

# **POMPEII SUSTAINABLE PRESERVATION PROJECT**

Monica Martelli Castaldi – *Consultant Conservator-Restorer*

## **SOPRINTENDENZA SPECIALE PER I BENI ARCHEOLOGICI DI POMPEI ERCOLANO E STABIA**

### **POMPEII SUSTAINABLE PRESERVATION PROJECT PSPP**

#### **Preliminary Campaign**



*Fig 1 – Tomb 4EN*

#### **CONSERVATION SURVEY of the PORTA NOCERA NECROPOLIS**

(Including tombs of the Western area and of the Eastern area, next to the so called “*Fondo Pacifico*”)

22 September - 16 November 2014

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#### **CONSERVATION SURVEY of the PORTA NOCERA NECROPOLIS**

(Including tombs of the Western area and of the Eastern area, next to the so called “*Fondo Pacifico*”)

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**INTRODUCTION**

**and**

**AIMS OF THE PROJECT**



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### INTRODUCTION to the conservation survey

The objectives of this section of the campaign are aimed at understanding the site and its behavior, in relation to the several and different parameters that act simultaneously on all the areas of the site, including actions and reactions that are not always homogenous and consistent with each other, such as: environmental conditions, type of decorations and structural materials, flow and amount of visitors, movement of rain waters, sun irradiation, etc.

The analysis of the surfaces and structures, together with a proper archival research and a following definition of precise scientific approaches, constitute the necessary background to envisage a correct preservation of the area.

The basic point of view is to propose the minimal actions to improve and support the structures along their life, considering the basic assumption which has to lead any thoughts and proposals: the buildings and their surfaces are, and will be, continuously exposed to the environmental agents, to a more or less extent. This is not beneficial to the “health” and preservation of the buildings, but these conditions are not easy to eliminate.

The considerations, which follow, are guided by the challenge of dealing with the problems on a daily basis. They cannot be eliminated, and thus can be only reduced and controlled as much as possible.

### LOCATION of the Necropolis in the archaeological site of Pompeii

Here below the identification of the area inside the map of the whole city of Pompeii, with the identification of the different areas.



Fig 2 - Touristic plan of Pompeii - by the Soprintendenza Archeologica di Pompei 2002

Circled in RED, on the right side, the area of the necropolis of Porta Nocera in its total extent: Western area and Eastern area, next to the Via Nucerina Necropolis (west of the so called “Fondo Pacifico”). Between the two areas the RED ARROW indicates the entrance to the archaeological site from “Porta Anfiteatro”.

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### ORGANISATION and detailed plan of Porta Nocera Necropolis

The archaeologist Pia Kastenmeier has done a review of the several published ground plans of the necropolis. For the purpose of this study we have received from the Soprintendenza a copy of a detail of the plan redacted by Ruggero Morichi in 2012 (*“Nuova pianta topografica del sito archeologico di Pompei”*). This is the plan on which we have redacted the different maps which are in attachment and to which we refer in the description of the different chapters of this report.

The necropolis is today divided in two areas - Western and Eastern - at the left and at the right of the new entrance to the archaeological site of Pompeii, from *Porta Anfiteatro*.

