders if perhaps a structural overproduction existed, resulting in low prices and minimal profits. Furthermore, the data on grain prices in the Roman period are sparse.[3376] Still, it is possible to get an indication. At grain prices of 40-50 g of silver per hectolitre,[3377] the proceeds from the surplus produced at Ten Hove would be as in table VI.1. Another approach to estimate the revenue of agriculture, is via the payments and rations of soldiers. A legionary earned c. 1,200 HS to 1,800 HS per year (c. 100/200 AD),[3378] but about one-third from this amount had to be paid for food, also 400-600 HS.[3379] Although perhaps 75% of the caloric intake consisted of grain, as assumed in the previous appendix, the cost of this grain was probably less than 75% of the 400-600 HS, because relatively more was spent on meat, wine and oil. If only one-third or half of 400-600 HS was spent on grain, this would amount to 133/200-200/300 HS. This is not far off from a calculation based on the daily grain ration. If this is taken as 1/8 *modius* per day,[3380] the yearly consumption of a soldier was 45.625 *modii* or 3.93 hectolitre, that is 140-187 HS at a rate of 40-50 g silver/hl (see above).

Even if each soldier spent the lowest estimated sum of 133 HS on grain, 500 men would spend 66,500 HS. This is more than the 40,863-52,270 HS in the table, but it is likely that not all money spent by the soldiers ended up in the strongbox of the producer.

Table VI.1. Voerendaal-Ten Hove. Indication of the proceeds with different surpluses sold at two prices levels.

Persons	Surplus (kg)	/ 80 kg = hectolitre	(modius) 8.62 l	* 40 or 50 = g silver/hl	/0.84 = HS
250	34325	429.06	3698	17162	20431
		429.06	3698	21453	25539
500	68650	858.13	9955	34325	40863
		858.13	9955	43907	52270
750	102975	1287.19	14933	51488	61295
		1287.19	14933	64360	76619

3376 Rathbone *s.a.*; Rathbone & Von Reden 2015.

3377 Rathbone & Von Reden 2015, esp. 180, table 8.2; cf. Hopkins 1980, 119.

3378 On military pay, see esp. M.P. Speidel (1973) and M.A. Speidel (1992) and also Duncan-Jones (1974, 130, table 3) and Goldsworthy (2003, 94-95).

3379 Buringh & Bosker 2015, 251.

3380 Roth 1999, 21.

Appendix VII Transport costs

H.A. Hiddink

An potentially important, but often ignored factor determining the profits of agriculture, are transport costs, assuming they have to be paid by the owner of a villa and not by the buyer. On transport in Roman times much is written in general, but most data concern the relative costs of different modes of transportation. In a more recent publication for instance, the cost of see, river and land transport is estimated 1 : 5-10 (down/upstream) : 52, on basis of the so-called Diocletian's Price Edict.[3381]

It is possible to get some idea of the costs of transport by road from the price edict. It states HS 20/mile as the maximum price for a wagon carrying 1200 pounds,[3382] A Roman pound (*libra*) equals c. 0.33 kg and therefore the load in question is 396 kg. Because the Price Edict also contains the maximum price of a *modius* of grain, set at HS 100/*modius castrensis*,[3383] at first sight it seems possible the calculate the actual transport costs. However, matters are not straightforward, firstly because the '*sestertius*' in the document is rather a unit of account than an actual coin. Therefore it is wise to express transport cost only in a percentage of the value of the cargo.
A second issue is the volume of the *modius castrensis*. Duncan-Jones thought it equalled 1.5 *modius* of 8.62 litres (more often set at 8.73 l) or 12.9 (13.1) litres.[3384] The price of HS 100 for a *modius castrensis* applies both to wheat and *spelta mundae* or 'clean spelt', while the set maximum price for barley is HS 60. The clean spelt must have been dehusked grain, which is important because the spelt stored in the *horreum* at Voerendaal was not. If it was shipped in this condition, the price was probably lower in line with the percentage of chaff: ca. 25-30%.[3385]

With these data, it is possible to make an estimate of the transport costs or value loss per Roman mile of c. 1500 m. The wagon with a load of 1200 *libra* or (* 0.33) 396 kg, carried the loads and represented the values given in Table VII.1. The transport costs and loss of value are summarized in Table VII.2. At first sight, these are not extraordinary high. However is obvious that transport entirely over land from Voerendaal to Xanten (nearly 100 km) should be avoided, because the loss would be c. 25-30%. Still, the loss over shorter distances is also not insignificant. Each cart load shipped to Maastricht (15 km) resulted in a loss of 3.5-4.7% and because 350 were needed to empty the *horreum* at Ten Hove a large amount of money was at stake. An important observation is that it was possibly advantageous to transport 'unclean' spelt. Although its price may have been lower, the transport costs were relatively low and the labour to dehusk it at the villa could be spared.

It seems significant that the 0.23-0.31% loss/km equals that of Medieval sources, for instance fourteenth-century English sheriffs records. These even allow for a comparison with grain prices.[3386] The conclusion was that the proceeds diminished with 0.4% per mile, or c. 0.25% per kilometre.

Obviously, it would be advantageous if grain was not shipped by road, but by river, even though transport over the Meuse was fraught with difficulties (low water, only small boats). As an example, one could take transport to Xanten, even while this would be relatively rare in reality. For c. 62 km still wagons had to be used: from Voerendaal to Maastricht (17 km) and Venlo to Xanten (45 km). The implication is a loss of 14.3-19.2% (cf. Table VII.2). A rule of thumb, the costs of river transport can be set as one-fifth of that by road.[3387] For convenience sake we will ignore extra costs for transferring load from carts to boat and vice versa (and perhaps temporary storage). The route via the Meuse from Maastricht to Venlo set at c. 70 km, the value loss per km would be 0.2 * 70 * 0.23 = 3.2% (clean spelt) or 0.2 * 70 * 0.31= 4.3% (wheat). The total transport costs are 17.5 respectively 23.5% of the value of the grain, 5.8-7.6% less than shipping by road only.

[3381] Scheidel 2014, 9-10.
[3382] *Edict.Diolcl*. 17.3 (for an recent translation, see Kropff 2016). For the discussion below, cf. Laurence 1999, 97ff.
[3383] *Edict.Diolcl*. 1.7.
[3384] Duncan-Jones 1976.
[3385] Kooistra 1996, 98 (25%; 367 kg/m³ spelt still with chaff); Dewilde 2015, 13-14 (minimal loss 30%; c. 400 kg/m³ spelt still with chaff). The weight of husked spelt is c. 700 kg/m³ and that of wheat c. 700-750 kg/m³.
[3386] Masschaele 1993.
[3387] Scheidel 2014, 9-10.

Table VII.1. Calculation of the value of four types of grain according to the Price Edict.

Type	Load/weight	Volume (m³)	*Modii castr.* (13 l)	'Tare loss'	'Edict value' (HS)
wheat	396/700	0.5657	43.5	0	4350
spelt clean	396/700	0.5657	43.5	0	4350
spelt in chaff	396/367	1.0790	83.0	0.7	5810
barley	312/700	0.4457	34.3		3430

Table VII.2. The loss of value at certain distances for two categories of grain.

Km	M.p.	Transport costs (HS)	Remaining value (HS) wheat/clean spelt	% Loss	Remaining value (HS) spelt in chaff	% Loss
1	0.68	13.53	4336.47	0.31	5796.47	0.23
5	3.38	67.66	4282.34	1.56	5742.34	1.16
10	6.77	135.32	4214.68	3.11	5674.68	2.33
15	10.15	202.98	4147.02	4.67	5607.02	3.49
20	13.53	270.64	4079.36	6.22	5539.36	4.66
25	16.92	338.30	4011.70	7.78	5471.70	5.82
50	33.83	676.60	3673.40	15.55	5133.40	11.65
100	67.66	1353.20	2996.80	31.11	4456.80	23.29

Appendix VIII Building costs

H.A. Hiddink

The sum of somewhere around 100,000-200,000 HS needed to build a villa is a rough estimate, based on prices mentioned in sources. In the publication of the villa at Hoogeloon-Kerkakkers we devoted some paragraphs on this theme and these are reproduced virtually unaltered in translation below.[3388] Because remains of a grave monument were found near the Hoogeloon villa, attention was given to the costs of these monuments.

It is impossible to calculate the building costs of a villa and perhaps not crucial to know, but it is still useful to get an impression. Duncan-Jones collected a large amount of data on costs of building and restauration works, grave monuments and gifts in the context of *munificientia*, mostly concerning Italy and North Africa.[3389] Obviously, price levels differ for each region and period (inflation!) and sums are sometimes exaggerated in the sources; besides, it is seldom possible to link sums to specific buildings. Still, one gets some idea on the order of magnitude of some investments.

For examples in Africa, the building costs of baths and theatres of HS (*sestertii*) 100,000 and c. HS 400,000 are mentioned, while repairs and more substantial additions reach sums of several times HS 10,000.[3390] Baths in Italy (outside Rome) are built for amounts exceeding HS 60,000, with several instances of sums around HS 300,000-350,000; repairs cost between HS 8,000 and 800,000.[3391] Pliny the younger did bequest in the early second century BC a sum of HS 300,000 for the decoration and 200,000 for the upkeep of baths in his birthplace Comum (Como).[3392] He also left a farm of HS 100,000 to serve as a pension to his nanny.[3393] A large part of this sum would have been needed for the soil (costing much in Italy); the house itself will have been quite modest. Another example of (building) costs of a villa can be found in the *Digesta*, in a case where a contract of HS 200,000 is imminent to be exceeded by HS 100,000.[3394] These amounts suggest that they apply to a rather large building, far greater than the timber-framed villa at the Kerkakkers. Finally there is the mention by Cicero of building costs of HS 16,000, but these are rather related to a small (out)building at a villa than an entire main building.[3395]

The prices of grave monuments are mentioned in many inscriptions and sometimes also the function of the deceased is known.[3396] It appears that the latter and spending are not directly related. At least it is clear that the costs of monuments for military men rarely exceed a/their monthly salary and mostly are much lower.[3397] The price level in Africa was well below that in Italy, because in the former area 86% the cost was below HS 20,000, while in the latter c. one third was below HS 4000 and two thirds less than HS 20,000.[3398] Obviously, it is often unknown what was built *in concreto* for the prices mentioned, but there is an illustrative and therefore well-known example. It concerns grave house A below St. Peter's basilica in Rome – an 'expensive' city –, commissioned by the heirs of C. Poplius Heracla.[3399] The supposedly Hadrianic building occupied a surface area of c. 7.5 by 4.5 m and was c. 5 m high; all for a sum of HS 6,000. Another interesting example is from our region. A fragmentary inscription from Maastricht mentions, somewhat loosely translated: '...executor of will Flori(...) ... / son (of the deceased) / this construction / 14,000.[3400] The price would have been expressed in *sestertii*. Especially relevant is that Panhuysen thought the inscribed block, with part of an equestrian scene visible (head/helmet and shield, arm of a barbarian) was part of a first-century grave tower, with a size similar to that of the Poblicius monument from Köln.[3401]

Based on the superficial enquiry above, the costs of the stone grave monument at Hoogeloon-Kaboutersberg can be estimated in the order of magnitude of several thousands of *sestertii*. The price of the building materials and construction as such would have been much lower than the monument at Maastricht, but the transport costs overland would have been relatively high. The building costs of the villa were certainly higher than those of a grave monument and lower than those of a public building like baths, perhaps somewhere around HS 100,000-200,000. As such this is only part of the story, because the villa owner probably wanted to be accepted in higher social strata, like the *ordo decurionum* of the *civitas*. Therefore he needed a *domus* in Tongeren – costing at least several tens of thousands of *sestertii* – combined with capital for *munificientia* (spent on public buildings, games etc.). All in all an amount of (several) hundred thousand(s) was needed. This is in line with the capital of HS 100,000 generally accepted as the assets required for members of the *ordo decurionum*, primarily based on a remark in one of Pliny's letters.[3402]

[3388] Cf. Hiddink 2014, 289-291.
[3389] Duncan-Jones 1974.
[3390] Duncan-Jones 1974, 91, no. 27-31; 93, no. 63a-69.
[3391] Duncan-Jones 1974, 157, no. 442-451; 160-161, no. 468-480.
[3392] Duncan-Jones 1974, 30-31; ILS 2927.
[3393] Plin., *ep*. 6.3; Duncan-Jones 1974, 28.
[3394] *Digesta* 19.2.60.4, see Martin 1989, 117-119. The passage is based on writings of M. Antistius Labeo, suggesting amounts of the period around the beginning of our era.
[3395] Cic., *Qfr*. 3.1.3.
[3396] Specifically for Rome, see also Schoen 2000, 258-261, table 1-2.
[3397] Duncan-Jones 1974, 79, table 2; 130, table 3.
[3398] Duncan-Jones 1974, 128.
[3399] See *AE* 1945, 136; Schoen 2000, 260, table 1, no. 43 (on the inscription); Toynbee 1971, 87-91, fig. 4; Von Hesberg 1987, fig. 2-4 (on the building).
[3400] [---ARB] ITRATV.FLORI[---] / FILI / IN.ID.OPV[S] / XIIII (line over the number); Panhuysen 1996, 270-274, no. 10.
[3401] See also Panhuysen 1996, 150-158, grave tower II.
[3402] Plin., *ep*. 1.19. The amount is an estimate by Pliny of the capital of Romatius Firmus, just because he is a *decurio*. He is willing to give him another HS 300,000 to be able to join the equites. Cf. Duncan-Jones 1974, 243; Derks 2011, 109.

Appendix IX Some remarks on the animal bone assemblage

H.A. Hiddink

The animal bone collected at Ten Hove was published by Kooistra and Laarman.[3403] Here no new and full publication of these remains is presented, because this would demand a considerable investment of time for a limited amount of useful information. Therefore, only some comments are made here. Our count of the material is given in table IX.1.

Most important is that we the authors just mentioned were too optimistic on the amount of dated material. We would prefer to exclude all materials from layers and most material from pits (but see below). At the same time, some contexts are dated differently at present.
At present there are still no contexts with animal bone that belong to the Iron Age, period 1.
Bone from this period is not preserved in the decalcified loess soil.

For period 2, or the beginning of period 3, the only dated 'rich' context is the cellar pit of building 409 (Table IX.2). The infill of basin 319 dates from the end of period 3, when the villa seems to have been destroyed by fire. In both contexts, cattle bone is the most frequent, but sheep is next in 409 and pig in 319. Although this could be coincidental because the number of fragments in both contexts is small, the difference is worth mentioning. Does it signify a change in the composition of livestock during the Roman period, or is the incidence of pig in 319 a reflection of consumption in the main building itself? Another noteworthy observation is that bones of domestic fowl, mallard and 'bird' are present in both these Roman context and not in those from period 4 (but beware of low numbers).[3404]

In table IX.2, the only pits considered to be dated are those with a terminus post quem in the Late Roman period or Early Middle Ages. Combined with building 226 and the sunken-floored huts, they constitute the sample for period 4. It doesn't make sense to try to make a further subdivision to phases, if only because of the low numbers. Anyway, the number of pig bones is equal to that of cattle, sheep apparently less important. And, for what it's worth, no bird is present, while red deer is.

Table IX.1. Voerendaal-Ten Hove. Summary of the animal bone found, except for burnt and worked bone, as well as 538 fragments (3228 g) of dog bone from well 314 and pit 811.

Species	N	%	Wt	%
Mammals				
Cattle	441	41.3	25308	62.3
Sheep/goat	199	18.6	2118	5.2
Pig	274	25.6	6348	15.6
Horse	93	8.7	6174	15.2
Dog	20	1.9	366	0.9
Birds				
Domestic fowl	13	1.2	22	0.1
Mallard	2	0.2	17	0.0
Bird	1	0.1	1	0.0
Wild animals				
Badger	3	0.3	30	0.1
Red deer	4	0.4	144	0.4
Mole	1	0.1	1	0.0
Fox	18	1.7	90	0.2
Total	**1069**	**100.0**	**40619**	**100.0**

[3403] Kooistra & Laarman 1996.
[3404] The mallard bone in Kooistra & Laarman 1996, table 33 was originally identified as goose (handwritten identification forms 1988).

The deer bone was found in sunken hut 513, suggestive of antler working but no definitive proof for this. Among the worked bone, not included in table IX.1 and 2, there is an antler fragment that probably belongs to phase 4b-d (727-1; Chapter 66). Antler was also used in the Roman period, as shown by a piece from period 2 (304-2). The skeleton of a fox from pit 722 can either be the result of hunting in period 4 or an animal died in its own fox-hole. This could also be the explanation for the badger remains in basis 319 and the bone of a mole in pit 722 (fox prey?).

Table IX.2. Voerendaal-Ten Hove. Animal bone from all find numbers (excl. dog from well 314 and pit 811), cellar pit 409, basin 319 and a number of contexts from period 4.

Species	All finds* N	%	Per. 2: 409 N	%	Per 3: 319 N	%	Per. 4 N	%
Mammals								
Cattle	441	41.3	47	48.0	20	30.3	46	36.8
Sheep/goat	199	18.6	32	32.7	13	19.7	8	6.4
Pig	274	25.6	12	12.2	25	37.9	46	36.8
Horse	93	8.7	4	4.1	2	3.0	2	1.6
Dog	20	1.9	0	0.0	2	3.0	0	0
Birds								
Domestic fowl	13	1.2	2	2.0	1	1.5	0	0
Mallard	2	0.2	0	0.0	0	0.0	0	0
Bird	1	0.1	1	1.0	0	0.0	0	0
Wild animals								
Badger	3	0.3	0	0.0	3	4.5	0	0
Red deer	4	0.4	0	0.0	0	0.0	4	3.2
Mole	1	0.1	0	0.0	0	0.0	1	0.8
Fox	18	1.7	0	0.0	0	0.0	18	14.4
Total	**1069**	**100.0**	**98**	**100.0**	**66**	**100.0**	**125**	**100**

Appendix X Tables not included in text

Table *4.2. Heerlen Basin. References to Archis (including RCE map sheet-site numbers) and literature on the sites of figure 4.7.

No.	Place	Toponym(s)	ROB/RCE-site no.	References
201	Heerlen	Heerlen 1		Van Doorselaer 1964, 320; Putker 1987, 24, fig. 2
202	Heerlen	Heerlen 2		Van Doorselaer 1964, 320-321; Putker 1987, 24, fig. 2; De Grooth & Mater 1997, 53-56
203	Heerlen	Heerlen 3		Van Doorselaer 1964, 321; Putker 1987, 24, fig. 2
204	Heerlen	Heerlen 4		Van Doorselaer 1964, 321-322; Putker 1987, 24, fig. 2
205	Heerlerbaan	Heerlen 5		Van Doorselaer 1964, 321-322
222	Schaesberg	Schaesberg 2	62BN-72	Isings 1959, 8, pl. 3, nr. 4; Van Doorselaer 1964, 330
236	Voerendaal	Mijnwerkerskolonie	62BN-75	Byvanck 1947, 26; Van Doorselaer 1964, 336
437	Vrank		62BN-126	
609	Winthagen		62BN-217, 260	De Vries 1999
2091	Welten	Welterhof, De Doom	62BN-99	
2092	Heerlen	Euterpelaan	62BN-4, 41	
2093	Heerlen	Lindeplein, Schoolstraat	62BN-42	
2094	Swier	Kickenweg	62BN-11, 127	De Groot 2007, 80-81, fig. 26-27
2096	Klimmen	ten nw kerk; Barrierweg	62BN-173, 265	Van de Graaf 1989, 89, nr. 149
2097	Meezenbroek	Meezenbroek, Frans Halsstr.	62BN-32	BROB 1950, 8-9, 42-43, 45
2098	Schaesberg	Schaesbeerg, castle ruin	62BN-78, 121	JROB 1986, 200
2099	Voerendaal	Ten Hove	62BN-91, 314	Braat 1953
2100	Rennemig	Wijngaardshof, Heerlerheide	62BN-69, 103	
2101	Heerlerbaan	Bovenste Caumer	62BN-76, 101	Peters 1930
2102	Wijnandsrade	Biesseweg	62BN-94, 240	De Groot 2007, 78-80, fig. 24-25
2103	Swier	Hulsbergerbeek	62BN-111, 134	Hiddink & De Boer 2003, vp 5
2104	Retersbeek	Retersbeek	62BN-109	
2105	Retersbeek/Klimmen	Nieuw Hof	62BN-133, 273	
2107	Voerendaal	Steenenis	62BN-130, 286	
2108	Vrank	Vrank, Peutzstraat	62BN-119	
2109	Winthagen	Overst-Voerendaal	62B-131	
2141	Klimmen	Craubeek	62B-108	
2337	Weustenrade		62BN-180	
8196	Heerlen	Weltertuinstraat	62BN-250	
8197	Heerlen		62BN-276	
8198	Voerendaal	Kunderberg	62BN-296	
8210	Swier		62BN-174	
8221	Voerendaal	Mareweg	62BN-104	
8222	Winthagen	Koestraat	62BN-110	
8223	Klimmen	Remigiuskerk	62BN-115	
8224	Ubachsberg	Kunderberg	62BN-132	
8225	Colmont	Karstraat	62BN-137	
8226	Winthagen	Bergseweg	62BN-156, 166, 167	
8227	Kunrade	Kunderberg	62BN-163	
8231	Voerendaal	Hoensbeek	62BN-280, 281	
8232	Voerendaal	Op gen hek	62BN-329	
8234	Voerendaal	Eerste Ned. Kalkbranderij	62BN-38, 81	Goossens 1918; Anon. 1918

Table *5.2. Voerendaal-Ten Hove. Weight of pottery finds (g) per trench and weight per m² for each trench, ranked from low to high.

Trench	Wt	g/m²		Trench	Wt	g/m²		Trench	Wt	g/m²
1	0	0.000		35	79	0.132		74	2648	4.413
2	0	0.000		77	87	0.145		46	2839	4.732
3	0	0.000		43	29	0.193		15	2929	4.882
30	0	0.000		59	39	0.195		56	657	5.973
32	0	0.000		61	132	0.220		106	4151	6.918
33	0	0.000		36	133	0.222		23	3976	7.255
38	0	0.000		50	142	0.237		17	338	7.682
40	0	0.000		92	144	0.240		109	3264	8.369
41	0	0.000		90	150	0.250		4	5515	9.192
44	0	0.000		65	193	0.341		19	7610	12.683
45	0	0.000		34	214	0.357		10	8272	13.787
47	0	0.000		97	257	0.428		94	5363	14.340
49	0	0.000		12	277	0.462		102	8950	14.917
53	0	0.000		42	322	0.537		101	6071	15.140
67	0	0.000		26	346	0.577		9	9466	15.777
71	0	0.000		75	320	0.748		105	9531	15.885
76	0	0.000		55	490	0.817		114	6780	19.371
82	0	0.000		58	333	0.854		104	5936	20.259
86	0	0.000		70	470	0.920		100	12980	21.633
87	0	0.000		8	563	0.938		89	5963	26.502
88	0	0.000		66	31	1.148		110	8557	38.031
91	0	0.000		29	730	1.217		108	6909	39.256
113	0	0.000		98	739	1.232		13	25364	42.273
80	1	0.002		81	32	1.391		107	25270	48.784
93	10	0.017		63	968	1.513		79	31013	51.688
25	6	0.018		60	1063	1.772		16	17519	55.091
51	7	0.019		52	1070	1.783		7	34770	57.950
5	12	0.020		73	1117	1.862		69	9447	64.705
31	16	0.027		64	449	1.987		115	10326	68.840
39	18	0.030		84	15	2.143		20	41828	69.482
72	8	0.030		6	1301	2.168		18	2372	79.067
48	15	0.032		14	1531	2.552		21	12915	105.861
83	20	0.033		99	1842	3.070		95	70191	117.180
112	4	0.053		103	275	3.274		22	19065	127.100
62	10	0.054		85	1929	3.326		68	104102	175.848
28	41	0.068		78	1671	3.452		27	128373	237.728
57	7	0.070		11	1924	3.603		96	11106	292.263
54	6	0.083		24	2609	4.348				
37	66	0.110		111	981	4.360				

Table *5.3. Voerendaal-Ten Hove. The find categories and periods represented in four sunken-floored huts.

Feature	514		510		520		507	
Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Pottery	40		50		60		2	
Handmade		0.9		4.0		-		-
Roman		37.5		70.0		100.0		100.0
Late Roman		55.0		26.0		-		-
Early Medieval		2.5		-		-		-
Coins								
Roman	-		-		1			-
Late Roman	11		2					-
Glass								
Roman	1		1		1			-
Late Roman	-		1		-		-	-
Window glass	1		-		1			-
Other								
Brick	10		25		6		5	
Metal	60		33		20		7	
Stone	-		22		1		-	
Millstone			16					
Animal bone	5		5		-		-	
Slag	1		1		1		-	
Flint	-		1		-		-	

Table *5.4. Voerendaal-Ten Hove. The find categories and periods represented in six pits.

Feature	757		737		713		740		752		702	
Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Pottery	338		32		70				109		245	
Handmade		2.5		3.1		-		0.2		-		-
Roman		43.2		81.3		97.1		99.8		100.0		100.0
Late Roman		28.4		15.6		1.4		-		-		-
Early Medieval		1.5		-		1.4		-		-		-
Coins												
Roman	-		-		-				1	-		
Late Roman	-		-							-		
Glass												
Roman	2		-		-					-		
Late Roman	1?		4		-				-	-		
Window glass	-		1		2		4			-	3	
Other												
Brick	28		33		125		23		13		1	
Metal	24		39		94		28		13		31	
Stone	5		9		1		1		-			
Millstone	26		-		1		-					
Animal bone	8		74		6		-		-		7	
Slag	3		3		12		-		-			
Flint	5		1		3		1		1			

Table *5.5. Voerendaal-Ten Hove. Radiocarbon dates of five mortar samples.

No.	Sample	Mat	Dating (years BP)	Labcode	Date (cal years AD; 1 sigma)	Date (cal years AD; 2 sigma)
15	I-20/4	mr	1880±60	GrN-13957	70-214	1BC-258, 296-321
16	II-20/5	mr	2010±60	GrN-13958	91-69, 61 BC-65	175 BC-90 AD, 99-124
17	III-21/3	mr	1820±60	GrN-13959	126-256, 300-318	65-346
18	IV-22/1	mr	2060±80	GrN-13960	178 BC-22 AD	357-283, 256-247, 235 BC-87 AD, 107-119
19	V-22/2	mr	2350±60	GrN-13961	538-367 BC	751-682, 669-636, 626-614, 592-352, 296-228, 221-212 BC

Table *7.1. Summary of characteristics of a sample of enclosed sites in the Netherlands, Belgium, Germany and Northern France.

Site	Buildings	Size (approx.)	Ditch profile, width/depth	Shape	Date
Voerendaal-Ten Hove 308	probably 3 houses some out-buildings	0.8 ha	V-shaped, 2 m/1.5 m	trapezoid	c. 150-100/50 BC
Sevenum-De Krouwel (N/L)	several houses, many outbuild-ings min. 3 phases	0.28 ha	no ditch but palisade	rectangle	LIA
Kontich-Alfsberg (B/AN)	1 large building 13.4 x 6.5-6.75 m	0.33 ha	V-shaped, flat bottom 8 m/4 m	rectangle	LT D2b
Latinne-Grandes Pieces (B/LI)	unknown	> 45 m long	V-shaped, -/1.5 m	-	LIA-ERP
Bonn-Vilich-Müldf. (G/NRW)	20 timber buildings	1.18 ha	unknown	polygon	LIA
Rees-Bergwick (G/NRW)	1 two-phased byre house several 4-12 post outbuild.	1.3 ha	V-shaped, -/1.4 m	polygon	IA BC.
Plattling-Pankofen (G/BAY)	7 buildings	1.58 ha	V-shaped. 3-7.5 m/1.1-1.8 m	trapezoid	LT D1
Westheim (G/RP)	5 buildings, two wells	0.9 ha	V-shaped, 4 m/- double pal-lisade	trapezoid	LTD2
Nordheim-Kupferschmied (G/BW)	1 house (two phases), 2 out-buildings	1.0 ha	V-shaped, -/1.10-2.60 m		LTC2-50 BC
Ronchères-Le Bois de la Forge (F/Yon.)	at least 5 buildings	0.93 ha	V-shaped, 4 m/-	parallelogram	LT/ERP
Sainte-Maure-de-Touraine-La Croneraie (F/IeL)	24 (out)buildings, size 2-100 m^2	0.8 ha.	unknown	trapezoid	LT/ERP
Bazoches-lès-Bray- La Voie Neuve (F/Niè.)	1 house, 1 outbuilding several granaries	0.5 ha	unknown	trapezoid	LT D
Sorigny-Montison (F/IeL)	9 buildings (villa after AD 70)	0.6 ha	V-shaped, 4.3 m/1.8 m	trapezoid	LTD2/ERP

Table *8.1. Sample of possible tower-granaries and defended structures at villa sites, classified as such in literature.

