Mapping the Merovingian mortuary landscape: A GIS-based analysis of the locations of Merovingian cemeteries in the landscape of Northern Gaul

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Chapter 1: Introduction

1.1 Introduction of the topic

Merovingian cemeteries are a fascinating phenomenon and have intrigued scholars for centuries. A lot of research has been done on these cemeteries, on their location, their chronology, and the burials within them, including their topography, lay-out, the buried individuals and the grave goods.

The research presented in this thesis will be dealing with the location of Merovingian cemeteries in the landscape. It is very likely that the locations of burials were chosen deliberately. Whereas most parts of the burial ritual, such as the ceremony and the grave goods, are visible only temporarily, the location of the grave is a more permanent element. As a result, any messages or claims communicated by 'external' elements, such as the burial location, will have stayed visible for a much longer time than the 'internal' elements of the burial (Effros, 2003b, p. 175). For this reason, the location of a cemetery can tell a lot about the funerary ritual and the role of the dead in society, but also about the way people perceived and used the landscape.

It has been argued that cemeteries could be seen as central places, where different communities gathered when somebody was buried, but also for other important social events, where memories were created and identities were emphasised (Williams, 2002). The locations of cemeteries at central and monumental places seems to support this view (Williams, 2002, p. 358). This ties in with the interpretation of cemeteries as places of power, as explained by Heinrich Härke (2001). Cemeteries have power in many ways: their location has power, the dead buried there have power, and the living descendants show their power there (Härke, 2001, pp. 28–29). It is very likely that especially the living descendants of the deceased used this power to their benefit, as they could perform the funeral ritual in a way that conveyed a message, not only to show their power, but also to express their identity and the way they saw their place in society. This message could have been conveyed by for example burying specific grave goods with the deceased, but also by carefully choosing the burial location, as argued by Frans Theuws (2019b).

There are different ways in which the locations of, in this case, cemeteries can be studied. Most studies carried out so far involved only one or a small number of cemeteries. In these studies, attention to the location of the cemetery ranges

from a few general observations about the location, without further explanation (such as in: (Brendle, 2014, p. 20)), to an entire chapter dedicated to the location and the surrounding landscape (for example in the recent publications on several Merovingian cemeteries in the southern Netherlands (De Haas & Theuws, 2013, pp. 10–23; Kars et al., 2016, pp. 10–25; Theuws & Van Haperen, 2012, pp. 10–29)). More regional overviews of all cemeteries in a specific area have been carried out as well, for example in western Germany (Nieveler, 2003; Plum, 2003). Several older general works on Merovingian cemeteries contain remarks about the locations of cemeteries on hillslopes, above a related settlement, near waterways and near Roman ruins (Böhner, 1958, pp. 258–259, 329; Périn, 1987, p. 20), but they do not go into the specific reasonings behind these trends.

Studies focussing especially on the locations of cemeteries are much less common. An exception is a thesis by Maaike de Haas (2010), in which she analyses the location characteristics of 29 early medieval cemeteries in the southern Netherlands and northern Belgium. Here she concludes that many cemeteries are located either at prominent locations in the landscape, such as elevated terrain, or at the boundaries between inhabited and uninhabited areas. Furthermore, there is a lot of variability in the locations of cemeteries, indicating that there was not a single rule for the location selection. Neither was there a direct relation between specific settlements and cemeteries, as cemeteries were often used by people from different communities (De Haas, 2010, p. 91).

Instead of a local scale as in the study by De Haas (2010), the research presented in this thesis will be done on a much larger scale, including cemetery data from different countries. Rather than finding an explanation for the location of a specific Merovingian cemetery, this research will use a GIS-based approach to attempt to recognise larger patterns in cemetery locations. This will be done by analysing three variables in the location of cemeteries: the elevation of the terrain, and two variables derived from that: the slope gradient (steepness) and orientation (usually called ‘aspect’).

Based on the older works by Böhner (1958) and Périn (1987), but also the more recent works by Nieveler (2003) and Plum (2003), it could be concluded that Merovingian cemeteries were located on hillslopes, and near hilltops and other high locations in the landscape. The location at high places in the landscape can be explained by practical reasons, such as a decreased risk of flooding (Nieveler,

2003, pp. 146–153), but also more culturally significant reasons, such as their prominence, or visibility in the landscape, as argued by Williams (2002, p. 358).

In this thesis I want to use GIS to see if these observations also result from a large-scale analysis of Merovingian cemetery locations. Additionally, based on the exact results from the analyses, I will attempt to find explanations for the resulting general image.

1.2 Research questions

The main research question in this thesis is as follows:

What are the location characteristics of the location of cemeteries in the Merovingian landscape, and how do these relate to the societal and religious changes taking place during the period?

In order to answer this question, the following sub questions are posed:

- What are the elevation, slope gradient and aspect values for the locations of Merovingian cemeteries?
- Do cemeteries indeed often occur on hillslopes, and how can this be explained?
- Are cemeteries often located on hillslopes facing a specific direction, and how can this be explained?
- Are cemeteries indeed often situated at high positions in the landscape and how can this be explained?
- Are there differences in these general observations between different periods within the Merovingian Period?

This research will be carried out based on geographical and chronological data from 190 accurately dated cemeteries in Merovingian Northern Gaul. These data are stored in a database from the Rural Riches project, which contains data from hundreds of excavated archaeological sites in The Netherlands, Belgium, Luxemburg, Northern France, and Western Germany. By using accurately dated excavation data from such a large area, it may also be possible to see differences between earlier and later Merovingian cemeteries.

1.3 Thesis outline

Chapter 2 will give some background information on the Merovingian Period. It will deal with the existing views on early medieval society in North-Western Europe, especially regarding the burial ritual and landscape factors. Furthermore, different views on the locations of Merovingian cemeteries will be discussed.

In chapter 3 the data and methodology used in this study will be explained. This chapter will give a description of the Rural Riches database, as well as explain which data are selected. Furthermore, this chapter will show the spatial analyses that will be carried out. An explanation of the chronological subdivision of the Merovingian cemeteries will be given as well.

Chapter 4 presents the results of the analyses, for each of the variables, and throughout different periods within the Merovingian Period. These results will be discussed in chapter 5, where an attempt will be made to explain some of the observations, with the help of the information from earlier studies discussed in chapter 2. Another part of this chapter will deal with some limitations of this study.

Chapter 6 will conclude this thesis by a discussion of the answers to the research questions mentioned above, together with suggestions on further research.

Chapter 2: Literature Review

This chapter will provide the research background of this thesis. First some important characteristics and developments of the Merovingian Period will be discussed, as well as the background of the research area. After that, I will go deeper into the characteristics of Merovingian cemeteries, including an overview of the developments in Merovingian cemeteries over time. Following this I will discuss some of the earlier studies on the location of Merovingian cemeteries and burials.

2.1 The Merovingian Period

The Merovingian period began in the 5th century and lasted roughly until the first half of the 8th century, and is named after the dynasty of the Frankish kings that ruled over large parts of modern-day France, Germany and the Low Countries (Effros & Moreira, 2020, p. 6). The period has been studied by historians and archaeologists for a long time. However, being in between the Roman and the Carolingian Period, for a long time it was seen as a transitional period and a period of stagnation or even decline. More recently, this image has changed to that of a period of connectivity and vitality, and more to a period on its own (Effros & Moreira, 2020). During the Merovingian Period a number of important developments took place, which would strongly impact the rest of the Middle Ages.

The Merovingian Period starts with the collapse of the Roman state, although it is still debated precisely how much of the Roman influence had actually disappeared, as some institutions and some of the infrastructure were still in use (Theuws, 2019b, p. 126). Most of the Roman *villae* were abandoned, large areas were completely deserted, and economic activity will have decreased dramatically, although some towns survived (Theuws, 2020, pp. 885–886). However, finds from towns and especially the rich and exotic grave goods from rural cemeteries show the wealth and connected economy that was still present in society in the 6th century (Theuws, 2020).

It is unclear how much power the aristocracy actually had and how much of the economic activity was driven by the rural population itself. After the collapse of the Roman Empire, the role of the aristocracy seems to have been small in northern Gaul, but towards the end of the Merovingian Period (so roughly from the 7th century onwards) their prominence and power seem to have increased

(Theuws, 2020, p. 897). Their role probably became much stronger from the 8th or 9th century onwards (Loveluck, 2013, pp. 35–36; Theuws, 2020, p. 907).

Another development that took place was the Christianisation of Northern Gaul. Although the Merovingian kings were already Christian from approximately the end of the 5th century onward and bishops were present in the towns, it took until the 7th century to see clear evidence of Christianity among the rural population (Theuws, 2020, p. 886). It is important to keep in mind however, that this does not necessarily mean that (at least a part of) the rural population was not already Christian earlier, just that it is hard to recognise them as such, as many 'signs of Christianity' are not unambiguous and not necessarily always present in for example burials, as will be discussed later in this chapter.

In this chapter, these developments will be discussed more in depth and their relation to the burial ritual, and the choice of locations for cemeteries in particular, will be further explained.

2.2 Background of the research area

The locations of the cemeteries studied in this thesis have been collected in the Rural Riches project, (*About Rural Riches*, n.d.). For this reason, the area analysed in this thesis is the same as the research area of the Rural Riches project. It consists of a large part of north-western Europe, including The Netherlands, Belgium, Luxembourg, and parts of Northern France and Western Germany (Theuws, 2018). From the Roman to the Merovingian Period, the part of this area south of the river Rhine is often referred to as Northern Gaul. There were large differences between the northern and southern parts of Merovingian Gaul, not only politically, but also economically, culturally and religiously (Effros, 2003b, p. 5; Theuws, 2020, p. 883). This has likely led to differences in the developments between Northern and Southern Gaul (Theuws, 2020, p. 885).

Northern Gaul is an interesting area within the Merovingian world. During the Roman Period, Northern Gaul was located at the northern limits of the Empire. As a border area it had long been a peripheral area, especially in the Late Roman Period, when the Roman Army had largely left the area. The amount of historical sources about Merovingian Northern Gaul is very limited, as most sources concern the areas more to the south (Theuws, 2020, pp. 896–897). During the Merovingian period, this region changed from being a peripheral area to being the centre of the Merovingian Kingdoms and the later Carolingian Empire (Theuws, 2020).

Apart from the differences between Northern and Southern Gaul, there were also large differences within Northern Gaul. Geographically, the research area was very diverse, which also has consequences for the habitation of different parts of the area.

The landscape in the period after the Roman Empire left Northern Gaul has often been imagined as densely forested, but in reality it was probably a more open landscape, with many signs of human activity (Peytremann, 2020, p. 694). This is at least the case for the southern part of the area (present Northern France), as the northern part was more scarcely inhabited (see for example Theuws (2008, p. 202) for the southern Netherlands and northern Belgium). Some areas, such as the large peatlands in the western and northern Netherlands, will have been completely unsuitable for agriculture and habitation. In the region around Metz in Northern France, habitation seems not to have occurred in areas with high elevations: based on the locations of cemeteries, it appears that habitation only occurred below 300m above sea level (Halsall, 2006, p. 228). In the Dutch province of Noord-Brabant habitation was limited to the highest parts of the landscape, where there was no risk of flooding and the soil was fertile enough for cultivation (De Bont, 1989, pp. 104–109; Theuws, 2010, p. 42). At many places, the remains of Roman *villae* and other structures will still have been visible, although many of them will have been located in areas that were more or less abandoned at the beginning of the Merovingian Period (Theuws, 2019b, pp. 126–128).

This uneven distribution of habitation also impacts the archaeological record. The places where archaeological excavations have been carried out, are for a large part defined by the places where the soil would be disturbed, such as building sites. This bias can greatly impact our understanding of the past, as argued by Périn (2004), who states that only villages that have been abandoned since the Early Middle Ages have been excavated, as their locations are now built upon, while the surviving settlements still exist as villages today (Périn, 2004, pp. 267–268). Apart from this and similar biases, there are also parts of the research area which simply have been studied a lot more than other areas, such as the Kempen region in the southern Netherlands and Northern Belgium (Theuws, 2010), and parts of the Rhineland in Germany (for example the works by Nieveler (2003) and Plum (2003)). The lower intensity of research in other regions does of course not necessarily mean there were fewer cemeteries there.

Apart from the geographical differences between for example the lower Rhine Delta in the Netherlands and the Ardennes in eastern Belgium, there were also differences in the political and economic situation. At some places, the Roman influence will still have been felt stronger than in others, depending on how much of the Roman infrastructure was still functional (Theuws, 2019b, p. 126).

In northern France, there seems to have been a lot of continuity in habitation. Most of the Roman *villae* were abandoned between the 3rd and the middle of the 5th century, but this does not necessarily mean there was no continuous habitation of the area (Halsall, 2006, p. 210). There is evidence that settlements have been inhabited continuously from the Merovingian or even the Late Roman Period to the present day (Halsall, 2006, p. 215). Many present-day towns and villages will have originated or already existed in the Early Middle Ages, and only the exceptions were abandoned, which made them more likely to be excavated (Périn, 2004). In the Kempen region in the southern Netherlands and northern Belgium, however, almost all earlier inhabited settlements were abandoned in the 12th and 13th century in favour of new locations, which allowed them to be excavated and researched in the past decades (Theuws, 2019a, pp. 355–356).

The relation between settlements and cemeteries is hard to determine. As shown above, there are large differences between different regions within the research area with regard to the continuity of habitation from the Early Middle Ages until now. This makes it very difficult to determine if present-day settlements already existed in the Merovingian Period, and if they were at the same location. It is further complicated by the possibility that cemeteries could be used by more than one settlement (Theuws, 1999). It is also likely that members from one community could be buried at vastly different cemeteries, each with its own meaning (Theuws, 1999, pp. 344–345). Together with the fact that, at least in Northern Gaul, many more cemeteries than settlements have been found, this means it will be almost impossible to perform large scale analyses on settlement locations and their relations to cemeteries.

The landscape and settlements changed during the late 6th and early 7th century. The larger villa-communities fragmented into smaller groups, which can be seen by the change in size and number of cemeteries (Halsall, 2006, p. 224). In general, settlement sizes increased and previously uninhabited areas were colonised (Loveluck, 2013, p. 33; Peytremann, 2020, pp. 703–704). This could have been the result of multiple factors, including population growth, but also in

an increase in power of the elites, and new concepts of landholding (Loveluck, 2013, p. 33). Also during this period there were changes concerning the burial custom; in the type and layout of cemeteries (Effros, 2003b, p. 193; Halsall, 2006, p. 224), but also in the practice of grave goods (Theuws, 1990, p. 60). These developments will be discussed more in depth in the next section.

2.3 Merovingian cemeteries

Although historical sources do exist about the Merovingian Period, there are not many, and most do not concern the northern parts of the Merovingian Kingdom (Theuws, 2020, p. 883). A similarly uneven distribution is the case in the archaeological records. In Northern Gaul, large numbers of cemeteries with richly furnished graves are known and relatively few settlements. In the southern parts of Gaul, the image is almost reversed, as much more is known about the urban centres and other settlements, while the graves in cemeteries are mostly empty (Theuws, 2020, pp. 883–884). This has meant that most of our knowledge of Merovingian Northern Gaul is largely based on archaeological sources, and mostly on finds from cemeteries.

An important characteristic of Merovingian burials are the grave goods. People were often buried with objects such as jewellery, ceramic pots, metal tools or weapons and other goods. Research in the past centuries has mostly focussed on these grave goods, as they are the most frequently occurring and most visible remains from this period that can be found. The meaning of these practices has been the subject of debates for centuries (Effros, 2003b; Härke, 2014) and this continues to this day. Many different possible meanings have been suggested, for example that they were gifts to the deceased, items belonging to the deceased person, but also a way to increase the prestige of the community that buried the person, or to protect them against the dead (Härke, 2014, pp. 44–52).

For a long time, the grave goods and other remains of the burial ritual were seen as a way to identify the buried person. Particularly interpretations of the gender and ethnicity of the deceased have often been made on the basis of grave goods, based on the idea that specific types of grave goods were linked to specific ethnic identities (and also genders). For example, a battle axe would indicate a Frankish origin, while a seax would indicate a Saxon, but this does not seem to be the case (Effros, 2003b, p. 110). These ethnic interpretations were common especially in the period after the Second World War, but do still occur in more recent works. More recently it has become more and more accepted that the reality is more complicated than this. There is a lot of variation between and

within cemeteries with regard to grave goods, which makes it unlikely that ethnic identity was the only or most important element which determined the choice of grave goods and other parts of the burial ritual (Effros, 2003b, p. 110).

Theuws (2009, pp. 307–309) argues that the types of grave goods deposited in graves were part of a ritual that was intended to deliver a specific message, performed by the people that buried the deceased. The burial ritual was a way to lay new claims on the land. They were probably used by the local people to pursue their own agendas, rather than to express ethnic identity.

Some parts of the burial ritual changed significantly during the Merovingian period. The developments of several parts of the burial ritual through time has often been interpreted as the result of the growing influence of Christianity. Especially the change from cremation to inhumation burials, changes in the orientation of the graves and the disappearance of the practice of grave goods were seen as indicators of Christianity. However, it is unlikely that the growth of Christianity itself was the decisive factor in these changes, as Dierkens argues (1981, pp. 56–63), as the 'pagan' parts of the ritual were never forbidden for Christians (at least until the 8th century) and probably also were carried out by Christians. The disappearance of some types of grave goods in graves from the late 6th century onwards and the appearance of others is more likely the result of broader changes in society, among which changes in religious practices, rather than a change of religion (Effros, 2003b, pp. 85–88).

2.4 Cemetery types throughout the Merovingian Period

Throughout the Merovingian period, different cemetery types were in use, which also had different location characteristics.

The earliest Merovingian cemeteries sometimes occurred at or near Late Roman cemeteries, suggesting some continuity in habitation (Périn, 1987, pp. 17–19). Especially near the Roman *villae* that were still inhabited after the 3rd century, quite a number of Merovingian cemeteries occur (Halsall, 2006, p. 220). Many other Early Merovingian cemeteries appear to be newly founded, often occur near villages (still existent or since disappeared), and could be related to the reoccupation of areas deserted in the later Roman Period (Périn, 1987, pp. 19–20). This reclamation of previously deserted lands seems to be reflected in the grave goods found in cemeteries in these areas (as argued by Theuws (2019b)). Often there appears to be a relation, at least spatially, to an older structure, for example Roman ruins or megalithic structures (Effros, 2003b, p. 191; Périn,

1987, p. 20). However, burials inside Roman ruins only occur from the 7th century onwards (Effros, 2003b, p. 191). Usually, these early cemeteries were quite small, with about thirty to forty burials. They appear to have been suddenly abandoned in course of the early Merovingian Period (Effros, 2003b, p. 190).

At the end of the 5th century the first so-called row grave cemeteries occurred, and they spread to the rest of Northern Gaul during the 6th century (Effros, 2003b, pp. 192–193). These row grave cemeteries consisted of graves in parallel rows and existed in various sizes, from a few dozen to multiple thousands of graves (Effros, 2003b, p. 193). However not all cemeteries were as neatly organised as the term row-grave cemetery suggests.

There are some remarkable differences between cemeteries from the 6th and the 7th century. In the 7th century cemeteries became smaller, but the number of cemeteries increased, indicating that the communities using the cemeteries became smaller (Halsall, 2006, p. 224), or that more different cemeteries were used by the same community, as shown for example by Theuws (1999, pp. 344–345). These changes occur at more or less the same time as the changes in settlements as discussed above.