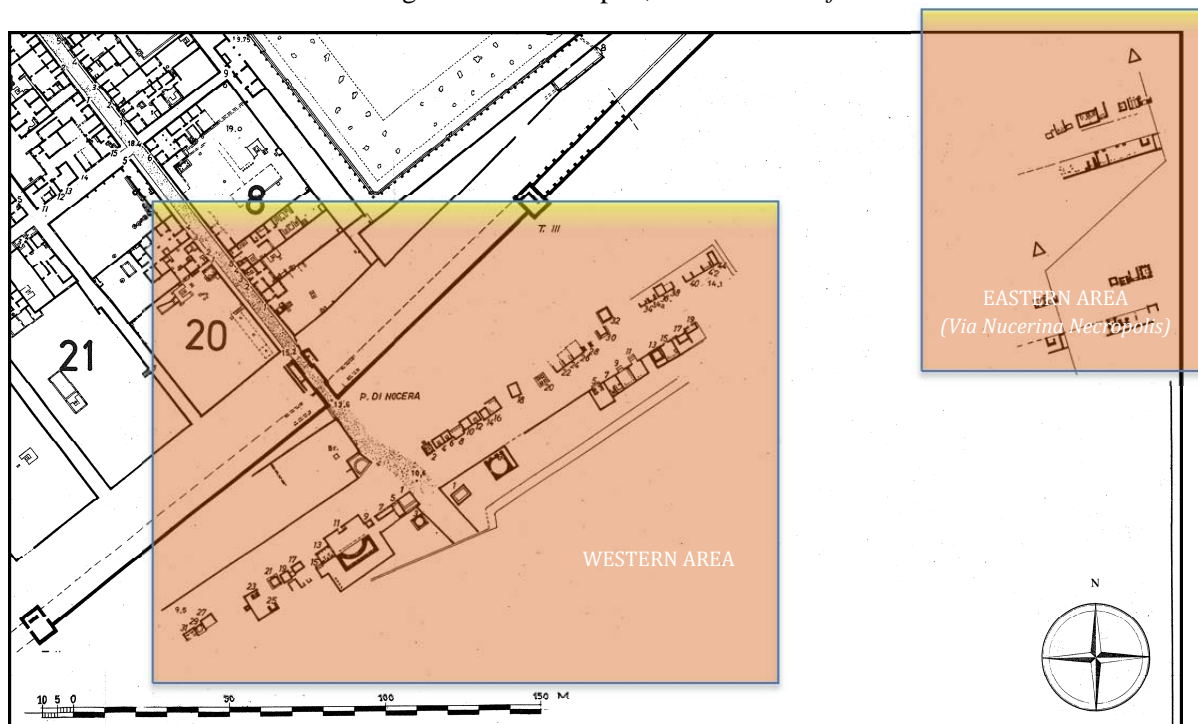


Fig 3 - Detail of the *“Nuova pianta topografica del sito archeologico di Pompei”* – by Ruggero Morichi – 2012, with, in evidence, the two areas of the Porta Nocera Necropolis (excavation 1954 and excavation 1983)  
(see also MAP n. 0 - Location of the Necropolis inside the general plan of the archaeological site of Pompeii)

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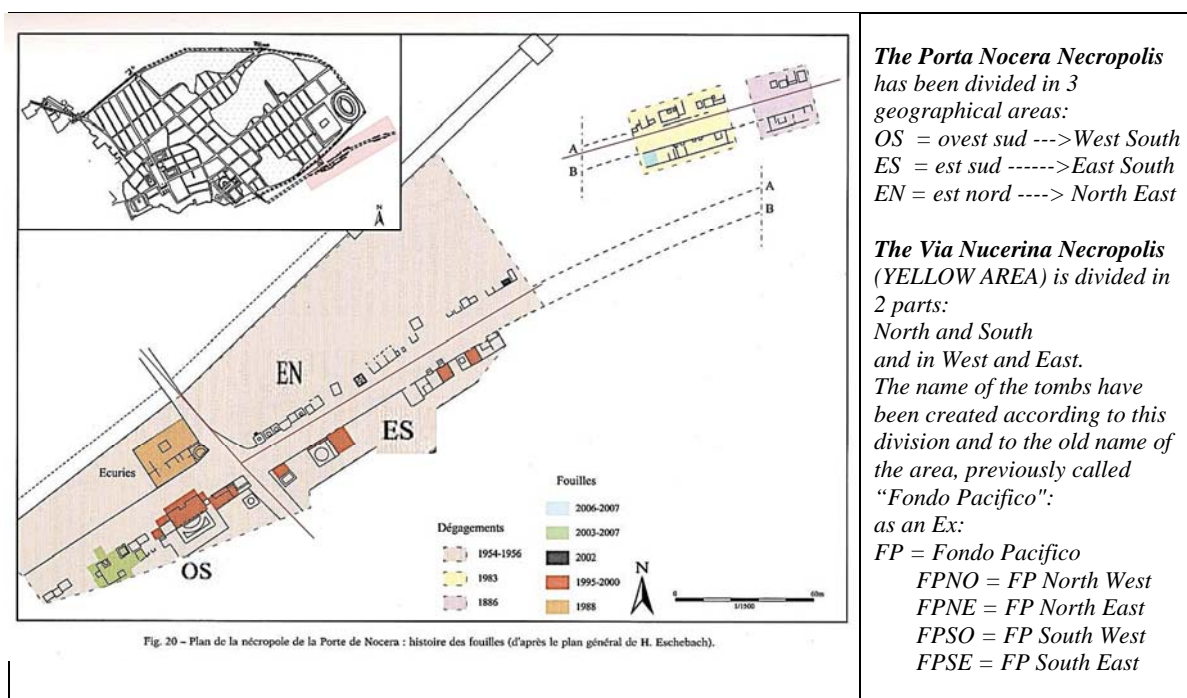