Site (country/province)	Size (m external)	Width foundations (cm)	Date / remarks	References
Aiseau-Presles (B/HT)	3.2 x 4.9	60-70	II-III (site)	Herinckx, in Brulet (ed.) 2008, 303-304
Bocholtz-Dellender (NL/Li, D/NRW)	5.5 x 6	80-100	IV?	Wagner 1992, fig. 39
Echternach-Schwarzuecht (L)	19 x 12	80-100	IV (period 5)	Metzler *et al.* 1981, map 2; Van Ossel 1992, 157, tab. 18
Froitzheim-auf der Kohlstraße (D/NRW)	8.1 x 8.1	45-60	c. AD274-380	Barfield 1968; Klages 2017; Van Ossel 1992, 157, tab. 18
Goeblingen-Miécher (L)	7.8 x 8	55-90	around AD 300	Metzler *et al.* 1973; Lahur 2014, fig. 6; Van Ossel 1992, 157, tab. 18
Habay-La-Vieille-Mageroy (B/LX)	9 x 9.5	140-190	after AD 263	Zeippen & Halbardier 2006; Zeippen in Brulet (ed.) 2008, 469-474
Hambach 111-3 (D/NRW)	4.7 x 3.9	30	-	Schubert 2016, 138-139; Befundkatalog
Hambach 125-3 (D/NRW)	5 x 4.4	75-105	-	Schubert 2016, 140-141; Befundkatalog
Hambach 132-2 (D/NRW)	4.2 x 3.5	70	late III	Brüggler 2009, 122-123; Van Ossel 1992, 157, tab. 18
Hambach 488-9/10 (D/NRW)	11 x 8.4	40-50	II-III	Schubert 2016, 150-154; Befundkatalog
Köln-Braunsfeld (D/NRW)	5.8 x 5.5	95	IV?	Fremersdorf 1930, 119-121, pl. 29; Van Ossel 1992, 157, tab. 18
Köln-Müngersdorf 6 (D/NRW)	12.2 x 12.2	130	after AD 150	Fremersdorf 1933, 36-37, pl. 9; Van Ossel 1992, 157, tab. 18
Mayen-Im Brasil (D/RP)	5 x 5	60-70?	period 5 (of 8)	Oelmann 1928, pl. 2; 7
Rheinbach-Flerzheim (D/NRW)	8 x 8	60-80	ditch 55 x 55 m	Gechter 1986, 18; Van Ossel 1992, 157, tab. 18
Seclin-Hauts de Clauwiers (F/Nd)	16 x 9	80	IV (period 4)	Révillion *et al.* 1994, 130, fig. 11-12
Voerendaal-Ten Hove 407 (N, L)	9.2 x 8.5	100-140	after AD 260	this report; Van Ossel 1992, 157, tab. 18
Weilerswist 112 (D/NRW)	18.9 x 12	70	-	Heimberg 2002/2003, 121, fig. 46
Irsch-Auf freiem Feld (D/RP)	14 x 10	100	beginning III?	Van Ossel 1992, 157, tab. 18; 254-255
Wasserbillig-An de Freinen (L)	15 x 14.5	90	IV	Van Ossel 1992, 157, tab. 18; 360, fig. 152

Table *11.1. South Limburg. Fragments of Iuppiter columns found in the province.

Findspot	Fragments	Stone	Original context/remarks	References
Bunde	enthroned Iuno or Minerva	L Norroy	villa?	Pepels 2012
Grevenbicht-Houtstraat	base? column, enthroned Iuppiter	S	villa?	Noelke 1981, no. 4; A 34017
Grevenbicht-Houtstraat	enthroned Iuppiter	S	villa?	Noelke 1981, no. 34; Panhuysen 1980, fig. 23; A 34017
Grevenbicht-Houtstraat	enthroned Iuppiter	S	villa?	Noelke 1981, no. 35; A 34017
Groot-Haasdal	column	S, Nivelstein	villa, sec. use grindstone	Noelke 2010/2100, no. 292
Heel	column	L	vicus? findspot probable	Noelke 1981, no. 84
Heerlen-Schoolstraat	column	S	vicus	Noelke 1981, no. 85
Kerkrade-Holzkuil	capital, different columns	S, Nivelstein	villa, in well/pond, some fragm. unfinished	Noelke 2010/2011, no. 233-235; Kars 2005, 271-273, fig. 9.17-20
Kessel-church	base with 3 deities	L	villa? under altar late-Gothic church	Noelke 1981, no. 187, pl. 96, 1-3
Maastricht-Derlon	Iuppiter-pillar	L, Norroy	vicus/sanctuary	Panhuysen 1996, 203-214, no. 56-62, map 6; Noelke 1981, no. 193; 2010/2011, no. 239
Maastricht-Derlon	statue (rider?)	L, Norroy	vicus/sanctuary	Panhuysen 1996, no. 74; Noelke 2010/2011, no. 256
Maastricht-Derlon	base or pillar	L, Norroy	vicus/sanctuary	Panhuysen 1996, no. 67

Table *11.1, cont.

Findspot	Fragments	Stone	Original context/remarks	References
Maastricht-Stokstraat	column	L, Chémery-Verdun	vicus, Roman cellar	Noelke 1981, no. 93; Panhuysen 1996, no. 72
Maastricht-O.L.V. church	column	L, Jurassic	vicus, found in cloister	Noelke 1981, no. 94; Panhuysen 1996, no. 71
Maastricht-O.L.V. church	base with four deities	L Norroy	vicus, under floor of church	Noelke 1981, no. 182; Panhuysen 1980, fig. 14A; 1996, no. 64
Maastricht-O.L.V. church	base with at least one deity	L, Norroy	vicus, in wall 5th/6th cent.	Panhuysen 1996, no. 66; Noelke 2010/2011, no. 324
Maastricht-O.L.V. church	capital at least 2 deities	S	vicus, in pit 4th century	Noelke 2010/2011, no. 312
Maastricht-Roman bridge	column	L, Norroy	spolium in bridge	Noelke 1981, no. 149; Panhuysen 1996, no. 73
Maastricht-Roman bridge	base four deities, column base	L, Chémery-Verdun	spolium in bridge	Noelke 1981, no. 183; Panhuysen 1980, fig. 14B; 1996, no. 65
Maastricht-Roman bridge	base, at least 3 niches/deities	L, Jurassic	spolium in bridge	Panhuysen 1996, no. 68
Maastricht-Roman bridge	base with niches	L, Norroy	spolium in bridge	Panhuysen 1996, no. 69-70
Melick-Waterschei	enthroned Iuppiter	S, Nivelstein	vicus?	Panhuysen 2010; Noelke 2010/2011, no. 271
Mook-Plasmolen	column/octagonal plinth	L	villa	Noelke 1981, no. 222; Braat 1934, 13, fig. 7, no. 37
Nazareth (Maastricht)	column	S, Nivelstein	villa or post-built settlement, off-site pit	Noelke 2010/2011, no. 339
Rimburg	column	S	vicus	Noelke 2010/2011, no. 302
St. Odiliënberg-church	base or pillar, at least 3 deities	S	vicus? (Melick)	Noelke 1981, no. 194

L limestone; S sandstone; A Archis

Table *12.3. Summary of data on Late Roman/Early Medieval settlements discussed in this chapter.

Site / Excavated area (ha)	Element	Date (years AD)	Date based on	Reference
Alphen-Kerkakkers 2.7	8 houses 1 outbuilding, 14 granaries 26 sunken huts 34 pits (14 ovens) 3 wells finds	401-403 / 552-568 375-550	dendrochronology pottery, glass	De Koning 2005
Baelen-Nereth 1.6	6 houses (1 LH?) 2 outbuildings 3 sunken huts 22 hearths (metal?) finds	320-425	pottery, coins	Fock 2018; 2019 Fock *et al.* 2014; 2016 Hanut *et al.* 2012
Bergeijk-De Ploeg <1	sunken hut 'burning pit' well finds	396 400-475	dendrochronology two brooches (pottery)	Theuws & Hiddink 1996, 77-78 Die Franken...1996, 826; Archis 57BN-128/33674
Breda-Steenakker A >12	1-2 houses (1 LH) 6 sunken huts granaries finds	350(-425)	handmade pottery	Berkvens & Taayke 2004; Hoegen 2004; Taayke 2004, 277-279
Breda-Steenakker B	4 houses 6 outbuildings 16 wells	465-604	dendrochronology	Berkvens&Taayke 2004

Site / Excavated area (ha)	Element	Date (years AD)	Date based on	Reference
Cuijk-De Nielt 1	(3 houses?) 6 sunken huts one with hammerscale pits	(IIId-VIA) (>350) 375-425 id.	type, glass wheel-turned pottery idem	Habermehl & Van Renswoude (eds) 2017
Donk-Krikeldries 2.5	2 sunken huts 2 wells finds in byres of previous phase	86-429, 495-507, 522-526 cal AD (2σ) / >350 383 + 10-15 >325	radiocarbon handmade pottery dendrochronology pottery	Van Impe 1983; *et al.* 1992, 560-561
Geldrop-'t Zand 0.3	2 houses 1 granary 5 sunken huts 5 pits with charcoal finds	(350-)	pottery, glass	Bazelmans 1990; 1991
Gennep-Stamelberg 3.5	ca. 10 houses (7 LH) outbuildings 4 granaries 123 sunken huts 3 wells coins finds	390- / ca. 408 (375-)388-402 375-(500)	dendrochronology majority of coins metal, pottery, glass	Heidinga & Offenberg 1992
Goirle-Huzarenwei 1.6	4 houses (4 LH) 1 outbuilding > 1 granary 3 sunken huts 7 pits finds	375-425/450	pottery	Bink 2005
Helden-Schrames 2.5	7 houses (2-3 LH) 1 outbuilding 4 sunken huts coin hoard finds	388- 300- / 400-500	coins pottery glass	De Winter 2010; Kemmers 2010
Holtum-Noord 1	10 houses? 5 outbuildings 5 sunken huts 11 hearths coins finds	(275-)388- 375-425/450	stratigr. association pottery, glass	Wagner & Van der Ham (eds) 2010; Tichelman 2012 Kemmers 2010; 2012
Meldert-Zelemsebaan 1.5	6 houses 2 sunken huts 1 granary 1 well 1 water pit 9 hearths finds	phase 411-; phase 422- 375-425/450	dendrochronology pottery (ts, tn)	Bakx & Steenhoudt 2012; Van Daalen 2012
Neer-Wijnaerden 1.7	3-4 houses 10 sunken huts 8 granaries 2 wells/water pits finds	375-425/450	pottery (ts, tn, coarse)	Meurkens (ed.) 2021
Neerharen/Rekem-Het Kamp 3.1	4 houses (3 LH) 2 granaries 31 sunken huts coins finds	(330-)388-350-450	spatial association pottery, metal	De Boe 1985; 1986; Die Franken...1996, 825; Stroobants 2013
Tilburg-Stappegoor 1.2	2 houses 1 well	353-537 / 428-555-650 375- / -602	radiocarbon pottery/radiocarbon	Kooi 2005
Wange 0.4	6 sunken huts finds	400-550	pottery	Opsteyn & Lodewijckx 2004
Wijchen-Tienakker 1.1	2 houses 7 sunken huts 6 wells 24 hearths finds	(310/20-350) 375-425	mainly coins	Heirbaut & Van Enckevort (eds) 2011

Table *15.1. The approximate surface of the yards of 27 villas.

No.	Site	Yard surface (m²)	Reference
2438	Hambach 403	7616	Gaitzsch 1986, fig. 6
2436	Hambach 69	9112	Gaitzsch 1986, fig. 5
2437	Hambach 516	11256	Gaitzsch 1986, fig. 8
2577	Jüchen-Neuholz	14509	Frank & Keller 2007, fig. 264
2446	Hambach 59	18290	Hallmann-Preuß 2002/2003, fig. 6
2081	Groot Haasdal-Steenland	19857	Habets 1882, 127, pl. 1
2487	HA 127	20500	Heimberg 2002/2003, 107, fig. 36
2447	Hambach 412	20566	Kießling 2005, appendix 4
2492	HA 488	22216	Noelke 2010-2011, 156, fig. 4
2440	Hambach 512	24756	Gaitzsch 1986, fig. 7
2464	Blankenheim	26808	Oelmann 1916, fig. 2
2549	Hamois-Sur Le Hody	33577	Lefert 2006, 69
4413	Kerkrade-Holzkuil	40631	Tichelman 2005, fig. 5.1
2550	Champion-Sur Rosdia	41580	Van Ossel & Defgnée 2001, fig. 13
2459	Köln-Müngersdorf	43361	Fremersdorf 1933, 51-52
2571	Jemelle-La Malagne	45000	Mignot 1997, 10
2099	Voerendaal-Ten Hove per. 3	46350	
1040	Hoogeloon-Kerkakkers	53566	Hiddink 2014, fig. 7.6
2422	Hambach 132	56974	Brüggler 2009, appendix 1
2553	Mettet-Bauselenne	57600	Brulet (ed.) 2008, 547, fig. 481
91	Borg	67504	Miron (ed.) 1997, appendix 1
4514	Dilbeek-Wolsemveld	68526	Weterings 2017, 10
92	Reinheim-Heidenhübel	77807	Stinsky 2016, fig. 1
93	Bartringen-Burmicht	82315	Krier 2011, 216
94	Echternacht-Schwarzuecht	83837	Metzler *et al.* 1981, fig. 201
2556	Saint-Gérard-Try Hallot	137500	Brulet (ed.) 2008, 550, fig. 488
2566	Anthée-Grand Bon Dieu	150525	De Maeyer 1937, 81, fig. 18b

Table *15.2. The surface and number of rooms of 94 main buildings (phases for Voerendaal), without portici and praefurnia.

No.	Site	Surface (m²)	Rooms	Baths separate	References
2436	HA 69	115	6	-	Gaitzsch 1986, fig. 5
2567	Serville-Pré des Wez	172	3	-	Brulet (ed.) 2008, 565, fig. 517
2437	HA 516	175	3	-	Kaszab-Olschewski 2006, general plan
2554	Mettet-Try Salet	177	8	-	Brulet (ed.) 2008, 548, fig. 484
2546	Le Roux-lez-Fosses-Vigetaille	188	5	-	Brulet (ed.) 2008, 528, fig. 454
2039	Buchten-Welder	193	11	-	Holwerda 1928
2317	Bierbeek	233	6?	-	Deweerdt & Provoost 1981, 20
2111	Colmont-Stockveld	246	3	-	Remouchamps 1923, fig. 33
2565	Haillot-Matagne	254	7	no	Brulet (ed.) 2008, 560, fig. 507

No.	Site	Surface (m²)	Rooms	Baths separate	References
2202	Broichweiden-Kaninsberg	284	6	-	Heimberg 2002/2003, 95, fig. 23
2533	Maillen-Arche	285	6	no	Brulet (ed.) 2008, 511, fig. 418
2234	Rosmeer	291	5	-	De Boe & Van Impe 1979, fig. 8
2165	Overasseltz-Scheiwal	320	>7	yes	Braat 1934, 14, fig. 9
2286	Sauvenières-Arlansart	325	10	no	Brulet (ed.) 2008, 531, fig. 459
2439	HA 66	330	9	no?	Heimberg 2002/2003, 107, fig. 36
2562	Évelette-Résimont	334	13	no	Brulet (ed.) 2008, 559, fig. 506
2438	HA 403	339	7	-	Gaitzsch 1986, 406, fig. 6
2246	Val-Meer-Meerberg	340	6?	no	De Boe 1971, plan 2
2454	Wesseling	350	4	-	Heimberg 2002/2003, 96, fig. 24
2569	Roly-La Crayellerie	351	11	no	Brulet (ed.) 2008, 566, fig. 520
2075	Houthem-Ravensbosch	381	21	no	Remouchamps 1925, fig. 41
2557	Vedrin-Berlacomines	384	5	-	Brulet (ed.) 2008, 559, fig. 504
2101	Heerlen-Bovenste Caumer	400	14	-	Peters 1930, 191
2311	Wange-Damekot	443	12	no	Opsteyn & Lodewijckx 2004, fig. 2
2555	Graux-Al Ronce	444	13	no	Brulet (ed.) 2008, 550, fig. 486
2198	Stolberg-Propsteier Wald	449	22	no	Biermanns *s.a.*, fig. 1
2422	HA 132	450	12	no	Brüggler 2009, Beilage 1
2283	L'Écluse-Leckbosch	452	9	-	Brulet (ed.) 2008, 283, fig. 1
2315	Vechmaal-Walenveld	456	7	-	Vanvinckenroye 1990, map 2
2320	Merchtem-Dooren	457	8	-	Van den Vonder 2008, fig. 2
2099	Voerendaal-Ten Hove 1	468	12	-	
2440	HA 512	474	18	-	Gaitzsch 1986, 406, fig. 7
2577	NOüchen-Neuholz	475	8	-	Heimberg 2002/2003, 96, fig. 24
2190	Alsdorf-Höngen-Bachfeld	476	15	-	Vogt 1992, fig. 27
2112	Simpelveld-Stampstraat	501	12	-	Stoepker 1990, fig. 36
2055	Vaesrade/Thull-Zandbergseweg	502	13	-	Braat 1934, fig. 19
2455	Köln-Braunsfeld	503	13	no	Fremersdorf 1930, fig. 2
2117	Lemiers-Plattenbend	506	15	yes	Braat 1934, fig. 12
4514	Dilbeek-Wolsemveld	512	17	yes	Weterings 2017, 10
4307	Yesrharen-Rekem	529	25	yes	De Boe *et al.* 1992, fig. 286
2532	Maillen-Al Sauvenière	537	21	no	Brulet (ed.) 2008, 510, fig. 417
2443	HA 264	543	18	-	Heimberg 2002/2003, 107, fig. 36
2485	Neuss-Weckhoven	553	11	-	Chantraine *et al.* 1984, 91, fig. 56
2541	Matagne-la-Petite-Plaine de Bieure	565	11	-	Brulet (ed.) 2008, 523, fig. 446
2081	Groot Haasdal-Steenland	606	8	no	Heimberg 2002/2003, fig. 17
2486	Nettesheim-Lommertzhof	608	12	no	Heimberg 2002/2003, 96, fig. 24
2490	HA 206	617	22	yes	Heimberg 2002/2003, 107, fig. 36
2540	Dinant-Gemechenne	626	20	yes	Brulet (ed.) 2008, 517, fig. 429
2549	Hamois-Sur Le Hody	629	15	no	Lefert 2006, 69

Table *15.2, cont.

No.	Site	Surface (m²)	Rooms	Baths separate	References
2316	Kerkom-Boskouterstraat	637	7	-	In 't Ven *et al.* 2005, 284, fig. 3
2127	Kaalheide-Krichelberg	651	18	no	Brunsting 1950
2543	Vodelée-Vieille Terre au Couvent	652	15	no	Brulet (ed.) 2008, 525, fig. 448
2547	Gesves-Sur le Corria	652	18	yes	Brulet (ed.) 2008, 532, fig. 461-462
2321	Noette	661	22	no	De Maeyer 1937, 69, fig. 13
2450	Rheinbach-Flerzheim	669	18	no	Heimberg 2002/2003, 96, fig. 24
2313	Broekom-Sassenbroekberg	678	15	-	Vanvinckenroye 1988, map 2
2447	HA 412	715	12	-	Kießling 2005, Beilage 4
2487	HA 127	719	13	no	Heimberg 2002/2003, 107, fig. 36
2556	Saint-Gérard-Try Hallot	724	26	no	Brulet (ed.) 2008, 551, fig. 489
2099	Voerendaal-Ten Hove 2	740	24	yes	
2441	HA 56	764	17	no	Heimberg 2002/2003, 107, fig. 36
4413	Kerkrade-Holzkuil	768	16	no	Tichelman (ed.) 2005, fig. 5.1
2492	HA 488	772	22	no	Noelke 2010-2011, 156, fig. 4
1040	Hoogeloon-Kerkakkers	780	32	no	Hiddink 2014, fig. 8.10
4502	Erps-Kwerps-Lelieboomgaarden	786	11	-	Verbeeck 1994, fig. 2
2310	Modave-Survillers	787	21	no	Brulet (ed.) 2008, 424, fig. 258
2114	Bocholtz-Vlengendaal	818	23	no	Goossens 1916, pl. 5
2031	Maasbracht-Steenakker	824	25	no	Vos 2017, fig. 2.3
2578	Weilerswist-Klein Vernich	849	17	-	Heimberg 2002/2003, 101, fig. 29
2475	Schuld	857	23	no	Heimberg 2002/2003, 99, fig. 27
2542	Matagne-la-Petite-Aux Murets	908	28	no	Brulet (ed.) 2008, 524, fig. 447
2470	Bad-Neuenahr-Ahrweiler	932	32	no	Fehr 2000, map 2
2446	HA 59	951	20	no	Hallmann-Preuß 2002/2003, fig. 11
2099	Voerendaal-Ten Hove max	966	30	yes	
2573	Treignes-Les Bruyères	1008	24-30	no	Brulet (ed.) 2008, 578, fig. 545
2464	Blankenheim	1143	36	no	Oelmann 1916, pl. 13
2459	Köln-Müngersdorf	1185	25	no	Fremersdorf 1933, Taf. 3
2550	Champion-Sur Rosdia	1268	31	yes	Van Ossel & Defgnée 2001, fig. 13
2193	Lürken-Alte Burg	1402	44	no	Piepers 1981, fig. 8
2304	Liège-Place St. Lambert	1418	22	no	Brulet (ed.) 2008, 422, fig. 254
2531	Maillen-Ronchinne	1423	37	no	Brulet (ed.) 2008, 510, fig. 415
91	Borg	1638	52	no	Miron (ed.) 1997, Beilage 1-2
2465	Kreuzweingarten-Weingartenstraße	1650	40	no	Heimberg 2002/2003, 98, fig. 26
2285	Basse-Wavre-L'Hosté	1702	48	no	Brulet (ed.) 2008, 298, fig. 36
2021	Mook-Plasmolen	1777	40	no	Braat 1934, fig. 3
2481	Morken	2009	>20	no	Heimberg 2002/2003, 103, fig. 31
2553	Mettet-Bauselenne	2145	>50	no	Brulet (ed.) 2008, 548, fig. 482
2571	Jemelle-La Malagne	2229	44	no	Brulet (ed.) 2008, 571, fig. 530

No.	Site	Surface (m²)	Rooms	Baths separate	References
2576	Rognée-Péruwelz	2878	>40	no	De Maeyer 1937, 104, fig. 25
94	Echternacht-Schwarzuecht	3412	61	no	Metzler *et al.* 1981, fig. 13; 201
92	Reinheim-Heidenhübel	3442	58	no	Stinsky 2016, fig. 1; 13.
2566	Anthée-Grand Bon Dieu	3454	90	no	De Maeyer 1937, fig. 18a
2307	Haccourt 5	4385	69	yes	De Boe 1975, fig. 17
93	Bartringen-Burmicht	5727		no	Krier 2011, 216

It is indicated if the baths were in a separate building, at some distance of the main building (yes) or were integrated or added to the latter (no); - indicates that no baths are present.

Table *16.2. Voerendaal-Ten Hove. Simplified overview of (grain) crops and other edible plants in Late Roman and Early Medieval features. + ^{14}C-dated; * ^{14}C-date too old.

Species Structure	Spelt	Bread wheat	Emmer	Rye	Barley	Millet	Broad bean	Pea	Hazel	Chesnut	Prunus
4a >>											
241+	X	3	-	-	-	-	-	-	-	11	-
630	X	-	-	-	2	-	-	-	1	-	-
4b >>											
501+	X	-	-	4	13	-	-	-	3	-	-
507	-	-	-	3	-	-	-	-	-	-	-
509*	X	-	-	-	1	-	-	-	1	-	-
511*	X	-	-	-	4	1	-	-	3	1	-
514*	-	16	2	-	2	-	-	-	1	-	-
515*	X	-	-	-	1	-	-	-	-	-	-
627+	x	-	-	33	2	-	-	-	-	-	-
632*	-	9	-	-	-	-	-	-	-	-	-
634	-	-	1	-	-	-	-	-	1	-	1
635+	-	-	-	42	-	-	-	-	6	-	-
737	X	-	-	2	79	8	1	-	-	-	-
791	X	2	-	-	9	-	-	17	-	-	-

Table *19.2. Voerendaal-Ten Hove. Coin percentages per period, for 1) all Late Roman coins, 2) contexts taken into account and 3) contexts and clusters taken into account.

Period	Years AD	All coins (1) n= 90	Contexts (2) n= 94	Contexts, clusters (3) n= 95
16	260-275	0.4	3.2	2.1
17	275-296	2.8	2.1	1.1
18	296-317	1.2	0.0	0.0
19	317-330	0.8	1.1	1.1
20	330-348	13.1	2.1	1.1
21	348-364	2.4	1.1	0.0
22	364-378	3.2	25.2	20.6
23	378-388	4.8	14.0	13.4
24	388-(402/403)	71.3	51.3	60.7
Total		**100.0**	**100.1**	**100.1**

Table *19.3. Coin percentages pro period of four cities/vici and three rural sites.

Period	Years AD	Tongeren Atuatuca Tung. n= 1377	Maastricht Traiectum n= 517	Heerlen Coriovallum n= 487	Cuijk Ceuclum n= 190	Wijchen-Tienakker n= 233	Holtum-Noord n= 251	Neerharen-Rekem n= 501
16	260-275	21.7	16.4	22.2	4.7	4.3	0.4	1.0
17	275-296	2.1	4.8	0.6	0.0	0.0	2.8	0.0
18	296-317	2.1	1.5	2.1	3.2	0.9	1.2	0.4
19	317-330	3.9	2.3	2.5	6.3	2.1	0.8	0.0
20	330-348	51.6	21.3	40.2	41.6	8.2	13.1	6.2
21	348-364	2.8	5.6	2.9	5.8	1.3	2.4	1.8
22	364-378	8.6	11.2	16.2	20.5	6.4	3.2	4.0
23	378-388	1.2	6.0	3.7	3.2	5.2	4.8	5.2
24	388-(402/403)	5.9	30.8	9.7	14.7	71.7	71.3	81.4
Total		**99.9**	**99.9**	**100.1**	**100.0**	**100.1**	**100.0**	**100.0**

Tongeren after Stroobant 2013; coins of period 16-17 supplemented with data from Aarts 2000, app. 10; Maastricht and Cuijk Aarts 2000, app. 10; Heerlen Beliën *s.a.*; Wijchen-Tienakker Reijnen 2011, 89, table 10.1; Holtum-Noord Kemmers 2010; 2012; Neerharen-Rekem Stroobant 2013.

Table *20.2 Voerendaal-Ten Hove. Summary of the metal objects per category, unless stated otherwise dating to the (Early and) Middle Roman period.

Cat.	Subcategory	MBR	MFE		Cat.	Subcategory	MBR	MFE
1	jewellery. brooches	37			6	furniture/casket fittings		
	see table 20.4					lock pin with bust	1	
						open-worked plate	1	
2	other jewellery					decorative nail	1	
	hairpin with biconical head	2				decorative hollow disc	1	
	'deep eye' pin	2				semi-circular mount	1	
	Cortrat hairpin (LROM)	1				V-shaped mount	1	
	hairpin/armring globular hd	1				sheet-metal	1	
	armring thickened terminals	1				handle		1
	finger ring	1	4					
	pendant dotted decoration	1			7	buckles and belt fittings		
						belt hook? (IA)	1	
3	body care, medical instrum.					openwork belt fitting	1	
	tweezers	2				belt knobs	3	
	ear-scoop	6				Tierkopfschnalle (LROM)	2	
	spatula probe	1				buckle/strap end (EMA)		1
	(sowing) needles	2				buckle/with plate (EMA)	2	
	mirror?	3				back/counter-plate (EMA)		2
						attachment buckle (EMA)	1	
4	eating and drinking							
	spoon	3			8	horse-harness, yoke fittings		
	strainer	3				strap junction	1	
	basin with sieve	1				looped strap mount	1	
	plate	1				phalera?	1	
	basin?	1				decorative. horse gear	8	
	vessel?	4				idem (sub recent?)	1	
						horse bit		1
5	writing and sealing					bead?	1	
	stylus		1			strap junction rings?	7	
	seal box	1				terret ring	1	
						bells	4	1

Cat.	Subcategory	MBR	MFE		Cat.	Subcategory	MBR	MFE
9	weapons				14	locks and keys	2	24
	sax (EMA)		1			see table 20.6		
	spearhds (1 LROM, 1 EMA)		2					
	arrowheads (LROM)		2		15	fire, hearth and cooking		
	'hunting' knife (LROM)		1			equipment		
	axe (1 LROM, 1 EMA)		3			fire striker (EMA)		1
						hearth shovels		3

Table *20.2, cont.

Cat.	Subcategory	MBR	MFE		Cat.	Subcategory	MBR	MFE
10	cutting tools					hearth shovel/auger?		1
	knives		5			meat fork		1
	cleavers		2			ladle		1
	shears		5			hearth chain/hook		1
11	woodworking tools				16	water pipe collars		30
	adze-hammer		1			see table 20.7		
	spoon-bit auger		2			flange		1
	saw		2					
	nail-puller		1		17	structural fittings		
						T-clamps		5
12	agricultural implements					joiner's dogs		2
	hoe		1			hinges		2
	plough? (sub-recent?)		1			rings/loop-headed spikes		2
	unidentified (post-ROM?)		1					
	reaping/pruning hooks		3		18	miscellaneous, unidentified		
	pushing hoe? (post-ROM?)		1			bolts		2
	rake(s)		1			rings		2
						strips/fittings		4
13	possible tools					knife-like fitting		1
	chisel?		1			hook		1
	awl?		1					
	ferrules		2				MPB	
					19	lead objects	97	

Table *20.8. Voerendaal-Ten Hove. Finds formerly identified as (possible) fragments of water pipe collars.

Item	Findnumber	Id	Remarks
	16-2-29	2362	small fragment of an iron strip may belong to a collar, but is not really recognizable as such
809	16-6-21	2693	fragment of an iron strip certainly does not belong to a collar
	22-1-4	3973	find number should contain a collar fragment according to the OD; a quite thick strip of iron is the only fragment with some resemblance to a collar
	22-6-4	4242	strip of iron 41 mm wide clearly not belongs to a collar; it has a hole and no ridge(s)
	27-1-11	4834	fragments of iron strip were mentioned as possible collar(s) in the OD, but they are not recognizable as such (any more)
	106-3-8	9338	none of the fragments is recognizable as belonging to a collar.

Table *21.5. Voerendaal-Ten Hove. Quantitative overview of the characteristics of the pottery assemblages from pits 750, 749 and 772.