By the end of the 7th and start of the 8th century row grave cemeteries had grown out of use, and smaller cemeteries became more common (Effros, 2003b, p. 193). During the 8th century there was also a development towards burials around (small) churches (Effros, 2003b, pp. 198–199; Périn, 1987, p. 21). Burial inside small churches also became more widespread, though often seems to have been reserved for the elite (Effros, 2003b, p. 211).

2.5 The location of Merovingian cemeteries

The focus among researchers on the rich grave goods has meant that other parts of the burial ritual have often been overlooked. The inclusion of skeletal evidence, isotope analysis, aDNA analyses and other elements has drastically changed our image of the Merovingian Period in the last decades. The location of cemeteries is another of those aspects that have not really been studied before, and only in the last two or three decades has received any attention. Often some remarks are made about the landscape in which the cemetery is situated, but studies at a larger scale are rare. Furthermore, many studies on Merovingian grave locations are aimed at the individual graves within the cemetery and not the cemetery as a whole (for example (Effros, 2003a; Sayer, 2020)).

Just as the other elements of the burial ritual, the burial location will not have been chosen arbitrarily, as argued for example by Effros (2003b, pp. 175–177). In contrast to the grave goods and other parts of the burial ritual that were only temporarily visible, the location of the burial and other 'outside' characteristics would have lasted much longer. This means that it could also convey its message for much longer, making it likely that the choice of location for a burial was deliberate. A deliberate choice for a specific location implies that, like the grave goods deposited in the grave, the location of the grave was an important element of the burial ritual. A deliberately chosen location must have had some kind of significance, just as the deliberately chosen grave goods had. This meaning of the location of cemeteries has been discussed by some scholars, whose views I will discuss more in depth here.

In some of the earliest observations about cemetery locations, they are often said to be located generally on a hillslope above the corresponding settlement, often, but not always, on the same side of a stream as the settlement (Böhner, 1958, pp. 329–330). However, as De Haas discusses in her thesis (2010, pp. 12–13), these conclusions were not the result of systematic analyses.

The notion that cemeteries are located on hillslopes has been proposed many scholars, for example by Périn (1987, p. 20), who states that cemeteries occur on a slope in the vicinity of a settlement, often on the nearest slope facing the settlement. On the direction he further mentions that there seems to be no preference for east-facing slopes, which was thought earlier (Périn, 1987, p. 20).

More recently data are used better, but still often interpreted only from a rational or economic viewpoint (De Haas, 2010, p. 13), for example the studies by Nieveler (2003) and Plum (2003). They both made an overview of Merovingian settlements and cemeteries found in two regions in western Germany (Erftkreis and Euskirchen, and Aachen and the region Düren, respectively), in which they also addressed the locations of settlements and cemeteries, and the relations between them.

According to Nieveler (2003), many Merovingian cemeteries are located at or within 50m of the location of 19th century settlements, though there is also a large group at a distance of 200-300 metres. These settlements are often located near waterways or other sources of water, and in the presence of arable fields, meadows and woodland (Nieveler, 2003, p. 135). An important observation is the occurrence of Merovingian sites in areas with soils that are suitable for

agriculture, such as limestone or loess, while in the sandy or slaty areas Merovingian sites are rarer or even completely absent (Nieveler, 2003, pp. 140–141). A final point is the location of settlements and cemeteries at higher point in the landscape, which can be explained by a decreased risk of flooding compared to lower lying areas (Nieveler, 2003, pp. 146–153).

The importance of geology, soil type, climate and vegetation, as well as the presence of a nearby water source, as factors for the location of Merovingian settlements and cemeteries is also stressed by Plum (2003, pp. 83, 156). The location of cemeteries on hillslopes is explained by the lower suitability of hillslopes for agricultural purposes due to erosion, and such economic reasonings can be seen throughout the region (Plum, 2003, p. 156). Like Nieveler, Plum observes a lower occurrence of cemeteries and settlements in areas with unsuitable conditions for agriculture, such as the higher areas in the Eifel (Plum, 2003, pp. 162, 165).

A problem with both works, as also argued by De Haas (2010, pp. 13, 16), is the use of the density of all Merovingian finds and sites to determine the Merovingian habitation in the area. The problem here is that settlements and cemeteries are signs of two different ways in which the landscape was occupied, and cemeteries do not necessarily reflect habitation of an area (De Haas, 2010, p. 16).

Another problem, also present in the work of Böhner (1958, pp. 329–331), is the use of the locations of 19th century settlements for analysing the location of Merovingian settlements. While there are indications that, at least in some areas such as northern France (Périn, 2004), Merovingian settlements were the origin of modern settlements and were often at the same location, there are also clear signs that this was not the case everywhere, for example in the Kempen region (Theuws, 2019a, pp. 355–356). Without proof of individual cases, it cannot be assumed that Merovingian settlements were indeed at the same location as 19th century villages. This makes the analyses of the relations between settlements and cemeteries in the works of Böhner, Nieveler and Plum problematic.

In her thesis, De Haas (2010) distinguishes different types of cemetery locations. A large number of the cemeteries she studied occur on the boundaries of areas that are suitable for habitation and cultivation. Other cemeteries are located in the middle of these ‘habitation-cultivation’ areas, while there are also cemeteries that seem to be situated on prominent features in the landscape, such as points with

high elevation and high-lying river terraces (De Haas, 2010, pp. 79–81). These different types of locations can be explained by different mental aspects, such as claiming land, monumentality and the creation of social memories.

Cemeteries are often understood as central places and places of power. Härke (2001) for example explains different situations where cemeteries are places of power. As a place of ritual, a cemetery is automatically a place of power and a place where power is shown and expressed. The cemetery itself may have been experienced as having power, and the people buried there as well. Power relations can be shown by the lay-out of the cemetery and the locations of specific graves, but also by elements of the burial ritual.

Williams (2002) argues that early medieval cemeteries (in Britain) were central places, where people from multiple communities came together to perform ritual and social activities. Their locations near crossroads, remains of earlier occupation and prominent hilltops, all show a large visibility and accessibility, indicating their centrality and the possibility that people from different groups could gather there.

Theuws (2019b) sees the entire burial ritual, including the choice for a specific location, as an effort by the relatives of the deceased to paint an image, not only of the deceased person, but also of themselves. He explains this using the example of the burial of the Merovingian King Childeric, which he sees as an attempt by Childeric's successor Clovis, to stress the differences between him and his father. This was done by giving specific grave goods, which showed Childeric as a 'Roman' general, instead of a Frankish king, but also by burying him in Tournai, which was a small town in the periphery of the Merovingian kingdom, as a 'man of the past'. In this case, the remains of Childeric's burial tell more about Clovis' narrative, than about king Childeric. This is a way the burial ritual could be used by the relatives of the deceased to convey a message about themselves, and not necessarily about the deceased. This means that the grave goods found in many Merovingian graves do not necessarily belong to or give information about the buried person. The same may then be true about the location of the burial: it could be a part of the message the descendants of the deceased wanted to bring across.

Chapter 3: Methodology

This chapter will describe the data used in this research, as well as how these data were analysed. This includes an exact description of the research area and the selection of sites on which the analysis is based. Furthermore, it will be explained how the cemeteries across the research area can be compared, using the landscape variables of elevation, slope and aspect. This will not only be a comparison between the sites in the research area, but also a comparison between different phases in the Merovingian period.

The research done in this thesis is largely based on data from the Rural Riches project (*About Rural Riches*, n.d.). This is an archaeological project in which the Early Medieval economic development of North-western Europe is studied. The project is led by prof. dr. Frans Theuws, Professor of Medieval Archaeology of Europe at Leiden University.

3.1 Research area

The Rural Riches research area consists of the Merovingian region of northern Gaul, and some neighbouring areas (Theuws, 2018). This includes the Low countries, western Germany and northern France. The extent of the research area corresponds to the modern countries of The Netherlands, Belgium and Luxembourg, the modern states of North Rhine-Westphalia, Rhineland-Palatinate and Saarland in Germany, and the region of Hauts-de-France and the northern parts of the Grand Est region in France (Figure 3.1). The precise limits of the research area are based on modern borders, and it may seem arbitrary to use them in a historical context. However, the reason behind them is the use of a natural and historical boundary (the Rhine river) and the inclusion of the areas across the river. The southern boundaries were defined so that they included some important Late Roman and Merovingian centres, such as Metz, Reims, and Amiens. However, areas that are part of the very different developments in Central Gaul were not included (Theuws, 2018).

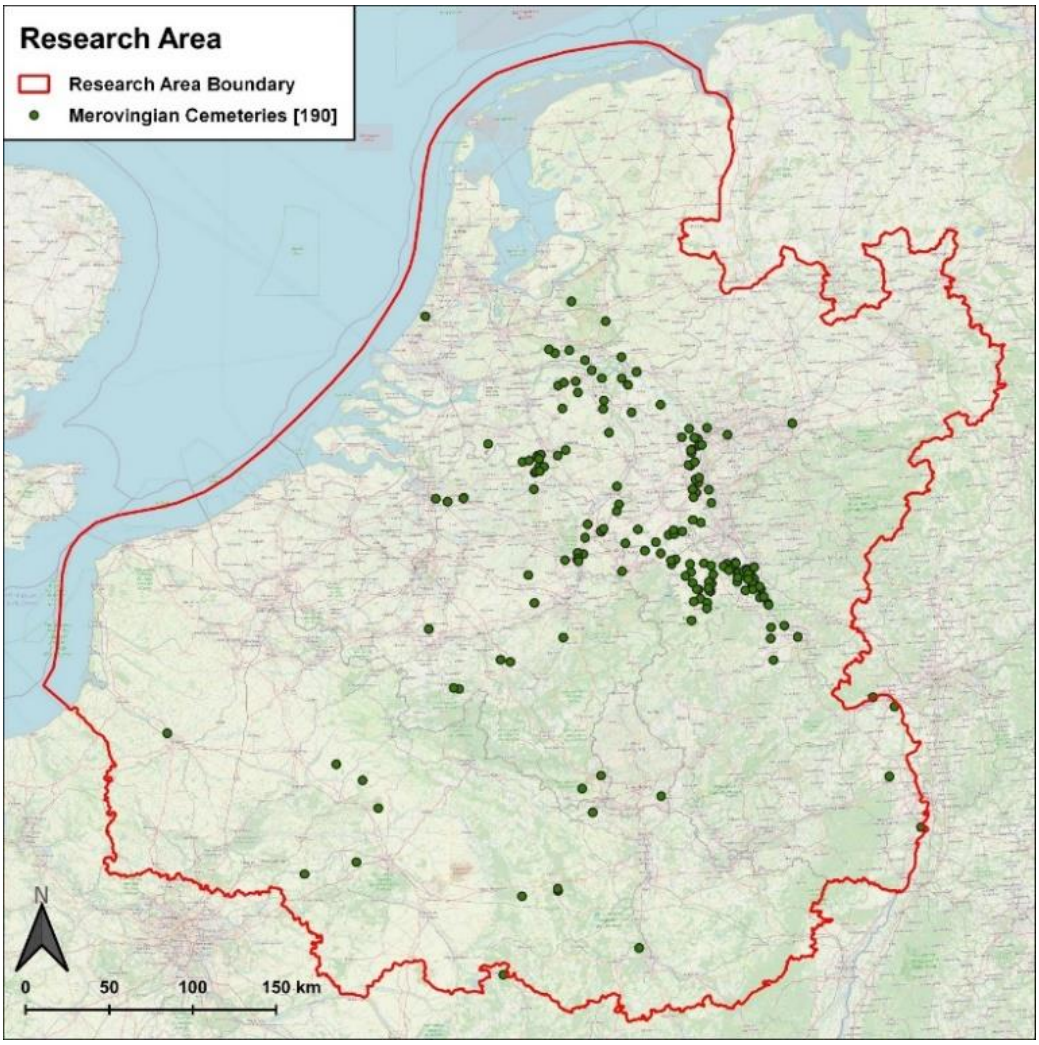

Figure. 3.1: Extent of the research area and locations of the analysed cemeteries (Figure: BvH, based on dataset 2021 – Rural Riches project; OpenStreetMap (n.d.)).

3.2 Cemetery selection

For the analysis 190 Merovingian cemeteries were selected from the database. These cemeteries were selected based on two main criteria. One criterium was an accurate begin and end date, allowing for comparisons between different parts of the Merovingian Period. The other criterium was the exactness of the location coordinates. The database contains cemeteries of different kinds, including single burials, burials beneath churches, and row graves.

The database entries consist of a number of different data inputs. The entries used here are the Site ID, name, country, region, latitude, longitude, location precision, chronological phase system, begin phase and end phase. Four different chronology systems were used for the dates of the cemeteries, and the

phases are numbered differently in each system. Further explanation of the chronological phases and their classification will follow at the end of this chapter.

Not all of the accurately dated cemeteries had exact location coordinates. 190 cemeteries were labelled as ‘exact location’, while others were labelled as either ‘environs 100m’, ‘environs 500m’, ‘one kilometre square’, or ‘locality’. Due to the resolution of the elevation maps, it was impossible to use the less accurate locations. As the resolution (cell size) of these maps is about 25 by 25 metres, sites with a lower accuracy than within 25 metres cannot be used, because they cannot be placed in a specific map cell. This problem could have been partly solved by using a lower resolution elevation map, but this would also mean the actual analyses would be less accurate. As 190 cemeteries provided a large sample size, it was decided to use the 25m resolution data and discard the less accurately localised cemeteries for now.

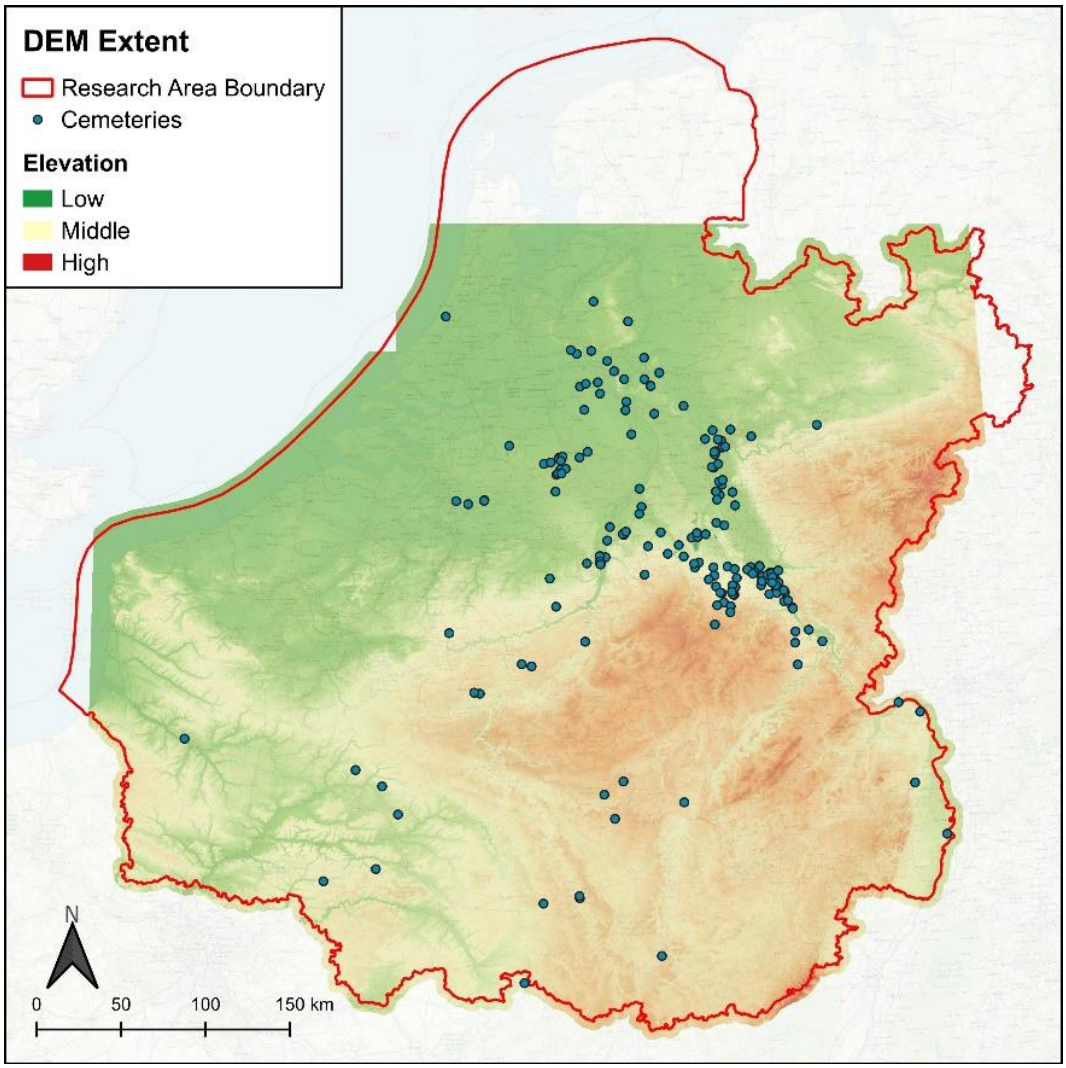

Figure 3.2: The Digital Elevation Model used for the location analyses (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

3.3 Maps

For the elevation, slope and aspect analyses, elevation data from NASA's SRTM project (NASA Shuttle Radar Topography Mission (SRTM), 2013) was used. These data were used in the form of a digital elevation model (DEM) of the research area and a margin outside it (Figure 3.2). This map was a raster map with 25 by 25 metre cells. It was first resized to just the area that the database sites were located in. In some parts of the research area, no sites are located that were selected, for example in the northern Netherlands. These unnecessary parts were removed in order to decrease the size of the files, and to speed up the map calculations.

After the unnecessary parts of the model were removed, derivative maps could be made using tools in QGIS. First a slope map and an aspect map were calculated using the GRASS GIS tool r.slope.aspect[1]. This resulted in two raster maps with the same resolution as the original DEM. The slope map gives the steepness of the hillslope in each cell was given, in degrees (between 0 and 90). Where the slope gradient indicates the steepness of the hillslope in the cell, the aspect value indicates the direction the slope is facing (Figure 3.3). In the aspect map, each cell was given a value between 0 and 360 degrees, with 0° indicating a northern direction, and the other directions following in a clockwise order (so 90° indicates an east-facing slope, 180° a south-facing slope, etc.). Cells with a slope value of 0 degrees were given an aspect value of -9999, as these parts of the map are level, which means they automatically have no aspect value, and in this way they are easily recognisable.

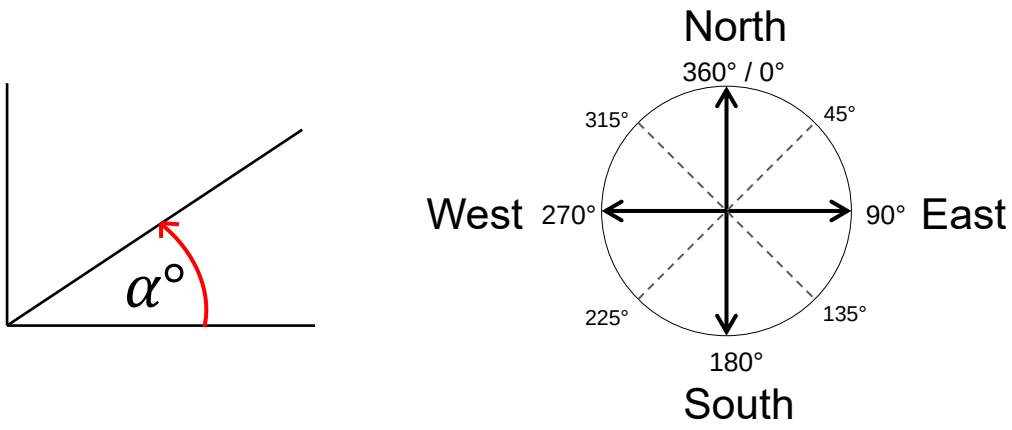

Figure 3.3: A visualisation of the degree of slope (left) and aspect (right) (Figure: BvH).