Fig 4 - In the plan the four areas in which the necropolis has been divided are identified with initials, which are also used to nominate the tombs in the publications (ex in Eschebach: ES 14 (Map: Van Andringa 2013, Fig. 20)).

## CHRONOLOGY of the construction of the Necropolis

Please refer to the report by the archaeologist Pia Kastenmeier.

Very briefly, according to D'Ambrosio-De Caro 1983 introduction, the today visible monuments were mostly built in four different phases, as visible in the scheme below:

late sullan and caesarian period, untill the first augustan period (ca. 70-20 BC)	augustan period (ca. 27 BC - 14 AD)	julio-claudian period ( ca 20 BC - 54 AD)	last 25 years of city life (ca. 54 - 79 AD)	late neronian-flavian period, in part after the earthquake 62 AD (ca. 58 - 79 AD)
9 / 55	12 / 55	9 / 55	11 / 55	6 / 55
16,36%	21,81%	16,36%	20%	10,9%

Fig 5 – from archaeologist Pia Kastenmeier's study for the PSPP Preliminary Campaign: table with the construction periods of the Porta Nocera Necropolis and the amount of tombs identified for each period, calculated over the total of 55 funerary monuments and areas.

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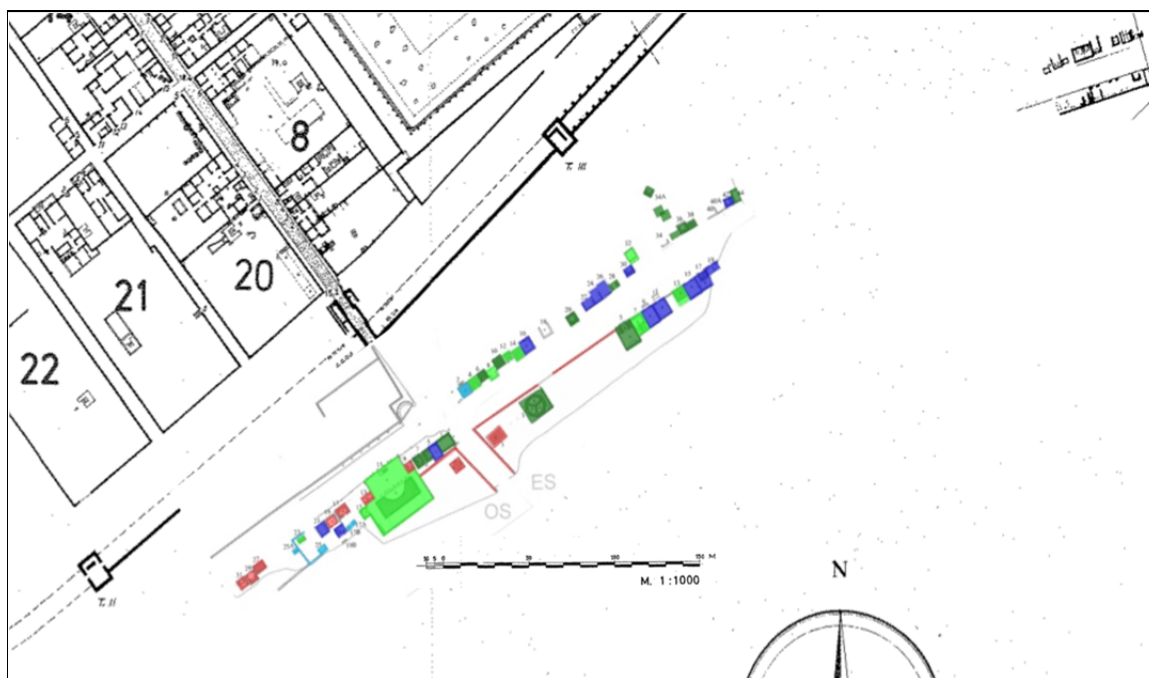


Fig 6 – MAP of the Chronology of the edification of the tombs, by Pia Kastenmeier (according to the scheme in Fig 5) from her study for the PSPP Preliminary Campaign and from D'Ambrosio-De Caro publication of 1993.