	Pit 750	Pit 749	Pit 772
Number of fragments	**49**	**43**	**247**
Total weight (g)	**1543**	**830**	**6626**
MNI	**5**	**0**	**19**
Number of rims	**6**	**0**	**32**
Rim decoration	**3 (50%)**	**0 (0%)**	**7 (22%)**
Fingertip	3 (100%)	-	6 (85.5%)
Nail	-	-	1 (14.5%)
Location rim decoration			
Top	1 (33.5%)	-	6 (85.5%)
Exterior	-	-	
Interior	2 (66.5%)	-	1 (14.5%)
Rim finish			
Flattened	1 (50%)	-	3 (16%)
Rounded	1 (50%)	-	16 (84%)
Wall decoration	**7 (14.5%)**	**1 (2.5%)**	**8 (3%)**
Fingertip	-	-	2 (25%)
Groove	-	1 (100%)	6 (75%)
Comb streak	7 (100%)	-	-
Wall finish			
Burnished	1 (2%)	6 (14%)	1 (0.5%)
Roughened	15 (30.5%)	3 (7%)	75 (30.5%)
None	33 (67.5%)	34 (79%)	169 (69%)
Temper			
Organic and grog	-	1 (2.5%)	10 (4%)
Grog	43 (88%)	34 (79%)	216 (87.5%)
Grog, stone grit	6 (12%)	8 (18.5%)	21 (8.5%)
Vessel composition type			
Type 1 (open)	1 (16.5%)	-	2 (13.5%)
Type 2 (closed)	-	-	11 (63%)
Type 3 (closed with neck)	5 (83.5%)	-	2 (13.5%)
Firing atmosphere			
Oxidizing	12 (75%)	33 (15.5%)	200 (82.5%)
Reducing	4 (25%)	6 (84.5%)	43 (17.5%)

Table *21.8. Voerendaal-Ten Hove. Quantitative overview of the characteristics of the pottery assemblages from pits 756 and building 214.

	Pit 756	Building 214
Number of fragments	**40**	**68**
Total weight (g)	**1903**	**1207**
MNI	**7**	**7**
Number of rims	**8**	**7**
Rim decoration	**- (0%)**	**- (0%)**
Rim finish		
Rounded	8 (100%)	8 (100%)
Wall decoration	**- (0%)**	**1 (1.5%)**
Nail	-	1 (100%)
Wall finish		
Burnished	-	2 (3%)
Roughened	22 (58%)	31 (45.5%)
None	16 (42%)	35 (51.5%)
Temper		
Organic and grog	-	-
Grog	40 (100%)	63 (92.5%)
Grog, stone grit	-	-
Grog, sand	-	5 (7.5%)
Vessel composition type		
Type 1 (open)	-	4 (44.5%)
Type 2 (closed)	8 (100%)	5 (55.5%)
Type 3 (closed with neck)	-	-
Firing atmosphere		
Oxidizing	36 (100%)	49 (78%)
Reducing	-	14 (22%)

Table *21.11. Voerendaal-Ten Hove. Quantitative overview of the characteristics of the pottery assemblages from ditch 308 in trenches 89 and 105/108 respectively.

	Ditch 308-trench 89	Ditch 308-trench 105/108
Number of fragments	**245**	**196**
Total weight (g)	**4570**	**3694**
MNI	**20**	**17**
Number of rims	**30**	**18**
Rim decoration	**2 (6.5%)**	**8 (44.5%)**
Fingertip	1 (50%)	8 (100%)
Spatula	1 (50%)	-
Location rim decoration		
Top	-	7 (87.5%)
Exterior	2 (33.5%)	-
Interior	4 (66.5%)	1 (12.5%)
Rim finish		
Facetted	4 (16%)	-
Flattened	1 (4%)	1 (11%)
Rounded	13 (52%)	8 (89%)
Pointed	4 (16%)	-
Thickened	3 (12%)	-
Wall decoration	**79 (32%)**	**8 (4%)**
Fingertip	-	2 (25%)
Groove	3 (4%)	1 (12.5%)
Comb streak	76 (96%)	5 (62.5%)
Wall finish		
Burnished	-	3 (1.5%)
Roughened	-	41 (21%)
None	245 (100%)	152 (77.5%)
Temper		
Organic and grog	14 (5.5%)	12 (6%)
Grog	1 (0.5%)	164 (84.5%)
Organic, sand, grog	31 (12.5%)	3 (1.5%)
Organic, sand, chalk	80 (32.5%)	4 (2%)
Organic, sand	110 (45%)	7 (4%)
Organic, sand, chalk, grog	9 (4%)	-
Grog, sand	-	4 (2%)
Vessel composition type		
Type 2 (closed)	6 (25%)	15 (94%)
Type 3 (closed with neck)	18 (100%)	1 (6%)
Firing atmosphere		
Oxidizing	92 (46%)	127 (71%)
Reducing	109 (54%)	52 (29%)

Table *21.16. Voerendaal-Ten Hove. Quantitative overview of the characteristics of the pottery assemblages from buildings 219 and 223 and pits 794 and 769.

	Building 219	Building 223	Pit 794	Pit 769
Number of fragments	**117**	**49**	**66**	**71**
Total weight (g)	**1218**	**511**	**962**	**1575**
MNI	**11**	**1**	**12**	**2**
Number of rims	**13**	**2**	**17**	**2**
Rim decoration	**4 (31%)**	**0 (0%)**	**0 (0%)**	**0 (0%)**
Fingertip	4 (100%)	-	-	-
Location rim decoration				
Interior	6 (100%)	-	-	
Rim finish				
Facetted	2 (28.5%)	-	-	-
Rounded	4 (57%)	1 (100%)	4 (33.5%)	2 (100%)
Thickened	1 (14.5%)	-	8 (66.5%)	-
Wall decoration	**43 (37%)**	**23 (47%)**	**26 (39.5%)**	**0 (0%)**
Groove	-	1 (4.5%)	-	-
Comb streak	43 (100%)	22 (95.5%)	26 (100%)	-
Wall finish				
Burnished	-	2 (4%)	-	2 (3%)
Roughened	-	-	-	14 (19.5%)
None	117 (100%)	47 (96%)	66 (100%)	55 (77.5%)
Temper				
Organic and grog	6 (5%)	2 (4%)	17 (26%)	8 (11.5%)
Grog		-	1 (1.5%)	63 (88.5%)
Sand		2 (4%)	-	-
Organic	1 (1%)	4 (8%)	19 (29%)	-
Organic, sand, grog	13 (11%)	1 (2%)	8 (12.5%)	-
Organic, chalk	-	-	6 (9%)	-
Organic, sand, chalk	24 (20.5%)	16 (32.5%)	2 (3%)	-
Organic, sand	73 (62.5%)	21 (42.5%)	8 (12.5%)	-
Organic, chalk, grog	-	-	1 (1.5%)	-
Organic, sand, chalk, grog	-	3 (6%)	3 (4%)	-
Vessel composition type				
Type 2 (closed)	9 (75%)	1 (100%)	10 (71.5%)	1 (100%)
Type 3 (closed with neck)	3 (25%)	-	4 (28.5%)	-
Firing atmosphere				
Oxidizing	92 (89.5%)	32 (76%)	45 (79%)	56 (89%)
Reducing	11 (10.5%)	10 (24%)	12 (11%)	7 (11%)

Table *32.3. Voerendaal-Ten Hove. The fabrics of building ceramics.

Fabric	Description	Group	Related to	Specimen figure 32.1
1	white-beige; dense matrix	B	KERE 2 / HETH B	--/20-4-33/3625
	small red-brown inclusions (1-2 mm)			
	no sand visible, occasional gravel			
	somewhat powdery, not very porous; quite hard fabric			
2	yellow-yellowish pink; irregular matrix	B	KERE 1 / HETH B	--/106-3-23/9307
	light yellow, round or thread-shaped large / light red angular incl.			
	occasional gravel; much very fine quartz (grey and red)			
	somewhat powdery, not very porous; quite hard fabric			
3	orange; dense matrix	C?	HEVA 4 / HETH E	--/9-1-33/609
	occasional red angular and yellow inclusions			
	very fine rounded colourless quartz			
	powdery, not porous; medium hard fabric			
4	light-orange; irregular matrix	C	KERE 3/ HETH D	326-3/14-1-6/2003
	red small angular inclusions			
	angular fine white quartz, incidentally larger			
	somewhat powdery, moderate porous; quite hard fabric			
5	orange-red to brown-red; dense matrix	A	HEVA 1 / HETH A	--/68-1-6/6238
	small angular black inclusions, sometimes bigger dark incl.			
	fine to coarse angular quartz			
	somewhat to very powdery, moderate porous; oblong small pores			
	moderate to quite hard fabric			
6	orange-red; dense matrix	A	HEVA 2 / HETH A	--/21-3-12/11965
	often combination of black, red and light inclusions			
	sometimes coarse sand or fine gravel; fine white-grey and red quartz			
	hardly powdery, sometimes porous, sometimes irregular fractures			
	fairly hard fabric			
7	orange-red to pink; very dense matrix		KERE 5	--/68-1-5/11974
	fine quartz with mica/muscovite; (dark)red inclusions			
	powdery, moderate porous			
	moderate-fairly hard fabric			

KERE Kerkrade-Holzkuil (Kars 2005, 257-258, table 9.1); HEVA Heerlen-Valkenburgerweg (Vanderhoeven & Kars 2012); TETH Heerlen-Thermenterrein (Vanderhoeven *et al.* 2018).

Table *32.5. Voerendaal-Ten Hove. Signatures on tegulae.

Find number / Id	Fabric	Description	N
106-2-15/9296	2	arc, one finger; 50% complete; estimated width 12 cm	1
27-2-12/5502	2	arc-shaped vertical line, one finger; ca. 10 cm remaining disturbed by oblique streak to left, possibly unintentional	1
10-2-7/963	3	arc, 2 fingers; left part; estimated width 10 cm	1
20-1-83/3196	3	vertical lines bend slightly to the right; 3 fingers height ca. 8 cm	1
21-3-12/3868	3	bend line; one finger	1
28-2-6/5676	3	large low arc, 3 fingers; width ca. 25 cm	1
68-1-3/6233	3	bend line with curl at the end; one finger remaining part ca. 20 cm long	1
7-1-22/11942	3	large arc, 2 spread fingers, 40% complete estimated width 20 cm	1
95-2-9/11008	3	high arc, 3 fingers, deep impressions; 50% complete, estimated width 12 cm	1
101-4-1/8725	4	large arc, 2 spread fingers, 75% complete estimated width 20cm	1
20-1-1/2867, 20-1-1/11950, 21-1-2/11960	4	loop, 2 fingers; height 8.5 cm	3
20-1-80/3154	4	arc, one finger; right part; estimated width 14 cm	1
79-2-6/8072	4	arc, 2 fingers; 75% complete; estimated width 10 cm	1
20-1-82/3184	5	V-shape; made with tool; height ca. 8 cm	1
21-1-2/11962	5	curl, one finger?	1
21-2-1/3856	5	double curl, 2 fingers; height ca. 6 cm	1
23-7-1/4531	5	oblique lines to the right with 'festoon'; 2 fingers length ca. 5 cm	1
68-1-6/6238 (3x), 68-2-88/13134	5	short oblique thick line; 2 fingers; length ca. 3cm	4
68-2-88/13133	5	curved line or arc, 2-3 fingers; 50% complete? left part	1
68-2-88/6422, 68-2-88/11976, 68-1-16/13140	5	double S-shaped festoon; 2 fingers. height ca. 5 cm	3
7-1-39/309	5	vertical lines, 2 fingers; height ca. 6 cm	1
79-1-1/8058	5	arc, 2 fingers; width 10 cm	1
107-2-22/9626	6	arc, 2 spread fingers; 50% complete; estimated width 20 cm	1
111-2-1/10114	6	proper vertical line; one finger; length 8 cm	1
16-2-34/2372	6	arc, 2 fingers; right part; estimated width 10 cm	1
20-1-82/11953, 20-1-82/11954	6	V-shaped; one finger; left part low bend; ca. 8 cm wide	2
27-2-8/11972	6	small arc, 1 finger. 50% complete; right part; 4 cm high	1
27-2-9/5492	6	low arc, 1 finger; width 9 cm	1
68-1-16/6229	6	small arc, 2 fingers. 75% complete estimated width ca. 6 cm	1
68-2-9/6415	6	small arc, 2 fingers. 50% complete; left part	1
68-4-2/ 6437	6	loop with small eye and long legs; made with tool height ca. 10 cm	1
95-4-28/11181	6	arc, one finger; 50% complete; estimated width ca. 15 cm	1
89512024/12018	?	oblique line, 1 finger; remaining part ca. 10 cm long	1
20-4-32/3618, 21-1-2/3848	4/5	small arc; one finger; steep left side; width 5 cm	2

Table *32.6. Voerendaal-Ten Hove. Impressions of shoes and animal paws on tiles.

Find number	Fabric	Form	Imprint
23-4-21/4513	1	tegula	sheep/goat, hobnailed sole
100-2-2/8552	1	tegula	sheep
114-1-1/10179	1	tegula	even-toed ungulate (deer, pig)
10-2-7/924	2	tegula	hobnailed sole
20-1-87/3237	2	tegula	dog
24-3-30/4722	2	tegula	bird (chicken?)
106-2-15/9296	2	tegula	dog?
106-3-23/9301	2	bessalis	even-toed ungulate (deer, pig)
106-3-23/9303	2	bessalis	cat and fox
114-2-1/10207	2	tegula	sheep/goat
13-1-12/11945	2	tegula	bird (chicken?), hobnailed sole
7-1-24/177	3	tegula	dog
7-1-40/313	3	tegula	dog
10-2-12/973	3	tegula	sheep/goat
10-3-4/977	3	tegula	cat?
13-3-44/1851	3	tegula	dog?
20-1-81/3171	3	tegula	sheep/goat
21-3-12/3868	3	tegula	indet.
24-3-18/4715	3	tegula	dog
27-2-8/5507	3	tegula	indet.
27-2-25/5532	3	tegula	sheep/goat
68-1-3/6233	3	tegula	rodent
21-1-2/11963	3	tegula	even-toed ungulate (deer, pig)?
24-3-18/11970	3	tegula	sheep/goat
24-3-18/11971	3	tegula	dog
27-2-8/13138	3	tegula	young hare or rodent
953-2-18/13020	3	wall tile	dog?
13-1-12/1784	4	tegula	dog
14-1-6/2003	4	tegula	dog
68-4-24/6467	4	tegula	dog?
68-4-25/6475	4	tegula	invertebrate
68-4-32/6480	4	imbrex	dog
27-2-8/13139	4	tegula	indet.
20-3-2/14470	4	imbrex	cat
7-1-39/309	5	tegula	dog
20-1-78/3124	5	tegula	even-toed ungulate (deer, pig)
68-2-88/6423	5	tegula	dog
95-1-19/10847	5	tegula	dog?
95-2-24/11071	5	tegula	dog

Table *32.6, cont.

Find number	Fabric	Form	Imprint
21-1-2/11956	5	tegula	indet.
21-1-2/11962	5	tegula	dog
68-2-9/11975	5	tegula	hobnailed sole
10-1-63/947	6	tegula	hobnailed sole
68-2-22/6421	6	tegula	mammal
13-3-44/11947	6	tegula	sheep/goat
79-2-6/11978	6	tegula	bird (chicken?)
16-2-6/2232	7	tegula	dog

Table *35.2. Voerendaal-Ten Hove. Results of the XRF measurements on the painted plaster fragments.

Sample	Item	Find no.	Id	Fragment/ colour	Elements
00338	-	1953-2.0 (6?)	13084	red	**Ca,Fe**, Si, (Sr)
00431	314-3	114-1-3	10185	white fragment 1	**Ca**, (Fe), (Sr)
00432	314-3	114-1-3	10185	white fragment 2	**Ca**, (Fe), (Sr)
00433	314-3	114-1-3	10185	white fragment 3	**Ca**, Fe, (Si), (Sr)
00434	314-3	114-1-3	10185	white fragment 4	**Ca**, Fe, Si, (Sr)
00368	314-4	114-2-9	10214	white fragment 1	**Ca**, Fe, (Si), (Sr)
00369	314-4	114-2-9	10214	white fragment 2	**Ca**, Fe, (Si), (Sr)
00370	314-4	114-2-9	10214	white fragment 3	**Ca**, (Fe), (Si), (Sr)
00381	314-4	114-2-9	10214	white with blue spot	**Ca,Fe**, (Si), (Sr)
00405	314-4	114-2-9	10214	white fr. 1 measurement 1	**Ca**, (Fe), (Sr)
00406	314-4	114-2-9	10214	white fr. 1 measurement 2	**Ca**, (Fe), (Sr)
00407	314-4	114-2-9	10214	white fr. 1 measurement 3	**Ca**, (Fe), (Sr)
00408	314-4	114-2-9	10214	white fr. 1 measurement 4	**Ca**, (Fe), (Sr)
00409	314-4	114-2-9	10214	white fr. 4 measurement 1	**Ca**, (Fe), (Sr)
00410	314-4	114-2-9	10214	white fr. 5 measurement 1	**Ca**, (Fe), (Si), (Sr)
00411	314-4	114-2-9	10214	white fr. 6 measurement 1	**Ca**, (Fe), (Sr)
00412	314-4	114-2-9	10214	white fr. 7 measurement 1	**Ca**, (Fe), (Sr)
00477	314-5	114-1-3	13110	red fr. 1 with some dirt	**Ca,Fe**, Si, (Mn), (Ti), (Sr)
00478	314-5	114-1-3	13110	red fr. 2 with some dirt	**Ca,Fe**, Si, (Mn), (Ti), (Sr)
00508	314-5	114-1-3	13110	red fragment 1	**Ca,Fe**, Si, (Sr)
00509	314-5	114-1-3	13110	red fragment 2	**Ca,Fe**, Si, (Sr)
00416	318-10	111-1-1	13107	white fragment 3	**Ca**, Si, Fe, (Ti), (Sr)
00382	318-3	111-1-5	13104	red	**Ca,Fe**, Si, (Sr)
00387	318-4	111-1-5	13105	red	**Ca,Fe**, Si, (Sr)
00389	318-4	111-1-5	13105	red	**Ca,Fe**, (Si), (Sr)
00390	318-4	111-1-5	13105	white	**Ca**, Fe, (Si), (Sr)
00391	318-4	111-1-5	13105	blue grey	**Ca,Fe**, Si, Cu, (Sr)
00392	318-5	111-1-5	13106	red	**Ca,Fe**, (Si), (Sr)

Sample	Item	Find no.	Id	Fragment/ colour	Elements
00383	318-6	110-1-5	10112	red fragment 1	**Ca,Fe**, Si, (Sr)
00384	318-6	110-1-5	10112	red fragment 2	**Ca,Fe**, Si, (Mn), (Sr)
00385	318-6	110-1-5	10112	red fragment 3	**Ca,Fe**, Si, (Sr)
00386	318-6	110-1-5	10112	red fragment 4	**Ca,Fe**, Si, (Sr)
00554	318-6	110-1-5	10112	red fragment 1	**Ca,Fe**, Si, (Sr)
00555	318-6	110-1-5	10112	red fragment 2	**Ca,Fe**, Si, (Sr)
00556	318-6	110-1-5	10112	red fragment 3	**Ca,Fe**, Si, (Sr)
00557	318-6	110-1-5	10112	red fragment 3	**Ca,Fe**, Si, (Mn), (Sr)
00558	318-6	110-1-5	10112	red fragment 5	**Ca,Fe**, Si, (Sr)
00559	318-6	110-1-5	10112	red fragment 6	**Ca,Fe**, (Si), (Sr)
00560	318-6	110-1-5	10112	red fragment 7	**Ca,Fe**, Si, (Sr)
00561	318-6	110-1-5	10112	red fragment 8	**Ca,Fe**, Si, (Sr)
00562	318-6	110-1-5	10112	red fragment 9	**Ca,Fe**, Si, (Sr)
00563	318-6	110-1-5	10112	red fragment 10	**Ca,Fe**, Si, (Sr)
00564	318-6	110-1-5	10112	red fragment 11	**Ca,Fe**, Si, (Mn), (Sr)
00565	318-6	110-1-5	10112	red fragment 12	**Ca,Fe**, Si, (Sr)
00566	318-6	110-1-5	10112	red fragment 13	**Ca,Fe**, Si, (Sr)
00567	318-6	110-1-5	10112	red fragment 14	**Ca,Fe**, Si, (Sr)
00568	318-6	110-1-5	10112	red fragment 15	**Ca,Fe**, Si, (Sr)
00569	318-6	110-1-5	10112	red fragment 16	**Ca,Fe**, Si, (Sr)
00570	318-6	110-1-5	10112	red fragment 17	**Ca,Fe**, Si, (Sr)
00571	318-6	110-1-5	10112	red fragment 18	**Ca,Fe**, Si, (Sr)
00572	318-6	110-1-5	10112	red fragment 19	**Ca,Fe**, Si, (Sr)
00573	318-6	110-1-5	10112	red fragment 20	**Ca,Fe**, Si, (Sr)
00423	318-7	111-1-5	13103	white fragment 1	**Ca**, Si, Fe, (Ti), (Sr)
00424	318-7	111-1-5	13103	white fragment 2	**Ca**, (Fe), (Sr)
00510	318-9	111-1-4	10111	red fragment 1	**Ca,Fe**, Si, (Sr)
00511	318-9	111-1-4	10111	red fragment 2	**Ca,Fe,Si**, Al, (Sr)
00512	318-9	111-1-4	10111	red fragment 3	**Ca,Fe**, Si, (Mn), (Sr)
00513	318-9	111-1-4	10111	red fragment 3	**Ca,Fe**, Si, (Mn), (Sr)
00514	318-9	111-1-4	10111	red fragment 4	**Ca,Fe,Si**, Al, (Sr)
00515	318-9	111-1-4	10111	red fragment 5	**Ca,Fe,Si**, Al, (Sr)
00427	319-18	110-2-4	10056	white	**Ca**, Si, Fe, (Sr)
00428	319-19	110-2-7	10057	white	**Ca**, Fe, Si, (Ti), (Sr)
00518	336-2	111-2-3	13109	green fragment	**Ca,Fe,Si**, Cu, K, (Sr)
00379	336-3	111-2-4	13102	blue	**Ca**, Fe, Cu, Si, (Sr)
00380	336-3	111-2-4	13102	red	**Ca**, Fe, Si, (Sr)
00532	336-3	111-2-4	13102	green fragment with red	**Ca**, Fe, Si, Cu, (Sr)
00413	336-4	111-2-3	10115	white fragment 1	**Ca**, (Fe), (Sr)
00414	336-4	111-2-3	10115	white fragment 2	**Ca**, (Fe), (Si), (Sr)
00415	336-4	111-2-3	10115	white fragment 3	**Ca**, (Fe), (Si), (Sr)
00371	336-5	111-2-4	10116	red fragment 1	**Ca,Fe**, Si, (Mn), (Sr)
00372	336-5	111-2-4	10116	red fragment 2	**Ca,Fe**, Si, (Sr)

Table *35.2, cont.

Sample	Item	Find no.	Id	Fragment/ colour	Elements
00373	336-5	111-2-4	10116	red fragment 3	**Ca,Fe**, Si, (Sr)
00374	336-5	111-2-4	10116	red fragment 4	**Ca,Fe**, Si, (Sr)
00375	336-5	111-2-4	10116	red fragment 5	**Ca,Fe**, Si, (Mn), (Sr)
00376	336-5	111-2-4	10116	red fragment 6	**Ca,Fe**, Si, (Sr)
00377	336-5	111-2-4	10116	red fragment 7	**Ca,Fe**, Si, (Sr)
00378	336-5	111-2-4	10116	red fragment 8	**Ca,Fe**, Si, (Sr)
00519	336-5	111-2-4	10116	red fragment 1	**Ca,Fe**, Si, (Sr)
00520	336-5	111-2-4	10116	red fragment 2	**Ca,Fe**, Si, (Mn), (Sr)
00521	336-5	111-2-4	10116	red fragment 3	**Ca,Fe**, Si, (Sr)
00522	336-5	111-2-4	10116	red fragment 4	**Ca,Fe**, Si, (Sr)
00523	336-5	111-2-4	10116	red fragment 5	**Ca,Fe**, Si, (Sr)
00524	336-5	111-2-4	10116	red fragment 6	**Ca,Fe**, Si, (Mn), (Sr)
00525	336-5	111-2-4	10116	red fragment 7	**Ca,Fe**, Si, (Sr)
00526	336-5	111-2-4	10116	red fragment 8	**Ca,Fe**, Si, (Mn), (Sr)
00527	336-5	111-2-4	10116	red fragment 9	**Ca,Fe**, Si, (Sr)
00528	336-5	111-2-4	10116	red fragment 10	**Fe,Ca,Si**, (Sr)
00529	336-5	111-2-4	10116	red fragment 11	**Ca,Fe**, Si, (Sr)
00530	336-5	111-2-4	10116	red fragment 12	**Ca,Fe**, Si, (Sr)
00531	336-5	111-2-4	10116	red fragment 13	**Ca,Fe**, Si, (Sr)
00429	336-6	111-2-4	13101	white fragment 1	**Ca**, Fe, (Si), (Sr)
00430	336-6	111-2-4	13101	white fr. 2 with black spots	**Ca**, Fe, Si, (Mn), (Sr)
00516	336-7	111-2-3	13108	red fragment 1	**Ca,Fe**, Si, (Sr)
00517	336-7	111-2-3	13108	red fragment 3	**Ca,Fe**, Si, (Sr)
00352	400-10	1953-2.6	13085	white	**Ca**, (Fe), (Si), (Sr)
00353	400-10	1953-2.6	13085	green	**Ca**, Fe, Si, (Sr)
00354	400-10	1953-2.6	13085	green	**Ca**, Si, Fe, (Sr)
00355	400-10	1953-2.6	13085	grey	**Ca**, Si, Fe, (Sr)
00574	400-10	1953-2.6	13085	loam	**Si,Ca,Fe**, (Al), (Ti), (K), (Sr)
00346	400-11	1953-2.6	13093	white	**Ca**, (Fe), (Si), (Sr)
00347	400-11	1953-2.6	13093	white	**Ca**, Si, (Fe), (Sr)
00348	400-11	1953-2.6	13093	red	**Ca**, Fe, (Si), (Sr)
00329	400-12	1953-2.6	13088	white	**Ca**, (Fe), (Si), (Sr)
00330	400-12	1953-2.6	13088	flower petal	**Ca**, Si, Fe, (Sr)
00331	400-12	1953-2.6	13088	red line	**Ca**, Fe, (Si), (Sr)
00332	400-12	1953-2.6	13088	blue grey	**Ca**, Si, Fe, (Sr)
00333	400-12	1953-2.6	13088	red brown	**Ca**, Si, Fe, (Sr)
00340	400-13	1953-2.6	13086	worn red	**Ca**, Fe, Si, (Al), (Sr)
00341	400-13	1953-2.6	13086	worn	**Ca,Si**, Fe, (Sr)
00342	400-13	1953-2.6	13086	grey	**Ca**, Si, Fe, (Sr)
00575	400-13	1953-2.6	13086	loam	**Si,Ca,Fe**, Al, (Ti), (K), (Sr)
00349	400-15	1953-2.6	13087	white	**Ca**, Si, (Fe), (Sr)

Sample	Item	Find no.	Id	Fragment/ colour	Elements
00350	400-15	1953-2.6	13087	dark red	**Ca,Fe**, Si, (Sr)
00351	400-15	1953-2.6	13087	pink	**Ca**, Fe, Si, (Sr)
00343	400-16	1953-2.6	13091	red	**Ca,Fe**, Si, (Sr)
00344	400-16	1953-2.6	13091	white	**Ca**, (Fe), (Si), (Sr)
00335	400-18	1953-2.4	13082	green	**Ca,Fe,Si**, (K), (Cu), (Sr)
00334	400-21	1953-2.4	13083	red	**Ca,Fe,Si**, (P), (Ti), (Sr)
00345	400-22	1953-2.6	13090	white	**Ca**, (Fe), (Si), (Sr)
00578	400-4	1953-2.6	11999	fr. with circles, white	**Ca**, (Si), (Fe), (Sr)
00579	400-4	1953-2.6	11999	fr. with circles, flower heart	**Ca**, Si, Fe, (Sr)
00580	400-4	1953-2.6	11999	fr. with circles, red	**Ca**, Fe, Si, (Sr)
00581	400-4	1953-2.6	11999	fr. with circles, yellow petal?	**Ca**, (Fe), (Si), (Sr)
00582	400-4	1953-2.6	11999	fr. with circles, yellow petal?	**Ca**, Si, Fe, (Sr)
00583	400-4	1953-2.6	11999	fr. with circles, loam on back	**Ca,Si,Fe**, (Ti), (Sr)
00584	404-1	1953-2.20	12005	red fragment	**Ca,Fe**, Si, (Al), (Sr)
00585	404-1	1953-2.20	12005	red fr. with thin white line	**Ca,Fe**, Si, (Sr)
00336	404-3	1953-2.20	13080	white	**Ca**, Si, Fe, (Ti), (Mn), (Sr)
00337	404-3	1953-2.20	13080	red	**Ca,Fe**, Si, (Ti), (Sr)
00339	404-4	1953-2.20	13081	red	**Ca,Fe**, Si, (Sr)
00425	762-2	114-1-12	10196	white fragment 1	**Ca**, Fe, (Sr)
00426	762-2	114-1-12	10196	white fragment 2	**Ca**, Fe, Si, (Sr)
00356	763-10	114-1-14	13120	white	**Ca**, Si, Fe, (Sr)
00357	763-10	114-1-14	13120	red	**Ca**, **Fe**, Si, (Sr)
00470	763-11	114-1-14	13112	red	**Ca,Fe**, Si, (Ba), (Sr)
00462	763-13	114-1-14	10198	red fragment 1	**Ca,Fe**, Si, (Sr)
00463	763-13	114-1-14	10198	red fragment 2	**Ca,Fe**, Si, (Sr)
00464	763-13	114-1-14	10198	red fragment 3	**Ca,Fe**, Si, (Sr)
00465	763-13	114-1-14	10198	red fragment 4	**Ca,Fe**, Si, (Sr)
00469	763-13	114-1-14	10198		**Ca,Fe**, Si, (Ba), (Sr)
00471	763-14	114-1-14	13113	red	**Ca,Fe**, Si, (Ba), (Sr)
00472	763-15	114-1-14	13118	red fragment 1	**Ca,Fe**, Si, (Sr)
00473	763-15	114-1-14	13118	red fragment 2	**Ca,Fe**, Si, (Sr)
00474	763-15	114-1-14	13118	red fragment 3	**Ca,Fe**, Si, (Ba), (Sr)
00475	763-15	114-1-14	13118	red fragment 4 with some dirt	**Ca,Fe**, Si, (Ti), (Mn), (Sr)
00358	763-16	114-1-14	13119	white	**Ca**, Si, Fe, (Sr)
00359	763-16	114-1-14	13119	dirty	**Ca**, Si, Fe, (Sr)
00435	763-16	114-1-14	13119	white fragment 1	**Ca**, Si, Fe, (Sr)
00436	763-16	114-1-14	13119	white fragment 2	**Ca**, Fe, (Si), (Sr)
00437	763-16	114-1-14	13119	white fragment 3	**Ca**, Si, (Fe), (Sr)
00438	763-16	114-1-14	13119	white fragment 4	**Ca**, Si, (Fe), (Sr)
00439	763-16	114-1-14	13119	white fragment 5	**Ca**, (Fe), (Si), (Sr)
00440	763-16	114-1-14	13119	white fragment 6	**Ca**, Si, Fe, (Sr)

Table *35.2, cont.