[1] More information about this tool can be found at (Shapiro & Waupotitsch, n.d.).

Slope and aspect are variables that have the same meaning in all parts of the research area. A 10° slope is a steep slope, whether you are in the flat parts of the Netherlands, or in the more mountainous terrain of the Ardennes. Similarly, a 180° aspect means that that side of the hill is south facing, wherever you are in the research area. However, elevation values do not have the same meaning in the entire research area. A value of 20 meters represents quite a high hill in The Netherlands, while in Germany, the bottom of the Rhine valley is already 150 meters above sea level. This makes it impossible to compare elevation value between different parts of the research area one-to-one. In order to compare them, some kind of 'relative' elevation value, compared to the surrounding area, has to be used, instead of an absolute value. It would be very useful to see how high cemeteries are placed in the landscape: at the bottom of a hill, halfway up the hill, or at the top.

Relative elevation values were generated by using neighbourhood statistics, with the r.neighbors tool[2]. For each raster cell in the map, the minimum value within a radius of 250 meters was gathered in a 'minimum value' map. The same was done for the maximum value in the specified radius, to create a 'maximum value' map. This radius was chosen because it corresponds to 10 map cells, and I think it is a reasonable approximation of the direct environment of a location where even small differences in elevation will be noticeable. Using these two maps, and the DEM, a relative elevation map could be calculated. This was done using the following formula: Relative elevation = (Original elevation – (minimum value + maximum value – Original elevation)) / (maximum value – minimum value).

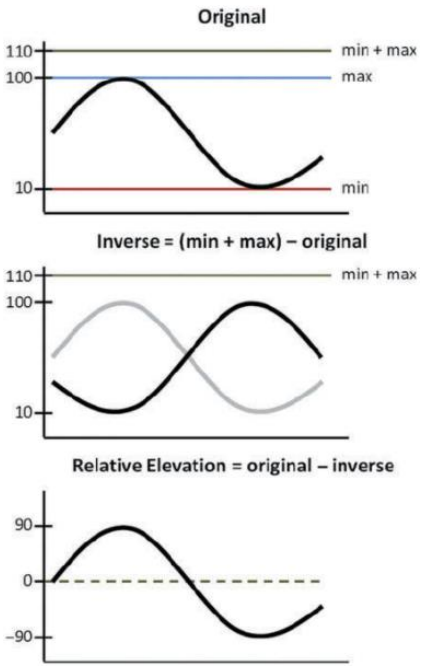

Figure 3.4: Illustration of the first part of the formula used to calculate the relative elevation value. In the second part of the formula, the relative elevation value as shown above, is divided by the difference between the minimum and maximum value. Source: Miller 2014, p. 169.

The formula consists of three parts and is based on the formula described by Miller (2014). First the 'inverse' is calculated (see Figure 3.4): the cell elevation is

[2] More information about this tool can be found at (Shapiro & Clemets, n.d.).

subtracted from the maximum and minimum neighbourhood values combined. Next this inverse is subtracted from the elevation value of the cell, which gives a relative elevation. A last step was added, in which the result of the above was divided by the difference between the maximum and minimum values. In this way a value is created between -1 and 1, where a negative value indicates a low elevation within the neighbourhood, and a positive value indicates a high elevation within the neighbourhood (Figure 3.5).

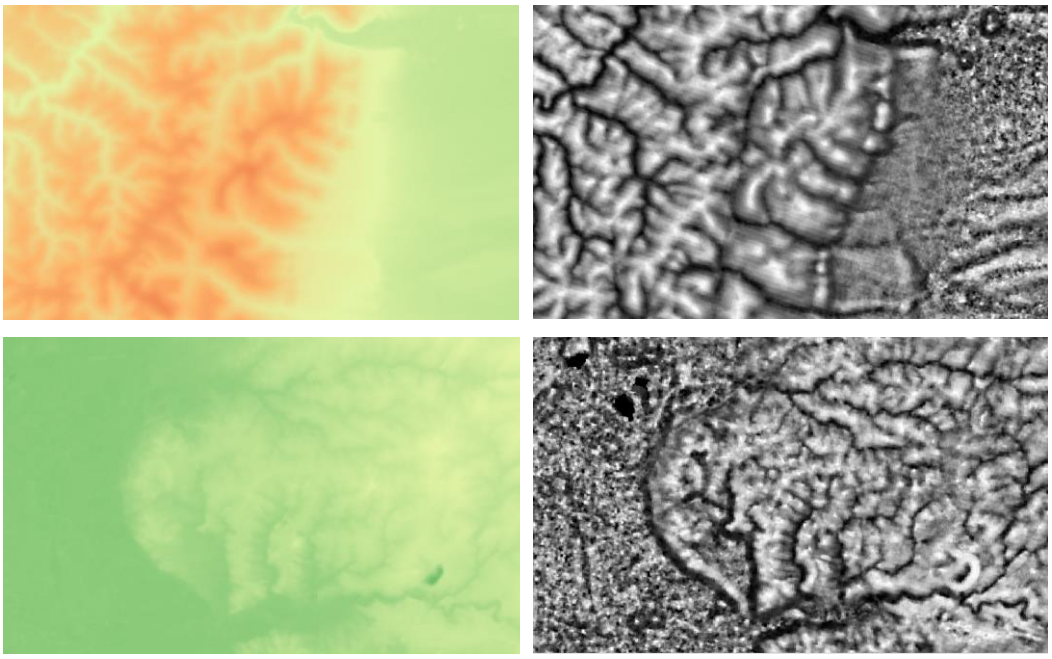

Figure 3.5: A comparison of two areas with very different elevation ranges. The upper images show a relatively mountainous area near Speyer, Germany, with an elevation range of 120 – 650 m. The lower images show a less mountainous area near Düsseldorf, Germany, with an elevation range of 40 – 180 m. The images on the left show the absolute elevation values, the images on the right show relative elevation values, according to the formula described above. (Figures: BvH, elevation data from: NASA Shuttle Radar Topography Mission (SRTM) (2013)).

For each cemetery, the value of the cell it is located in was sampled from each of the maps and added to a table with all the data (Appendix 1). As a last step, the aspect values were converted into 5 categories: one for each cardinal direction (north, east, south, west) and one 'flat' category, according to the values in Table 3.1 (see also Figure 3.3).

Table 3.1: The aspect values that correspond to each direction

Aspect value (degrees)	Direction
<0	flat
0-45; 315-360	north
45-135	east
135-225	south
225-315	west

3.4 Chronological subdivision

The sites in the dataset have dates spanning from the early 5th to the 8th century. During this period a lot of changes occurred, for example in the political situation in the Northern Gaul, but also in the burial ritual (see for example Theuws (2019b)). In order to investigate if these changes are visible in the location choice for cemeteries, the cemeteries in the dataset were grouped into three chronological phases: Early, Middle and Late Merovingian. After the relative elevation, slope and aspect were analysed for the entire dataset, they were also analysed for each chronological phase. This analysis is based on the begin date for each cemetery, as this is the moment when the location was chosen. Quite a number of cemeteries continued on into later periods, but this has not been analysed, as their location was chosen at their begin date.

Making the chronological subdivision was not as straightforward as it may seem. The cemeteries in the database are dated using different typo-chronologies for each region, according to which finds from the cemetery are dated. Based on the dates for these finds, the begin and end phase for the cemetery have been inferred. The typo-chronological systems used to date the cemeteries were developed by Siegmund for the Lower Rhine, Ament and Franken AG for the Rhineland, and Legoux et al. for Northern France.

The use of different chronological systems means that the phases given for each cemetery do not necessarily line up with each other, as the developments that the phases are based on may have taken place in a slightly different timespan for each region. To overcome this, each phase listed in the dataset was given a rough indication of the years it corresponds to, using the comparisons by Nieveler & Siegmund (1999, p. 8) and Friedrich (2016, p. 133). Three larger chronological groupings were made based on those years, as can be seen in Table 3.2 and Figure 3.6. The Early Merovingian period lasted from the fifth century to 530, the Middle Merovingian Period from 530 to 610, and the Late Merovingian Period from 610 to the eighth century. The spatial distribution of Merovingian cemeteries from each of these three periods is shown in Figures 3.7 to 3.9.

Table 3.2 Division of typochronological phases into three periods.

Period	Ament	Franken AG	Siegmund	Legoux et al.
Early Merovingian	AM I	RL1-3	NR1-3	PM-MA1
Middle Merovingian	AM II-III	RL4-6	NR4-7	MA2-3
Late Merovingian	JM I-III	RL7-10	NR8-11	MR1-3

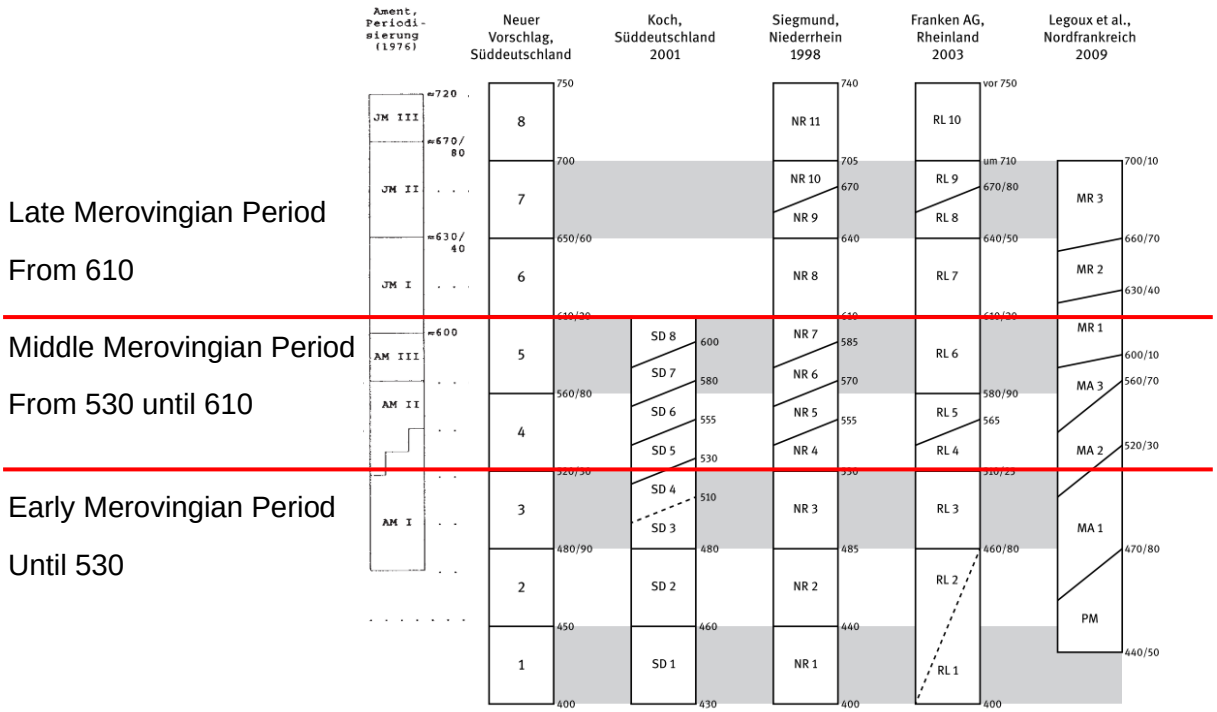

Figure 3.6: Combination of typo-chronological phases used in this research (Figure: BvH, based on: Friedrich (2016, p. 133); Nieveler & Siegmund (1999, p. 8)).

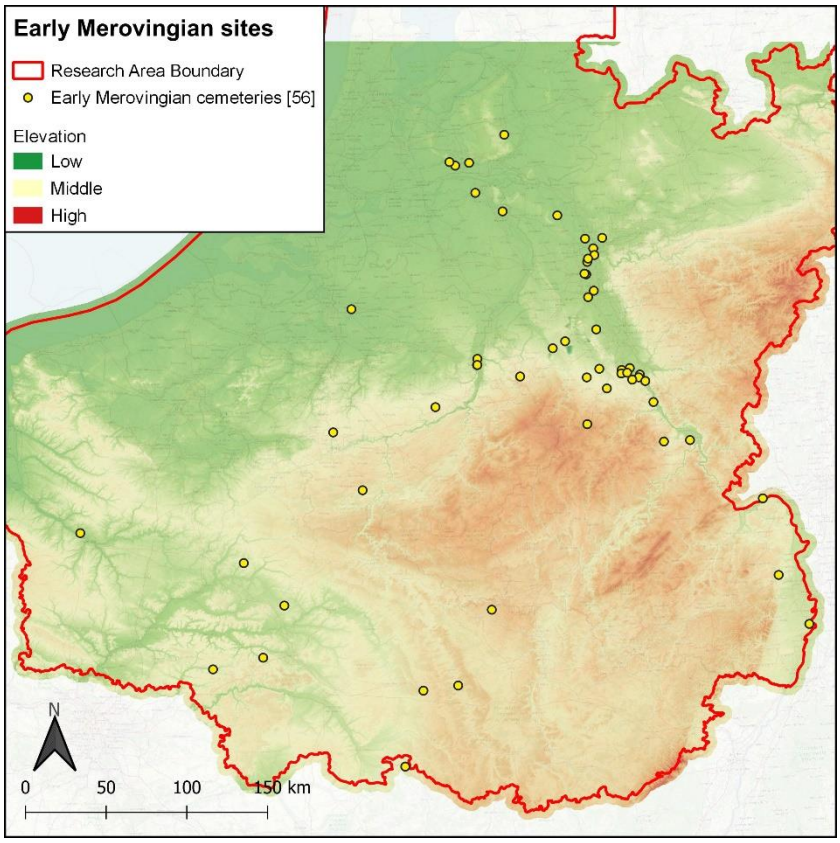

Figure 3.7: The spatial distribution of all Early Merovingian cemeteries (n=56) (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

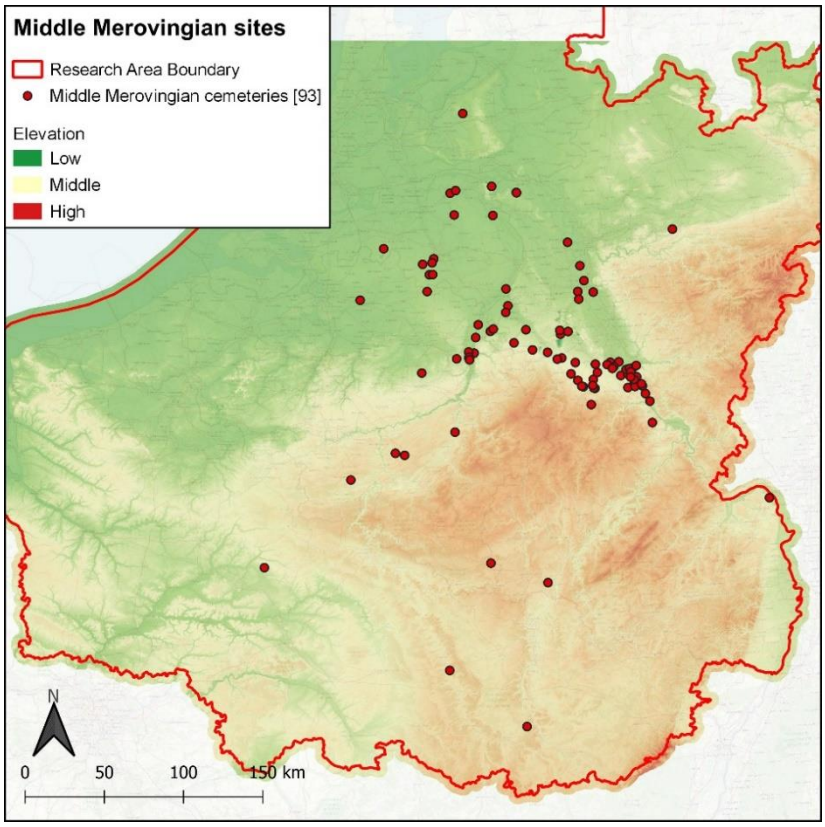

Figure 3.8: The spatial distribution of all Middle Merovingian cemeteries (n=93). (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

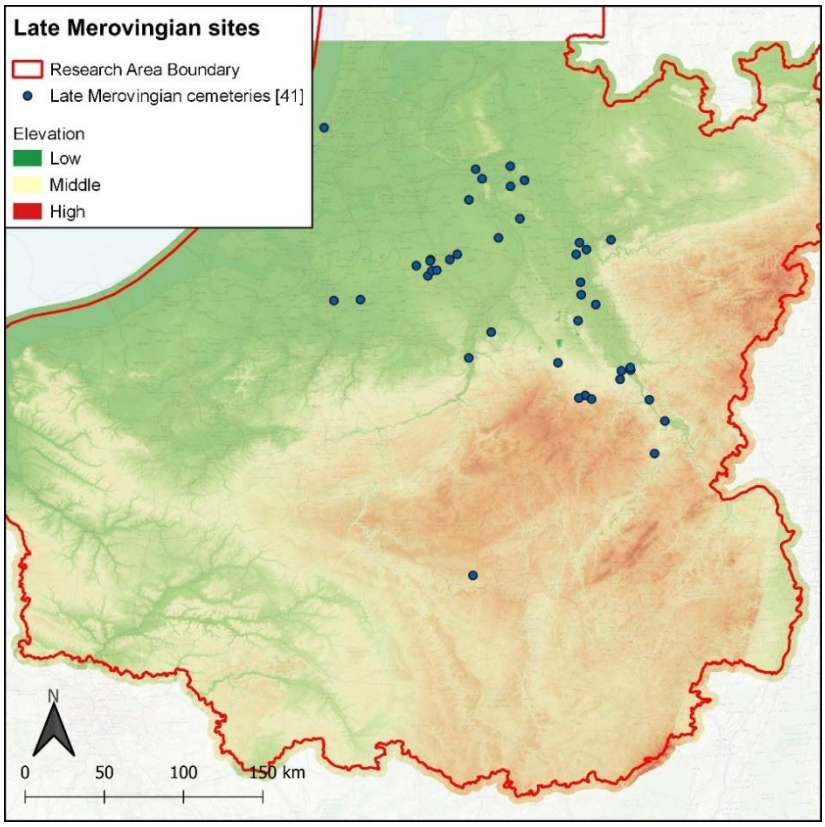

Figure 3.9: The spatial distribution of all Late Merovingian cemeteries (n=41) (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

Chapter 4: Results

In this chapter the results will be described from the elevation, slope and aspect analysis as described in the previous chapter. First the distribution maps for each variable will be discussed. Then the results will be shown per variable in diagrams, first for all selected sites combined, then divided per sub-period, according to the chronological subdivision described in the previous chapter.

A total number of 190 sites are included in the analysis. The sites are distributed throughout the entire research area, though there are some areas with a much higher concentration of sites than the rest of the research area, as can be seen in Figure 3.1.