## **Chapter I**

# **DESCRIPTION OF THE MONUMENTS and of the ORIGINAL CONSTRUCTION TECHNIQUE OF THE DECORATIVE SURFACES**



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### 1. ORIGINAL CONSTRUCTION TECHNIQUE

#### 1.1 Types of monuments

(see MAP n. 1- *Original construction technique - 1.1 Typologies of funerary precincts*)

According to the archaeologist Pia Kastenmeier's definition, the Porta Nocera / Via Nucerina Necropolis is divided into 73 funerary precincts, those precincts show a different layout typology, there are:

- *funerary monuments,*
- *enclosures,*
- *enclosures with facade,*
- *precinct without architectural elements: "concessione" -*
- *particular immobile items inside enclosures.*

These different typologies of monuments are identified in map n. 1.1, but some examples are here below, to allow an easy recognition. For the purpose of this study we have used the general term Tomb for any of the buildings or spaces in the necropolis.



Fig 7 - Tombs 10-12-14EN - Funerary monuments.  
In this case a niche is visible on the Southern face of the central Tomb.



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*Fig 8 - Tomb 3ES general and detail - funerary monument with funerary chamber.*



*Fig 9 - Tomb 11bOS - view of the large internal chamber.*



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Fig 10 - Tomb 16EN – Enclosure.



Fig 11 - Tomb SES - Enclosure with facade, front.



Fig 12 - Tomb SES - Enclosure with facade, back.



Fig 13

Tomb FPSA - Precinct without architectural elements: "concessione" (grant of land).  
General view and detail of the several "colummelle" which are usually placed in the area.



Fig 14



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Fig 15 - Tomb FPNE - Immobile items (sporadic elements).

The archaeologist Pia Kastenmeier, has done a detailed study on the different typologies found in the necropolis (please see her report).

For the identification of possible preservation actions to improve the conservation of the Necropolis, these different typologies seem to have no specific interest, as the materials used to build the monuments are more or less homogeneous. This has given also a quite uniform behavior in relation to the decay and the different deterioration problems encountered until now. However, it would be interesting to see if a more “detailed” study could show that there is a different behavior to the weathering agents in relation to the construction materials.

### 1.2 Original structure

(see MAP n. 1 – *Original construction technique* – 1.2 1.2 *Original structure* )

For a better understanding of this paragraph, it is also important to read the report by the archaeologist Pia Kastenmeier, who has done a detailed revision of all the building materials and their distribution along the Necropolis.

The internal **core structure** of most of the buildings is mainly made of *opus caementitium*, a mixture of lava stones + brick fragments + a lime based mortar containing coarse and medium size volcanic sand. This rough and thick mixture was thrown into a “box” generally made of wood, in which the future **external surfaces** were layer by layer prepared, with clean and good shaped lava stones or bricks (see next paragraph). In the necropolis this is very visible, and generally made with lava stones. The roman building technique also foresaw some **reinforcements** with bricks, either in the corners or as horizontal lines on the external faces in stones. This is visible in the necropolis, as shown in the photos below.

Over these external surfaces, different kinds of **coatings/finishing** were then applied (see next paragraph).

The materials used are common to all of the different types of funerary monuments, according to the following division. These materials were also frequently used, in combination, on the same monument.

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Fig 16 - Tomb 1 OS – general view, with volcanic stones for the basement and for the upper cornice, lava stones for the outer faces of the inner core structure and brick reinforcements on the corners.

### 1.2.1 Original internal core structure

#### *Opus caementitium*

This building technique is generally diffused for the entire monument. It constitutes the inner core conglomerate composed by volcanic stones, fragments of stone or terracotta, sand (in coarse and medium granulometry) and lime.



Fig 17 - Tomb 19OS – inner core in opus caementitium, back wall in with outer face in common lava stones (opus incertum) and more visible front faces in well-cut big volcanic stones (opus quadratum).

**Volcanic stone blocks** used both as:

- building structural elements
- reinforcement of the corners



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Fig 18 - Tomb 11OS - volcanic stone blocks used as building structural elements.