Sample	Item	Find no.	Id	Fragment/ colour	Elements
00441	763-16	114-1-14	13119	white fragment 7	**Ca**, Si, (Fe), (Sr)
00442	763-16	114-1-14	13119	dirt with pink on fragment 7	**Ca**, Fe, Si, (Sr)
00443	763-16	114-1-14	13119	white fragment 8	**Ca,Fe**, Si, (Ti), (Sr)
00444	763-17	114-1-14	13122	white fragment 1	**Ca**, Si, (Fe), (Sr)
00445	763-17	114-1-14	13122	white fragment 2	**Ca**, Si, (Fe), (Sr)
00446	763-17	114-1-14	13122	white fragment 3	**Ca,Si**, Fe, (Sr)
00447	763-17	114-1-14	13122	white fragment 4	**Ca**, Si, Fe, (Sr)
00448	763-17	114-1-14	13122	white fragment 5	**Ca**, Fe, Si, (Sr)
00449	763-17	114-1-14	13122	white fragment 6	**Ca**, Si, Fe, (Sr)
00455	763-18	114-1-14	13126	white fragment 1 with red line	**Ca**, (Si), (Fe), (Sr)
00456	763-18	114-1-14	13126	white fragment 2 with red line	**Ca**, Si, Fe, (Sr)
00457	763-18	114-1-14	13126	white fr. 3 with red line and grey	**Ca**, Si, Fe, (Sr)
00458	763-18	114-1-14	13126	white fragment 4 with red	**Ca**, Si, Fe, (Sr)
00459	763-18	114-1-14	13126	red fragment 4 with white	**Ca**, Fe, Si, (Sr)
00460	763-18	114-1-14	13126	red fragment 3 with white	**Ca,Fe**, Si, (Sr)
00461	763-18	114-1-14	13126	red fragment 5 with white	**Ca,Fe**, Si, (Sr)
00450	763-19	114-1-14	13127	white fragment 1	**Ca**, Si, (Fe), (Sr)
00451	763-19	114-1-14	13127	white fragment 2	**Ca**, Si, (Fe), (Sr)
00452	763-19	114-1-14	13127	white fragment 3	**Ca**, Si, (Fe), (Sr)
00453	763-19	114-1-14	13127	white fragment 4	**Ca**, Si, (Fe), (Sr)
00454	763-19	114-1-14	13127	light grey zone fragment 4	**Ca,Si**, Fe, (Mn), (Sr)
00476	763-2	114-1-14	13117	red with some dirt	**Ca,Fe**, Si, (Sr)
00360	763-4	114-1-14	13115	white	**Ca**, Si, (Fe), (Sr)
00361	763-4	114-1-14	13115	white fragment 2	**Ca**, Si, Fe, (Sr)
00576	763-4	114-1-14	13115	white, red and yellow line	**Ca**, Fe, (Si), (Sr)
00468	763-5	114-1-14	13116	yellow	**Ca,Fe**, Si, (Sr)
00533	763-6	114-1-14	13128	white fr., red line, grey zone	**Ca**, Si, (Fe), (Sr)
00534	763-6	114-1-14	13128	grey fr. white with red and grey	**Ca**, Fe, (Si), (Sr)
00417	763-7	114-1-14	13123	white fragment with red line	**Ca**, Si, (Fe), (Sr)
00466	763-8	114-1-14	13124	red bow	**Ca,Fe**, Si, (Sr)
00467	763-8	114-1-14	13124	white	**Ca**, Si, Fe, (Sr)
00363	783-1	114-1-6	10191	white fragment 1	**Ca,Si**, Fe, (Ti), (Sr)
00364	783-1	114-1-6	10191	white fragment 2	**Ca**, Si, (Fe), (Sr)
00365	783-1	114-1-6	10191	white fragment 2	**Ca,Si**, Fe, (Ti), (Sr)
00366	783-1	114-1-6	10191	beige	**Ca,Si**, Fe, (Ti), (Sr)
00418	783-1	114-1-6	10191	white fragment 1	**Ca**, Fe, Si, (Ti), (Sr)
00419	783-1	114-1-6	10191	white fragment 1	**Ca**, Si, (Fe), (Sr)
00420	783-1	114-1-6	10191	white fragment 2	**Ca**, Si, (Fe), (Sr)
00421	783-1	114-1-6	10191	white fragment 3	**Ca**, Fe, Si, (Sr)
00422	783-1	114-1-6	10191	white fragment 4	**Ca,Si**, Fe, (Ti), (Sr)
00577	783-1	114-1-6	10191	white fragment 3	**Ca**, Fe, Si, (Sr)
00362	783-2	114-1-6	13111	red on red mortar	**Fe,Si,Ca**, (Ti), (K), (Al), (Mn), (Sr)

Analyses were performed with a Bruker Tracer 5i in Mudrock Dual mode. Major elements (quantified by the mudrock dual method as over 10%) are printed bold, minor elements in plain text and trace elements (<0.1%) in brackets.

Table *37.5. Voerendaal-Ten Hove. Basic dimensions of the unmodified artefacts.

Type	L(mm)			W (mm)			T (mm)		
	min.	max.	av.	min.	max.	av.	min.	max.	av.
Flake, complete	10	115	54.9	15	114	49.7	2	78	17.5
Flake, complete?	32	32	32.0	83	83	83.0	26	26	26.0
Flake, broken	9	127	37.8	10	89	34.2	2	42	11.3
Flake(?), complete	54	58	53.3	59	61	60.7	15	22	19.0
Flake(?), broken	20	20	20.0	17	17	17.0	6	6	6.0
Flake of ground axe, broken	19	19	19.0	19	19	19.0	3	3	3.0
Flake of hammerstone, entire	36	36	36.0	38	38	38.0	14	14	14.0
(Micro)blade, complete	32	109	58.9	12	49	23.1	3	40	11.6
(Micro)blade, broken	11	86	27.7	7	41	15.6	2	23	4.7
(Micro)blade(?), broken	46	46	46.0	23	23	23.0	9	9	9.0
Core preparation piece, complete	87	87	87.0	28	28	28.0	20	20	20.0
Core preparation piece, broken	29	62	45,5	12	27	19.5	6	12	9.0
Core rejuvenation piece, complete	25	128	67.0	12	88	46.6	8	56	21.9
Core rejuvenation piece, broken	37	47	42.0	32	49	40.5	8	14	11.0
Core rejuvenation piece(?), complete	75	76	75.5	26	48	37.0	24	30	27.0
Core rejuvenation piece(?), complete?	31	31	31.0	27	27	27.0	12	12	12.0
Core rejuvenation piece(?), broken	47	47	47.0	59	59	59.0	21	21	21.0
Core, complete	16	150	63.7	14	120	62.5	9	86	41.8
Core, broken	11	89	54.5	35	64	46.5	24	32	28.3
Core(?), complete	48	48	48.0	24	24	24.0	11	11	11.0
Indeterminate piece (brok)	18	130	68.7	10	107	43.5	6	76	24.7

Table *37.6. Voerendaal-Ten Hove. Basic dimensions of the modified artefacts.

Type	L(mm)			W (mm)			T (mm)		
	min.	max.	av.	min.	max.	av.	min.	max.	av.
Retouched flake, complete	19	91	56.2	16	68	42.3	6	35	17.9
Retouched flake, broken	10	38	22.3	16	26	20.5	3	6	4.3
Retouched flake, complete?	56	56	56.0	15	15	15.0	3	3	3.0
Retouched flake(?), complete	26	26	26.0	21	21	21.0	5	5	5.0
Notched flake, complete	21	78	45.4	18	75	42.9	5	30	14.8
Notched flake(?), broken	25	25	25.0	24	24	24.0	7	7	7.0
Notched and truncated flake, complete	48	48	48.0	24	24	24.0	4	4	4.0
Denticulated flake	32	45	40.3	23	43	31.3	6	13	9.3
Retouched blade, complete	81	81	81.0	37	37	37.0	14	14	14.0
Retouched blade, broken	23	48	38.3	15	24	18.5	4	6	5.0
bilaterally retouched blade, broken	24	54	46.0	19	34	25.6	6	8	7.0
Notched blade, complete	38	38	38.0	14	14	14.0	4	4	4.0
Notched blade, broken	16	35	23.7	9	22	14,7	3	4	3.7
Denticulate blade	33	42	37.5	15	18	16.5	3	5	4.0
Truncated crested blade, complete	40	40	40.0	17	17	17.0	7	7	7.0
Notched crested blade	53	53	53.0	25	25	25.0	11	11	11.0

Table *37.6, cont.

Type	L(mm)			W (mm)			T (mm)		
	min.	max.	av.	min.	max.	av.	min.	max.	av.
Denticulated core preparation, complete	60	60	60.0	34	34	34.0	15	15	15.0
Retouched core rejuvenation piece, complete	30	84	53.8	14	110	51.8	12	41	21.4
Notched core rejuvenation piece, complete	37	37	37.0	51	51	51.0	18	18	18.0
Retouched core, complete	108	108	108	87	87	87.0	38	38	38.0
Retouched piece, complete	41	65	52.0	17	51	34.2	7	26	17.0
Retouched piece, broken	27	27	27.0	15	15	15.0	7	7	7.0
Notched piece	45	90	64,8	33	59	47.0	12	31	20.5
End-scraper, complete	44	44	44.0	32	32	32.0	13	13	13.0
End-scraper, broken	27	52	36.7	17	49	30.0	7	18	12.0
End- and side-scraper, complete	24	40	34.8	22	37	29.3	7	15	11.8
End- and side-scraper, broken	27	27	27.0	26	26	26.0	6	6	6.0
Double side-scraper, broken	44	44	44.0	57	57	57.0	9	9	9.0
Scraper retouched all around, complete	55	55	55.0	42	42	42.0	29	29	29.0
Scraper, type indet., broken	26	26	26.0	26	26	26.0	6	6	6.0
Scraper (racloir)	55	55	55.0	60	60	60.0	20	20	20.0
Borer/awl, complete	48	58	53.0	44	45	44.5	4	17	10.5
Borer/awl, broken	24	24	24.0	10	10	10.0	4	4	4.0
Borer/awl(?), complete	31	31	31.0	19	19	19.0	5	5	5.0
Leaf-shaped arrowh. bifacial retouch, broken	41	41	41.0	25	25	25.0	8	8	8.0
Rectangular trapeze, damaged	18	18	18.0	10	10	10.0	3	3	3.0
Rectangular trapeze(?), broken	9	9	9.0	15	15	15.0	3	3	3.0
Rhombic trapeze, damaged	24	27	25.5	10	10	10.0	3	3	3.0
Burin on a break (A-steker), complete	38	38	38.0	14	14	14.0	5	5	5.0
Dihedral burin? (AA-steker), complete	58	58	58.0	41	41	41.0	18	18	18.0
Burin on a truncation? (RA-steker), compl.	52	52	52.0	21	21	21.0	11	11	11.0
Hammerstone, complete	78	84	81.0	58	72	65.0	46	53	49.5
Hammerstone?, complete	55	55	55.0	37	37	37.0	34	34	34.0
Spitznackiges Flint-Ovalbeil, complete	127	127	127.0	60	60	60.0	32	32	32.0
Strike-a-light, complete?	38	38	38.0	13	13	13.0	5	5	5.0
Strike-a-light, broken	33	33	33.0	22	22	22.0	10	10	10.0
Tool, type indet.	16	40	28.3	13	36	22.7	3	12	7.2

Table *37.7. Voerendaal-Ten Hove. Basic dimensions of the other flint.

Type	L(mm)			W (mm)			T (mm)		
	min.	max.	av.	min.	max.	av.	min.	max.	av.
Artefact type indet., complete	30	30	30.0	31	31	31.0	12	12	12.0
Artefact type indet., broken	36	58	47.3	19	34	25.7	11	16	13.3
Potlid, broken	17	28	22.5	14	18	16.0	4	4	4.0
Splintered piece, complete	40	40	40.0	34	34	34.0	9	9	9.0
Natural piece, complete	37	62	49.5	20	40	30.0	11	11	11.0
Frost flake, broken	39	39	39.0	21	21	21.0	6	6	6.0

Table *39.1. Voerendaal-Ten Hove. Phosphate level and location of the samples.

Sample no.	Trench	Feature	P (ppm)	Location
7-1-26	7	1	423	North of building 410
7-1-31	7	4	404	Inside building 410
10-10-7	10	2	712	Inside north hallway building 405
13-1-64	13	30	558	Subsoil under sunken-floored hut 508
13-1-66	13	14	519	Subsoil in/under granary 249
16-5-51	16	87	1442	Fill of hearth 633
20-1-54	20	9	492	Inside building 401
69-0-8	69	46	712	L. grey-yellowish 'eluviated' subsoil inside bulding 404
69-0-9	69	56	1441	Light grey 'eluviated' subsoil inside bulding 404
69-0-10	69	20	1923	Ca. Roman surface inside building 403
69-0-11	69	18	678	'Raised' layer inside building 403
69-0-12	69	3	1346	Dark layer over building 403
69-0-13	69	1	610	Arable/colluvium
69-0-15	69	108	1695	Blue clay layer under floor level in building 403
69-0-21	69	109	593	Subsoil outside building 403
69-0-22	69	7	1271	Dark layer outside building 403
69-0-23	69	110	831	Dark layer outside building 403
69-0-24	69	2	636	Dark layer outside building 403
69-0-25	69	1	398	Arable/colluvium
94-0-4	94	52	731	Subsoil next to horse pond 413
94-3-11	94	14	1346	Fill of horse pond 413
94-3-12	94	17	1250	Fill of horse pond 413
94-3-13	94	13	102	Fill of horse pond 413
94-3-14	94	15	654	Fill of horse pond 413
94-3-15	94	15	720	Fill of horse pond 413
94-3-16	94	4	1154	Soil outside horse pond 413
94-3-17	94	18	673	Fill entrance of horse pond 413
94-3-18	94	19	769	Fill of horse pond 413
94-3-19	94	20	452	Subsoil near entrance of horse pond 413
94-3-20	94	20	364	Subsoil outside horse pond 413
94-4-09	94	46	1827	Fill of horse pond 413
94-6-07	94	65	746	Between stones of floor or horse pond 413
95-1-22	95	7	731	'Clean' layer inside building 403
95-1-23	95	8	669	Soil west of building 403
95-1-24	95	4	673	Soil west of building 403
95-1-25	95	3	962	Soil west of building 403
95-1-26	95	1	763	Soil west of building 403
95-1-27	95	9	822	Soil west of building 403
95-1-28	95	10	913	Soil west of building 403
95-1-29	95	11	673	Subsoil northwest of building 403/418

Table *39.1, cont.

Sample no.	Trench	Feature	P (ppm)	Location
95-3-26	95	160	1102	Grey soil inside/over building 418
95-3-27	95	171	673	Subsoil northwest of building 403/418
96-0-09	96	45	508	Arable/colluvium
96-0-10	96	7	492	Dark layer over building 403
96-0-11	96	2	865	'Raised' layer inside building 403
96-0-12	96	44	542	Ca. Roman surface inside building 403
96-0-13	96	9	407	Grey subsoil inside building 418 and 403
96-0-14	96	46	297	Subsoil inside building 418 and 403
96-0-15	96	42	1195	Light-grey yellowish soil inside building 418
96-0-16	96	43	1635	Yellowish-brown soil inside building 418
96-0-17	96	16	1186	Dark grey stained subsoil inside building 418
96-0-18	96	46	962	Subsoil inside building 418
96-0-19	96	7	1695	Dark layer over building 403 and surroundings
96-0-20	96	41	1923	Yellowish-brown soil inside building 418
96-0-21	96	19	1695	Dark grey stained subsoil inside building 418
96-0-22	96	46	1525	Subsoil inside building 418
96-0-23	96	19	1923	Dark grey stained subsoil outside building 418
96-0-24	96	40	1102	Light grey 'eluviated' subsoil outside bulding 418
96-1-3	96	2	788	'Clean' layer inside building 403
102-1-32	102	22	542	Subsoil inside horreum 408
102-1-33	102	16	769	Grey (disturbed?) soil inside horreum 408
102-1-34	102	3	481	Light grey soil inside horreum 408
102-1-36	102	23	1250	Subsoil porticus in front or horreum 408
102-1-37	102	23	433	Subsoil in front of porticus/horreum 408
103-1-10	103	1	678	Dark grey soil inside horreum 408
103-1-11	103	2	542	Grey soil in porticus in front of horreum 408
103-1-12	103	4	508	Grey (disturbed?) soil in porticus fronting horreum 408
103-1-13	103	6	381	Subsoil in front of porticus/horreum 408
108-2-8	108	23	1538	Fill of pit/building 757
108-2-9	108	27	433	Subsoil near pit/buiding 757
108-3-5	108	26	1923	Fill of pit/building 757
108-4-1	108	26	1923	Fill of pit/building 757
108-4-3	108	26	720	Subsoil below pit/buiding 757

Appendix XI Notes on the digital excavation plan

Henk Hiddink

For each trench and excavation level, a 1:100 dxf-file was made on basis of a scan of the original 1:50 field drawing. A few files consist of combinations of several trenches (RMO excavation) or trial trenches (ROB trench 1-5). The filenames are a combination of the site name, trench number, excavation level and scan number on which the plan is based, e.g. voerendaal_11_2_19221. Each file contains, if applicable, the layers in table XI.1. The ca. 220 separate files are combined in an overall plan (Voerendaal_10p500), with the help of the original zero points of each trench, the registration marks at the southwest corner of the drawings. A simplified version of this plan can be found in appendix XXII.

Table XI.1. Voerendaal-Ten Hove. Main layers in the general excavation plan.

Layer name	Contents
coördinaat	co-ordinate of Dutch grid system (RDN)
paskruis:	registration mark of co-ordinate at south-west corner of trench
spoornummer_vlak01 - _vlak08	featurenumber_level01 -_level08
putgrens	trench outline
muurgrens	outline of wall
muursteen	stones of wall
- muurbeton:	layers of mortar in the core of walls or separating courses of stonework
- muurplaats:	robber trenches or traces of walls of unknown character
- vloer:	intact bottom floor of hypocaust
stenen	all stones not part of walls
natuurlijk	obvious non-anthropogenic features (often marked on field drawing)
recent	recent disturbances (including old trenches, plough-marks, recent ditches and pits)
karrespoor	cart track
spoor_vlak01 - _vlak08	outlines and lines of anthropogenic features
lijnen_vlak01 - _vlak08	all remaining lines, possibly to be used later (often boundaries of layers)

Appendix XII The features and finds database

Henk Hiddink

1 features

The main data on features and structures are stored in four tables, after they have been entered via the forms Sporenformulier and Structuurformulier (cf. Table XII.1-3). The data entered in the former are stored in TABEL_SPOOR, except for the find numbers, ending up in TABEL_LAAG, because more of these can belong to a single feature. After the feature numbers are entered and a structure is analysed, via TABEL_STRUCTUUR, a series of features can be linked to a structure number. The structure number is also stored in TABEL_SPOOR. Because the database was originally designed for a contract archaeology firm with a specific system of recording, some adaptations had to be made. The sections on the field drawings were indicated by a character + excavation level, e.g. C1, to which in the field COUPENRS the scan with the drawing is added: 19202-C1. Find numbers in the ROB-format trench-level-feature are translated in numbers. For example, 10-3-4 becomes 1003004 and 100-2-33 becomes 10002033. In the TABEL_LAAG it is also indicated which find numbers concern archaeobotanical samples (Table XII.3). and how these samples are related to those published by Kooistra.[3405] In the TABEL_STRUCTUUR, the field opmerkingen/remarks contains referenced to the old feature designations, e.g. ditch 302 = b, building 405 = E, drain 327 = α. The coordinates of find numbers, or groups of numbers belonging to specific structures, are stored in the TABEL_COORDIN_VNRS.

[3405] Kooistra 1996, table 28, 30, 32.

Table XII.1. Voerendaal-Ten Hove. The main data on features and related finds and structures in the database.

Table, field name	Dutch	English	Data type	Notes
TABEL_SPOOR	Sporentabel	Feature table		
WP	werkput	trench	number, integer	
SN	spoornummer	feature number	number, integer	
VLAK	idem	trench level	number, integer	
spoordef	spoordefinitie	feature type	text	
DIEPTE_SPOOR	diepte (cm)	depth (cm)	number, integer	
COUPENRS	coupenummer(s)	section number(s)	text	e.g. 19202-C1 = scan-section-level; stored in TABEL_COUPES
FEATURENR	structuurnummer	structure number	number, long integer	
TABEL_LAAG	Vondstnummers	Find numbers		
WP	werkput	trench	number, integer	
SN	spoornummer	feature number	number, integer	
LN	vondstnummer(s)	find number(s)	number, integer	1003004: trench 10, level 03, find 004 10002033: trench 100, level 2, find 033
MONSTER	monster	sample	text	
KOOISTRA	monster nummer	sample number	text	28-001, 30-005; 32-021 numbers in Kooistra 1996, table 28, 30, 32
TABEL_STRUCTUUR	Structuurtabel	Structure table		
FEATURNR	structuurnummer	structure number	number, long integer	associated features stored in TABEL_SPOOR
AARD_STRUCTUUR	structuurdefinitie	struct. definition		
OPMERKINGEN	opmerkingen	remarks	long text	including old designations
TAB_COORDIN_VNRS	Vondstcoördinaten	Finds coordinates		simultaneously centres of structures
Xcoord	X-coördinaat	X-coordinate	double precision	
Ycoord	Y-coördinaat	Y-coordinate	double precision	

Table XII.2. Voerendaal-Ten Hove. The feature types found in the database.

REF_SPOORDEF	Feature types	Remarks
crematiegraf	cremation grave	
goot	conduit, drain, basin	every feature related to water (except for wells)
greppel	ditch	
hutkom	sunken hut	
inhumatiegraf	inhumation grave	
karrenspoor	cart track	ranging from whole paths/roads to the track of one wheel
kuil	pit	
laag	layer	
muur	wall	foundation, proper wall/stonework, robber trench
natuurlijk	natural feature	
onbekend	unknown	likely anthropogenic feature, yet to be classified
onderkant	'bottom'	possible post hole, depth < 10 cm
oven	hearth	all pits related to fires (red colour, charcoal)
paalkuil	post hole	
plantkuil	planting hole	
recente verstoring	recent disturbance	
spitsporenbaan	spade marks	remnants of a ditch, lowermost levels of arable
standgreppel	ditch for/with sleeper beam	
vloer	floor	base/lower floor of hypocaust
waterput	well	

Table XII.3. Voerendaal-Ten Hove. Sample types found in the database.

Sample type	Dutch	English	Remarks
HK	houtskool	charcoal	
M	monster	sample	non-specific sample, often soil
MF	monster fosfaat	phosphate sample	
MP	monster pollen	pollen sample	
MZ	monster zaden e.d.	seeds, chaff etc. sample	

2 finds

The table TABEL_nieuwevondstdeterminaties is a modified, expanded version of the table TABEL_VONDSTDETERMINATIE of the original VUhbs-database used, and therefore contains some peculiar elements which perhaps seem less logical. Some data concerning pottery are stored in the table TABEL_AARDEWERK_EXTRA
OD= old/original database; ND= new/this database
Below, the format and contents of the fields are explained.

Id AutoNumber
Number generated by Access to distinguish between the sometimes many different records with the same find number (also see below under 'LN' and 'Item').

LN Number
The find number, actually the combination of trench, level and find number (originally a combination of trench, feature and layer number, each in a separate field). The level number always has a leading zero, the find number one or two, so that it consists of three digits. Some examples of find numbers on the field drawings and their equivalent in the database: 1-2-10/102010, 16-3-2/1603002, 110-1-23/11101023.

ITEM Short text
A running number of special/drawn finds in a specific structure. In the original version of the database, all the finds are entered via a form. After entering the trench, feature and layer number of a find, the database recognizes the structure involved, assigns a running/item number and stores them in the finds table, together with the other data concerning the find. Because here an existing table is used, the structure and item numbers were entered manually in the table itself.

xtranrs Short text
Additional identification of finds, in practice either a letter added to the find numbers of coins or an inventory number of the RMO at Leiden (l1895, 1932 or 1953 for excavations Habets, Holwerda or Braat).

HOOFDCAT Short text
Main find category (Table XII.4).

MATCAT Short text
Find category (Table XII.4).

oorsprMATERIAAL Short text
Find category according to the OD, see document KERALL_code.

SOORT Short text
Material/group (Table XII.5).

BAKSEL Short text (in TABEL_AARDEWERK_EXTRA)
Pottery fabric, also used for slag (Table XII.6).

VORM Short text
Shape/vessel type (Table XII.7).

typeJULIE Short text
Type designation according to Van Kerckhove (cf. Chapter 23).

TYPE Short text
Abbreviations of type designations/typologies used, with publications referred to, see table XII.8 below.

oorsprTYPE Short text
Types used in the OD, see document KERALL_code.

RAND Number (TABEL_AARDEWERK_EXTRA)
WAND
BODEM
OOR
Number of rim, wall, base and ear(/other) fragments.

oorsprFRGM Number
The number of brick and tile fragments according to the OD.

FRAGMENTEN Number
Total number of fragments. In the original version of the database, the values of rim, wall, base and other fragments are stored in a separate table and only the automatically calculated total is shown in the main finds table. Because for Voerendaal no entry form is used (see above under ITEM), the total was not calculated by the program and some incorrect totals may be present.
Important:
- pottery: if the number of fragments is 0, this material was not found or recognized in 2019 (and probably included in another record).
- brick/tile: only numbers for which also a weight is given (see below) relate to material present.
- bronze: only present if a 'weight' is given.
- coins: only present if a 'weight' is given.
- stone/flint: only present if a weight is given.
- slag: only present if a weight is given.

GEW Number
Weight in gram of the fragments.
Important:
- pottery: if the weight is 9999, the fragments are lost but still probably important.
- brick/tile: only if a weight is given, the fragments of that record are present.
- bronze: a weight of 99 means that the item is present at De Vondst, Heerlen.
- coins: a weight of 999 means that the coin is present.
- stone/flint: only if a weight is given, the fragments of that record are present.
- slag: only if a weight is given, the fragments of that record are present.

- animal bone: nthe weight of animal bones was taken from the original handwritten forms, where only the total weight per species was noted: e.g. 5 records with bones of cattle, with a weight of 170 g. In the ND, for each of these 5 records a weight of 34 g was entered.

KILOGRAM Text

The weight of brick and tile according to the OD, expressed in kg with two decimals (rounded up/off to 100 g). Only used for brick/tile and slag.

oorsprGEW Number

The value of KILOGRAM converted into grams.

GETEK

Here 'JA'/yes indicates that the object is drawn, also indicated by a feature + serial number (like 312-0001 or 409-0008).

OPMERKINGEN

Most remarks are those from the OD, some are kept although not entirely correct or relevant anymore.

Table XII.4. Voerendaal-Ten Hove. Find categories.

HOOFDCAT	Main category	MATCAT	Category
AWX	pottery		
		AWPREH	prehistoric = handmade pottery (HGV)
		AWIJZV	Early Iron Age
		AWIJZM	Middle Iron Age
		AWIJZL	Late Iron Age
		AWROM	Roman
		AWROML	Late Roman
		AWVME	Early Medieval
		AWHME	High Medieval
		AWLME	Late Medieval
		AWPME	post-Medieval
BOT	bone	CR	cremains
		ODB	animal bone
		VDB	burnt animal bone
		BDB	worked animal bone
BOUW	building material	BST	brick
		MRT	mortar/concrete
		VKL	burnt clay/loam

Table XII.4, cont.

HOOFDCAT	Main category	MATCAT	Category
GLS	glass	GLSLT	La Tène
		GLSROM	Roman
		GLSROML	Late Roman
		GLSVME	Early Medieval
HK	charcoal	--	
MET	metal	MET	
NST	stone	NST	
		VST	(possibly) worked flint
SLK	slag	SLK	

Table XII.5. Voerendaal-Ten Hove. Sorts of finds, subdivisions of MATCAT.