Below are the distribution maps for each variable (Figures 4.1 to 4.3). Clear regional differences or patterns in the distribution of the variables are not immediately visible. Cemeteries on steep slopes or at relatively high elevations

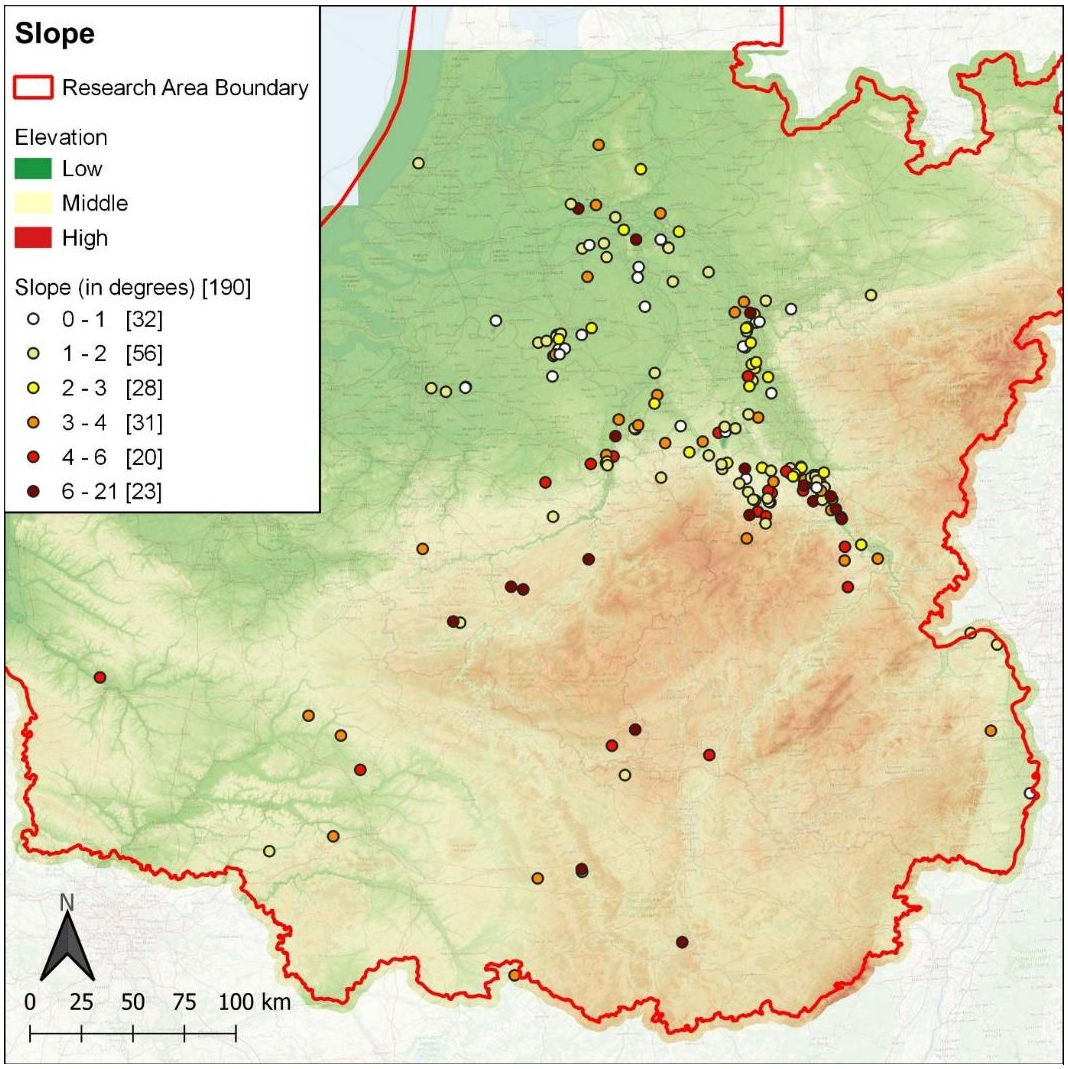

Figure 4.1: A distribution map of all cemeteries with their slope gradients (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

occur everywhere, also in the flatter or lower lying parts of the area, just as cemeteries on gentle slopes or at low elevations occur in the mountainous parts of the research area. The directions of the hillslopes (aspect) are also quite evenly spread over the research area, although they do seem to correspond to the orientations of the river or stream valley, if the cemetery is located in one.

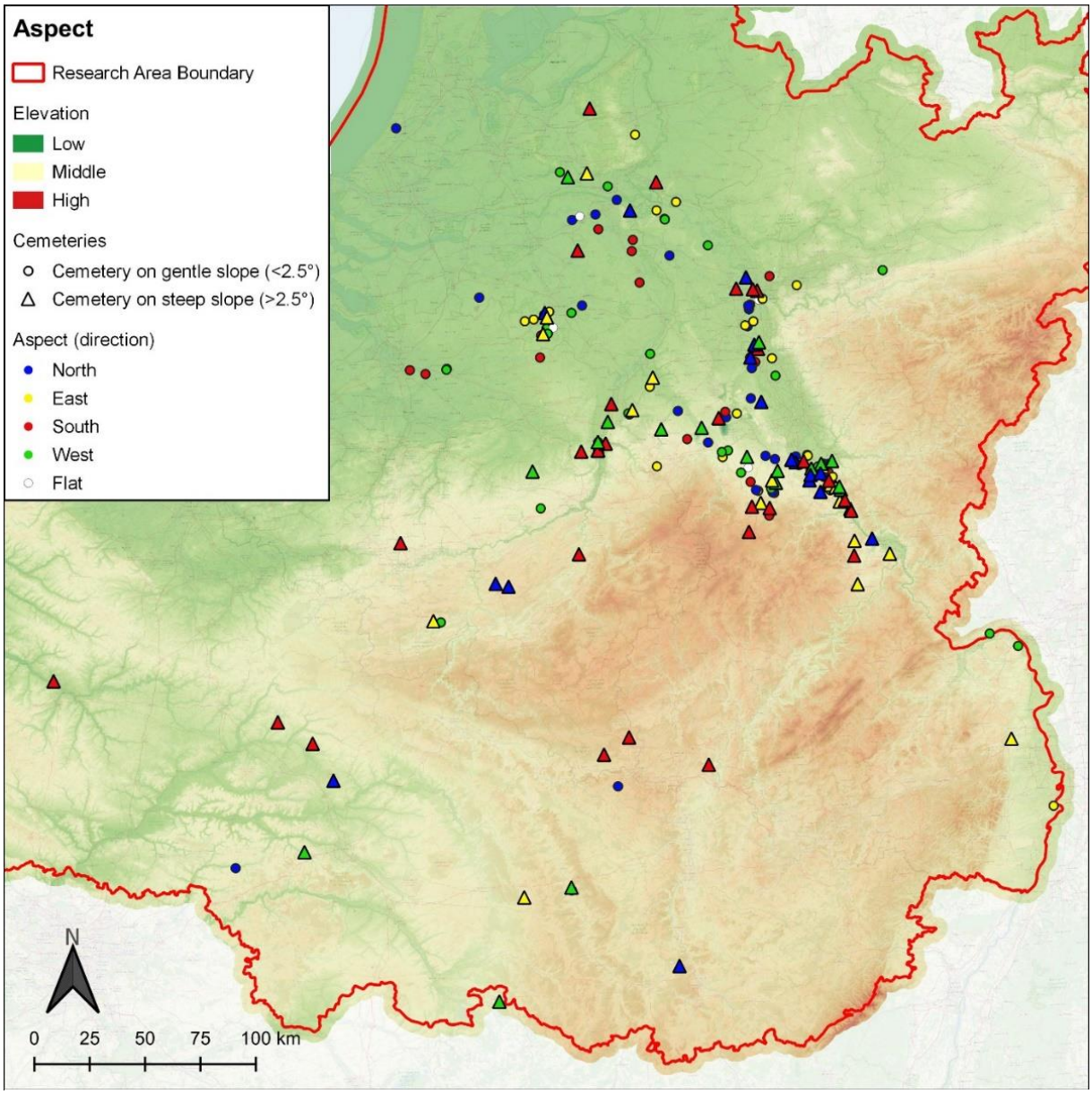

Figure 4.2: A distribution map of all cemeteries with their orientation, divided into cemeteries on hillslopes steeper and gentler than 2.5° (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

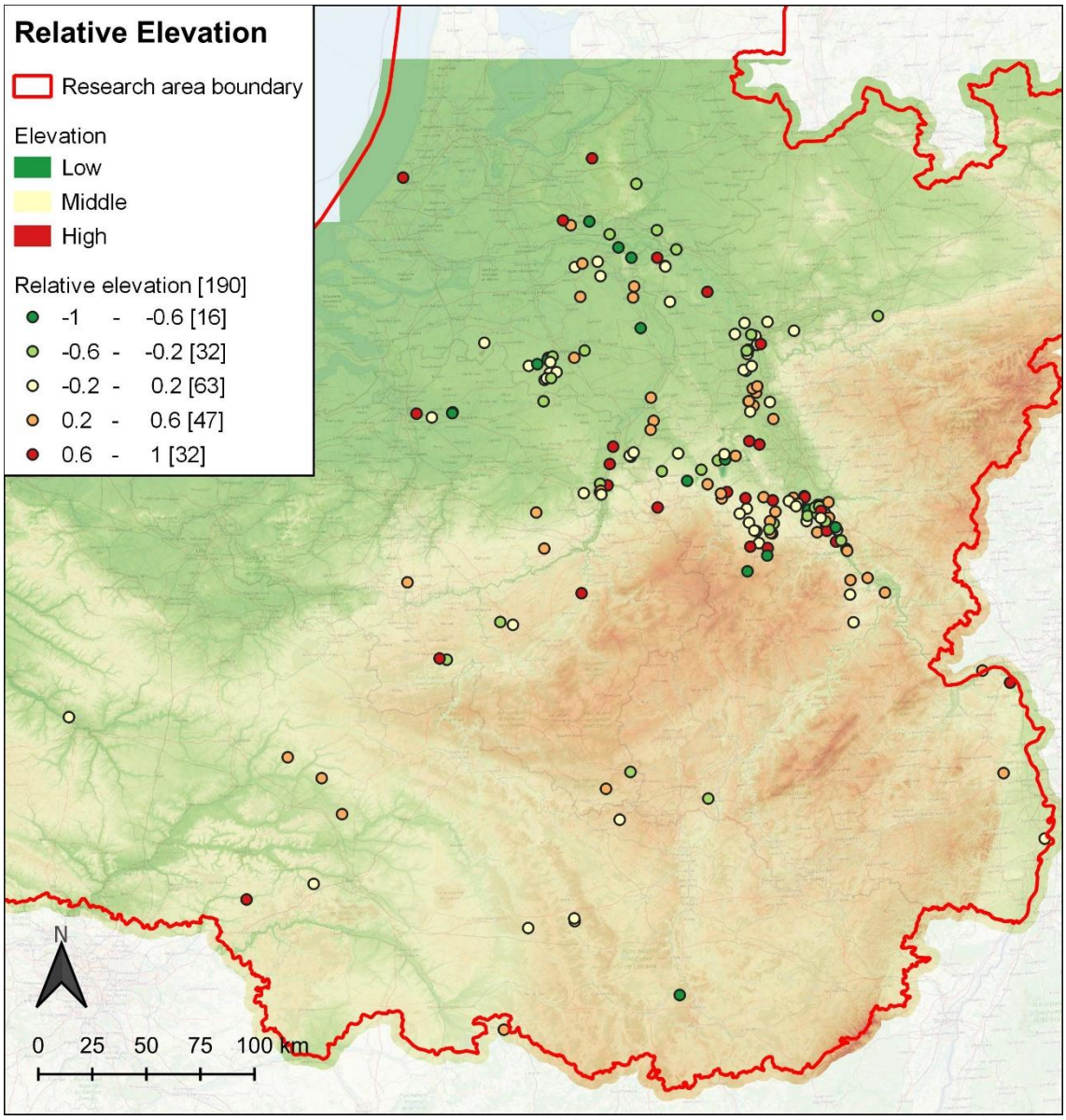

Figure 4.3: A distribution map of all cemeteries with their relative elevation values (Figure: BvH, based on dataset 2021 – Rural Riches project; NASA SRTM (2013); OpenStreetMap (n.d.)).

4.1 Slope

The slope gradient values for all 190 cemeteries have been compiled in a graph (Figure 4.4), with the degree of slope on the horizontal axis and the number of cemeteries on the vertical axis. The slope distribution graph shows a clearly uneven distribution. Most cemeteries are located on hardly or only gently sloped terrain. The steeper the slope, the fewer cemeteries there are. 147 of the 190 cemeteries (77%) are located on slopes with a gradient of less than 4°. On the steeper slopes, the number of sites per degree declines rapidly, although there are even some sites on slopes steeper than 10°.

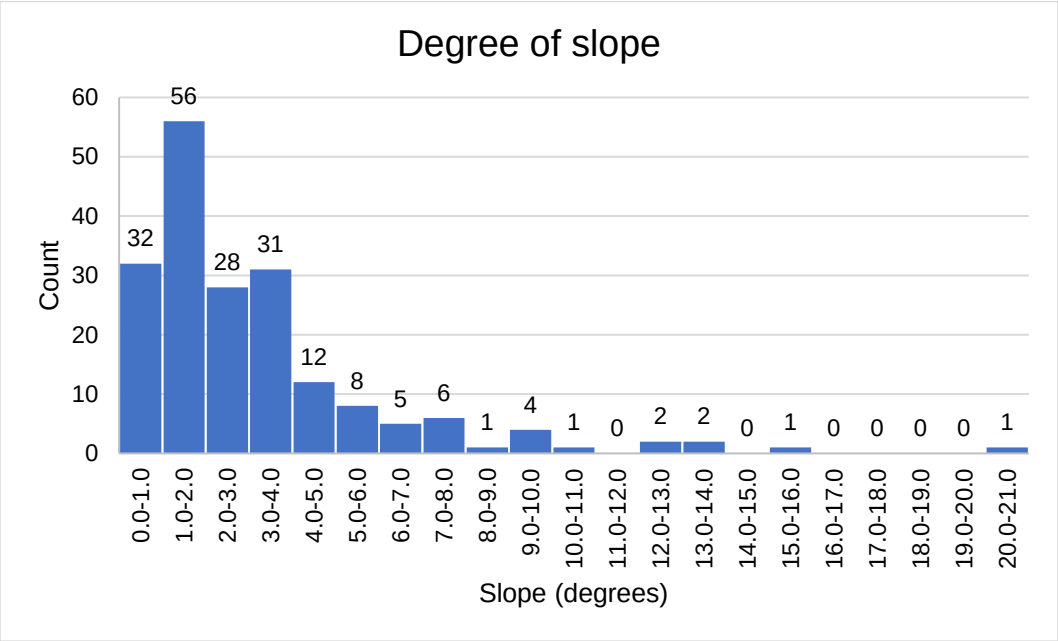

Figure 4.4: A graph of the slope distribution of all selected Merovingian cemeteries in the research area (n = 190).

Figure 4.5 shows a graph of the slope values of all cemeteries when they are grouped into 4 categories of steepness. As will be further discussed in Chapter 5, it is hard to translate the exact slope gradient values into subjective categories, such as ‘gentle’ or ‘steep’. Therefore four broad categories were made here, from ‘level or little slope’ to ‘(very) steep’, based on general slope classifications that can be found on the internet (for example: *Slope Gradient - Agriculture and Agri-Food Canada (AAFC)*, n.d.).

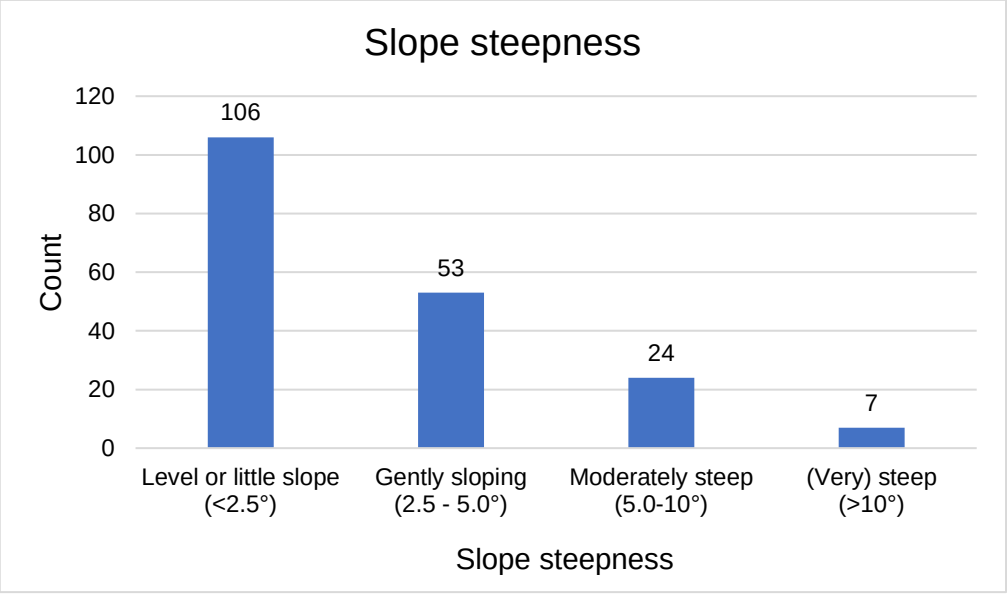

Figure 4.5: All Merovingian cemeteries divided into four classes of slope steepness.

After this general overview of the entire Merovingian Period, the slope values will now be shown per subperiod. Figures 4.6, 4.7 and 4.8 show the slope values for all cemeteries for the Early (n=56), Middle (n=92) and Late (n=41) Merovingian Period respectively, in similar graphs to Figure 4.4.

Overall, there seem to be no large differences between the three subperiods. In all three graphs, the distribution is similar, with by far most cemeteries being located on (very) gentle hillslopes. However, there are some minor differences between the periods.

The Middle Merovingian Period is the period within which all cemeteries on (very) steep slopes fall. This may be explained by this period also containing a much larger proportion of the total number of cemeteries, making it more likely that the steeper ones belong to this period.

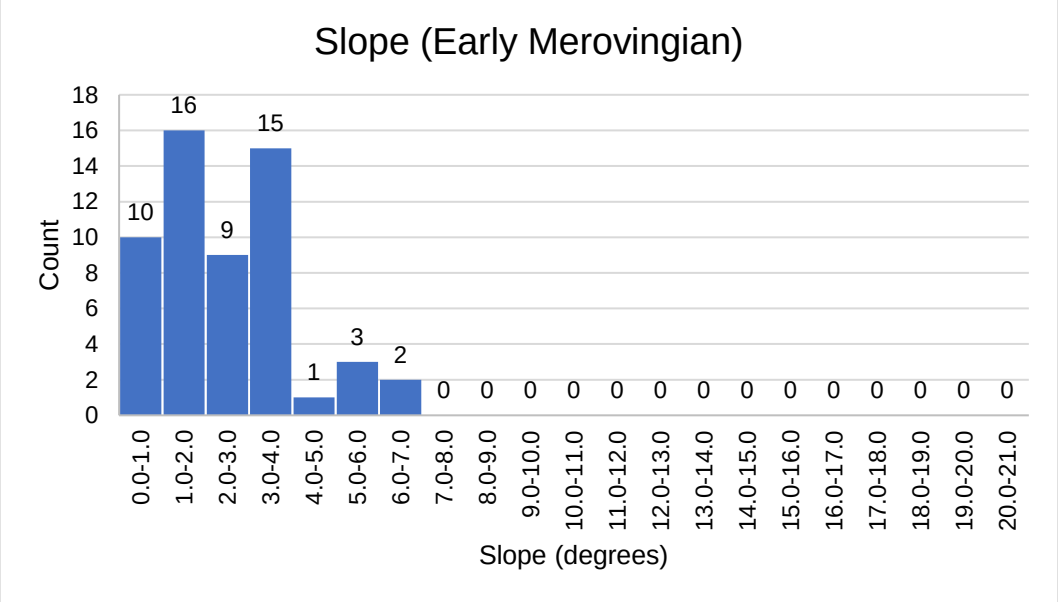

Figure 4.6: A graph showing the cemetery count per degree of slope, for all Early Merovingian cemeteries (n = 56).