Fig 19 - Tomb 3OS - volcanic stone blocks used as reinforcement of the corners.

### **Bricks** used as:

- building structural elements
- regular horizontal lines of “opus listatum”
- internal structure of columns
- reinforcement of the corners (but not easy today to differentiate the reconstructions)



Fig 20 - Tomb 15Es - bricks as building structural elements.



Fig 21 - Tomb 28EN - bricks as opus listatum in the pillars.

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Fig 22 - Tomb 20EN – bricks as *opus listatum* in the columns.



Fig 23 - Tomb 13OS - brick columns.



Fig 24 - Tomb 36EN – bricks as reinforcement of the corners.



Fig 25 – detail of brick reinforcement in the corners of Tomb 10EN.

### **Other stones**

Different kinds of stones are irregularly diffused inside the masonry, with no special or known purpose or action:

- tufa irregular stones
- travertine irregular stones

### **1.2.2 Outer faces of this structure**

During the construction, the *opus caementitium* was poured into a “mould” created out of the outside surface of regular building elements (such as volcanic stone, tuff or brick), which acted both as a proper mould (*formwork*) and as outer surface finishing, firmly bound to the inner core. Depending on the type of “masonry” used by the romans for this outer surface, several kinds are distinguished: *opus incertum*, *opus reticulatum*, *opus testaceum*, *opus latericium*, *opus mixtum*, *opus vittatum*. All of them generally contain, as interior core, the *opus caementitium*.



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Fig 26 – Tomb 19OS – Internal core in opus caementitium and outer layer of stone blocks.



Fig 27 – Tomb 19OS, internal core in opus caementitium and external covering in stone blocks.

### 1.2.3 Original height of the monuments

(see MAP n. 3 – *State of Conservation* – 3.2 *Loss of original height*.)

Most of the monuments don't have their original height anymore, as the majority of the structures have lost the top, probably during the 62 AD earthquake or the 79AD eruption.

This loss is not always measurable, but in many cases it seems to be quite important (from 2 to 4 mt or even more, if we think of the original aspect of Tomb 34AEN, now fallen down in the deepness below the city wall, which in origin was around 10 mt).



Fig 28 – Tomb 19OS – “not at the original height”.



Fig 29 - Tomb 31OS – “close to the original height”.

**PLEASE NOTE THAT:** this is a monument, which is preserved in its original height, but the socle today is reburied with mud, so the visitor does not see the original height since the foot level of monument is under ground

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### 1.2.4 Original ground level of the monuments

(see MAP n. 3 – *State of Conservation* – 3.5 *Direct contacts between structures and ground.*)

Not all the monuments are visible today at their **original** ground level. Some of them have the foundations visible and exposed, while some others are partially underground.

It is not easy to give clear and correct information about this, as at the time of the eruption (79 AD) some of these tombs could have been already partially buried because of many different reasons, among which also the earthquake of 62 AD<sup>1</sup> (see PIA Kastenmeier report).

However, from the conservation point of view it could be important to investigate more about this, both to understand if it is better to cover again the foundations (ment not to be exposed to the weather), and to think about the correct final presentation of a tomb, in case of complete restoration intervention.



Fig 30 - Tomb 27OS - "partially buried".



Fig 31 - Tomb 1 OS – in the bottom part, the foundations are visible, it is also visible the action of erosion by the water.

### 1.3 Originally closed/covered spaces (in reference to the preservation of decorated surfaces)

(see MAP n. 1 - *Original construction technique* – 1.3 *Original closed/covered spaces.*)

Thinking about the preservation of decorated surfaces in an archaeological site, it is very important to consider if these decorations are at the open air or in spaces covered by a roof (original or modern).

Through our very rough and rapid survey, we have found in the necropolis only 3 monuments which present a clear evidence of collapse of the original covering (the roof or the floor of the upper level)<sup>2</sup> and 5 monuments with an originally covered space without any decoration (Tomb 17OS, 15OS defined by the archaeologist Pia Kastenmeier as "open room", Tomb 9OS with chamber at ground level and in Fondo Pacifico Tomb FPND, FPSE).

In the Necropolis of Porta Nocera, our analysis has revealed 3 types of covered spaces: *funerary chambers, niches and door ways*.