MATCAT	SOORT	Sub-category
AWROM(L)	AMF	amphorae
	BLGR	blue-grey (Low Lands Ware I)
	DOL	dolia
	GB	Gallo-Belgic (beakers, excl. TN)
	GBR	mica-dusted
	GEV	colour-coated
	GLW	smooth-walled
	GLWGS	smoked smooth-walled
	KEROBJ	ceramic object
	KURN(A)	cork urn (like)
	METAG	metal gloss
	MGR	flat based amphora
	POMP	Pompeian red
	RUWW	coarse ware
	TN	terra nigra
	TS	terra sigillata
	WRF	mortaria
AWVME	GLW	smooth-walled (old subcategory)
	RUWW	coarse-walled (old subcategory)
AWHME	BG	blue-grey
	BG(-EL)	'classic' Elmpt
	PI	Pingdorf
	PI(-ZL)	South-Limburg
	PI(-ZL/S5)	South-Limburg/proto-stoneware
	WM	Meuse regio white

MATCAT	SOORT	Sub-category
AWLME	S1	stoneware, unglazed
	S2	stoneware, glazed
	S4	near-stoneware
	R	late medieval red firing
	W	late medieval white (green glaze)
AWPME	IW	industrial white
	P	porcelain
	PY	tobacco pipe
BST	BSTREC	(sub)recent brick/tile
	BSTROM	Roman brick/tile
GLS(LT/ROM)	SIERR	jewelry
	VAATW	vessels
	VENSTR	window glass
MET		
	MAR	silver
	MBR	bronze (including copper alloys)
	MFE	iron
	MPB	lead
MRT	BPW	painted wall plaster
NST	SAM	amfibiolite
	SBA	basalt
	SCC	coal
	SCH	chert
	SCG	conglomeratic sandstone
	SFY	phyllite
	SGI	jet
	SGR	granite
	SHA	shale
	SKA	chalk/limestone
	SKT	quartzite
	SKW	quartz
	SKZ	quartzitic sandstone
	SLE	slate
	SMA	marble
	SSI	siltstone
	STE	tephrite
	STU	tuff
	SVU	unworked flint
	SXX	stone unknown
	SZA	sandstone

Table XII.5, cont.

MATCAT	SOORT	Sub-category
ODB	DAS	badger
	EDELHERT	red deer
	GANS	goose
	HOND	dog (well 314 numbered 1-4)
	KIP	chicken
	MOL	mole
	PAARD	horse
	RUND	cattle
	SCHEIT	sheep/goat
	VARKEN	pig
	VOS	fox
SLK	GRUIS	grit
	HMRSLAG	hammerscale
	HW	hearth lining
	MFE	iron (raw material/ half finished)
	SINTEL	cinder
	SLAK	slag non-identifiable/specific
	SLAKBLOK	slag block
	SMHSL	smithy hearth bottom
	WOLF	raw iron bloom

Table XII.6. Voerendaal-Ten Hove. Specification of pottery fabric, type of slag, etc.

SOORT	BAKSEL	Fabric (baksel)
AMF	BAET	Baetica (Dressel 20)
	GAUL	Gauloise
GEV	GEV_A	Brunsting fabric a: red on white
	GEV_B	Brunsting fabric b: dark-grey/black (dull) on white
	GEV_C	Brunsting fabric c: black on orange
	GEV_MARM	marmoriert
	GEV_O	unknown
	GEV_POMP	Pompeian red-painted
	GEV_ROTGESTR	rotgestrichen
	GEV_A_RUWW	white coarse-walled with red/orange painted surface
	GEV_B_RUWW	white coarse-walled with grey/brownish painted surface
METAG	METAG_ARG	Argonne (black on grey)
	METAG_TR	Trier (black on red)
	METAG_WT-GR	dark grey on off-white/light grey
RUWW	MAY	Mayen
TS	TS_ARG	Argonne sigillata (Late Roman)
	TS_MG	Middle Gaul
	TS_MOG	Middle or Eastern Gaul
	TS_OG	Eastern Gaul
	TS_ZG	Southern Gaul
	TS_ZMG	Southern or Middle Gaul
SLAK	FE	iron/rusty
	SI	silica/glassy

Table XII.7. Voerendaal-Ten Hove. Forms/functional categories.

HOOFDCAT	VORM	Shape
AWX	AMF	amphora
	BAK	dish/bowl, deep
	BEELDJE	statuette
	BKR	beaker
	BRD	dish
	CIRKELPOT	'circle pot'
	DEK	lid
	DOL	dolium
	DOLFLS	'dolium bottle'
	FLS	bottle
	HON	honey pot
	KAASVORM	cheese strainer
	KAN	jug
	KANTH	kantharos
	KOM	bowl
	KRG	collared bowl
	KRK	flagon
	KWT	Knickwandtopf
	MASKER	mask
	NAP	small cup
	ONB	unknown
	OORPOT	eared jar
	PLANEET	'planetary vase'
	POT	pot/jar
	SCH	large bowl/dish
	SPINKL	spindle worl
	STAMF	'standing' amphora
	TUITPOT	jar with spout
	VERGIET	strainer
	VOETKOM	pedestalled bowl
	WEEFGEW	loom weight
	WRF	mortarium
	WWT	Wölbwandtopf
	ZOUT	salt container
BST	BESS	bessalis
	BESS_RO	round bessalis
	BESS_VK	square bessalis
	IMBREX	imbrex
	LATER	later
	SCHOORST	'chimney' tegula
	TEGULA	tegula
	TUBULUS	tubulus
	TUB_MAMM	tegula mammata
	TUB_CUN	tubulus cuneatus
	TUB_VOUSS	voussoir

HOOFDCAT	VORM	Shape
GLS	ARMRING	bracelet
	BKR	beaker
	BKRKON	beaker, conical
	BOLLEVORM	bulbous shape
	BRD/SCH	dish/plate
	FLES	bottle
	KAN	jug
	KOEPELGLS	dome sh. window pane
	KOM	bowl
	KRAAL	bead
	KRAALMELOEN	melon bead
	ONB	unknown
	POT	jar, pot
	RIBKOM	ribbed bowl
	SCH	dish, large
	UNGUEN	unguentarium
	ZALFFLESJE	
MET-MBR	ARMRING	bracelet
	BEL	bell
	BESLAG	fitting
	BESLAG_GORDEL	fitting, belt
	BESLAG_MEUBEL	fitting, furniture
	BESLAG_VVORM	fitting, V-shaped
	BLIK	sheet metal
	FIBULA	brooch
	GESP	buckle
	GORDELHAAK	belt hook
	HAARNAALD	hair needle
	HANGER	pendant
	INDET	indeterminable
	KNOOPPME	button, medieval
	LEPEL	spoon (hoofdcat MAR)
	MUNT	coin
	NAAINAALD	sowing needle
	NAALD	needle, not specified
	NAGEL	nail
	NIET	rivet
	OORLEPEL	ear probe
	PAARDETUIG	horse gear
	PINCET	tweezers
	PLAAT	sheet metal
	RING	ring
	SIERNAGEL	rivet, decorative
	SLEUTEL	key
	SLOTGRENDEL	latch/bolt
	SLOTPLAAT	lock plate

Table XII.7, cont.

HOOFDCAT	VORM	Shape
	SONDE	probe
	SPIEGEL	mirror
	STRIP	strip
	TEUGELGEL	terret
	VAATW	vessel
	WIJNZEEF	wine strainer
	ZEEF	sieve/strainer
	ZEGELDS	seal box
MET-MFE	BEITEL	chisel
	BEL	bell
	BESLAG	fitting
	BIJL	axe
	BIT	horse bit
	BOEI	shackels
	BOUWBESL	structural fitting
	BREEKIJZER	crowbar
	DISSELHAMER	adze hammer
	GESCHUTSPUNT	projectile point
	GESP	buckle
	GORDELBESL	belt fitting
	HAAK	hook
	HAARDKETTING	hearth chain
	HAARDSCHEP	hearth shovel
	HAKMES	cleaver
	HARKPUNT	rake point
	HENGSEL	handle
	INDET	indeterminable
	KOUTER	coulter
	KRAM	clamp/staple
	KRAM_T	idem, T-shaped
	LANSPUNT	spearhead
	LEPEL	spoon
	LEPELBOOR	spoon bit auger
	MES	knive
	MOF	water pipe collar
	MOF/FLENS	idem/flange
	MOFGEEN	object only resembling collar
	MOFX	collar visible at X-ray
	PEN	pin
	PIJLPUNT	arrowhead
	PLAAT	sheet metal
	RIEMTONG	belt/strap end
	RING	ring
	SAX	sax (sword)
	SCHAAR	scissors
	SCHACHTBESCH	ferrule

HOOFDCAT	VORM	Shape
	SCHARNIER	hinge
	SCHOFFEL	pushing hoe
	SCHOP	spade
	SIKKEL	sickle
	SLEUTEL	key
	SLOTKETTING	lock chain
	SNOEIMES	pruning hook
	SPATEL	spatula
	SPIJKER	nail
	SPIJKER_GROOT	nail, large
	SPLITPEN	split pin
	STAAF	rod
	STILUS	stilus
	STRIP	strip
	TOOM	bridle
	VINGERRING	finger ring
	VLEESVORK	meat fork
	VORK	fork
	VORK_2TAND	
	VUURSLAG	strike-a-light
	WERKT	implement
	ZAAG	saw
	ZEIS	skythe
	ZOOLSP?	hobnail
MET-MPB	DRAAD	wire
	GEWICHT	weight
	INDET	indeterminable
	KNOP	knob
	KOGEL	bullet
	PLAAT	sheet
	REPARATIE	repair
	SCHIJF	disc
	SMELT	molten
	SNIPPER	cutting
	SPINSCH	spindle worl
	STOPSEL	plug/repair
	STRIP	strip
	VERZWARING	weight (e.g. fishnet)
NST	AAMBEELD	anvil
	BEKKEN	basin
	BOUWBL	building block
	BOUWMAT	building material
	DAKLEI	roof slate
	DECO	decorative piece
	DEKPL	covering slab
	KAPITEEL	capital

Table XII.7, cont.

HOOFDCAT	VORM	Shape
	KLOPST	hammer stone
	KOOKST	'cook stone'
	KRAAL	bead
	MAALST	quern/millstone
	PLAAT	slab
	SLIJPBLOK	grinding block
	SLIJPGER	grinding tool
	SLIJPST	grinding stone
	TAFELPOOT	table leg
	WANDBEKL	wall lining/panelling
	WETST	whetstone
	ZUIL	column
ODB	ASTRAGALUS	
	ATLAS	
	AXIS	
	CALCANEUM	
	CENTROTARSALE	
	CORACOID	
	CRANIUM	
	DENTES_INF	dentes_inferior
	DENTES_SUP	dentes_superior
	DENTES_SUP/INF	
	FEMUR	
	HOORNPIT	horn-core
	HUMERUS	
	MANDIBULA	
	METACARPUS	
	METAPODIUM	
	METATARSUS	
	PA	patella
	PB	pubic bone
	PELVIS	
	PHAL_1	phalanx_1
	PHAL_2	phalanx_2
	PHAL_3	phalanx_3
	RADIUS	
	RIB	
	SACRUM	
	SCAPULA	
	STERNUM	
	TARSALE	
	TARSOMETATARSUS	
	TIBIA	
	ULNA	
	VERTR	vertebra
	VERTR_LUMB	vertebra_lumbar
	VERTR_STAART	vertebra_coccygeal (tail)

HOOFDCAT	VORM	Shape
	VERTR_THOR	vertebra_thoracic
	VRTBR_CERVIC	vertebra_cervical
VST	AA_STEKER	dehidral burin
	AFGEKNOT_KLING	truncated blade
	AFSL_V_GESL_BIJL	flake of ground axe
	AFSLAG	flake
	AFSLAG_GEKERF	flake, notched
	AFSLAG_GERET	flake, retouched
	ARTEF_INDET	artefact
	A-STEKER	burin on a break
	BIJL	axe
	BILAT_GERET_KLING	bilaterally retouched blade
	BIPOL_KERN	bipolar core
	BLADSPITS	leaf-shaped arrowhead
	BOOR/PRIEM	borer/awl
	DUBBEL_ZIJSCHRAB	double side scraper
	EIND+ZIJSCHRAB	end+side scraper
	EINDSCHRAB	end scraper
	GEKERF_AFSLAG	notched flake
	GEKERF_KLING	notched blade
	GEKERF_STUK	notched piece
	GEKERF+AFGEKN_AFSLAG	notched+truncated flake
	GERET_AFSLAG	retouched flake
	GERET_KERN	retouched core
	GERET_KLING	retouched blade
	GERET_STUK	retouched piece
	GETAND_AFSLAG	denticulated flake
	GETAND_KERNPREPSTUK	denticulated core preparation
	GETAND_KLING	denticulated blade
	KERN	core
	KERN_M_BEGIN_DEBIT	core, some debitage
	KERNPREPKLING	crested blade
	KLING	blade
	KLOPST	hammer stone
	KLOPST_AFSLAG	flake of hammer stone
	NATU_STUK	natural piece
	POTLID	idem
	RA-STEKER	burin on a truncation
	RECHT_TRAPZ	rectangular trapeze
	RHOMB_TRAPZ	rhombic trapeze
	RONDOM_GERET_SCHRAB	scraper retouched all around
	SCHAAF	scraper (racloir)
	SCHRAB_INDET	scraper, indet
	SPITZN_FL_OVALBEIL	spitznackige Flintovalbeil
	SPLINTERED_PIECE	idem
	VUURMAKER	strike-a-light
	WERKT_INDET	implement, indet.

Table XII.8. Typologies used in the database.

TYPE	Category/site	References
AL	Late Roman pottery Alzey	Unverzagt 1916
AR	glass Augst	Rütti 1991
BELTR	amphorae Spain	Beltrán 1970
BR(U)	pottery cemetery Nijmegen-West	Brunsting 1937
CH	Late Roman Argonne sigillata	Chenet 1941
DRAG	terra sigillata	Dragendorff 1895
DRES	amphorae	Dressel 1899
E	bronze vessels	Eggers 1951
FAG	Early Medieval pottery, metalwork	Müssemeier *et al.* 2003
FBA	metalwork (esp. axes)	Siegmund 1998
GAUL	Gauloise amphorae	Laubenheimer 1985
G(ELLEP)	cemetery Krefeld Gellep	esp. Pirling 1966; 1974
GEN	handmade pottery Gennep	Schotten 1991
HAEV	La Tène glass	Haevernick 1960
HB	pottery cemetery Nijmegen-Hatert	Haalebos 1990
HBG	blue grey (Arentsburg)	Holwerda 1923
HBW	Gallo-Belgic pottery Nijmegen	Holwerda 1941
H/F	brooces	Heeren & Van der Feijst 2017
HOFH	(pottery) Hofheim	Ritterling 1913
I	glass	Isings 1959
LENZ	Aldenhovener Platte	Lenz 1999
LRA	Late Roman amphorae	this report, section 54.2.6
LUD	terra sigillata Rheinzabern	Ludovici 1927
NB	pottery Niederbieber	Oelmann 1914
S	Early Medieval pottery, metalwork	Siegmund 1998
ST	Nijmegen	Stuart 1962; 1976
VDB	handmade pottery Oss	Van den Broeke 2012
VV	Tongeren	Vanvinckenroye 1991

Appendix XIII Description of the trench wall sections

Henk Hiddink

The trench wall sections (scale 1:50) can be found in appendix XXIII. Below, first the thickness (range) of each layer is given, starting from the top (plough soil). It is followed by the feature number of the layer(s), if present. Finally, a short description and interpretation of the layer is provided; the latter is also expressed by the colour in Appendix XXIII.

West wall trench 51, 50, 44

25-45	--	ploughsoil
>60	--	reddish yellow-brown, loess

East wall trench 4

30-35	4.033	plough soil
7-8	4.030	northern half trench only: grey-brown humus rich (partly caused by illuviation?)
0-25 cm	4.029	southern half trench only: brown(greyish) humus rich, lots of sherds and tile fragments; possibly (levelled) soil disturbed by previous excavations
0-15 cm	4.031	southern half: light yellow-white with grey-brown spots; eluviation layer/E-horizon
>80 cm	--	(reddish) yellow-brown loess, many animal burrows and pseudo-gley indicators

West wall trench 6/10

20-40	--	plough soil
0-35		6.001/10.001 brown, old arable; plan: (reddish) brown-yellow homogenous 'dump' layer,
10-35	6.011	brown-yellow, many sherds, tile fragments
5-10	10.029	mottled yellow (greyish) brown, dirty
5-22	10.011	white grey to brown; virgin soil mottled to very dirty
20-35	10.046/82	mottled grey to dirty

West wall trench 12/15 (mirror image)

20-30	--	plough soil
5-15	--	dark, dirty grey-brown; older arable layer
40-6	--	yellow-brown loess, many pseudo-gley indicators
> 30 cm	--	yellow-brown loess with small sand lenses

West wall trench 23

10-30	--	ploughsoil
5-40	23.001	dark grey/black dirty with pieces of tile and mortar, 'subrecent' (probably partly ploughsoil)
15-45	23.003/30	brown-black with gravel, to the south becoming light [?] grey with gravel, 'subrecent'; wheel ruts at the base and in layer(s) below (dirty grey, fine layered, bands of rust)
0-20	--	dirty brown-grey
0-35	--	'blue'grey, dirty
15-20	21.137	brown black, 'Roman level' (or A horizon?)
10-25	21.136	white loess [sic] with bioturbation 'pre? Roman level', possibly E horizon
30-130		brown loess
50		grey loess with spots of chalk and rust

East wall trench 22

45	--	ploughsoil
30-45	22.001	dark brown sandy loess, many small tile fragments, old arable layer
25-40	22.006	dark brown-black, rubble especially above pavement
20-25	22.013-14, 16	dark grey, large lumps of limestone with gravel on top
5-30	22.020	light yellowish-grey, 'pre-Roman level'
>55	22.047	reddish yellow-brown loess, many animal burrows and pseudo-gley indicators

East wall trench 102/103 (in part)

30-35	102.170/103.007	ploughsoil
15-20	many	series of layers, result of bioturbation and disturbances (previous excavations)
>70	102.023/103.006	reddish yellow-brown loess, 'clean' virgin soil

West wall trench 68/69

35-50	--	ploughsoil
0-85	68.001/69.001	brown-yellow, 'raised level, Late Medieval and/or subrecent'
0-60	68.03/35/102 69.002/7/10	dark brown-black, charcoal, pieces of tile, iron slag
15-20	69.046	light grey
5-10	69.049	light yellow-grey; 'eluviation horizon'
>100	69.109	red-yellow brown, traces of tree roots, frost fissures

South wall trench 96/69
a) top, layers over buildings

34-45	--	ploughsoil
50-90	69.001/96.010/45	brown-yellow, 'raised level, Late Medieval and/or subrecent'
10-55	69.002/3/7/50/ 110/96.003/7	dark brown-black, charcoal, pieces of tile, chalk

b) 'inside' building 403

5-25	69.042/96.002/6	light grey-yellowish, clean loess, 'raised layer'
5-10	69.055/96.044	black with charcoal, small chalk rubble, 'floor' building 403
10-30	69.054/96.009	grey loess

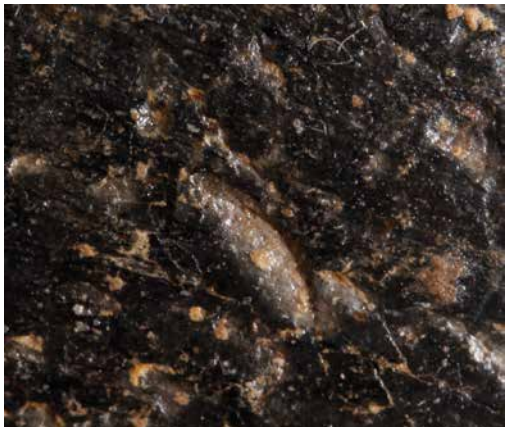
c) 'inside' and west of building 418

10	96.044	black with yellow spots, chalk rubble; ca. original surface
5-10	96.041/42	light-grey yellow
5-15	96.043	light-grey yellow, 'crumbly'
10-15	96.016/19	dark grey

d) lower part, below a-c

5-30	69.049/96.022/23	very light 'yellow'(-grey) loess, 'eluviation horizon'
80	69.109/96.046	red-yellow brown, traces of tree roots, frost fissures; loess
>65	69.112	light brown-grey with rust stains; loess

Appendix XIV Photographs of Late Roman pottery fabrics



TN fine hard

757-19/108-2-7

TN quartz

95-1-55/10890

Fig. XIV.1. Voerendaal-Ten Hove. Late Roman pottery fabrics (surface/fracture): terra nigra. Scale 5:1. (source: D.S. Habermehl)

CW Meuse Valley?

771-1/23-5-20

CW Urmitz/Weißenthurm

757-6/109-2-5

CW Mayen MR/MD

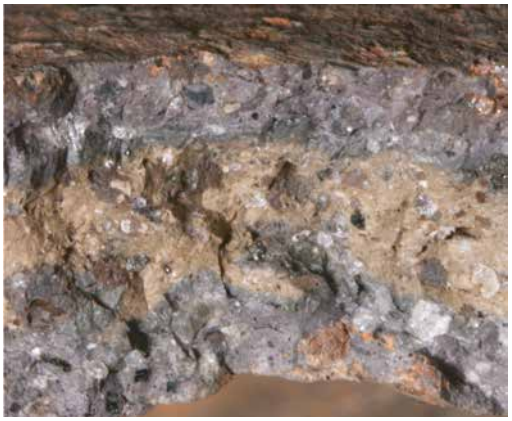
757-10/109-2-5

CW Mayen MR

222-1/95-1-48

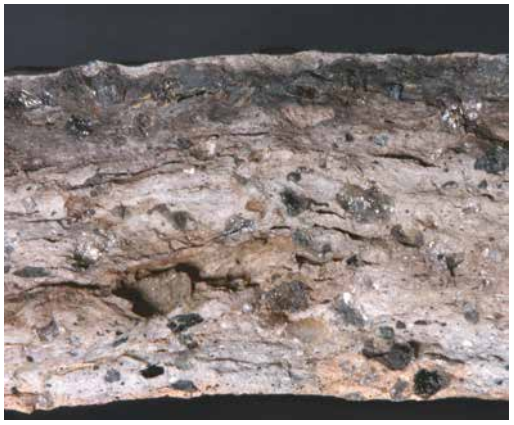
Fig. XIV.2. Voerendaal-Ten Hove. Late Roman pottery fabrics (surface/fracture): coarse wares. Scale 5:1. (source: D.S. Habermehl)

CW Mayen MR



226-1/107-3-30

CW Mayen MR



757-1,8/108-2-7

CW Mayen MR

15-1-1/2058

CW Mayen MR

27-3-6/5158

Fig. XIV.3. Voerendaal-Ten Hove. Examples of Late Roman pottery fabrics (surface/fracture): Mayen MR. Scale 5:1. (source: D.S. Habermehl)

CW Mayen MD

513-1/20-1-67

CW Mayen MD

723-1/24-3-2

CW Mayen MD

757-4/108-2-7

CW Mayen MD

791-1/95-2-22

Fig. XIV.4. Voerendaal-Ten Hove. Examples of Late Roman pottery fabrics (surface/fracture): Mayen MD. Scale 5:1. (source: D.S. Habermehl)

CW reduced/black

713-5/13-1-2

CW reduced/black

501-1/107-1-2

Fig. XIV.5. Voerendaal-Ten Hove. Examples of Late Roman pottery fabrics (surface/fracture): coarse reduced. Scale 5:1. (source: D.S. Habermehl)

Appendix XV Photographs of Early Medieval pottery fabrics

Maastricht MSF1

52-1-3/10435

Maastricht MSF1

106-1-6/9236

Fig. XV.1. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): MSF1. Scale 5:1. (source: D.S. Habermehl)

Maastricht F2

11-0-0/1200

Maastricht MFS2

381-41/11-1-37

Maastricht MFS2

383-27/11-1-91

Maastricht MFS2

20-1-61/2985

Fig. XV.2. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): MSF2. Scale 5:1. (source: D.S. Habermehl)

Maastricht F3

259-1/52-2-21

Meuse Valley nonspecific

17-1-1/2726

Indet. 381-9/11-1-69

Fig. XV.3. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): MSF3, Meuse Valley non-specific. Scale 5:1. (source: D.S. Habermehl)

Mayen MD

20-1-61/2989

Mayen MD

711-1/13-1-27

Maastricht MSR1

27-2-42/5103

Fig. XV.4. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): Mayen, MSR1. Scale 5:1. (source: D.S. Habermehl)

Maastricht MSR2

108-1-4/9855

Maastricht MSR2

94-2-1/10477

Maastricht MSR2

94-3-2/10493

Maastricht MSR2

94-4-6/10589

Fig. XV.5. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): MSR2. Scale 5:1. (source: D.S. Habermehl)

Unknown UPR1

20-1-61/2986

Unknown UPR1

20-1-62/3009

Unknown UPR1

20-1-90/3256

Unknown UPR1

46-1-3/11246

Fig. XV.6. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): UPR1. Scale 5:1. (source: D.S. Habermehl)

Unkown UPR1

733-3/46-1-12

Unkown UPR1

757-40/105-1-20

Unkown UPR1

20-2-12/11638

Unkown UPR1

807-1/16-4-22

Fig. XV.7. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): UPR1, cont. Scale 5:1. (source: D.S. Habermehl)

Unknown UPR1

733-5/46-2-1

Unknown UPR2

55-1-14/5879

Unknown UPR2

56-1-7/5944

Unknown UPR2

104-1-1/9055

Fig. XV.8. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): UPR1, 2. Scale 5:1. (source: D.S. Habermehl)

Unknown UPR3

13-1-24/1361

Unknown UPR4

733-4/46-2-1, 3

Unknown UPR5

23-1-7/4332

Unknown UPR5

24-1-17/4598

Fig. XV.9. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): UPR3-5. Scale 5:1. (source: D.S. Habermehl)

Unknown UPR6

27-3-3/5128

CW other fabrics

733-1/2/46-1-2

Fig. XV.10. Voerendaal-Ten Hove. Early Medieval pottery fabrics (surface/fracture): UPR6, other. Scale 5:1. (source: D.S. Habermehl)

Appendix XVI Examples of Late Roman and Early Medieval vessels

Fig. XVI.1. Voerendaal-Ten Hove. Examples of Late Roman vessels. (source: D.S. Habermehl)

Fig. XVI.2. Voerendaal-Ten Hove. Examples of Late Roman vessels, cont. (source: D.S. Habermehl)

Fig. XVI.3. Voerendaal-Ten Hove. Examples of Early Medieval vessels. (source: D.S. Habermehl)

Appendix XVII Photos of metal objects

Fig. XVII.1. Voerendaal-Ten Hove. Selection of brooches. (source: D.S. Habermehl)

765-2/1953-2.19

68-1-3/6269

95-2-21/11056

27-4-6/5332, 107-2-18/9750

761-2/107-3-50

107-2-18/9751

20-2-23/3326

328-1/100-2-15

Fig. XVII.2. Voerendaal-Ten Hove. Selection of brooches, cont. (source: D.S. Habermehl; ROB)

Fig. XVII.3. Voerendaal-Ten Hove. Hair needles, pins, finger rings, writing equipment. (source: D.S. Habermehl)

Fig. XVII.4. Voerendaal-Ten Hove. Tweezers, sowing needle, spatula probe, ear scoops, spoon, part of bronze vessel. (source: D.S. Habermehl)

Fig. XVII.5. Voerendaal-Ten Hove. Furniture fittings, belt fitting and Late Roman buckles. (source: D.S. Habermehl)

Fig. XVII.6. Voerendaal-Ten Hove. Early Medieval belt fittings and buckles. (source: D.S. Habermehl)

10-1-1/681

23-1-12/4345

711-2/13-1-27

716-9/19-2-2

27-1-17/4847

38-0-0/5747

1895-12.66/11374

20-2-3/3273

1953-2.5a/11420

0 5 cm

704-2/10-3-4

Fig. XVII.7. Voerendaal-Ten Hove. Parts of military equipment/horse gear. (source: D.S. Habermehl)

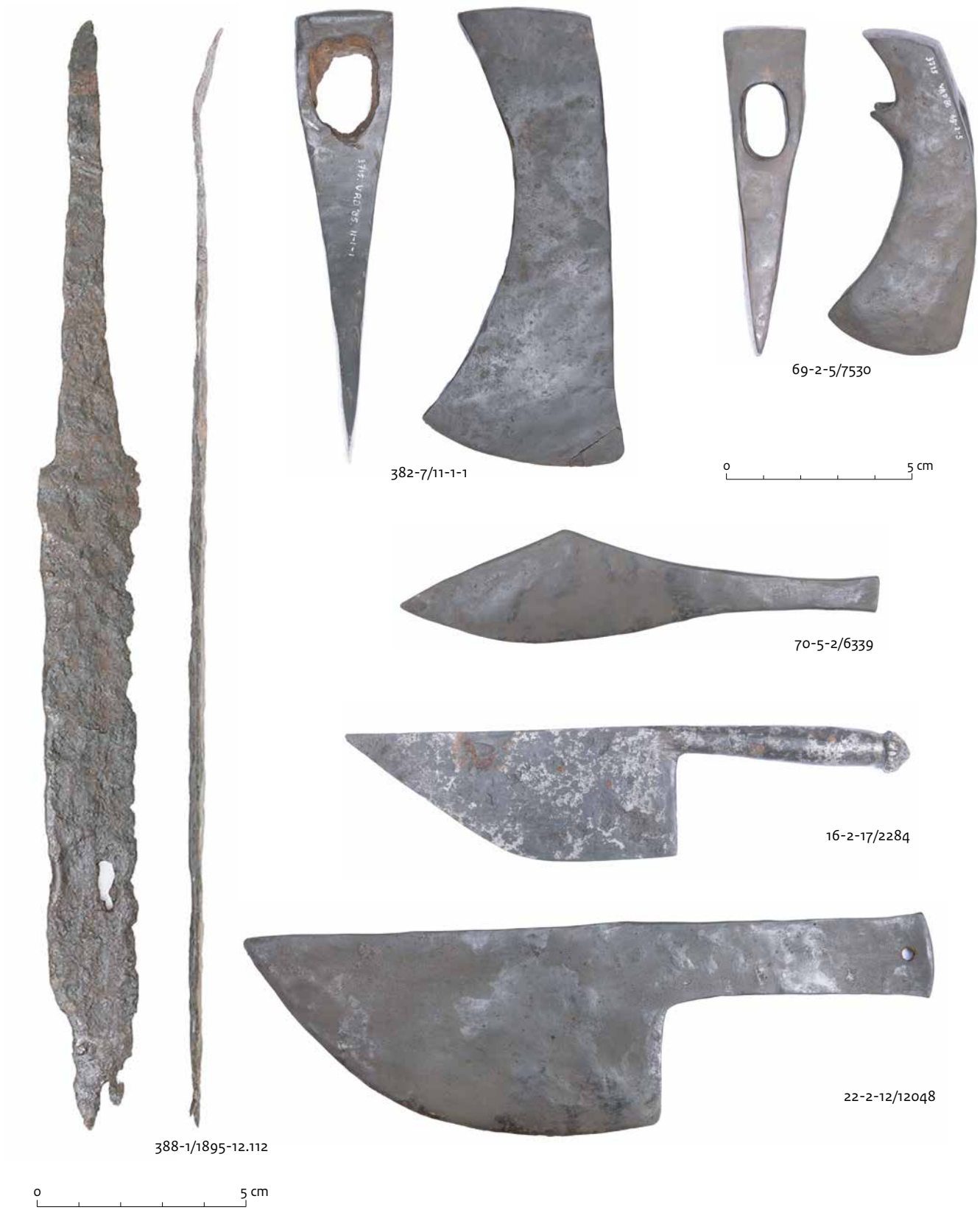


Fig. XVII.8. Voerendaal-Ten Hove. Sax, axes, knife and cleavers. (source: D.S. Habermehl)