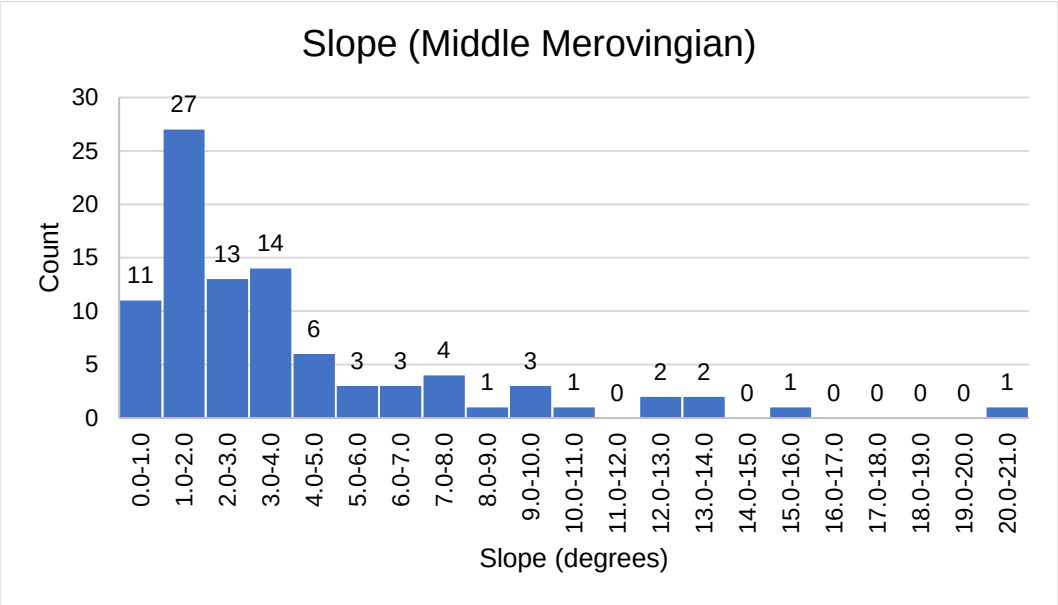

Figure 4.7: A graph showing the number of cemeteries per degree of slope, for all sites from the Middle Merovingian Period (n = 92).

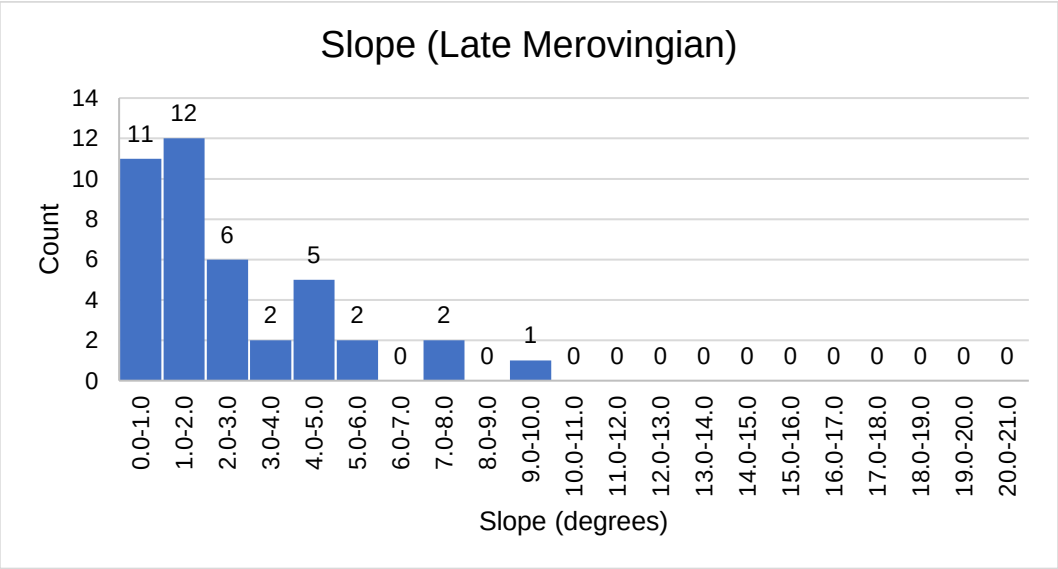

Figure 4.8: The slope distribution of all Late Merovingian cemeteries (n=41), per degree of slope.

Another difference is more subtle and is most clearly visible when directly comparing the graphs for the Early and Late Merovingian Periods (Figure 4.9). The proportion of cemeteries on ‘gentle’ slopes is much higher in the Early than in the Late Merovingian Period. In the Late Merovingian Period, the proportion of sites on ‘flat or little slope’ is slightly higher than in the Early Merovingian Period. The small sample sizes for both subperiods may have overemphasised this difference, however, as just a small number of sites can already change this image.

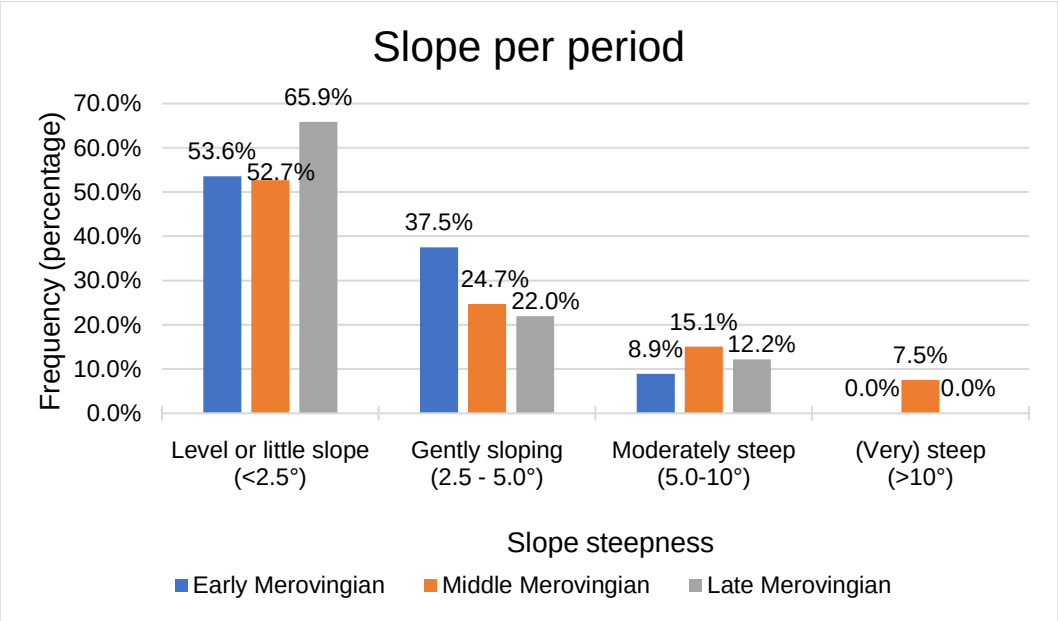

Figure 4.9: Graph showing the slope categories of all cemeteries per sub period, as a percentage of the total number of cemeteries in that period.

4.2 Aspect

When the aspect values of all cemeteries are plotted in a graph (Figure 4.10A), their distribution is (almost) completely equal. There are hardly any differences between the directions. As aspect signifies the direction the hillslope is facing, it is a more important characteristic for steeper gradients, as it is more noticeable there. However, as shown in the previous section about the slope distributions of the cemeteries, most of them are actually located on very gentle slopes on which

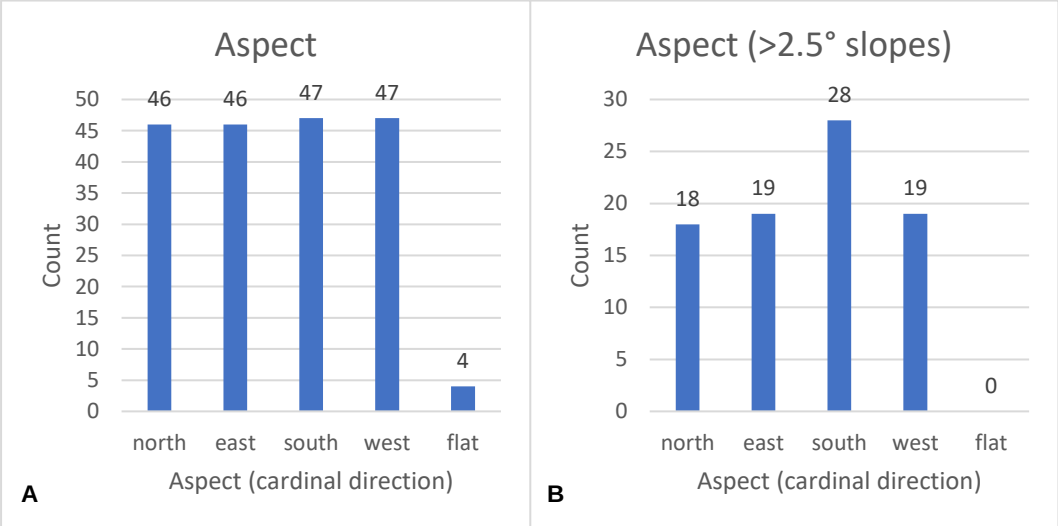

Figure 4.10: Graph A shows the aspect values for all sites (n = 190) as cardinal directions (cf. Table 3.1). Graph B shows the aspect values (cardinal directions) for all sites with a slope steeper than 2.5° (n = 84).

aspect is probably not a factor to consider (see also Figure 4.11). Therefore, another graph was created (Figure 4.10B), in which all aspect values for sites with a slope value of less than 2.5° were removed. In this graph, there is clearly a larger number of sites on a south-facing slope than on slopes facing other directions.

Between the Early, Middle and Late Merovingian period (Figures 4.12 to 4.14, next page), there are no big differences in the aspect distributions. Generally speaking, southern slopes tend to be favoured when the slope is significant (>2.5°). However, this tendency is very dependent on the exact slope value chosen for this significance turning point. A slightly higher value can already drastically decrease the sample size, which makes it hard to draw conclusions.

The differences between the periods are minimal, and may often also be ascribed to the limited sample sizes that remain after removing the cemeteries with very gentle slopes. Still, the occurrence of cemeteries on north-facing slopes seems to be lower during the Early Merovingian, compared to the Middle and Late Merovingian.

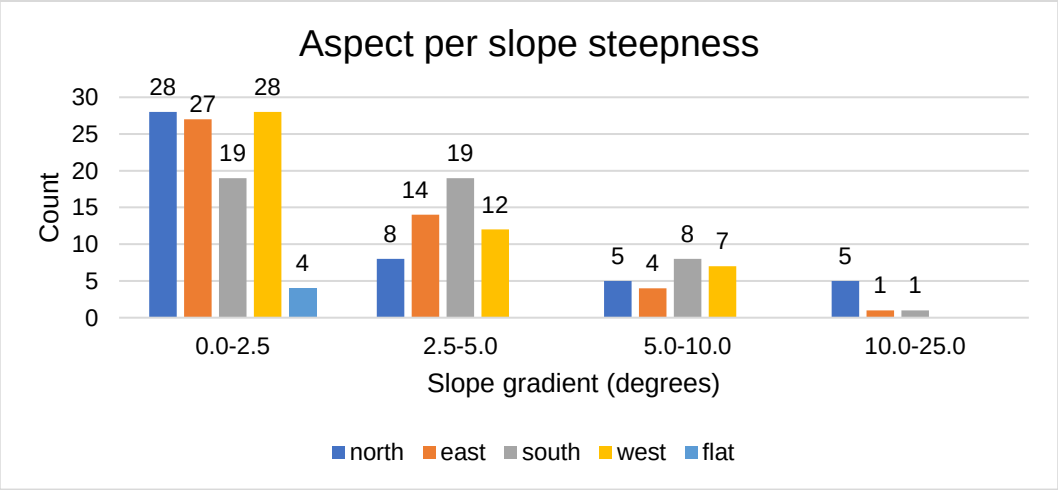

Figure 4.11: The number of cemeteries per slope direction, grouped based on the steepness of the slope.

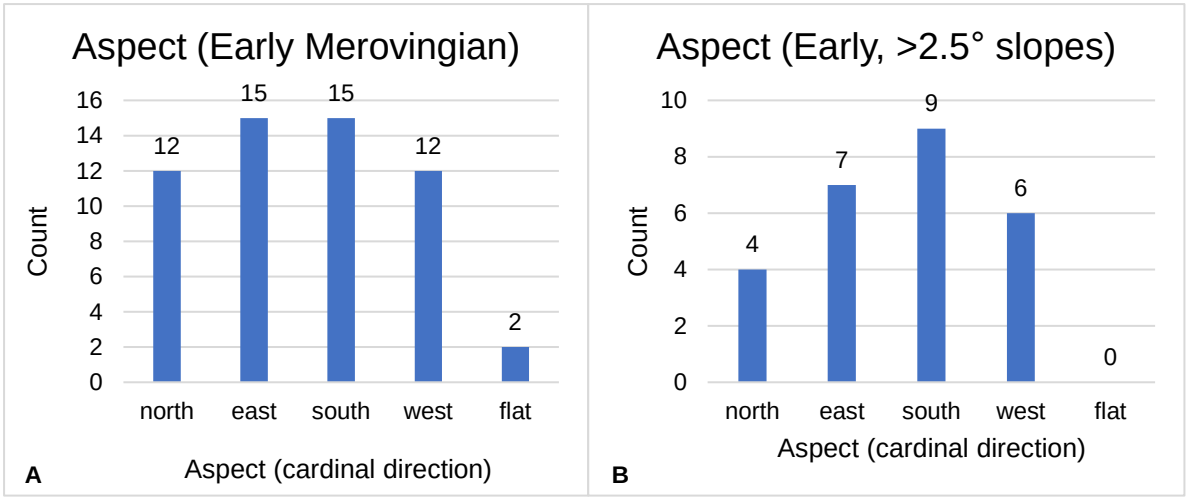

Figure 4.12: Graph A shows the aspect distribution of all Early Merovingian cemeteries (n=56). Graph B shows the aspect distribution of all Early Merovingian cemeteries with a slope steeper than 2.5° (n=26).

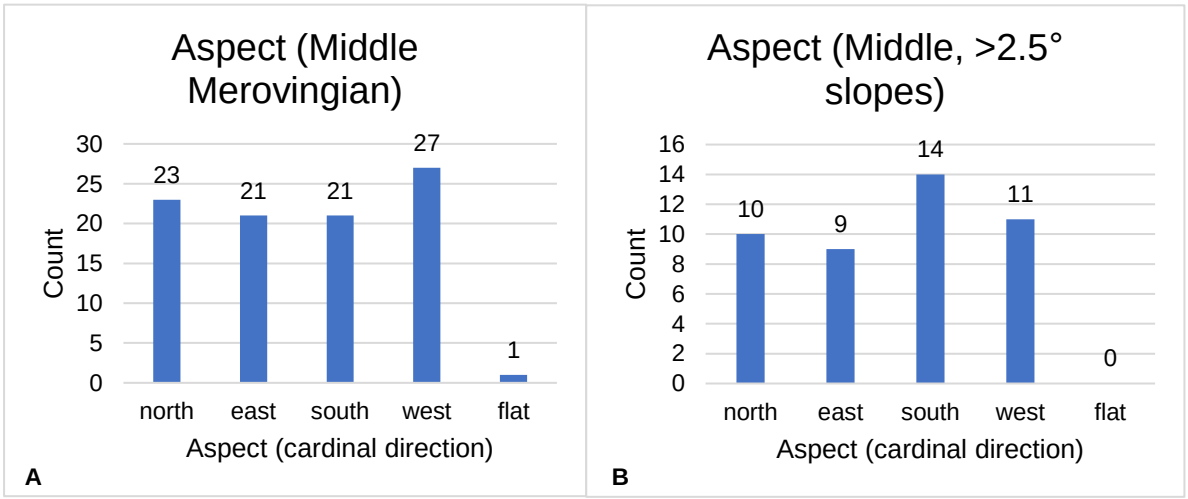

Figure 4.13: Graph A shows the aspect distribution of all Middle Merovingian cemeteries (n=92). Graph B shows the aspect distribution of all Middle Merovingian cemeteries with a slope steeper than 2.5° (n=44).

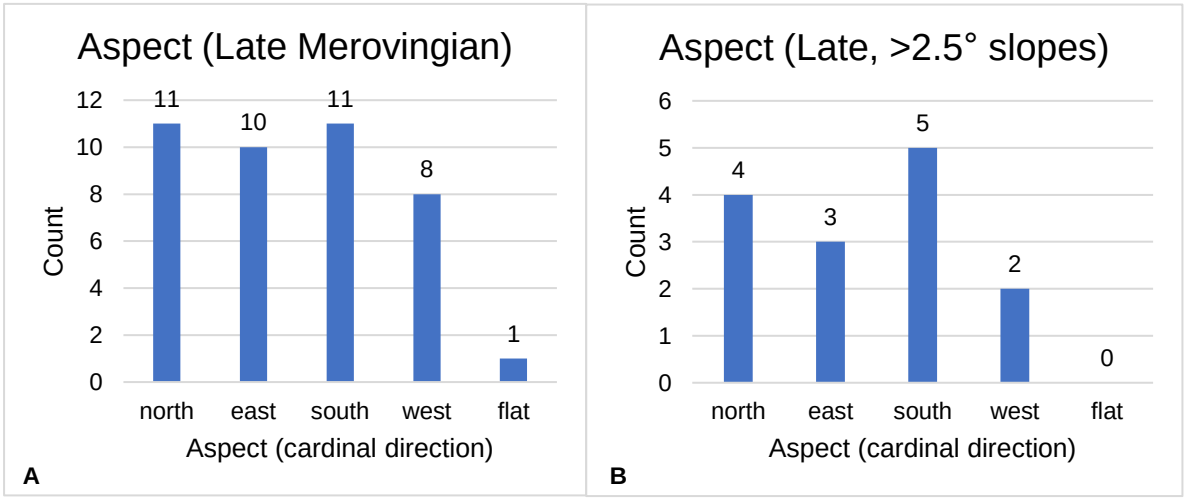

Figure 4.14: Graph A shows the aspect distribution of all Late Merovingian cemeteries (n=41). Graph B shows the aspect distribution of all Late Merovingian cemeteries with a slope steeper than 2.5° (n=14).