Only 6 funerary monuments conserve the internal *funerary chamber*<sup>3</sup>. The chamber was generally plastered (with white stucco) and in some cases decorated with mural paintings, which unfortunately are still visible in only 3 tombs (*Tomb 7ES, Tomb 17ES, Tomb 2EN*). Some of these paintings are only simple colored lines or backgrounds, *Tomb 2EN* has a more important ornamentation, today in very bad conditions, as visible in the images below.

<sup>1</sup> Tomb 34AEN, which today lays in the lower part of the North East side of the necropolis, in fact collapsed during the 62 AD earthquake.

<sup>2</sup> Tomb 25OS, Tomb 19OS, Tomb 17BOS, Tomb 17AOS, a small niche in Tomb 36EN and in Fondo Pacifico TombFPNA, Tomb FPNH, Tomb FPNi, Tomb FPSGA

<sup>3</sup> Tomb 11OS, Tomb 7OS, Tomb 3ES, Tomb 7ES, Tomb 17ES, Tomb 2EN)



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Fig 32 - Tomb 2EN, inside chamber after excavation.  
From D'Ambrosio-De Caro publication.



Fig 32 - Tomb 2EN, inside chamber (photo  
Pompeiinpictures 2010)

Other decorations, in stucco, are preserved inside niches<sup>4</sup> or in doorways<sup>5</sup>. The door way of Tomb 19ES has a beautiful mural painting with the representation of fake marble. One of the niches has few remains of surface finishing (Tomb 7OS).



Fig 33 - Tomb 19ES - mural painting decoration in the  
door way.

### 1.4 Original water collection and management system

(see MAP n. 1 - *Original construction technique – 1.4 Evidence of original water collection system*)

Some evidences of an original way to manage the rain water around the monuments are still visible.

<sup>4</sup> Tombs: 25AOS, Tomb 23OS, Tomb 25OS, Tomb 13OS, Tomb 4EN, Tomb 6EN, Tomb 12EN, Tomb 20EN, Tomb 30EN, Tomb 36EN, Tomb 3ES, Tomb 5ES and in Fondo Pacifico, Tomb FPSGA

<sup>5</sup> Tomb 7OS, Tomb 3ES, Tomb 9ES, Tomb 11ES, Tomb 19ES and in Fondo Pacifico Tomb FPNF, Tomb FPNH, Tomb FPNi

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The water was collected from the roofs thanks to well calculated slopes and *rain drains in terracotta* (or metal?) through which the water was sent out from the structure. Only 3 of these terracotta elements are still visible, on top of the original covering of Tomb 3ES.



Fig 34 – Original rain collector between Tombs 4EN and 6EN.



Fig 35 - Tomb 3ES original water collector in terracotta.

The water falling down from the roofs (through the above mentioned terracotta drains or just falling from the projections of *cornices* and *ledges*, was collected in well prepared and plastered *water channels (ditches)* running along the buildings. Some of these channels are still in good conditions and visibles (in Tomb 2EN, Tomb 4EN and Tomb 6EN, Tomb 10EN). In all of them, many fragments of the stucco decoration, fallen from the adjacent walls, are collected.

For these collectors, special considerations have to be taken on how to protect them properly from visitor's impact,



Fig 36 - Original rain collector between Tombs 4EN and 6EN, from the North side.



Fig 37 – another view of the same collector where the perfectly finished surface is evident.



Fig 38 – more detail of Fig 37 where is evident the great attention to obtain a compacted and smooth surface to help the running out of the water.



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Fig 38a – Another detail of Fig 36. The perfect conception and finishing of these collectors is clearly visible.



Fig 38b – back of Tombs 12EN and 14EN. Other original water collector (also filled with fragments of the stucco plaster fallen from the walls). As in the previous case, here too the detail of work done for the slope is important, to understand the care for a proper collection and direction of rain water.

### 1.5 Original architectural surface finishings and decorations

(see MAP n. 1 - *Original construction technique – 1.5a Original architectural decorations*)

For most of the tombs, what we see today is in reality the internal core structure in *opus caementitium* with its outer faces, plus very few remains of the original surface finishings and decorations.



Fig 39 - Tomb 15OS external face with few surface finishing.



Fig 40 - Tomb 2-4-6EN. Infernal core and few surface finishing.