Fig. XVII.9. Voerendaal-Ten Hove. General purpose and agricultural tools. (source: D.S. Habermehl)

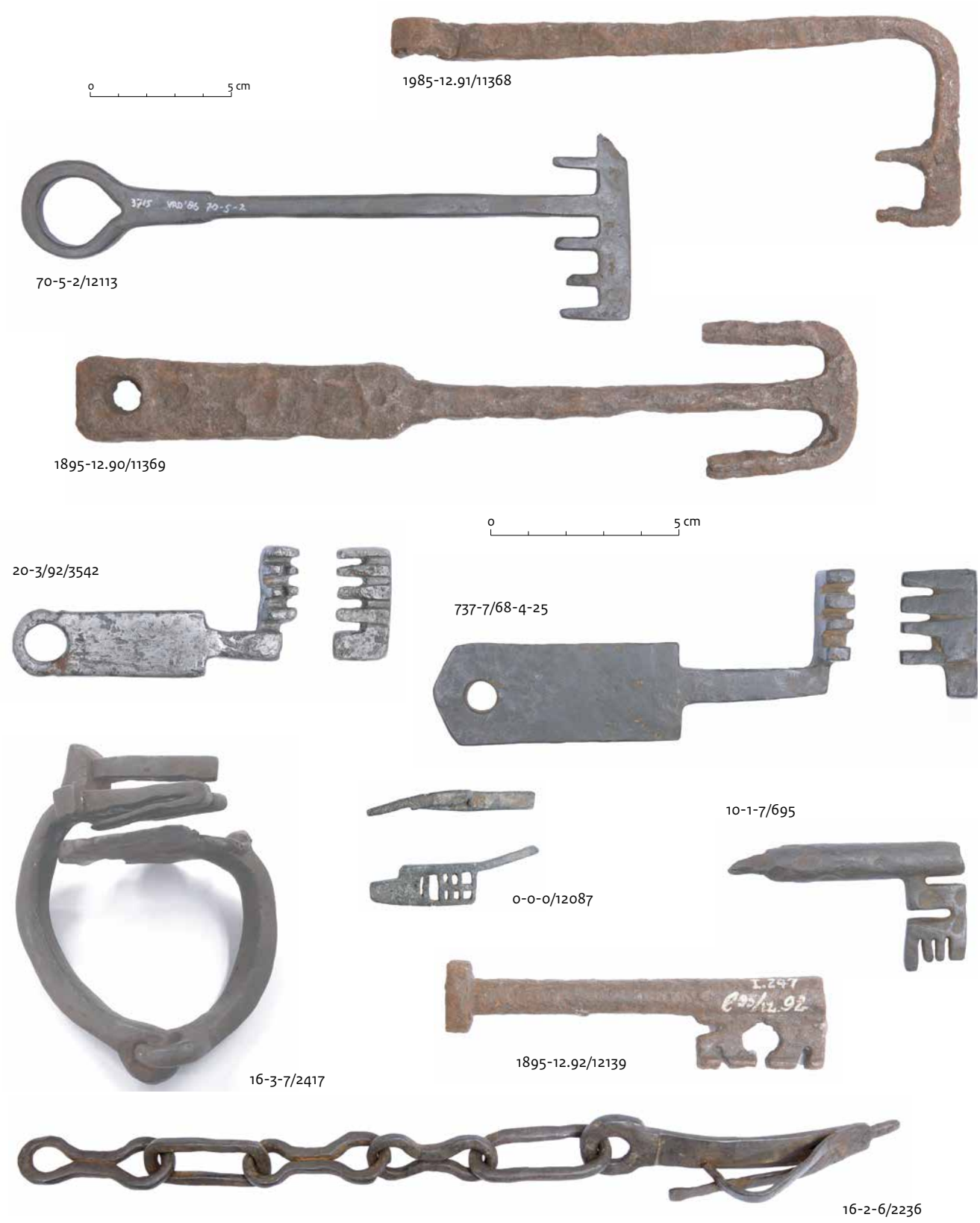


Fig. XVII.10. Voerendaal-Ten Hove. Examples of keys, shackles and other lock parts. (source: D.S. Habermehl)

Fig. XVII.11. Voerendaal-Ten Hove. Meat fork, fire-striker, hearth shovel, hinges and clamps. (source: D.S. Habermehl; ROB)

Fig. XVII.12. Voerendaal-Ten Hove. Some structural fittings and folded slab of lead. (source: D.S. Habermehl; ROB)

Appendix XVIII Photos of glass objects

Fig. XVIII.1. Voerendaal-Ten Hove. Selection of glass jewellery and vessels. (source: D.S. Habermehl, ROB)

Appendix XIX Photos of flint artefacts

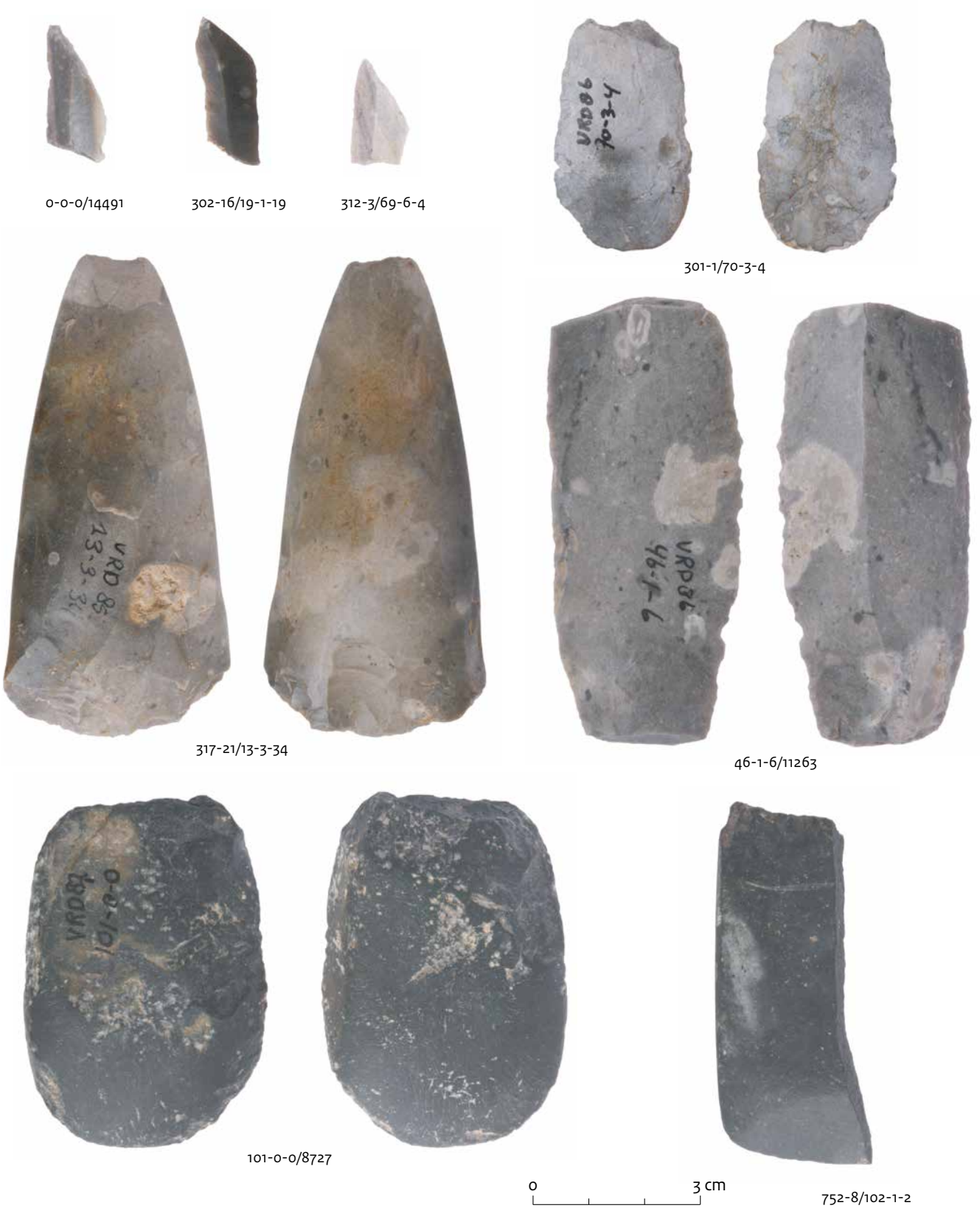


Fig. XIX.1. Voerendaal-Ten Hove. Selection of flint artefacts and stone axe fragments (source: D.S. Habermehl)

Appendix XX Plans of a selection of villa complexes

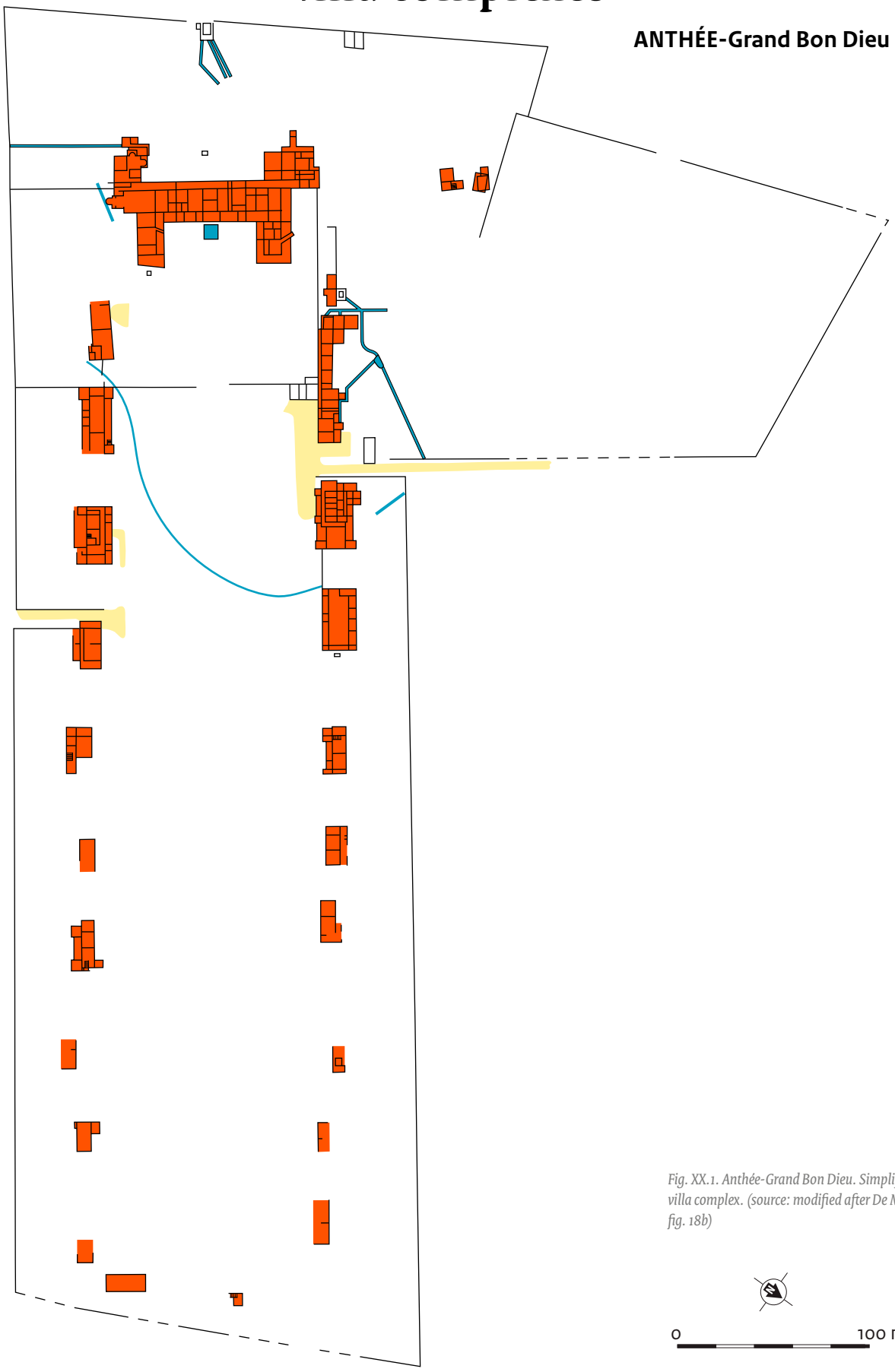


Fig. XX.1. Anthée-Grand Bon Dieu. Simplified plan of the villa complex. (source: modified after De Maeyer 1937, fig. 18b)

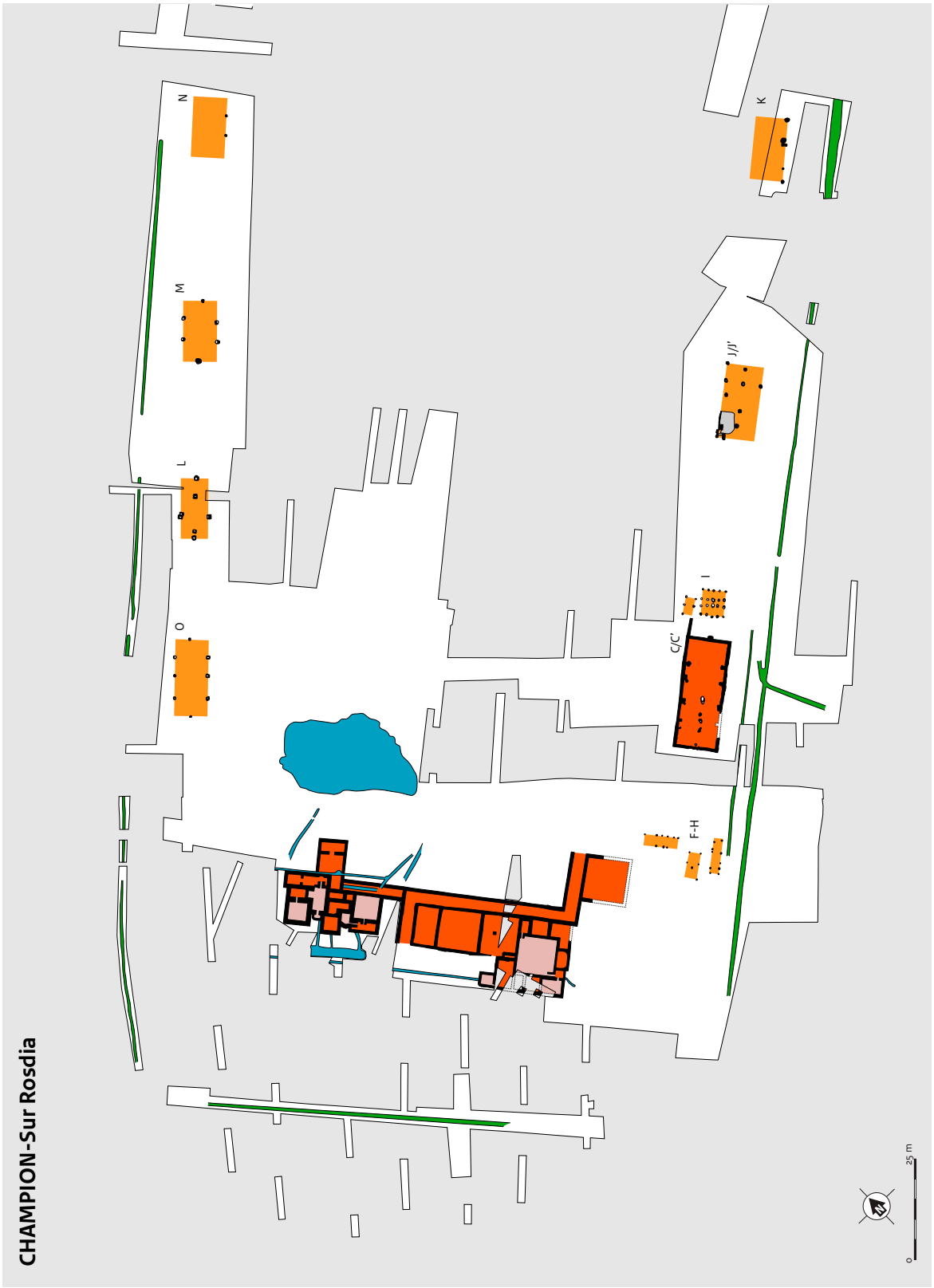


Fig. XX.2. Champion-Sur Rosdia. Plan of the villa complex. (source: modified after Van Ossel & Defgnée 2001, fig. 13)

DILBEEK-WOLSEMVELD 2015

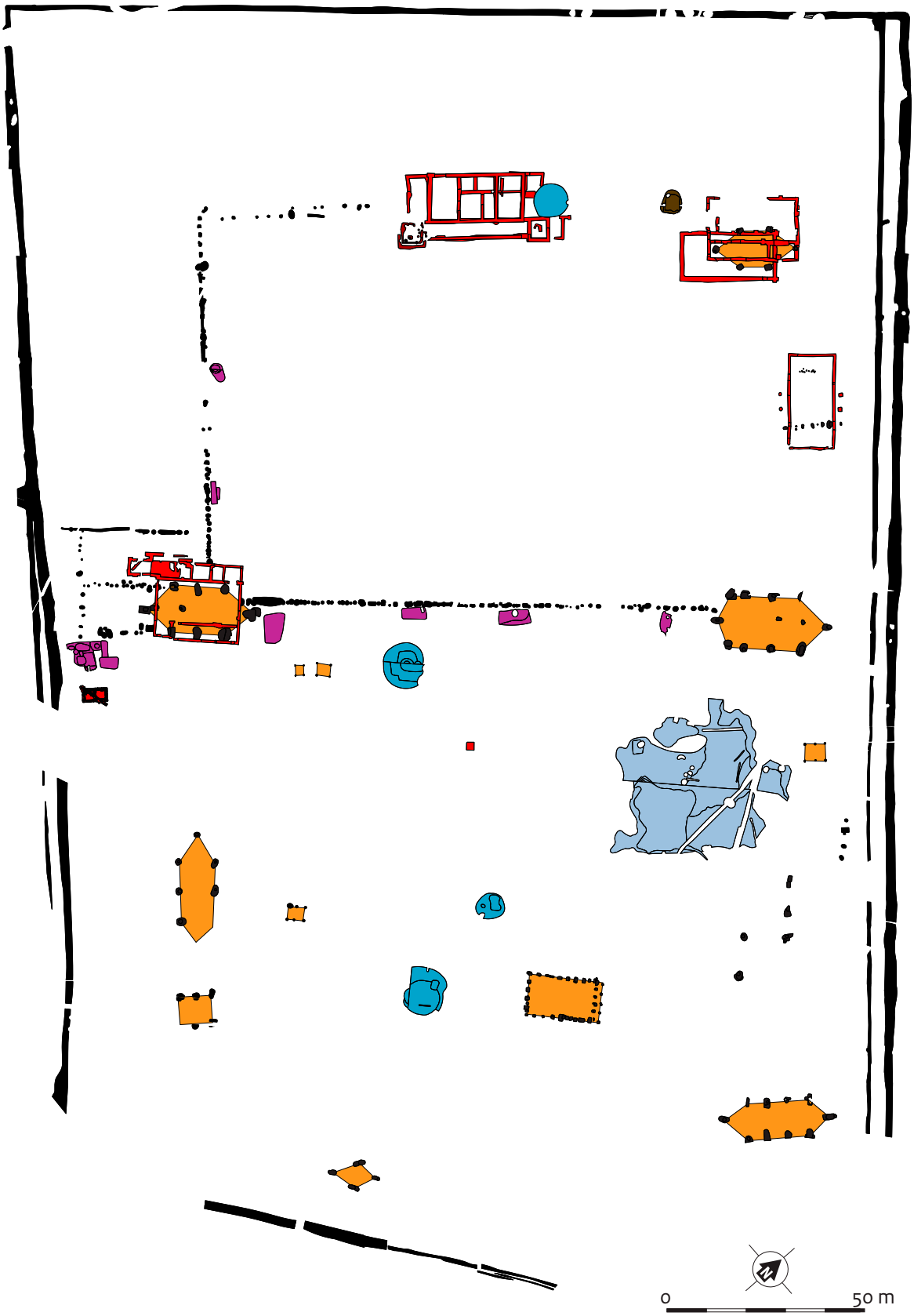


Fig. XX.3. Dilbeek-Wolsemveld. Provisional plan of the villa complex. (source: Weterings 2017, 10)

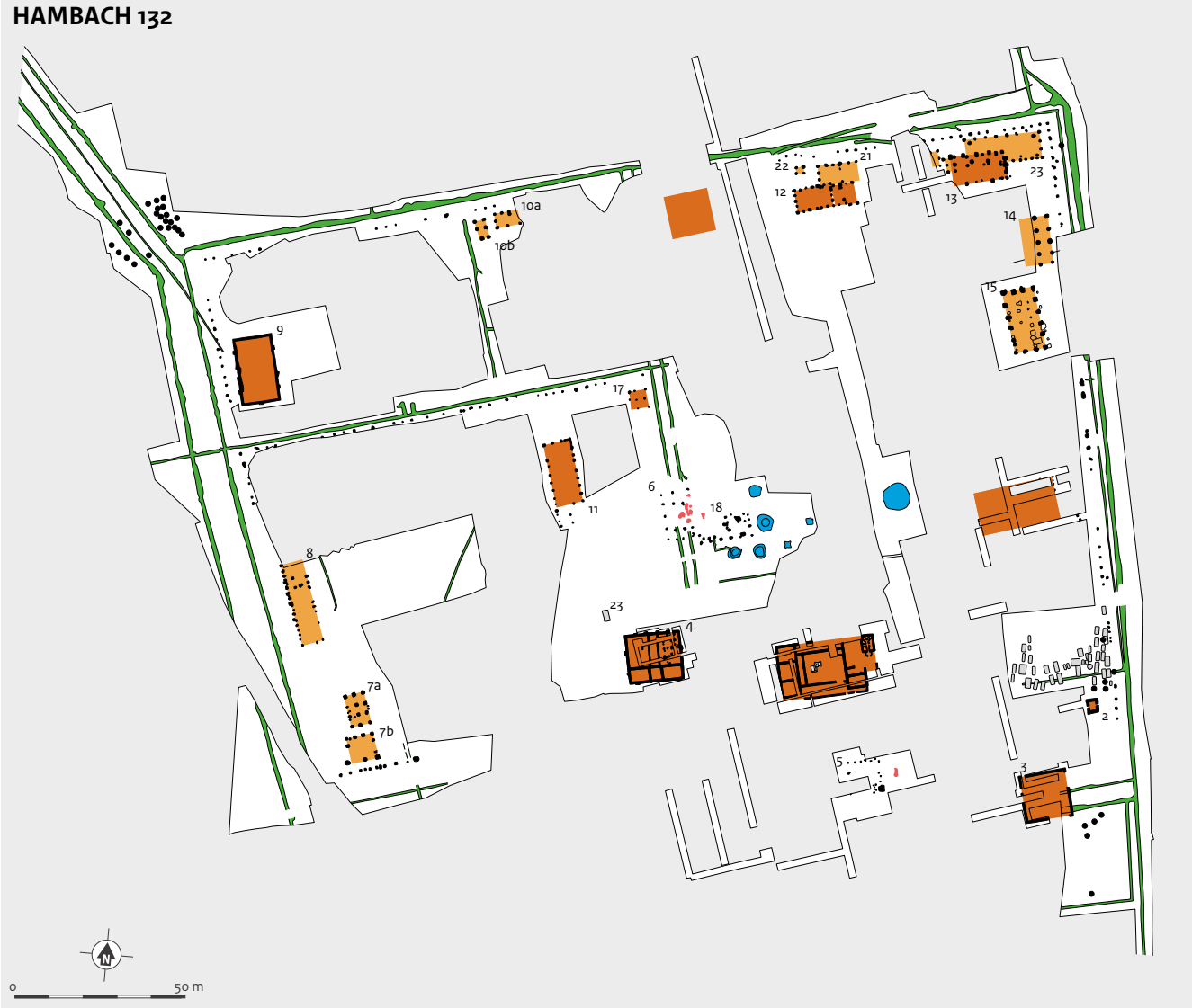


Fig. XX.4. Hambach 132. Plan of the villa complex (including Late Roman structures and graves). (source: modified after Brüggler 2009)

Fig. XX.5. Kerkrade-Holzkuil. Plan of the villa complex. (source: modified after Tichelman 2005, 50)

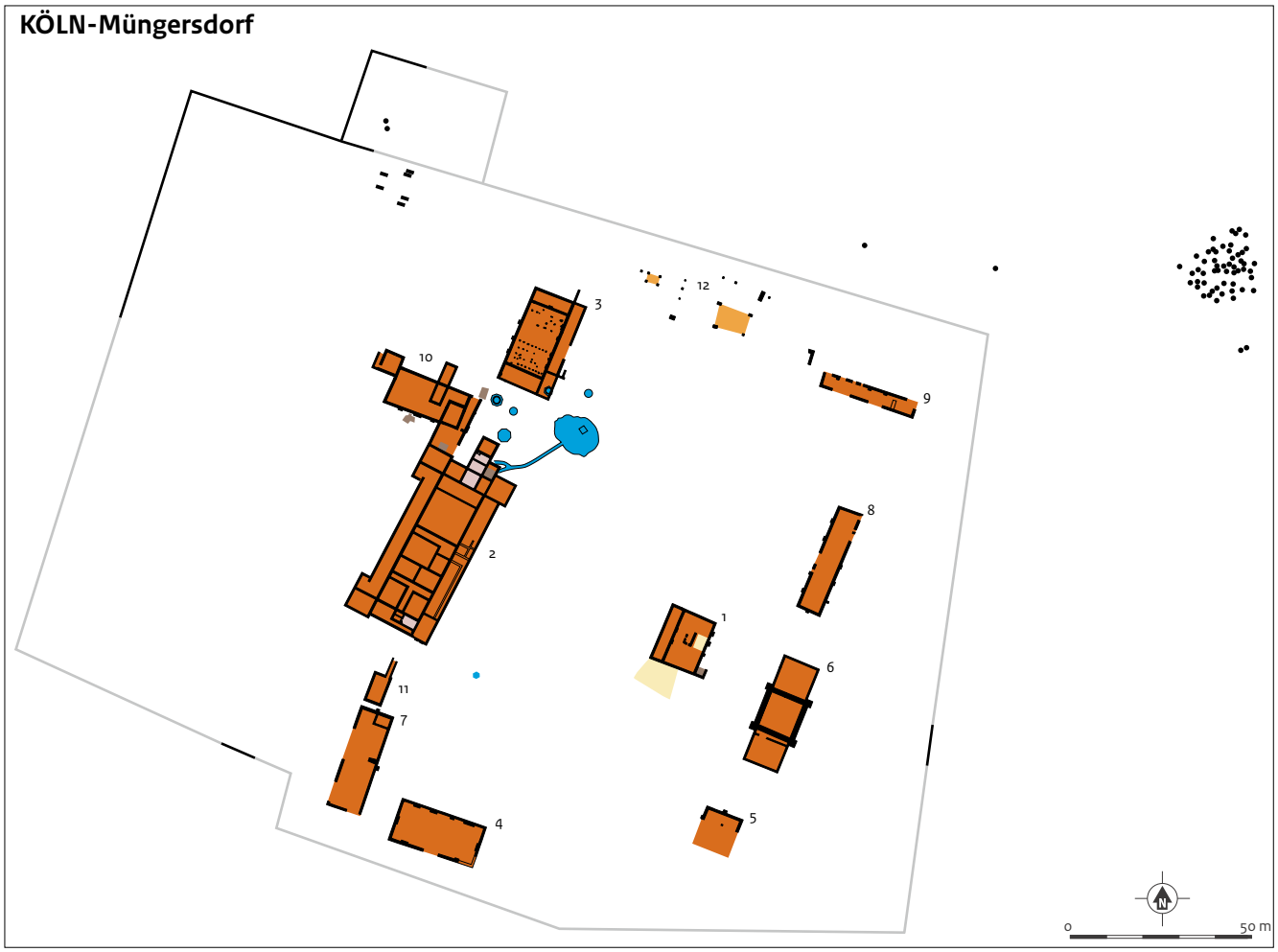


Fig. XX.6. Köln-Müngersdorf. Plan of the villa complex. (source: modified after Fremersdorf 1933, pl. 2-3.