4.3 Relative elevation

The relative elevation values for all sites as calculated according to the formula explained in the previous chapter can be seen in Figure 4.15. Many sites have an elevation that is not much higher or lower than their surroundings, resulting in values around 0. The values for the other sites show that, although there are both cemeteries located at a lower and at a higher elevation than their surroundings, there are considerably more of the latter. 40 sites have a value lower than -0.24, whereas 69 have a value higher than 0.24. This means that generally there are more sites situated at 'high' locations in the landscape, such as on or near hilltops, than at 'low' locations such as near the bottom of a valley.

The absence of cemeteries at the absolute lowest places in the landscape can be explained by those places often being at or very near rivers or streams, which makes them unsuitable because of the risk of flooding and soils generally being too wet.

The relative elevation values for the Early Merovingian cemeteries (n=56; Figure 4.16) show a clear tendency towards higher values. There are only a few cemeteries lying in 'low' parts of the landscape, while most are at average or high elevations.

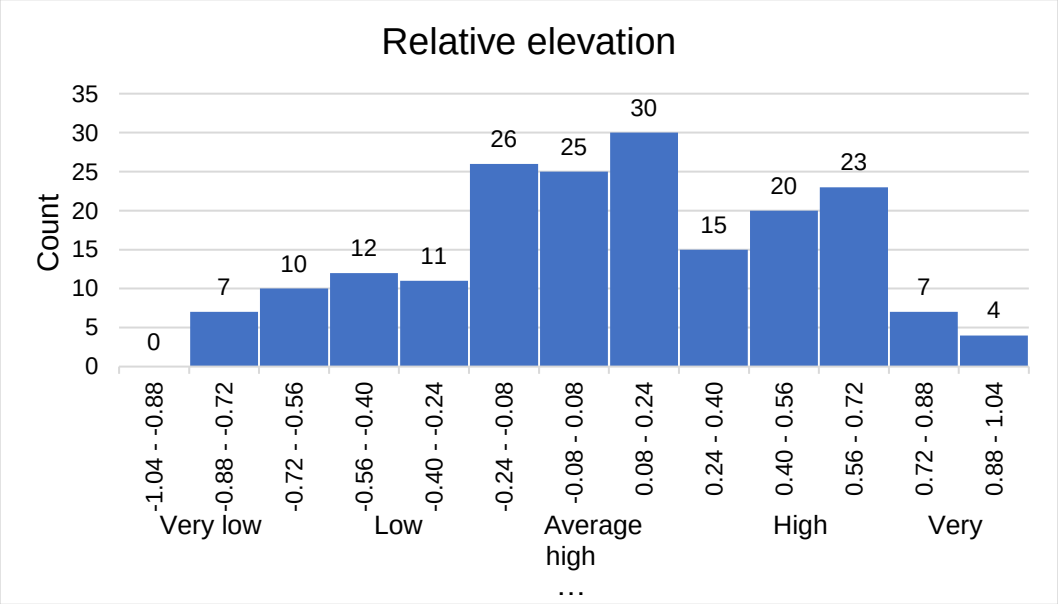

Figure 4.15: A graph showing the 'relative elevation' of all cemeteries (n = 190).

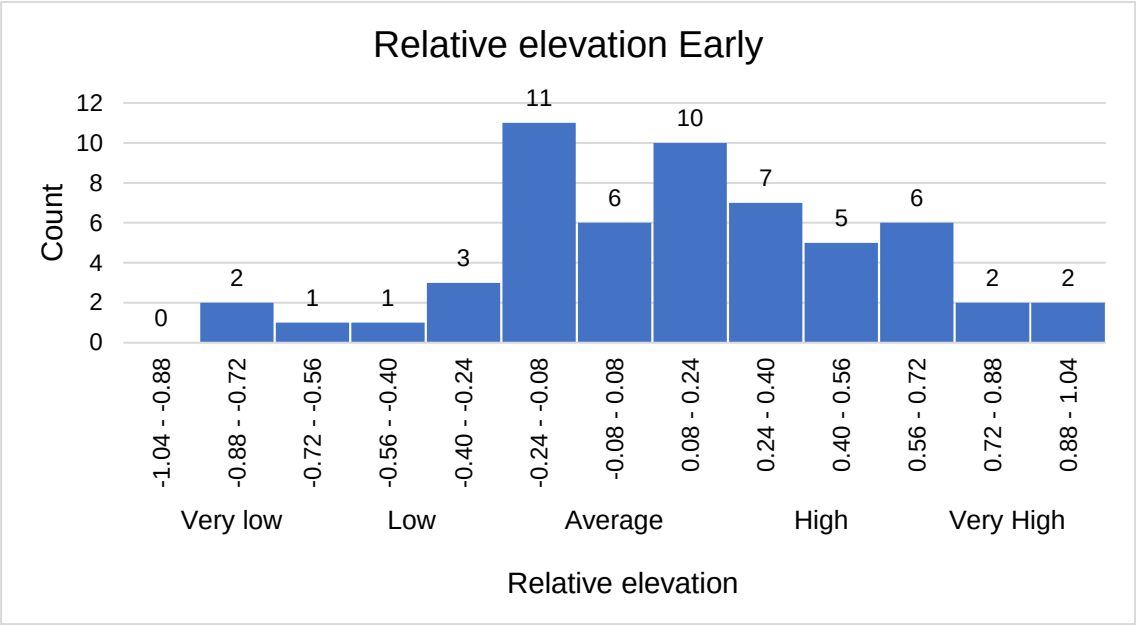

Figure 4.16: The relative elevation values for all Early cemeteries (n=56).

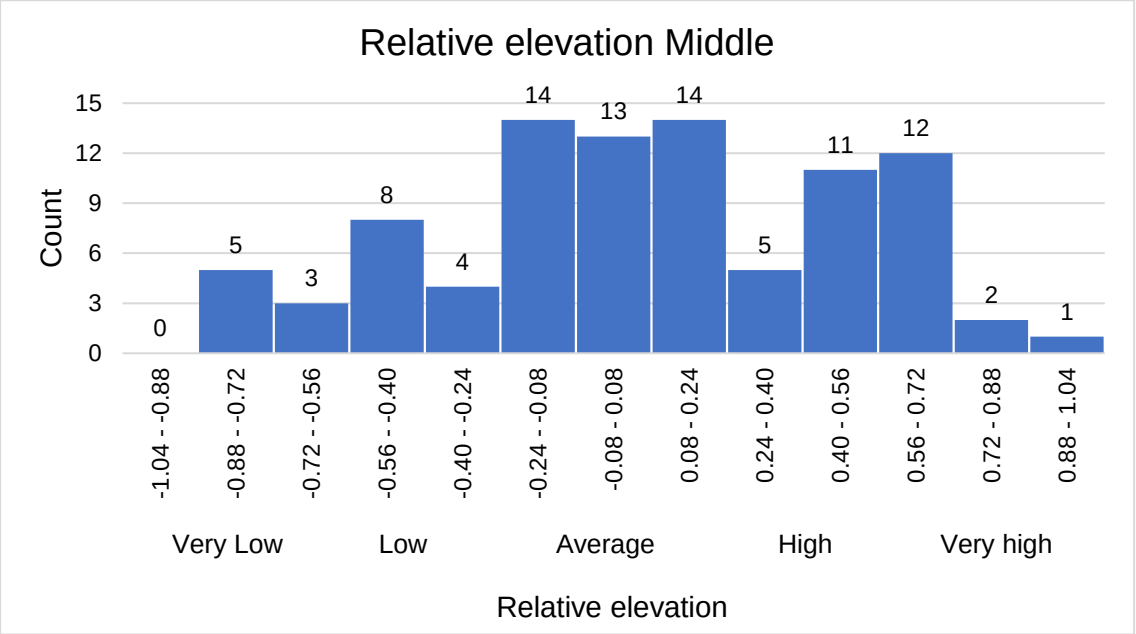

Figure 4.17: The relative elevation values for all Middle Merovingian cemeteries (n=92).

Among the Middle Merovingian Period cemeteries (n=92; Figure 4.17), the tendency towards higher places is not as clear as in the Early Merovingian period. There are cemeteries both above and below the average elevation, although there are still slightly more above than below.

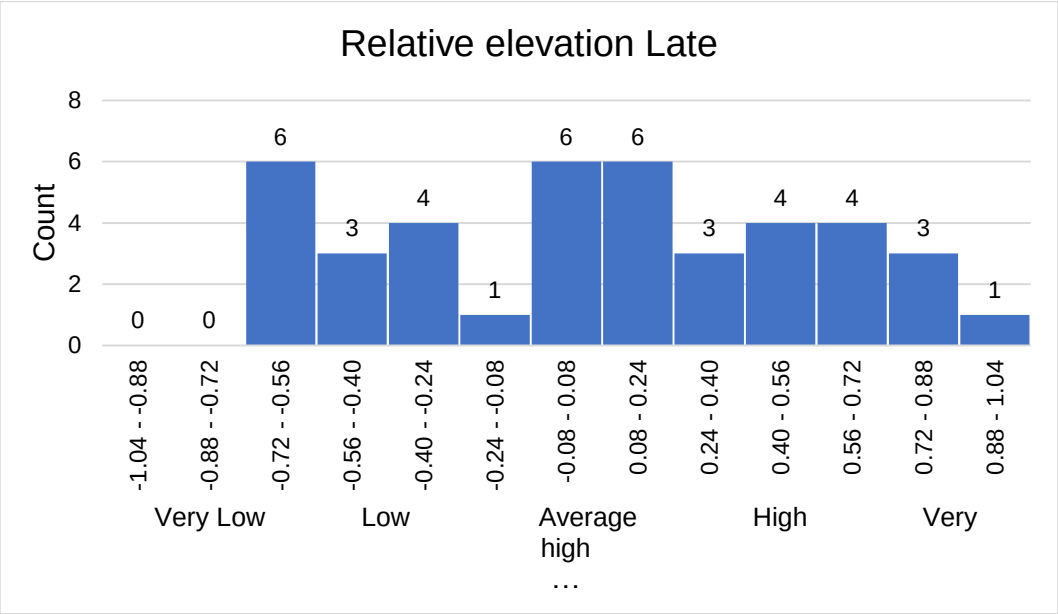

Figure 4.18: The relative elevation values for all Late Merovingian cemeteries (n=41).

In the Late Merovingian period (n=41; Figure 4.18), there are almost as many cemeteries in ‘high’ places as there are in low places, with 13 low-lying versus 15 high-lying cemeteries (with a relative elevation value lower than -0.24 or higher than 0.24, respectively).

From the graphs shown above, it seems that most cemeteries are located neither at very high, nor at very low positions, but somewhere in the middle. However, more cemeteries tend to be situated at higher than at lower positions, in comparison with the surrounding landscape. This difference is strongest in the Early Merovingian period, and becomes less evident in the later periods. In the Late Merovingian period a substantial proportion of cemeteries can be found at ‘low’ locations, though there are still slightly more cemeteries at ‘high’ locations.

4.4 Conclusion

The analyses resulted in some potentially interesting patterns. Most Merovingian cemeteries seem to have been located at locations with very gentle slopes. In the Early Merovingian Period these slopes were somewhat steeper than in the Late Merovingian Period.

Regarding aspect, no clear preference for a specific direction was visible. However, when cemeteries on very gently sloped terrain were removed from the comparison, significantly more appeared to be located on south-facing slopes.

From the Relative elevation analysis, it appears that most cemeteries are located about halfway up the hill, although there are more cemeteries at higher positions than at lower positions. This difference is largest in the Early Merovingian period, and becomes smaller in the later periods.

Chapter 5: Discussion

In this chapter I will first discuss the results of the analyses shown in the previous chapter. For each analysed variable, I will give an overview of the most important observations and try to explain them with the help of other studies discussed in chapter 2. After that I will critically review the methodology used in this study, to show which limitations and biases it involves, how these could be mitigated, and how this study can be expanded to include more different variables.

5.1 Interpretation of the results

5.1.1 Slope

In the previous chapter the slope values for all sites were shown (Figures 4.4 to 4.9). In general, cemeteries are located on gentle slopes, and the steeper the slope, the fewer cemeteries there are. Especially on slopes steeper than 5 degrees, the number of cemeteries declines rapidly. There are some minor differences between the three subperiods, but they do not seem substantial. The largest difference is that cemeteries in the Early Merovingian Period seem to occur slightly more often on the 'gentle' slopes, compared to the later periods, while during the Late Merovingian Period more cemeteries were located on 'level or little slope' terrain.

In order to explain these observations, it is necessary to get a feeling for what these slope angles mean. Slopes can be measured in degrees and in percentages, which both give different values: 1 degree of slope corresponds to about 1.75 percent.[3] The slope percentage is the vertical change (in metres) for every 100 horizontal metres. For example, a slope of 16% means that the elevation increases with 16m for every 100m of horizontal distance.

In percentages, it is somewhat easier to imagine how steep a slope is than in degrees, but it is still hard to define from what percentage onwards a slope can be considered as 'too steep'. From around 5 degrees (8.7%) onwards, the number of cemeteries quickly declines, which could indicate that slopes steeper than that were not considered very suitable to build a cemetery on. This steepness is quite sizeable, and it would take quite some extra effort to walk up

[3] This can be calculated using the following formula: $\alpha' = 100 \times \tan(\alpha)$, where α' is the slope percentage and α is the slope angle in degrees.

such a hillslope. However, there can be many other reasons as well as to why steeper slopes were hardly used, of which I will discuss two major ones here.

One reason is the amount of work required when burying people on sloped terrain. Carrying materials and the dead body up or down a steep slope takes a lot more effort than in a level area. Additionally, the grave would have to be deeper when dug into a hillslope, as also the lowest part of the slope has to be deep enough to cover it again (assuming the grave itself is level).

The second reason is soil erosion. The steepness of a slope is an important factor in soil erosion, together with other factors such as the amount of rainfall, the erodibility of the soil, the amount of vegetation and the land use (Fournier, 2011, pp. 7–15). Due to the large number of factors influencing the rate of erosion, it is unfeasible to determine the erosion rate for the entire research area here. However, in general the steeper (and longer) the slope, the more erosion takes place (Fournier, 2011, p. 9). This means that cemeteries on steep slopes would have been subject to significant soil erosion, which would have been a problem, just as it is for agriculture. If a lot of soil erodes from the surface of the cemetery for a long enough time, the graves could potentially be uncovered. Therefore, it was probably important to avoid erosion as much as possible.

5.1.2 Aspect

The aspect values shown in the previous chapter (Figures 4.10 to 4.14) seemed to be distributed equally. When looking at all sites together there are only minor differences between the occurrence of each cardinal direction.

There is one important factor to take into account when looking at the aspect values for each cemetery, which was already mentioned in the previous chapter. For very gentle slopes, their direction will not be as easy to notice, which makes it likely that in these cases, the direction is also not very important. It is difficult, though, to determine from which slope steepness it actually does matter. In the section above we have seen that from slopes with a steepness of 5 degrees, the occurrence of cemeteries becomes increasingly rare. This could indicate that from this value onwards, slopes are often considered too steep to build a cemetery. If this is indeed true, then slopes will probably have been noticeable already when they were a bit gentler.

Maybe we can conclude from the above that aspect will have been important from a few degrees of steepness onwards. If we then only look at the cemeteries on hillslopes steeper than for example 2.5 degrees (which is 4.4%), the image

changes considerably. Now a much larger share of the cemeteries is located on south-facing slopes, while the other directions occur less often.

There are hardly any differences in the aspect values between the Early, Middle, and Late Merovingian Period. For both the aspect distribution for all cemeteries and the distribution for cemeteries on slopes steeper than 2.5 degrees, the distribution for each subperiod and the entire period is very similar. There are some minor differences which can in part be explained by the small sample sizes that remain when looking only at a smaller number of sites.

The relatively high occurrence of south-facing slopes is remarkable. These slopes are often seen as the most suitable for agriculture (at least at the higher latitudes in the northern hemisphere), because they get more sunshine than the northern slopes, and as a result are warmer and drier than north-facing slopes (as shown for example in (Bennie et al., 2008; Boehm et al., 2021, p. 60). This means that cemeteries took up space that was suitable for agriculture. Whether this was a big issue, is difficult to assess. It depends among other things on whether land suitable for agriculture was scarce, and how important it was to build a cemetery at a specific location.

It could be the case that cemeteries were situated on the same hillslope as the corresponding settlement, as was stated by for example Böhner (1958, p. 330) and Périn (1987, p. 20). Because settlements were not included in the current analysis, this is impossible to verify here. But if this is indeed the case, the settlement would be located at a suitable spot for agriculture, which is understandable, and as a result the cemetery as well. In this case it appears that the fact that the cemetery took up valuable land was not a sufficient reason to build it somewhere else. This indicates that the location at which to found a cemetery was not dependent on economic or rational motivations alone.

5.1.3 Relative elevation

The final variable that was shown in the previous chapter was the relative elevation of Merovingian cemeteries. Because absolute elevation values could not be compared between different parts of the research area, a method was used to calculate an elevation value relative to the highest and lowest elevation in the surrounding area (as described in the Methodology section). This method calculates where the elevation value sits between the highest and the lowest elevation values in a radius of 10 map cells (250 metres). In order to be able to compare the values throughout the research area, the final values were

calculated in such a way that they would all be between -1 and 1, where -1 indicates the lowest elevation, 0 indicates an elevation exactly between the highest and the lowest elevation, and 1 indicates the highest elevation in the radius.

In a landscape with only small elevation differences, a small hill will already get a very high relative elevation value, and a small depression will get a very low value. In a landscape with larger elevation differences, a small hill will get a slightly higher value, and a small valley will get a slightly lower value. While this means that elevation in this way is still not completely comparable across the entire research area, it is now possible to say whether cemeteries are located at or near the highest points in the landscape, or at the lowest points, such as the bottom of a valley.

A problem with this way of calculating relative elevation is the high values that are given to small elevation differences if the landscape is very flat, as this generates noise. Small elevation differences are given very high or very low elevation values, while in reality they were probably hard to notice. As a result the relative elevation values in very flat areas, such as large parts of the Netherlands, but also parts of the Rhine valley in Germany, may be somewhat exaggerated.

The graphs in the previous chapter (Figures 4.15 to 4.18) show that most cemeteries do not have a very high or very low elevation, and most are somewhere in the middle. Still there is a sizeable number of cemeteries towards the higher and lower ends. Overall, there are more cemeteries at relatively high elevations than at relatively low elevations (69 against 40 cemeteries with a value of more than 0.24, and less than -0.24, respectively). However, there are considerable differences between the Early, Middle and Late Merovingian periods.

In the Early Merovingian Period there are almost no cemeteries at lower elevations (7 of the 56 cemeteries (13%) with a relative elevation value below -0.24). In the Middle Merovingian Period there are some more (20 of the 92 of the cemeteries (22%)), but in the Late Merovingian Period, a much larger part of the cemeteries is at lower elevations (13 of the 41 cemeteries (32%)). In contrast, the share of cemeteries at ‘medium’ elevations decreases from the Early towards the Late Merovingian Period (with 48%, 45%, and 32% of the cemeteries between -0.24 and 0.24 for the Early, Middle and Late Merovingian Period respectively), while the share of cemeteries at high elevations (>0.24) stays more or less the

same (39%, 34%, and 37%, respectively). It seems that in the course of the Merovingian Period, lower elevations were more and more considered suitable for founding a cemetery. Meanwhile, high elevations did not become considerably less suitable.

Different possible explanations can be given for this change. It could be related to the wider changes around the 7th century, as discussed in Chapter 2. The disappearance of large row-grave cemeteries in particular could be related, as it happens in a similar timeframe. The first row grave cemeteries appeared at the end of the 5th century, and they became less common again during the 7th century, disappearing altogether at the start of the 8th century (Effros, 2003b, pp. 192–193). In the meantime smaller cemeteries started to be used, by smaller communities than before, but in greater numbers (Halsall, 2006, p. 224). These developments are probably part of larger changes in Merovingian society, which also caused the growth of settlements and the occupation of previously uninhabited areas as described by Loveluck (2013, p. 33) and Peytremann (2020, pp. 703–704).

Especially the occupation of previously uninhabited areas could explain the increase in the number of cemeteries at low elevations. At least in France, low-lying places were probably first built at from the second half of the 7th century onwards (Peytremann, 2020, p. 704). It was also from this time that people were buried in different places, with cemeteries in the middle of settlements, but also more isolated graves, many of which were along roads, or at the limits of the built environment (Peytremann, 2020, p. 706). The occupation of new areas could also explain the relative increase in cemeteries on level or very gently sloped terrain. In these newly inhabited areas, it will have been easier to find locations with suitable conditions for cemeteries, and a level or only slightly sloping area may have been preferable.

As for the reason for the broader changes happening from the 7th century, many possibilities have been proposed, as was discussed in Chapter 2 of this thesis. They include population growth, an increase in the power of the elites in society, and new concepts of landholding (Loveluck, 2013, p. 33). The occupation of previously inhabited areas specifically also signifies that these were starting to be seen as more suitable locations for habitation, but also for burial.

This change may have been the result of changing ideas about the suitability of certain locations as a place for a cemetery, but it could also be caused by

changes in the landscape itself. The Merovingian Period was characterised by a colder and wetter climate than in the periods before and after. This is shown by evidence from south-eastern France for an increase in precipitation in the Early Middle Ages, roughly from the 5th to the 8th century, which together with evidence from Italy, Denmark and Germany, indicates that the climate was wetter and colder across (Western) Europe (Cheyette, 2008, pp. 160–161).

As a result of this worse climate, especially the increase in precipitation, many low-lying areas will have been unsuitable for habitation due to wet soils, but also a risk of flooding. A decrease in precipitation could then make these areas usable again, explaining the occupation of these areas in the Late Merovingian Period. However, there is a problem with this explanation, as the low-lying areas are starting to be occupied from around the 7th century onwards, while the period of increased precipitation indicated by the above-mentioned evidence seems to end only in the 8th century.

While this makes it unlikely that climate change was the most important reason for the increasing suitability of low-lying areas for occupation, it should be noted that the evidence for this colder and wetter period is not very precise (Cheyette, 2008, p. 158), and it only shows the broad outlines of this period. The climate might already have been slowly improving during the last part of the period, allowing for an earlier occupation of some low-lying areas.

5.2 Further comments on the data set and methodology

In this section I will discuss some of the problems with the dataset and methodology used in this study and how they were dealt with.

One of the first problems is the accuracy of the cemetery locations. Many cemeteries in the Rural Riches database do not have exact coordinates, and many are accurate within 100 or 500 metres or even less accurate. But even with the exact coordinates, they only indicate a point on a map, and not a surface. If a cemetery is large enough, it will extend beyond just this point location on the map. This is a problem in this thesis, because the landscape variables for the cemeteries are picked from the map cell where the coordinates are located. When a cemetery in reality spans multiple cells of the raster map, the values for these cells are not taken into account, only the cell where the coordinates are located. The differences between neighbouring cells can be quite large, which means the picked values may not be representing the entire cemetery

This problem is hard to solve, as the cemetery data do not include the exact extent of the cemetery (if the actual extent is even known at all). Even if the extent was known, it would be difficult to calculate a single value for the entire cemetery, as not every cell may have to be factored in equally.

Another issue with large-scale, GIS-based analyses is their dependence on the quality of the underlying data. In this study all the analysed variables are derived from an elevation map. This Digital Elevation Model (DEM) thus very strongly influences the results. A large problem is that the DEM is based on the present landscape, with modern buildings and infrastructure, but also modern vegetation cover. Since Merovingian times, erosion alone could have caused changes in elevation up to several meters (Plum, 2003, p. 84). For these reasons the landscape in the Merovingian period will have looked very different from today, but this is not represented in the map.

Another factor which influences the quality of the DEM, is the size of the map cells (resolution). The smaller the cells, the more accurately they can represent the actual landscape, as fewer details are lost. The map used in this study has a cell size of approximately 25m by 25m. With a higher resolution of the original elevation map, the resulting slope, aspect, and relative elevation maps would also have been more accurate, as more small geographical features would be incorporated. The downside of a higher resolution is that the cells are even smaller, so a cemetery spans even more different cells and the exact placement of the coordinates for the cemetery influences the results even more (see the point above). Another downside is the increased size of the raster map files, which also increases the required calculating time for the derived maps.

All in all, the resolution used in this study allowed for sufficiently accurate results, and feasible calculation speed, while preserving most important landscape elements. The presence of modern buildings, infrastructure and vegetation is hard to remove. An option to do this would be to use a LiDAR map, in which vegetation can be filtered away. However, the research area spans multiple countries, of which LiDAR maps are hard to come by and to combine into one map. If looking into a smaller region, the use of LiDAR maps would however be preferable.

The third and last limitation I want to discuss here is the overall approach taken in this study. The results of this GIS-based analysis are very generalised. Cemeteries from very different regions and situations are all grouped together for the analysis, without considering the particularities of their local contexts, for example burials in cities[4]. While this is done intentionally, as it is impossible to factor in all these details in a large-scale study of this scope, it is important to take into account when looking at individual cemeteries with the results of this study in mind. Due to the limited number of variables included in this study, the results will also be limited in scope. Expanding the analysis by including more variables (especially less 'geographical', and more 'social' factors such as visibility, the relation to older ruins or Merovingian settlements, and the distance to roads) could give a more complete overview of important factors in cemetery locations.

Using an even larger number of cemeteries in the analysis would also improve the results. The two criteria of both accurate locations and accurate dates for the cemeteries strongly impacted the resulting sample size, and removing the dating criterium would greatly increase the number of cemeteries, though chronological comparisons are no longer possible then, of course. For all these reasons, the results presented in this thesis will not be enough to understand and explain the situations of individual cemeteries, but it can give some insights in the general characteristics and developments of cemetery locations during the Merovingian Period.

[4] Burials in cities were very different from burials in rural contexts, for example because of different cemetery types, stronger presence of Christianity and elites, larger population densities and the remains of Roman architecture. Because of modern (and old) high buildings distorting the elevation maps, the results for cemeteries in city contexts in this thesis will be less reliable, but it they are difficult to distinguish from rural cemeteries with the data available for this study.

Chapter 6: Conclusion

In this research I have analysed the locations of Merovingian cemeteries as to their (relative) elevation, slope gradient and aspect, and compared the results to observations from earlier studies. From the analyses it appears that there were some clear ideas about what locations were suitable for building a cemetery. Gentle slopes were unmistakably preferred, while especially at locations with a more significant slope gradient, south-facing slopes occurred relatively often. The results of the elevation analysis show that most cemeteries are located at a medium elevation, relative to the surrounding landscape, though there are considerably more cemeteries with a relatively high elevation than a relatively low elevation.

The observation that cemeteries were often founded on hillslopes because those were less suitable for agriculture, does not seem to be reflected in the results from the analyses performed here. Many cemeteries are located on very gently sloping terrain, while cemeteries on steep slopes are rare. Furthermore, the problems for agriculture that are associated with hillslopes, such as their susceptibility to erosion, do also affect cemeteries. This makes it unlikely that the reason for cemeteries being located on hillslopes is their lower suitability for agriculture.

When the cemeteries were divided into three chronological groups, the Early, Middle and Late Merovingian Period, some interesting differences between the periods became apparent. In the slope and aspect distribution of the cemeteries there were some minor differences between the subperiods, but there were large differences in the relative elevation. While in the Early Merovingian Period almost no cemeteries were at locations with a relatively low elevation, the proportion increased strongly in the Middle and Late Merovingian period. This development may be understood as a part of broader societal changes taking place during the 7th and 8th centuries in Northern Gaul, which also include the growth of settlements, the colonization of new land, and the disappearance of the large row-grave cemeteries. In earlier studies these developments have been ascribed to various factors, such as an increase in population, but also the increasing presence of the aristocracy and clergy in the area. Together these changes created the circumstances under which the Carolingians would rise to power in the 8th and 9th century.

All in all this thesis shows the potential of large scale, GIS-based studies of cemetery locations. The general results from the analyses correspond to the characteristics of individual cemeteries as described in earlier studies. From this it can be concluded that the approach taken in this study has been a successful first step in generating the overall landscape characteristics of Merovingian cemeteries.

It would be interesting to expand this study further, in order to get a more complete understanding cemetery locations. This can be done for example by including a larger number of cemeteries in the analyses, or by using more data about the cemeteries, such as the size of the cemeteries or the precise locations of the earliest graves on the cemetery. Including more information about the cemeteries could improve the accuracy of the analyses, as well as make the resulting overall picture more complete. Analysing cemeteries in smaller regions could also improve our understanding, at least for the cemeteries in that specific region. Comparing different subregions in this way can also give insights in the different developments and different pace of development between those parts of the area.

Additionally, many more different variables can be incorporated into the analyses. The study presented in this thesis only analysed a limited number of variables: elevation and the slope gradient and aspect derived from this. Other variables that could be studied are for example soil quality, the distance to waterways, roads, and older structures, visibility, and the relation to settlements. Earlier studies of Merovingian cemeteries have shown that these factors could all have been important in the choice of the location of cemeteries, so it looks promising to further study these at a larger scale.

Abstract

In this research the location of Merovingian cemeteries in the landscape of Northern Gaul is studied using GIS. While Merovingian cemeteries have been studied for over a century, most studies have focused on the grave goods found in the graves, while little research has been done on the location of the cemeteries. The locations of cemeteries are often explained by very rational or economic reasonings, which state that cemeteries were located on land that was unsuitable for agriculture. However, the locations of cemeteries were likely the result of deliberate choices. The grave goods in graves and other parts of the burial ritual indicate the importance of the ritual, and the burial location will have been just as important as the other parts of the ritual, if not even more important.

In this thesis, the locations of 190 Merovingian cemeteries are analysed in Geographical Information Systems (GIS), using three different variables: slope, aspect and (relative) elevation. The comparison of these variables for each cemetery gives a general idea of the location characteristics of Merovingian cemeteries. By using accurately dated cemeteries for the analyses, it is also possible to see changes in the location characteristics through time and between different parts of the Merovingian period.

The results of the analyses are in line with earlier research on the locations of Merovingian cemeteries. They show that Merovingian cemeteries are generally located on gentle slopes, with no clear preference for a certain direction. However, the cemeteries that are located on steeper slopes, are more often found on south-facing slopes. Furthermore, most cemeteries are found at medium elevations, neither at the highest, nor at the lowest elevations in their surroundings. Through time, lower elevations seem to have become more suitable for cemeteries, as a larger proportion of the cemeteries is located at low elevations during the later periods.

The research presented in this thesis shows the potential of using GIS-based methods to analyse the location of Merovingian cemeteries. The results are coherent with the findings from earlier studies, while also showing indications for the changes that took place during the Merovingian Period. All in all, this study can form a starting point for further GIS-based analyses of Merovingian cemetery locations, which could be improved by including more cemetery sites, and incorporating many more additional variables into the analyses.

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Appendices

Appendix 1: Table with cemetery data

Site ID	Name	Country	Region	Precision	Phase system	Begin	Begin Year	Begin Period	End	Elevation (m)	Slope (°)	Aspect (°)	Cardinal Direction	Relative elevation
4	Altenessen - Kokerei Zeche Helene	Germany	Stadt Düsseldorf	Exact location	Siegmund	Phase 8	610-640	late	Phase 11	52	0.8825550	108.435	east	0
7	Andernach - Burgtor	Germany	Kreis mayen Koblenz	Exact location	Ament	JM1	600-630/640	late	JM3	67	2.8712122	29.0546	north	0.400000006
14	Kell-Altreusch	Germany	Rheinland-Pfalz	Exact location	Ament	AM3	570-600	middle	JM2	326	4.8068843	79.99202	east	0.441860467
42	Berghem-Lallenberg	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	6	1.2480226	333.4349	north	-0.142857149
46	Beuel-Vilich-Müldorf	Germany	Stadt Bonn	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 7	64	2.3995950	35.53768	north	-0.142857149
70	Bornheim-Waldorf I	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 6	78	2.6459918	18.43495	north	-0.125
71	Bornheim-Sechtem II	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 8	70	1.2480226	26.56505	north	0.25
72	Bornheim I	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 8	62	3.0799060	185.1944	south	0.666666687
73	Bornheim II	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	67	0.8825550	288.4349	west	0
76	Boxmeer-'t Zand	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 9	14	0.3947156	225	south	0.25
91	Deursen-Dennenburg	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	10	0.0000000	-9999	flat	0.333333343
137	Friemersheim-Rheingoldstrasse	Germany	Nordrhein-Westfalen	Exact location	Siegmund	Phase 3	485-530	early	Phase 10	35	0.5582033	0	north	0
138	Garderen - Beumelerberg	The Netherlands	Gelderland	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 9	49	3.3686178	155.556	south	0.714285731

240	Maastricht - Lage Kanaaldijk	The Netherlands	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	50	1.1163006	90	east	-0.06666667
251	Meiderich - Herwarthstrasse 23-25	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 1	400-440	early	Phase 9	31	2.7609138	225	south	0
344	Serm II - Südlich des Holtumer Hofes	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 7	585-610	middle	Phase 10	29	2.1246676	113.1986	east	0.06666667
385	Unkel	Germany	Kreis Neuwied	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	61	3.0799060	95.19443	east	0.636363626
387	Valkenburg-Castellum	The Netherlands	Zuid-Holland	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 10	3	1.1163006	0	north	0.600000024
396	Wachtberg-Villip	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 9	171	15.9498215	330.3763	north	0.538461566
406	Weckhoven	Germany	Rhein-Kreis Neuss	Exact location	Siegmund	Phase 7	585-610	middle	Phase 9	43	2.2317543	0	north	-0.142857149
410	Westerhoven	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	28	0.8825550	251.565	west	-0.384615391
423	Zülpich - Enzen I - Schievelsheide	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	196	1.1839969	45	north	0
428	Rhenen - Donderberg	The Netherlands	Utrecht	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 10	26	6.7141070	245.556	west	0.277777791
431	Rübenach	Germany	Rheinland-Pfalz	Exact location	Ament	AM1	450-540	early	JM2	179	3.1545830	135	east	0.333333343
432	Wageningen-Diedenweg	The Netherlands	Gelderland	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 10	15	3.0033579	111.8014	east	-0.800000012
438	Maastricht-Pandhof/Basiliek	The Netherlands	Limburg	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 9	60	6.0158777	56.30993	east	0
447	Wijchen - Centrum	The Netherlands	Gelderland	Exact location	Siegmund	Phase 1	400-440	early	Phase 8	12	1.1163006	0	north	-0.111111112
449	Maastricht-Vrijthof (4)	The Netherlands	Limburg	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 9	54	3.5479546	225	south	-0.466666669
458	Jülich I Gräberfeld Zitadelle	Germany	Kreis Düren	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 8	84	3.0033579	248.1986	west	-0.428571433

460	Broechem	Belgium	Antwerpen	Exact location	Legoux et al.	PM	440/450-470/480	early	MR 3	10	1.5784878	225	south	0.142857149
464	Bad Münstereifel - Iversheim - Pützberg	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 10	275	4.1139321	151.6992	south	0.658536613
466	Elst - 't Woud	The Netherlands	Utrecht	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 10	17	1.2480226	243.435	west	0.625
467	Nettersheim I - Ob de Kaul	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 10	450	3.1790826	164.7449	south	-0.789473712
474	Stratum I - Düsseldorfer Strasse 285	Germany	Kreis Krefeld	Exact location	Siegmund	Phase 2	440-485	early	Phase 8	32	0.7893937	135	east	-0.111111112
485	Eick	Germany	Stadt Düsseldorf	Exact location	Siegmund	Phase 4	530-555	middle	Phase 9	22	3.5479546	225	south	0
487	Spontin - Rue de Bouchat	Belgium	Namur	Exact location	Legoux et al.	MA 2	520/530-560/570	middle	MR 2	193	10.7121077	11.88866	north	-0.405405402
492	Xanten I St.-Viktor	Germany	Kreis Wesel	Exact location	Siegmund	Phase 3	485-530	early	Phase 11	32	1.6741862	270	west	0.714285731
498	Viesville - Pont-à-Celles	Belgium	Hainaut	Exact location	Legoux et al.	MA 1	470-520/530	early	MA 3	143	3.0799060	174.8056	south	0.428571433
508	Bergeijk - Fazantlaan	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 10	37	3.1790826	52.12502	east	0.142857149
516	Rosmeer	Belgium	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	109	5.8998857	188.1301	south	0.142857149
519	Lent - Azaleastraat	The Netherlands	Gelderland	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 10	9	2.1246676	23.19859	north	-0.600000024
542	Posterholt-Achterste Voorst	The Netherlands	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 10	42	2.1246676	66.80141	east	0.411764711
543	Sittard-Kemperkoul	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 9	56	1.4228971	281.3099	west	0.090909094
544	Beuel-Schwarzrheindorf I	Germany	Stadt Bonn	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 9	55	2.7889001	306.8699	west	0.111111112
547	Weilerswist - Lommersum -	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	150	4.4044280	71.56505	east	0.263157904

	Bodenheim I - Hof Dickop													
553	Stein-Groote Bongerd	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	55	9.5234213	244.179	west	0.600000024
554	Gennep - Touwslagersgroes	The Netherlands	Limburg	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 9	14	0.5582033	180	south	0.5
561	Grobbendonk - Floris Primsstraat	Belgium	Antwerpen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 9	13	0.8825550	288.4349	west	-0.846153855
567	Obbicht-Oude molen	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	35	3.5697320	218.6598	south	0.714285731
569	Meerveldhoven	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	22	1.5784878	135	east	-0.25
572	Alphen-Molenstraat	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 8	26	0.8825550	18.43495	north	0.142857149
574	Engelmanshoven	Belgium	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	96	4.2616925	258.6901	west	0.571428597
596	Weilerswist - Gross Vernich - Kiesgrube Jägershof	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 8	125	3.1545830	315	west	0.200000003
603	Rommerskirchen (St. Peter)	Germany	Nordrhein-Westfalen	Exact location	Siegmund	Phase 11	705-740	late	Phase 11	77	1.2480226	333.4349	north	0.777777791
606	Borsbeek - Vogelzang	Belgium	Antwerpen	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 9	11	1.2480226	206.565	south	0.666666687
608	Bad Godesberg-Friesdorf I	Germany	Stadt Bonn	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 10	63	0.8825550	341.5651	north	0
610	Hoogeloon - Broekeneind	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 8	25	1.5784878	135	east	-0.600000024
617	Meerssen-Rothem	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	58	5.0418515	186.3402	south	0.600000024
618	Euskirchen III - St. Martin Kirche	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	165	1.6741862	270	west	-0.333333343
619	Niederdollendorf	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	57	1.5784878	135	east	0.200000003