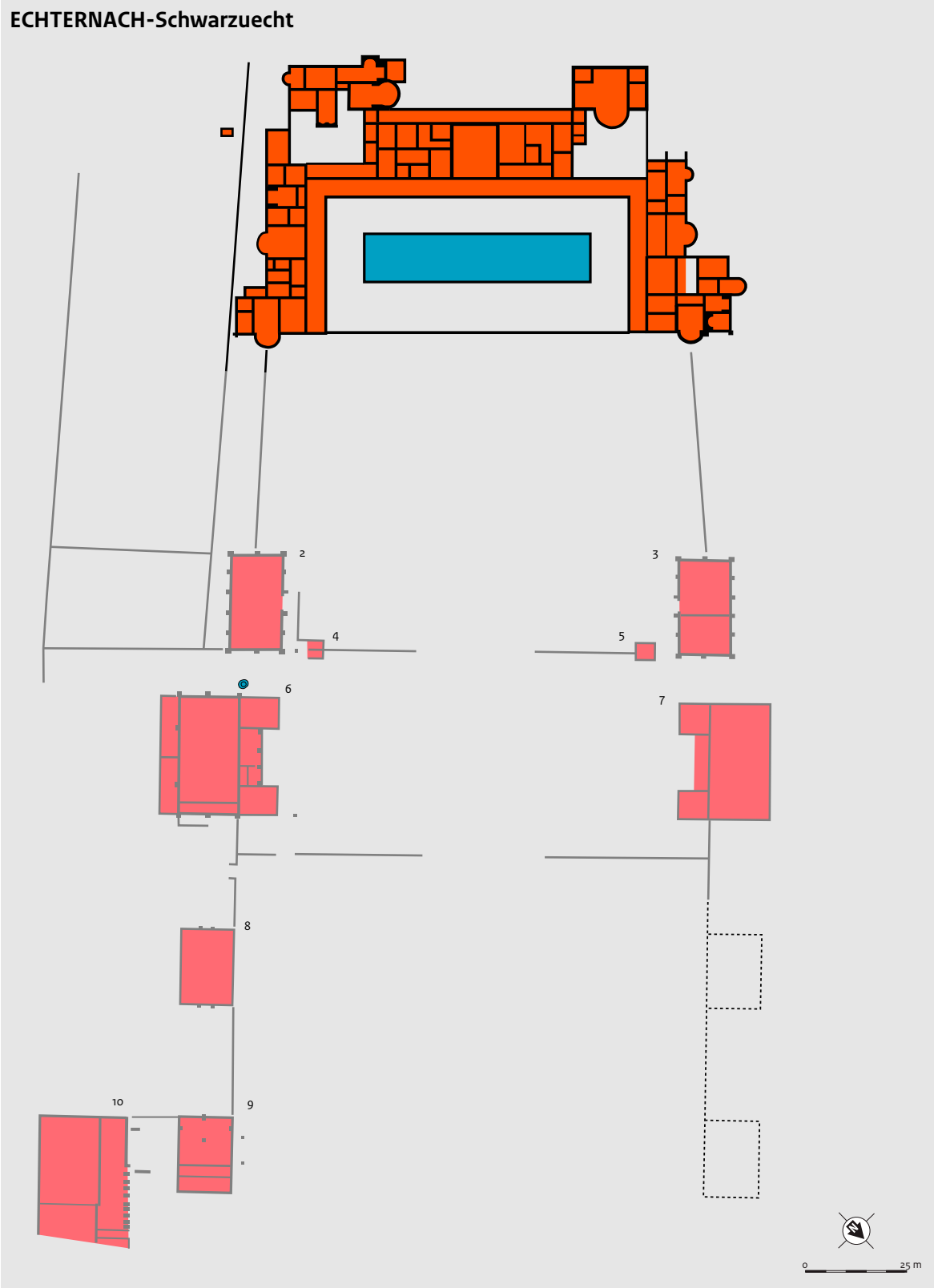


Fig. XX.7. Echternach-Schwarzuecht. Plan of the villa complex; grey plans only known from aerial photographs. (source: modified after Metzler et al. 1981, fig. 201)

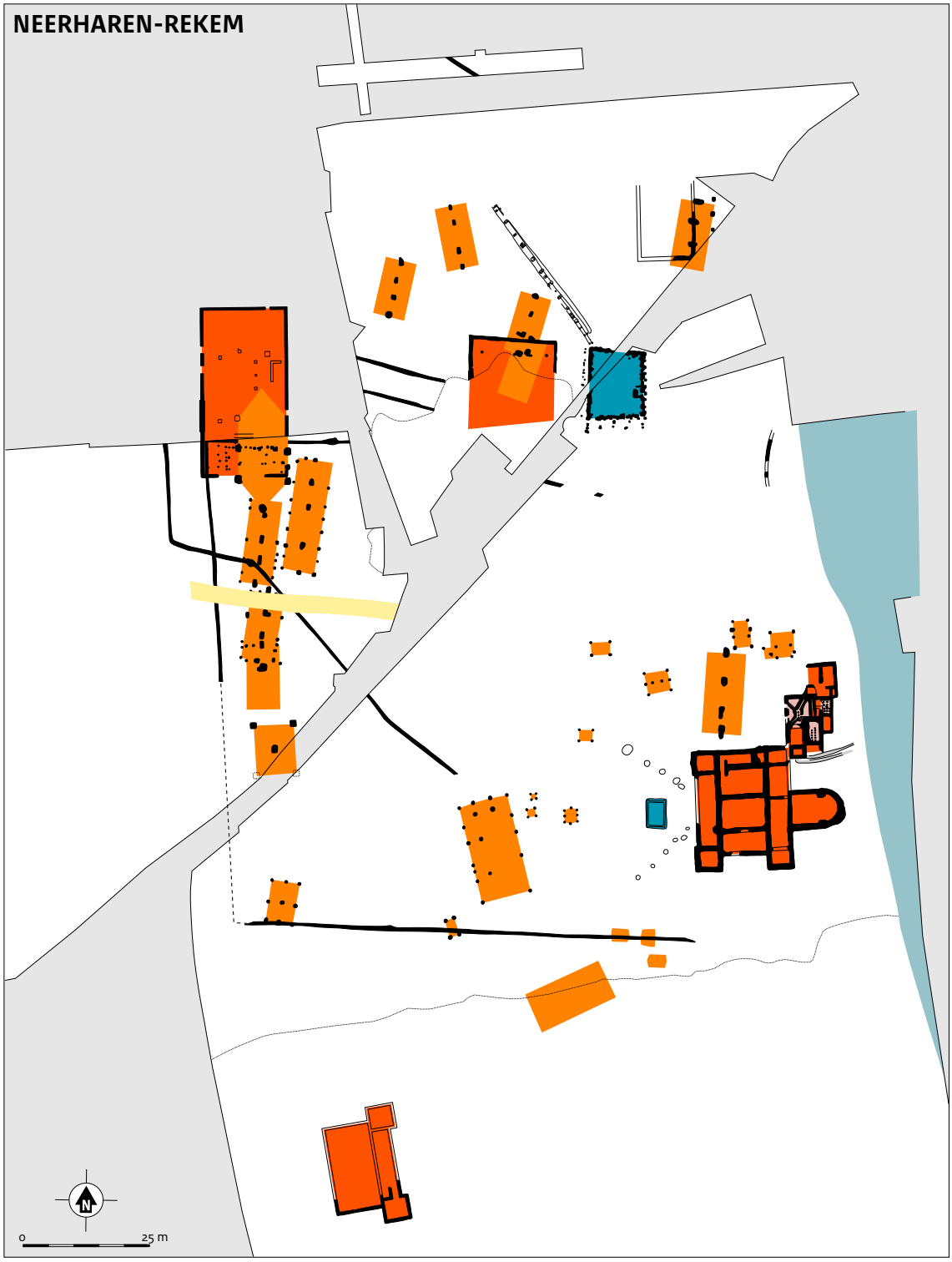


Fig. XX.8. Neerharen-Rekem. Plan of the post-built settlement and the villa complex succeeding it; for the Late Roman settlement, see fig. 12.8. (source: modified after De Boe et al. 1992, fig. 285-286)

Fig. XX.9. Hoogeloon-Kerkakkers. Plan of the post-built settlement and villa.

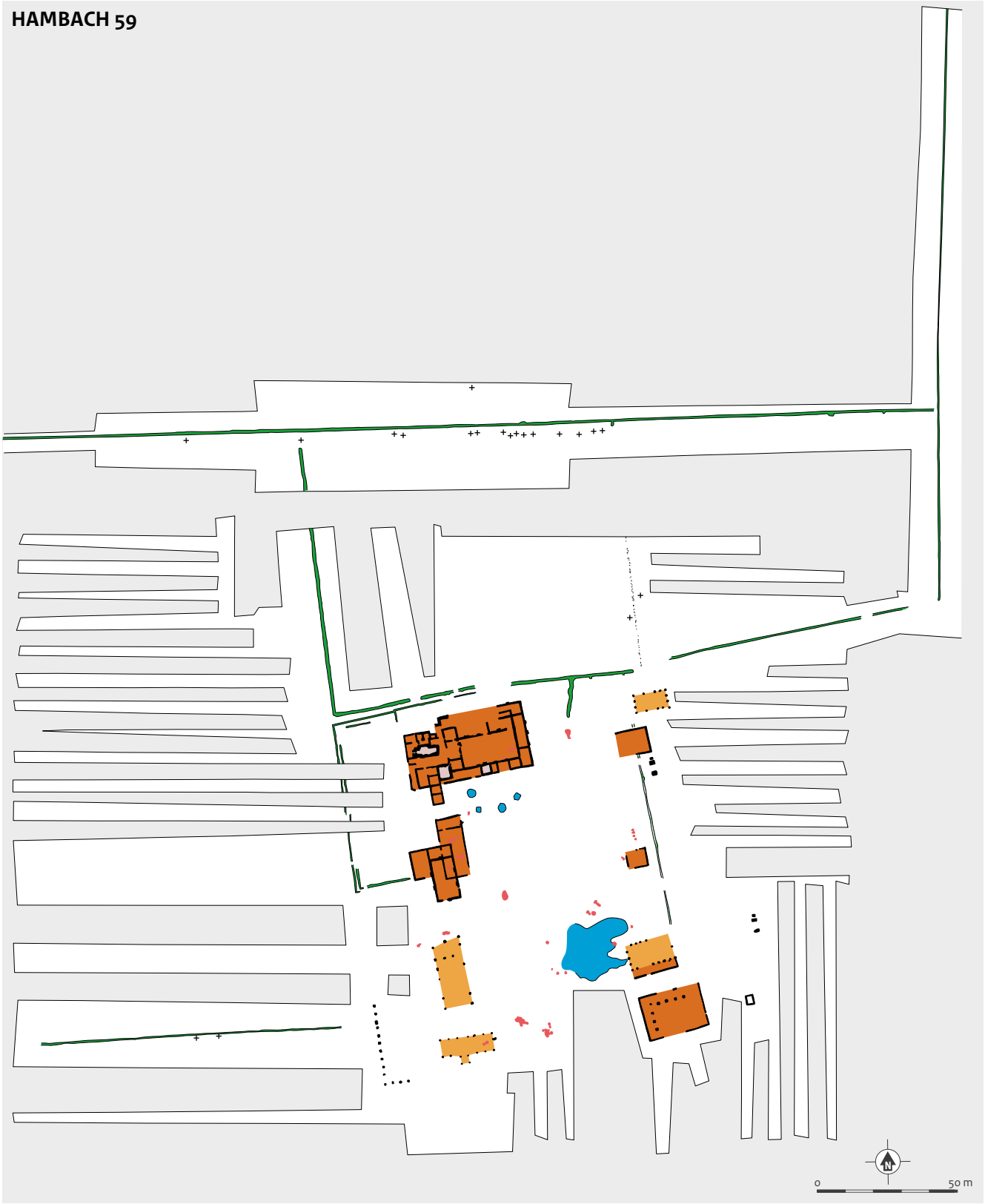
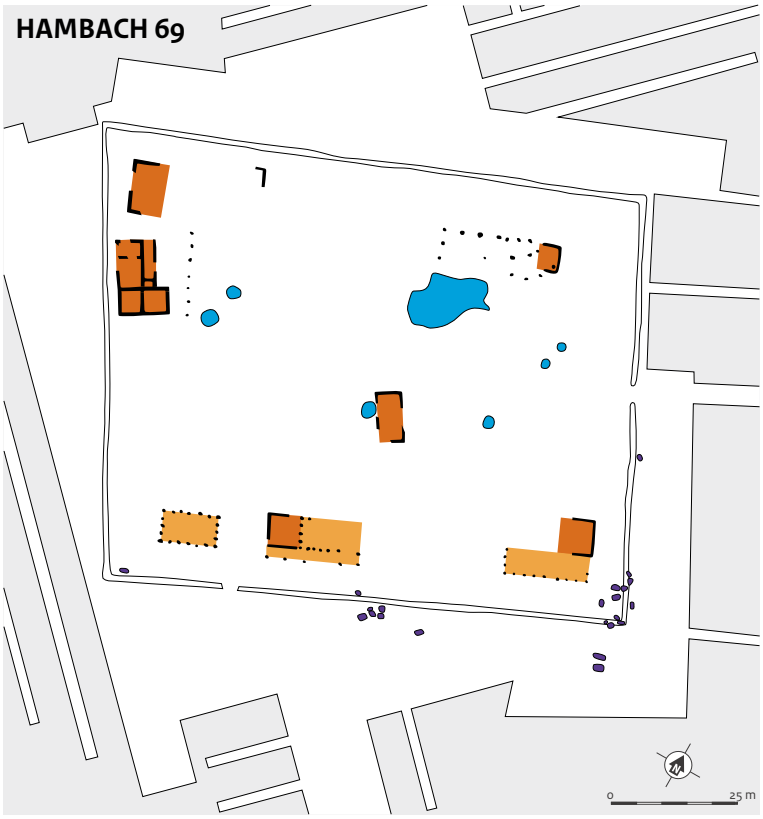


Fig. XX.10. Hambach 59. Plan of the villa complex, as well as ditches and graves in the surrounding fields; see also fig. 13.1. (source: modified after Hallmann-Preuß, B., 2002/2003, fig. 6)



HAMBACH 516

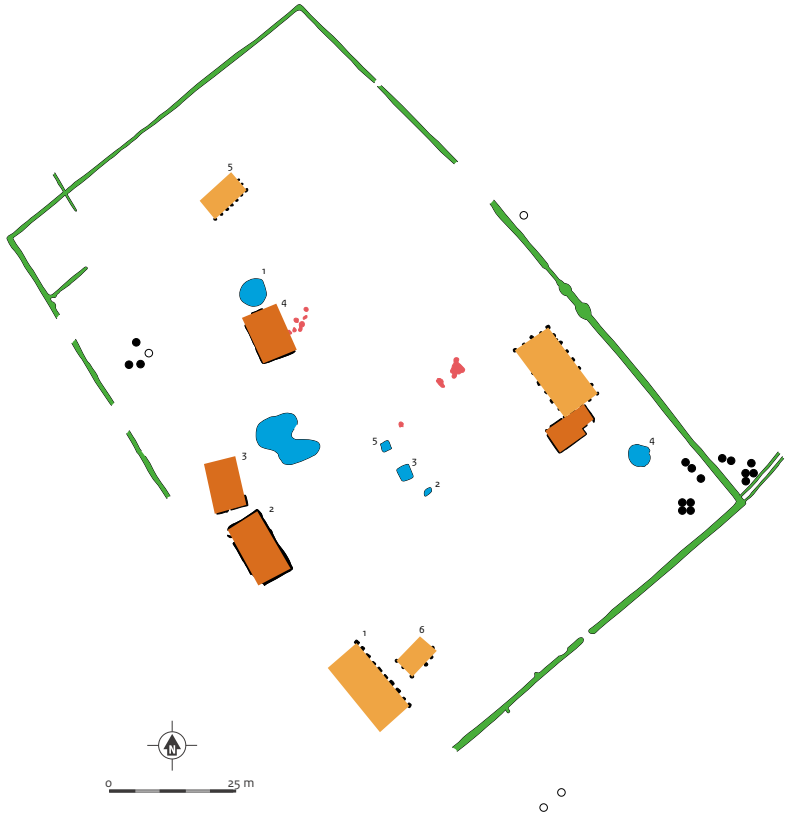


Fig. XX.11. Plan of the villa complexes Hambach 69 and 516; see also fig. 13.1 for the graves. (source: modified after Gaitzsch 1986, fig. 5, 8; Kaszab-Olschewski, 2006)

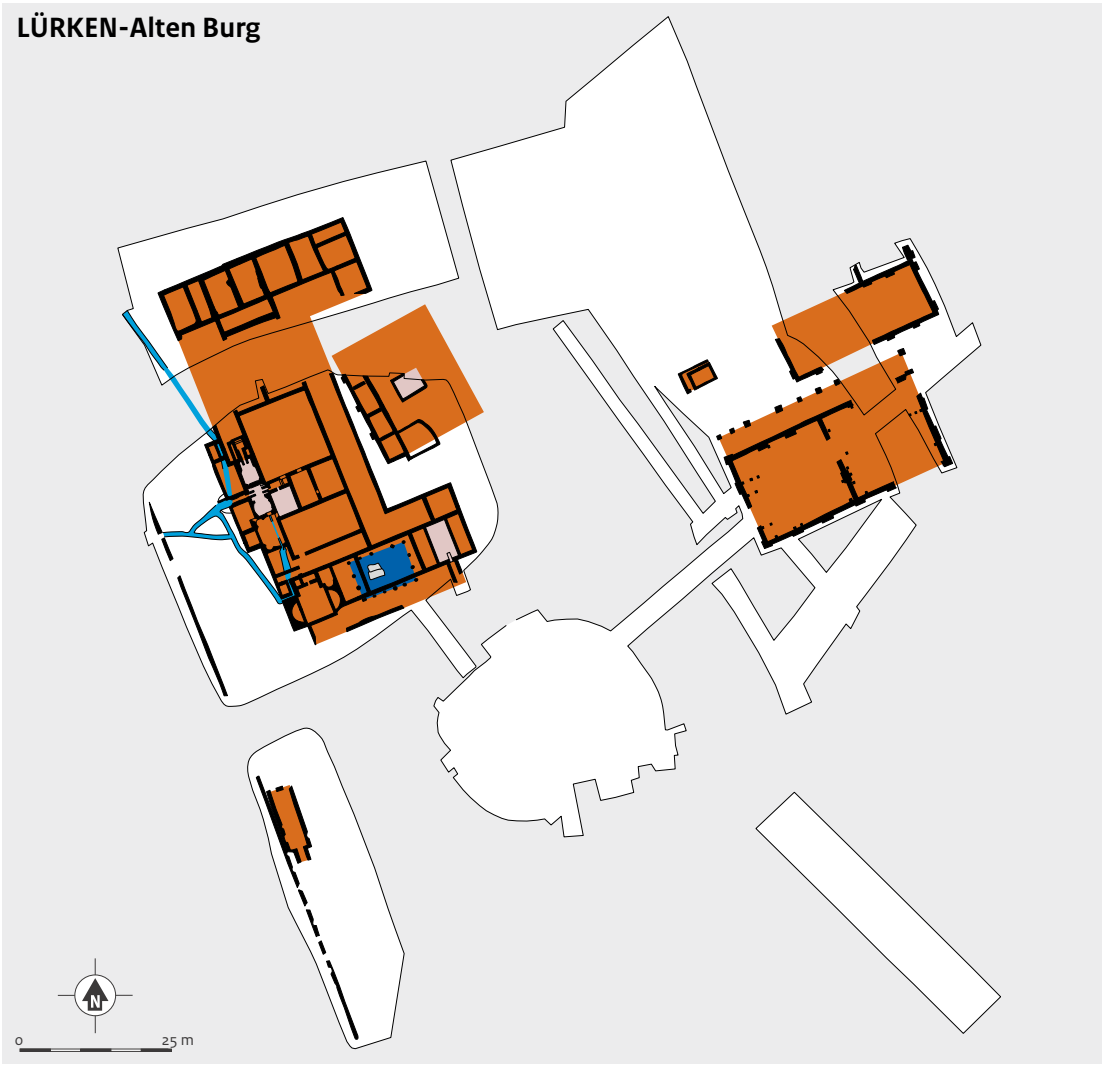
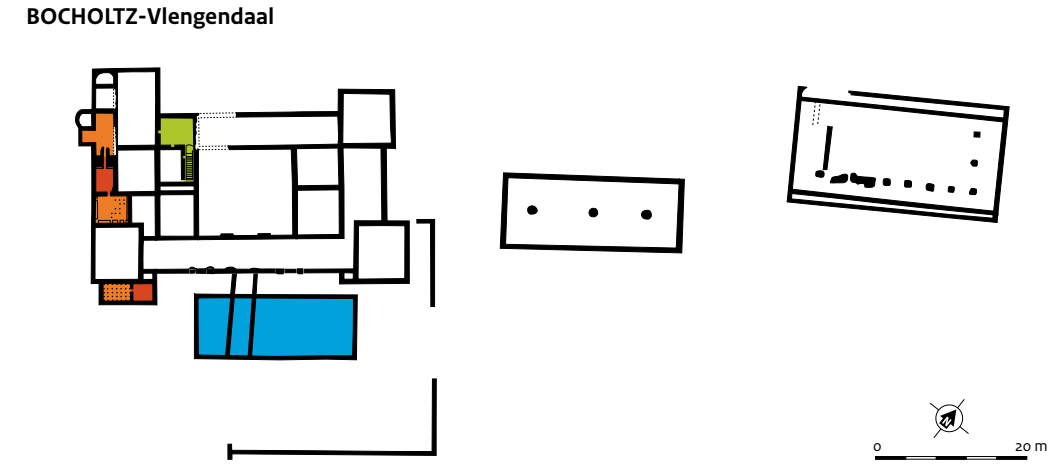
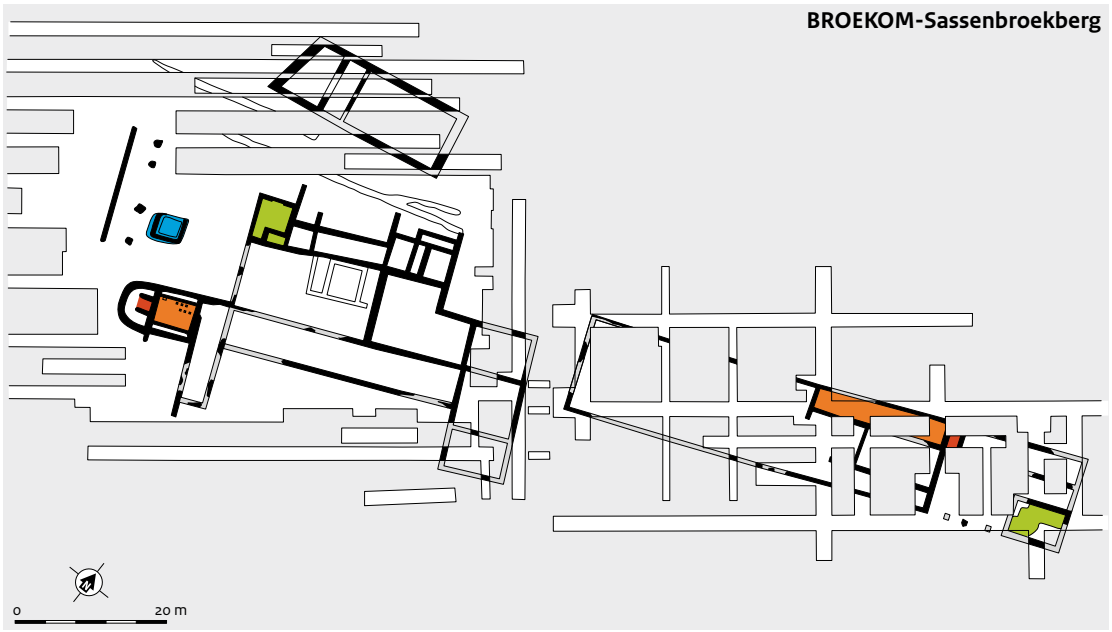


Fig. XX.12. Lürken-Alten Burg. Plan of the villa complex. (source: modified after Piepers 1981, fig. 8; pl. 48)





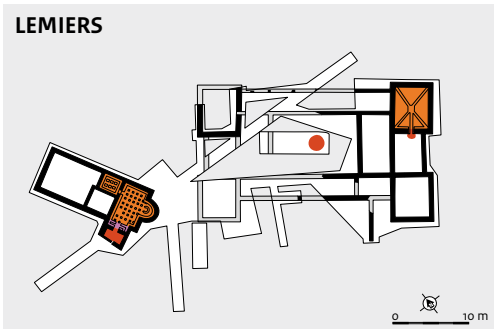


Fig. XX.13. Plan of the villas of Bocholtz-Vlengendaal, Broekom-Sassenbroekberg and Lemiers. (source: modified after Goossens 1916, pl. 5; Vanvinckenroye 1988; Braat 1934, fig. 13)

Fig. XX.14. Plan of the villas of Maasbracht-Steenakker, Kaalheide-Krichelberg, Simpelveld-Stampstraat and Houthem-Ravensbosch; post-built structures in red; sunken-floored huts green. (source: modified after Vos 2017, fig. 2.28, 30; Braat 1941, fig. 31; Brunsting 1950; Koster et al. 2002, 50-51; Braat 1941, fig. 33, 40; 1948, fig. 2; Stoepker 1989, fig. 36; Remouchamps 1925, fig. 40-41)

Appendix XXI Plans of a selection of post-built settlements, mainly Late Roman

Fig. XX1.1. Heerlen-Trilandis. Plan of the settlement; cf. fig. 4.10 for the third century-phase. (source: modified after Tichelman 2014, fig. 6.1; 14.9)

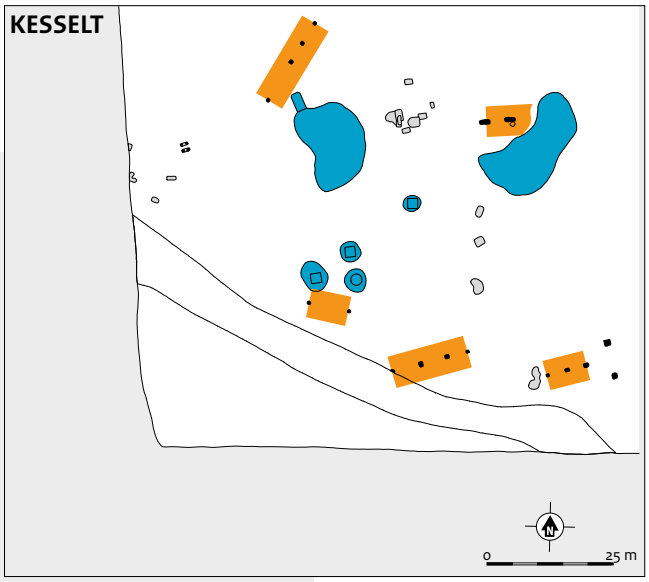


Fig. XXI.2. Plan of the settlements of Kesselt and Veldwezelt. (source: modified after Vanderhoeven 2015, fig. 2, 3)

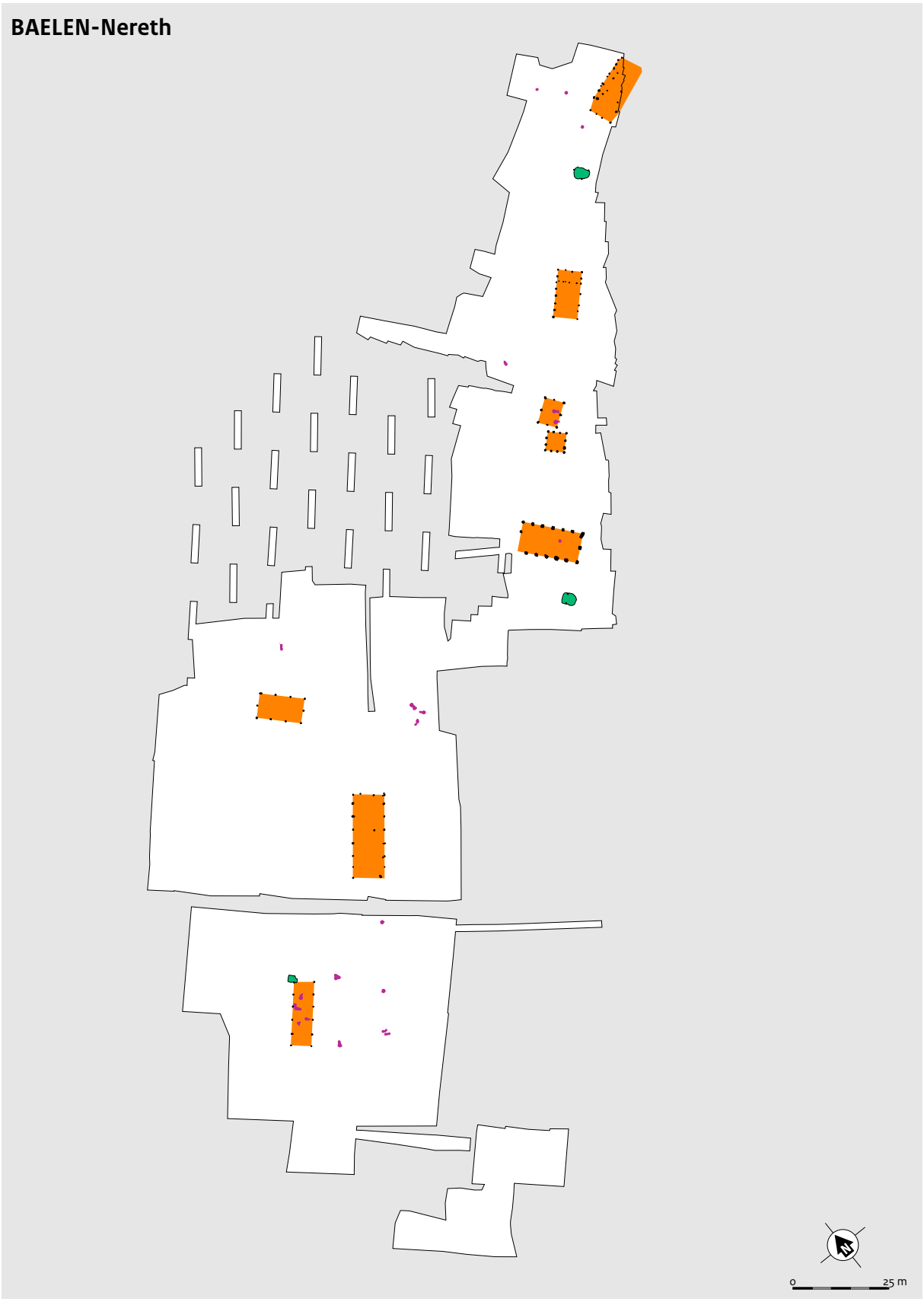


Fig. XXI.3. Baelen-Nereth. Plan of the Late Roman settlement. (source: modified after Fock 2018, fig. 1)

Fig. XXI.4. Geldrop-'t Zand. (source: modified after Bazelmans 1990, fig. 8; 1991, fig. 47-48)

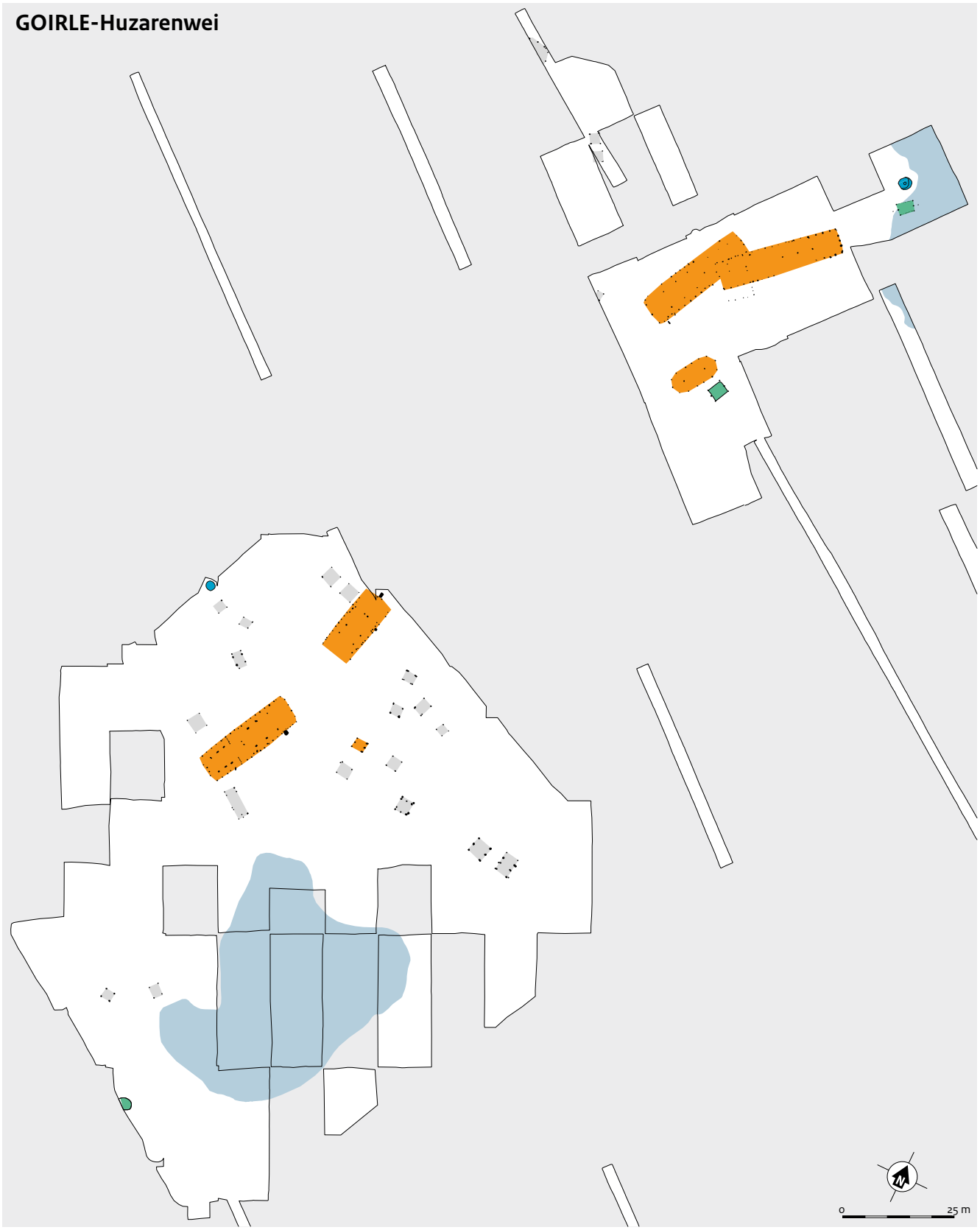


Fig. XXI.5. Goirle-Huzarenwei. Plan of the Late Roman settlement. (source: modified after Bink 2005, fig. 18)

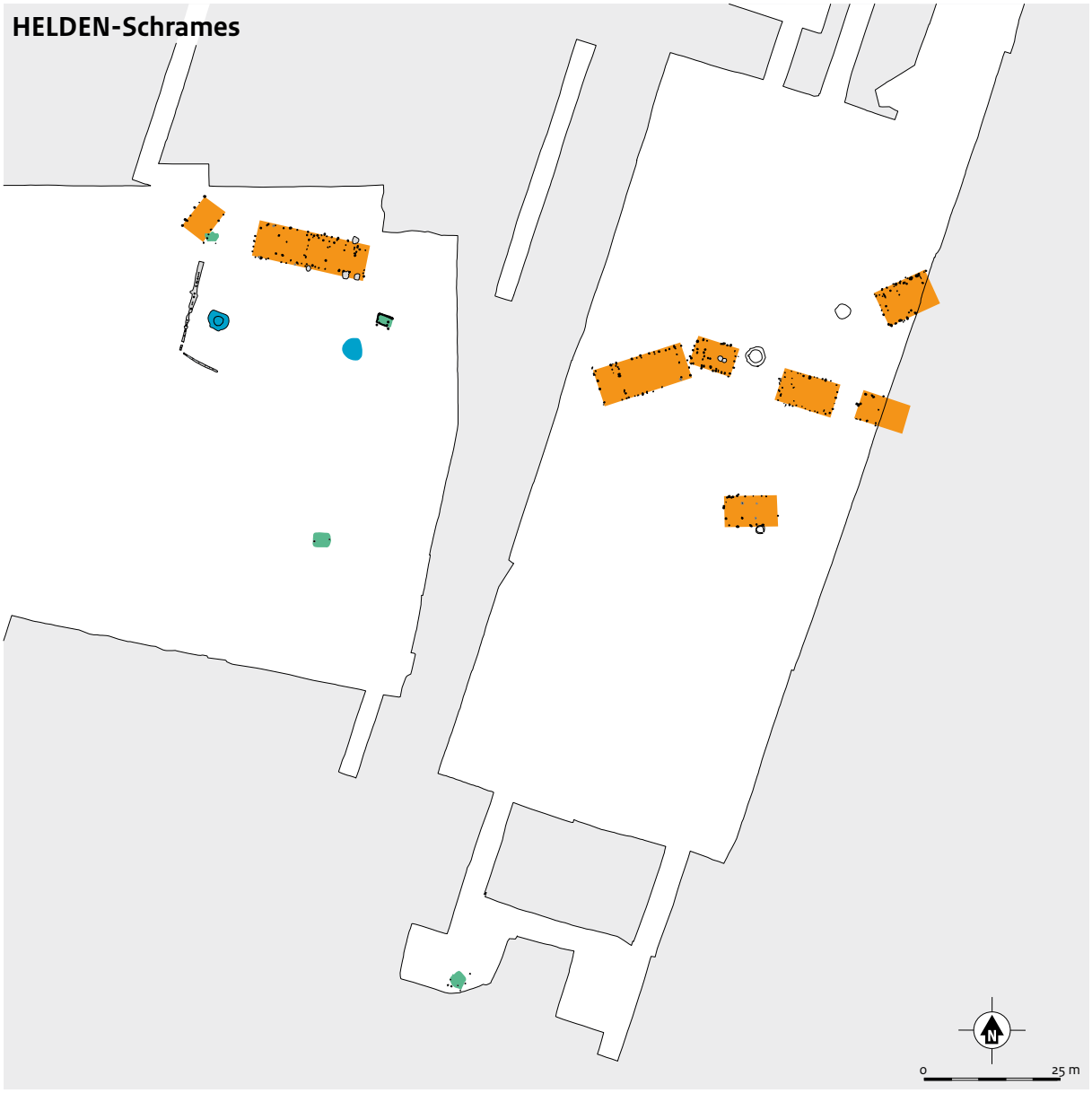
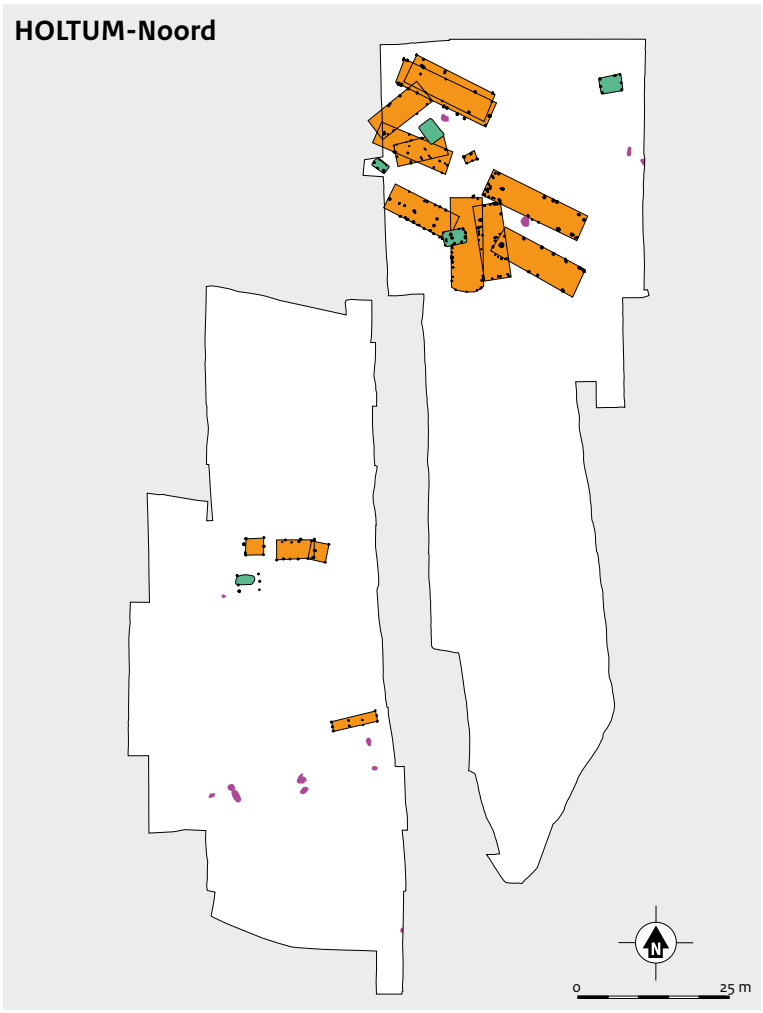


Fig. XXI.6. Helden-Schrames. Plan of the Late Roman and Early Medieval features. (source: modified after De Winter 2010, fig. 7.1; 8.2)



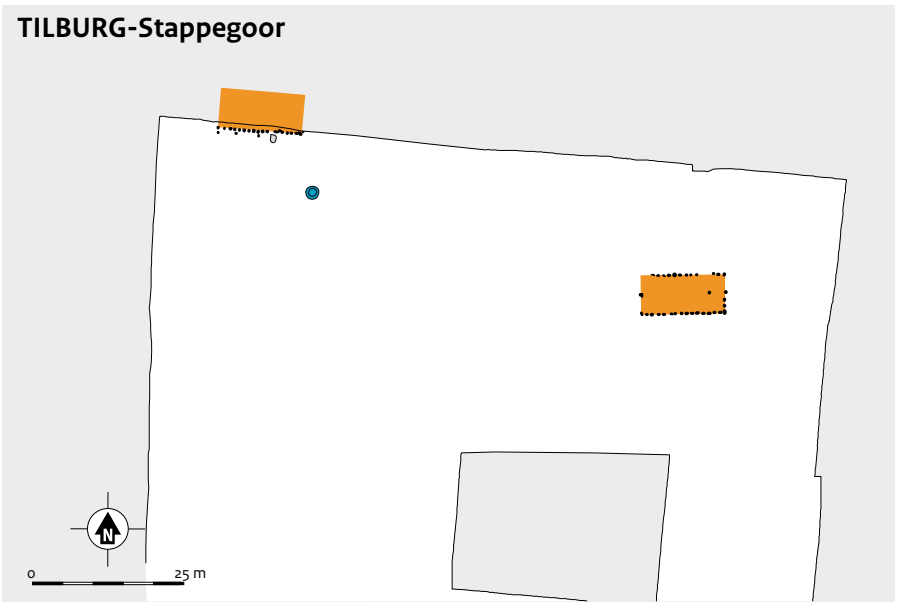


Fig. XXI.7. Holtum-Noord and Tilburg-Stappegoor. (source: modified after Wagner & Van der Ham 2010; Tichelman 2012, fig. 6.7; Kooi 2015, fig. 5.9)

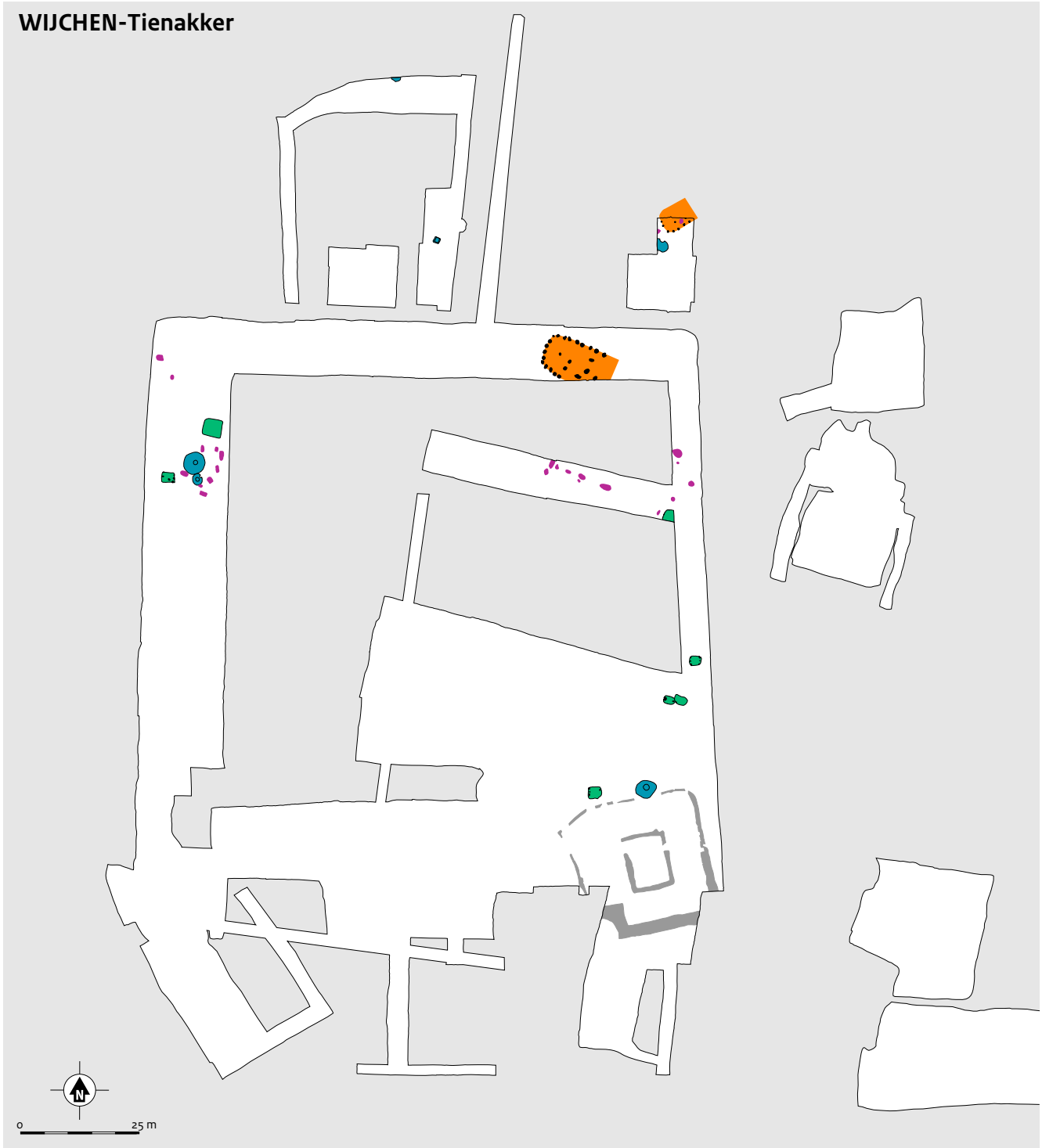
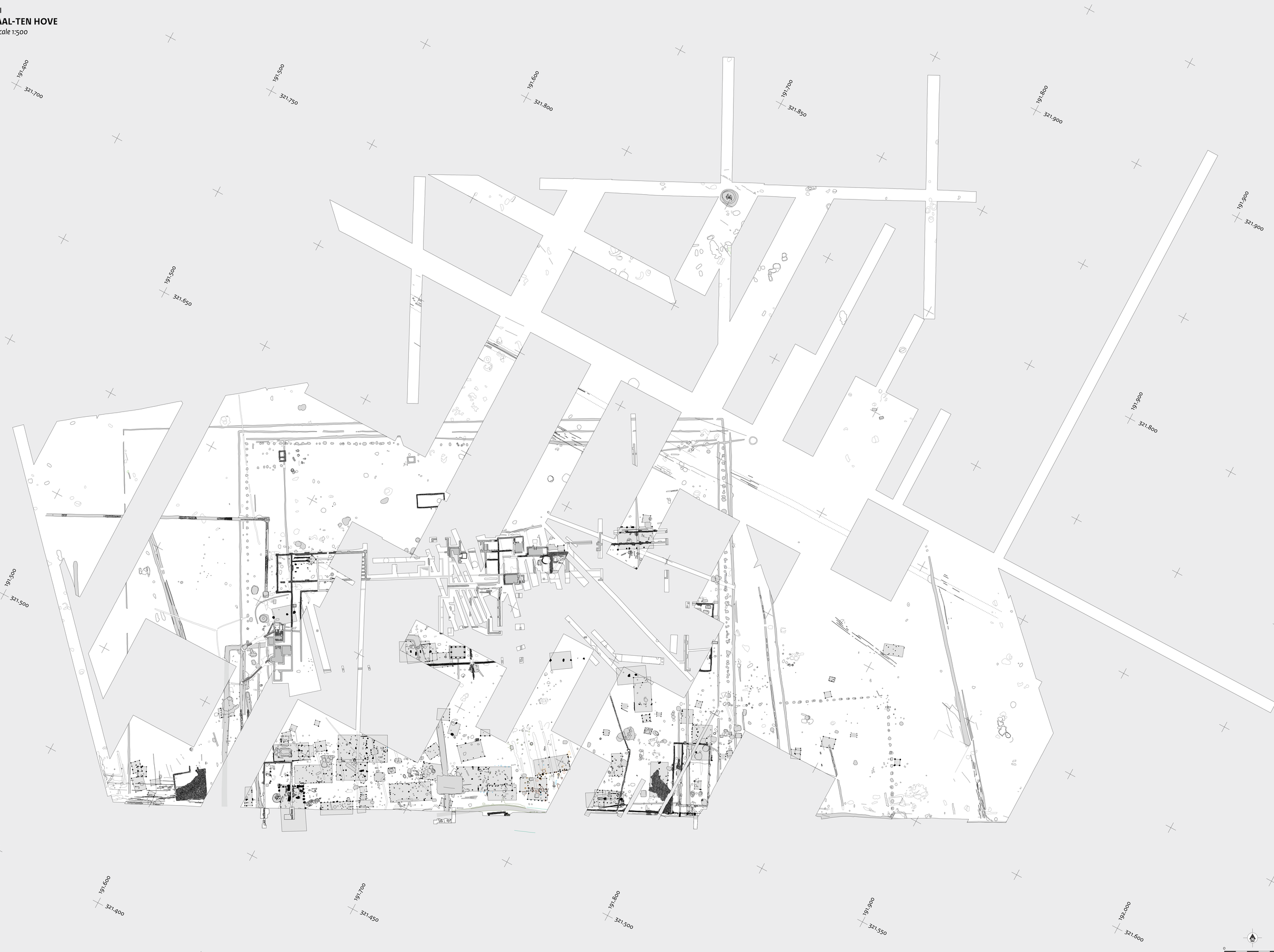


Fig. XXI.8. Wijchen-Tienakker. Plan of the Late Roman features. (source: modified after Heirbaut & Van Enckevort 2011, fig. 6.1; 7.1)

Appendix XXII

VOERENDAAL-TEN HOVE

General plan. Scale 1:500

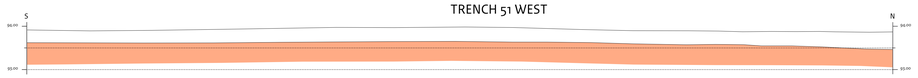


Appendix XXIII

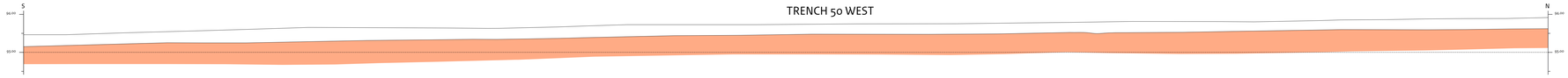
VOERENDAAL-TEN HOVE

Trench wall sections. Scale 1:50

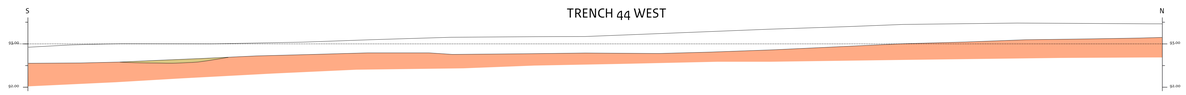
TRENCH 51 WEST

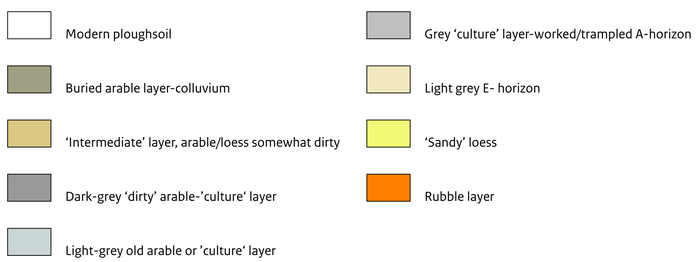


TRENCH 50 WEST

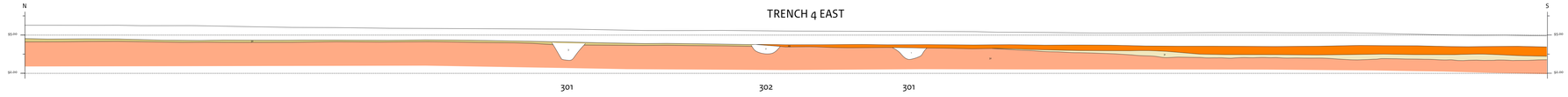


TRENCH 44 WEST

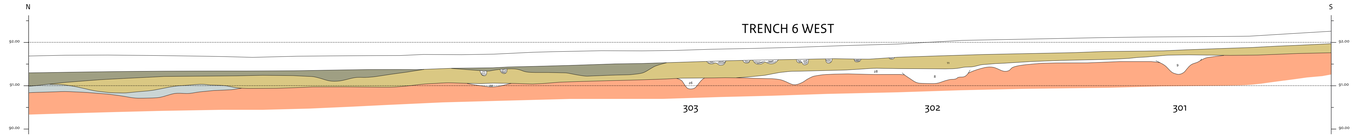




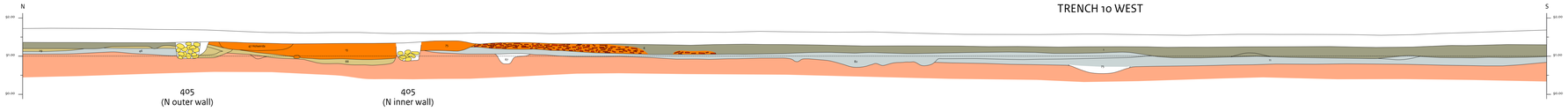
TRENCH 4 EAST



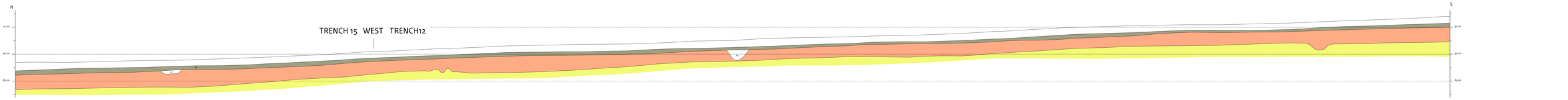
TRENCH 6 WEST



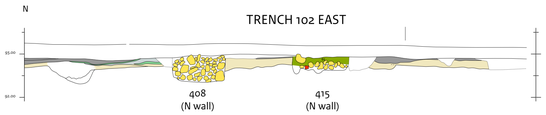
TRENCH 10 WEST



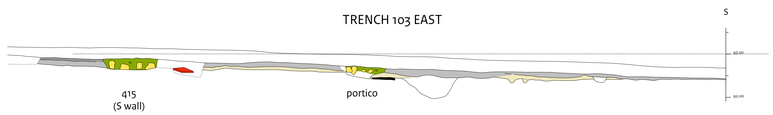
TRENCH 15 WEST TRENCH12



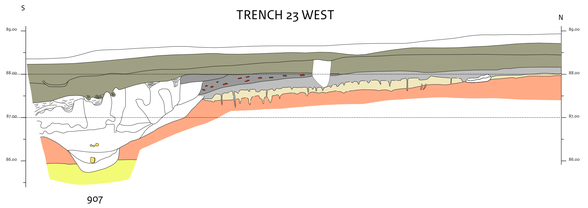
TRENCH 102 EAST



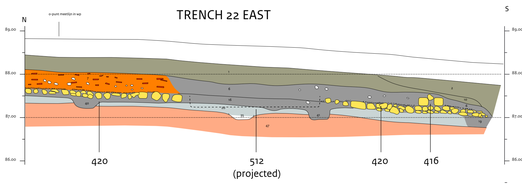
TRENCH 103 EAST



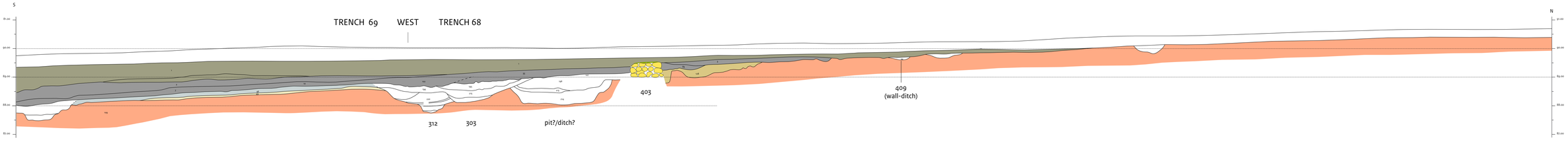
TRENCH 23 WEST



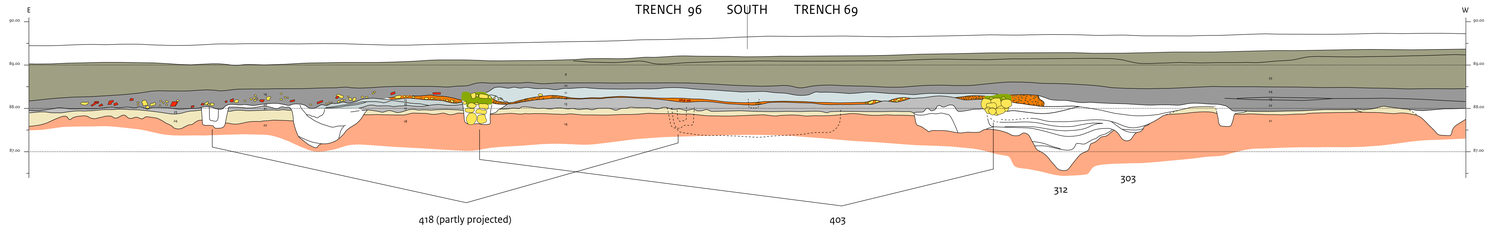
TRENCH 22 EAST



TRENCH 69 WEST TRENCH 68



TRENCH 96 SOUTH TRENCH 69



This report presents the results of the excavations at Voerendaal-Ten Hove, especially those conducted three decades ago by the State Service for Archaeological Investigations (ROB). A full publication of the Roman villa was long overdue because it represents only one of three Dutch examples investigated in its entirety. Moreover, the site is relevant for its Late Iron Age enclosure, post-built structures preceding the large villa and settlement remains and burials of the Late Roman and Merovingian period.

This fifth part of the publications is not printed. It contains explanatory comments on specific subjects, tables not included in the text of part I-IV, many photos of objects and pottery fabrics, as well as plans of other villas and settlements for comparison.

This scientific report is intended for archaeologists, as well as for other professionals and amateur enthusiasts involved in archaeology.

The Cultural Heritage Agency of the Netherlands provides knowledge and advice to give the future a past.