640	Bedburg-Kirchtroisdorf	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	78	1.2480226	153.435	south	-0.111111112
649	Elsdorf Niederembt I - Frankeshofen	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 10	72	0.7893937	45	north	-0.600000024
662	Merlemont-Bois de la Forêt	Belgium	Namur	Exact location	Legoux et al.	MA 1	470-520/530	early	MA 3	187	1.4228971	258.6901	west	-0.333333343
666	Bonn-Kessenich	Germany	Stadt Bonn	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 10	75	13.9341011	43.40886	north	-0.40625
668	Veldhoven-Oeienbosdijk	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	25	2.7609138	135	east	0.05882353
669	Bad-Godesberg-Alt-Godesberg	Germany	Stadt Bonn	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	70	3.1790826	164.7449	south	-0.519999981
670	Borgharen-Pasestraat	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	44	3.6342735	237.5288	west	-0.5
683	Hochemmerich - Gartenstrasse 19-21	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 3	485-530	early	Phase 8	30	1.4228971	348.6901	north	0.06666667
691	Beuel-Ramersdorf	Germany	Stadt Bonn	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	57	1.1163006	180	south	0.111111112
692	Dommelen - Kerkakkers	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	26	0.0000000	-9999	flat	0.111111112
701	Beuel-Vilich (Saint-Peter)	Germany	Stadt Bonn	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	65	1.4228971	258.6901	west	0.777777791
710	Zülpich III - Auf dem Guten - Friedhofseck Dreikönigenstrasse / Römerallee	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	171	1.9728291	225	south	0.125
716	Geldrop - Zesgehuchten Site C	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 10	23	0.8825550	251.565	west	0.200000003
740	Uden - Schepersweg	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 9	15	3.2514646	210.9638	south	0.428571433
748	Swalmen	The Netherlands	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 8	28	1.7646914	288.4349	west	0.200000003

751	Bonn-Lessenich-Messdorf	Germany	Stadt Bonn	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 8	77	1.6270423	210.9638	south	0.142857149
768	Oberkassel - Fabrikgelände / Hansaallee 32/34 / Mercatorstrasse	Germany	Stadt Düsseldorf	Exact location	Siegmund	Phase 3	485-530	early	Phase 11	40	2.8440413	191.3099	south	0.200000003
777	Euskirchen-Roitzheim - Alte Ziegelei	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	180	1.1839969	315	west	0.111111112
793	Bergheim-Glesch	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 7	65	1.4228971	78.69007	east	0.285714298
798	Hardtberg-Duisdorf II	Germany	Nordrhein-Westfalen	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 7	111	7.5385542	6.340192	north	-0.217391297
804	Bad-Godesberg-Muffendorf II	Germany	Stadt Bonn	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	98	20.2284107	65.80679	east	-0.396226406
814	Beuel-Vilich-Rheindorf	Germany	Nordrhein-Westfalen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 6	56	1.7646914	198.435	south	-0.400000006
850	Escharen	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 10	10	1.1839969	225	south	0
859	Lommel-Lutlommel	Belgium	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 8	45	0.8825550	198.435	south	-0.200000003
880	Orsoy - Rheinberg-Eversael	Germany	Kreis Wesel	Exact location	Siegmund	Phase 3	485-530	early	Phase 10	25	3.9409912	8.130102	north	0.111111112
908	Bad Honnef-Rhöndorf II	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 9	79	6.5057049	250.0169	west	-0.640449464
909	Bad Honnef-Zentrum	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 8	84	3.1790826	232.125	west	0.166666672
918	Grobbendonk - Ouwen	Belgium	Antwerpen	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 9	14	0.5582033	270	west	-0.578947365
934	Beeck II	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 9	640-670	late	Phase 11	25	7.7377443	194.5345	south	-0.5
937	Bornheim-Widdig I	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 7	57	1.1163006	180	south	0.625

990	Linz	Germany	Kreis Neuwied	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 8	79	5.1327682	257.4712	west	-0.438202262
1003	Sankt Augustin-Hangerlar	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	75	2.8440413	281.3099	west	0.230769232
1028	Casteren	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 10	25	1.6270423	120.9638	east	-0.142857149
1033	Mechernich - Lessenich III - 420 m westlich der Kirche Lessenich	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 10	268	4.7584710	110.556	east	0.130434781
1046	Bad-Godesberg-Muffendorf III	Germany	Stadt Bonn	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 6	129	7.0255742	18.43495	north	-0.139240503
1052	Beuel-Limperich	Germany	Nordrhein-Westfalen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	63	1.4228971	101.3099	east	0.846153855
1056	Bornheim-Merten-Altmerten	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	102	4.0187850	33.69007	north	-0.071428575
1057	Bornheim-Sechtem I	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 4	69	0.5582033	90	east	0.400000006
1069	Euskirchen - Grossbüllesheim - Bahnhof	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	151	5.1327682	257.4712	west	-0.200000003
1086	Mechernich II - Alte Kirche St. Johannes	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 7	327	7.0796962	191.3099	south	0.692307711
1129	Bad-Godesberg-Mehlem	Germany	Stadt Bonn	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	65	5.8475738	92.72631	east	0.444444448
1145	Bonn-Dransdorf	Germany	Stadt Bonn	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 10	62	3.5260410	251.565	west	-0.666666687
1207	Lindern - Linderner Bahn 33	Germany	Kreis Heinsberg	Exact location	Siegmund	Phase 4	530-555	middle	Phase 10	78	0.8825550	341.5651	north	-0.111111112
1208	Loenen-Vrijenberg	The Netherlands	Gelderland	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 4	36	2.3003671	75.96375	east	-0.333333343
1242	Palenberg I - St. Peter	Germany	Kreis Heinsberg	Exact location	Siegmund	Phase 6	570-585	middle	Phase 11	90	3.1790826	232.125	west	-0.217391297

1262	Speyer, IX Rulandstrasse	Germany	Speyer	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 3	103	0.8825550	108.435	east	-0.090909094
1304	Beuel-Ost	Germany	Stadt Bonn	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	61	1.7646914	71.56505	east	0.285714298
1312	Nord II	Germany	Stadt Bonn	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 5	61	1.2480226	296.5651	west	-0.230769232
1315	Bornheim-Brenig	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 7	139	2.4948621	333.4349	north	0.103448279
1317	Bornheim-Widdig II	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 7	56	2.1246676	66.80141	east	0.692307711
1346	Erfstadt- Lechenich I - Erper Strasse 11	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 3	103	2.3003671	14.03624	north	0.333333343
1444	Qualburg I - St. Martin	Germany	Kreis Kleve	Exact location	Siegmund	Phase 6	570-585	middle	Phase 9	17	1.2480226	296.5651	west	0.714285731
1475	Tüddern III - Westerheide	Germany	Kreis Heinsberg	Exact location	Siegmund	Phase 7	585-610	middle	Phase 8	54	3.3686178	114.444	east	0
1478	Unkel-Bruchhausen	Germany	Kreis Neuwied	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 9	189	9.6796980	178.3634	south	-0.200000003
1480	Wachtberg-Liessem	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	189	1.1163006	90	east	0.666666687
1482	Weeze II - St. Cyriakus	Germany	Kreis Kleve	Exact location	Siegmund	Phase 11	705-740	late	Phase 11	20	1.5784878	45	north	0.111111112
1492	Zülpich - Enzen II - In den Motten	Germany	Nordrhein-Westfalen	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 10	182	1.1163006	90	east	-0.166666672
1495	Linz-Dattenberg-Wallen	Germany	Kreis Neuwied	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 10	120	12.716761 6	212.6609	south	0.239999995
1507	Eltville-Erbacher Strasse	Germany	Hessen	Exact location	Siegmund	Phase 2	440-485	early	Phase 11	100	1.4228971	258.6901	west	0.368421048
1534	Pier II	Germany	Kreis Düren	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 10	106	1.1163006	0	north	0.5
1549	Bergheim- In den Peschen	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 10	670-705	late	Phase 10	30	2.0118670	326.3099	north	-0.272727281

1556	Dortmunder Hellweg - Kahle Hege	Germany	Nordrhein-Westfalen	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 7	92	1.5784878	315	west	-0.200000003
1638	Mertloch - Künzerhof	Germany	Kreis mayen Koblenz	Exact location	Ament	JM1	600-630/640	late	JM3	250	5.1327682	49.3987	east	-0.014925373
1674	Aachen I Königshügel	Germany	Städte region Aachen	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 10	240	1.1163006	90	east	1
1681	Niedermerz I	Germany	Kreis Düren	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 8	120	2.3995950	144.4623	south	-0.818181813
1688	Rödingen	Germany	Kreis Düren	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	82	5.2953105	183.0128	south	-0.200000003
1695	Birkesdorf I	Germany	Kreis Düren	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 10	132	1.2480226	296.5651	west	0.571428597
1697	Merzenich I	Germany	Kreis Düren	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	125	2.1246676	246.8014	west	0.666666687
1701	Vettweiss II (Milochfeldchen)	Germany	Kreis Düren	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 7	158	1.6270423	300.9637	west	-0.142857149
1782	Emmerich I - Jakob-Troost-Strasse	Germany	Kreis Kleve	Exact location	Siegmund	Phase 11	705-740	late	Phase 11	16	2.1246676	113.1986	east	-0.333333343
1790	Duisburg I - beim Kantpark	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 2	440-485	early	Phase 11	39	0.0000000	-9999	flat	0.166666672
1816	Krefeld - Gellep (East cemetery)	Germany	Kreis Krefeld	Exact location	Siegmund	Phase 1	400-440	early	Phase 11	33	2.1246676	336.8014	north	0.142857149
1830	Arlon-Vieux Cimetière	Belgium	Luxembourg	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 8	394	7.2184372	202.6199	south	-0.483870953
1832	Venray - Sint Anthoniusveld	The Netherlands	Limburg	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 8	24	0.8825550	161.565	south	-0.666666687
2115	Bonn-Zentrum V (Stifstkirche und Umfeld)	Germany	Stadt Bonn	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	71	2.1246676	293.1986	west	0.818181813
2138	Wyler - Nordostrand des Wyler Berges	Germany	Kreis Kleve	Exact location	Siegmund	Phase 7	585-610	middle	Phase 11	14	6.5409164	12.26477	north	-0.733333349
2163	Zons - Schloss Friedestrom	Germany	Nordrhein-Westfalen	Exact location	Siegmund	Phase 9	640-670	late	Phase 9	43	0.8825550	288.4349	west	0.272727281

2202	Vlodrop	The Netherlands	Limburg	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	35	3.5260410	108.435	east	0.5
2232	Eller - am Werstener Feld	Germany	Nordrhein-Westfalen	Exact location	Siegmund	Phase 6	570-585	middle	Phase 7	44	2.3995950	54.46232	east	0
2238	Erftstadt-Bliesheim I	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 5	107	1.6741862	0	north	0.714285731
2243	Golzheimer Heide - Zement und Kunststeinfabrik Salz&Schmitz	Germany	Stadt Düsseldorf	Exact location	Siegmund	Phase 6	570-585	middle	Phase 11	42	2.6459918	288.4349	west	0.428571433
2274	Oberlörick I - Bonifatiusstrasse 77	Germany	Stadt Düsseldorf	Exact location	Siegmund	Phase 10	670-705	late	Phase 10	36	2.8440413	11.30993	north	0.555555582
2281	Pulheim - Stommeln I - neuer Friedhofsteil	Germany	Rhein-Erft-Kreis	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 8	75	3.3686178	335.556	north	0.882352948
2287	Rindern I - St. Wilibrord	Germany	Nordrhein-Westfalen	Exact location	Siegmund	Phase 10	670-705	late	Phase 11	18	0.8825550	71.56505	east	1
2671	Riethoven	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 9	30	0.8825550	251.565	west	0
2878	Alfter-Witterschlick I	Germany	Rhein-Sieg-Kreis	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 9	149	4.8068843	10.00798	north	0
2927	Bergeijk - Kattenberg	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 7	610/620-640/650	late	Phase 9	35	1.6741862	180	south	0
2930	Veldhoven - Huysackers zone K	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	23	0.3947156	225	south	-0.600000024
2931	Veldhoven - Huysackers zone G	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 8	29	9.8409157	38.15723	north	0.285714298
2933	Mierlo-Centre	The Netherlands	Noord-Brabant	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	21	2.2317543	0	north	-0.5
2935	Maastricht - Boschstraat	The Netherlands	Limburg	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 9	53	2.3995950	305.5377	west	0.466666669
2936	Maastricht - Sint-Servaasklooster	The Netherlands	Limburg	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 8	65	2.6459918	71.56505	east	0.714285731

2937	Maastricht-Vrijthof (3)	The Netherlands	Limburg	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 5	55	0.8825550	341.5651	north	-0.666666687
2938	Maastricht-Vrijthof (6)	The Netherlands	Limburg	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	53	4.0571151	105.9454	east	-0.714285731
2954	Bad Münstereifel II - Stiftskirche Chrysanthus und Daria	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 4	510/525-565	middle	Phase 10	284	1.6741862	180	south	-0.807692289
2956	Düren I (Pfarrkirche St.Anna)	Germany	Kreis Düren	Exact location	Franken AG	Phase 9	670/680-710	late	Phase 10	130	1.4228971	78.69007	east	0.428571433
2962	Gladbach I (Mersheim)	Germany	Kreis Düren	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	129	0.0000000	-9999	flat	-0.142857149
2963	Hochkirchen (Pfarrkirche st. Viktor)	Germany	Kreis Düren	Exact location	Franken AG	Phase 5	565-580/590	middle	Phase 8	128	9.5470381	280.008	west	1
2995	Sittard - Haagsittard	The Netherlands	Limburg	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 9	64	0.3947156	45	north	0.166666672
2998	Borgharen-Daalderveld	The Netherlands	Limburg	Exact location	Franken AG	Phase 1-2	400-460/480	early	Phase 1-2	42	0.8825550	71.56505	east	-0.25
3114	Duissern - Unterm Kaiserberg	Germany	Kreis Duisburg	Exact location	Siegmund	Phase 10	670-705	late	Phase 11	43	0.3947156	135	east	0.75
3115	Didam-Randweg-Zuid	The Netherlands	Gelderland	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 9	11	3.5260410	198.435	south	-0.333333343
3134	Gnadental III - Magnolienweg	Germany	Rhein-Kreis Neuss	Exact location	Siegmund	Phase 8	610-640	late	Phase 9	42	1.5784878	225	south	0.230769232
3152	Neuss I - Rote Schule 1839	Germany	Rhein-Kreis Neuss	Exact location	Siegmund	Phase 6	570-585	middle	Phase 9	46	4.2435079	23.19859	north	0.555555582
3153	Neuss II - St. Quirin, Kindergarten 1963	Germany	Rhein-Kreis Neuss	Exact location	Siegmund	Phase 2	440-485	early	Phase 5	44	1.2480226	63.43495	east	0.333333343
3168	Qualburg III - Dorfsteg 4	Germany	Kreis Kleve	Exact location	Siegmund	Phase 7	585-610	middle	Phase 8	15	1.1839969	315	west	0
3170	Elst-Lijnden	The Netherlands	Gelderland	Exact location	Franken AG	Phase 8	640/650-670/680	late	Phase 9	7	1.7646914	251.565	west	-0.333333343

3183	Sterkrade II - Weselerstrasse / Oskarstrasse	Germany	Stadt Oberhausen	Exact location	Siegmund	Phase 3	485-530	early	Phase 9	46	1.2480226	153.435	south	-0.06666667
3186	Goudelancourt-lès-Pierrepont, Aux Fontaines	France	Aisne	Exact location	Legoux et al.	MA 2	520/530-560/570	middle	MR 3	100	3.2514646	210.9638	south	0.416666657
3189	Cutry	France	Meurthe-et-Moselle	Exact location	Legoux et al.	PM	440/450-470/480	early	MR 2	339	1.6270423	329.0363	north	-0.125
3190	Breny	France	Aisne	Exact location	Legoux et al.	PM	440/450-470/480	early	MR 3	106	1.6270423	30.96376	north	0.809523821
3225	Monceau-le-Neuf, la Ferme de Murcy	France	Aisne	Exact location	Legoux et al.	MA 1	470-520/530	early	MR 2	79	3.1545830	225	south	0.25
3783	Euskirchen V -Franz-Sester-Strasse	Germany	Kreis Euskirchen	Exact location	Franken AG	Phase 6	580/590-610/620	middle	Phase 8	180	0.7893937	45	north	0.200000003
3806	Saint-Sauveur	France	Somme	Exact location	Legoux et al.	PM	440/450-470/480	early	MR 3	32	4.0571151	195.9454	south	-0.100000001
3827	Lavoye 'La Haie-des-Vaches'	France	Meuse	Exact location	Legoux et al.	MA 1	470-520/530	early	MR 2	210	3.3455184	90	east	-0.157894731
3830	Liverdun, Bois de la Fourasse	France	Meurthe-et-Moselle	Exact location	Legoux et al.	MA 2	520/530-560/570	middle	MA 3	208	12.716761 6	346.2637	north	-0.771929801
3960	Sissonne 'Jeoffrécourt'	France	Aisne	Exact location	Legoux et al.	MA 1	470-520/530	early	MR 3	112	5.4669986	345.2564	north	0.5
4059	Bous-Assel	Luxemburg	Luxemburg	Exact location	Siegmund	Phase 7	585-610	middle	Phase 7	179	4.8068843	169.992	south	-0.403508782
4356	Dieue-sur-Meuse-La Potence	France	Meuse	Exact location	Legoux et al.	MA 1	470-520/530	early	MR 2	206	0.8825550	108.435	east	0
4637	Hamoir - Tombeu	Belgium	Liège	Exact location	Legoux et al.	MA 3	560/570-600/610	middle	MR 3	154	8.2687778	219.5597	south	0.872340441
4740	Merlemont-Les Wayons	Belgium	Namur	Exact location	Legoux et al.	MA 3	560/570-600/610	middle	MR 2	249	6.3988686	124.3803	east	0.666666687
4742	Ciney - Lienne	Belgium	Namur	Exact location	Legoux et al.	MA 3	560/570-600/610	middle	MR 2	235	13.171867 4	357.614	north	-0.032258064

5709	Verlaine - Campagne du Jointy	Belgium	Liège	Exact location	Legoux et al.	MA 1	470-520/530	early	MR 2	166	1.1839969	315	west	0.454545468
5849	Dieue-sur-Meuse 'Le Thumelou'	France	Meuse	Exact location	Legoux et al.	MA 2	520/530-560/570	middle	MR 1	233	7.2184372	270	west	-0.019607844
6109	Saint-Léger	Belgium	Luxembourg	Exact location	Legoux et al.	MR 1	600/610-630/640	late	MR 2	286	4.7422214	183.3665	south	0.533333361
6327	Niedermendig-An der Neuenrest	Germany	Kreis mayen Koblenz	Exact location	Ament	AM1	450-540	early	AM3	222	3.1790826	195.2551	south	0.13333334
6773	Obrigheim, I Bockheimer Hohl	Germany	Bad-Dürkheim	Exact location	Franken AG	Phase 3	460/480-510/525	early	Phase 9	149	3.9605849	129.2894	east	0.212121218
7184	Saint-Dizier-La Tuilerie	France	Haute Marne	Exact location	Legoux et al.	MA 1	470-520/530	early	MA 2	152	3.3686178	245.556	west	0.25
7230	Savigny-sur-Ardres, la Croix Cassée	France	Marne	Exact location	Legoux et al.	MA 1	470-520/530	early	MA 3	109	3.3915586	260.5377	west	-0.162790701