However, originally the outer faces of the structure were effectively protected (and decorated) by different kinds of external finishings and coatings, which we can still recognize:



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### 1.5.1 Masonry (as external finishing):

**big-size volcanic stone blocks** (*opus quadratum*) used as external face of the internal masonry structure in *opus caementitium*.



Fig 41 - Tomb 11OS, outer finishing with volcanic stone blocks.

**masonry of irregular medium-size volcanic stones** (*opus incertum*)

used as external masonry mainly for the back side of the tombs which were covered, on the main visible face, with big blocks of volcanic stone, or decorated with marble based stucco.



Fig 42 - back of the Tomb 17OS with the *opus incertum* wall and, on the right, part of the 3 others more visible walls, finished with well cut blocks of volcanic stone.

### 1.5.2 Surface coatings:

**stucco finishing**

Stucco refers in this context to all plasters and 3 dimensional decorative elements, made from a light colored white mortar, that contains mainly lime and calcite particles.

This kind of surface finishing is present in different typologies:

- stucco as *simple plane surfaces*



Fig 43 - Tomb FPNF

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- stucco as *fake stone slabs*



Fig 44 – Tomb 12EN, detail of the facade.



Fig 45 – Tomb 10EN, detail of the facade.



Fig 46 – Tomb 10EN, the stucco decoration on the East wall.



Fig 47 – Tomb 10EN, detail of the previous image, where the perfect work of the plastering is visible.



Fig 48 – Tomb 14EN, another detail of the very delicate work of the stucco.



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- stucco as *fake marble* to cover pilasters and columns (in general both worked out/“fluted” with vertical “*scanalature*”)



Fig 49 – Tomb 13OS, detail of the facade.



Fig 50 – Tomb 13OS, detail of the facade.



Fig 51 – Tomb 14EN detail of the facade.



Fig 52 – Tomb 14EN, front wall (South).

- stucco as three dimensional decorative elements



Fig 53 – Tomb 14EN, stucco relief with capital and decorative figures in the upper cornice.



Fig 54– Tomb 14EN, detail of the cornice.



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Fig 55 - Tomb 34A - stucco relief decoration.



Fig 56 - Tomb 34A – detail of the previous decoration.



Fig 57 - Tomb 3ES - stucco relief decoration.



Fig 58 - Tomb 3ES - stucco relief decoration.



Fig 59 - Tomb 14EN, person in stucco laying and reading.



Fig 60 - Tomb 30EN, incised preparatory drawing.

## mural paintings

- external mural decorations

present on 4 tombs (*Tomb 17ES, Tomb 19ES, Tomb 9ES, Tomb 11ES*)



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Fig 61 - Tomb 19ES. mural paintings decoration.



Fig 62 - Tomb 11ES. mural paintings decoration.

### - internal mural decorations

3 tombs have painted decorations on the walls of the internal funerary chambers (*Tomb 7bOS, Tomb 2EN, Tomb 25AOS*)



Fig 63 – Tomb 7bOS, view of the inside chamber with mural decorations.



Fig 64 – Tomb 2EN, view of the inside chamber with mural decorations

### simple plaster



Fig 65 – Tomb ... - a simple plaster.

### 1.5.3 Sculpted or carved decorative elements:

-decorative elements carved in the volcanic stone:

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- stone human statues
- stone animal statues



Fig 66 - Tomb 31OS – one of the two stone lion.



Fig 67 - Tomb 13OS – stone statues.



Fig 68 - Tomb 23OS – stone statues.



Fig 69 - Tomb 23OS – detail of the stone statues.



Fig 70 - Tomb 9bOS .



Fig 71 - Tomb 9bOS – detail of the stone statues.



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- stone capitals (*Tombs: 17ES, 34AEN, 9OS, 13OS, etc.*)



Fig 72 - Tomb 17ES, carved stone capital.



Fig 73 - Tomb 34AEN, carved stone capital.



Fig 74 - Tomb 34EN, stone capital.

- stone elements with surface finishing in stucco layer



Fig 75 - Tomb 34AEN, stone capital with stucco finishing.



Fig 76 - Tomb 34AEN, detail of Fig 75

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- stone decorative elements



Fig 77 - Tomb 17OS, decorative elements ("ovuli").



Fig 78 - Tomb 31OS, decorative elements ("ovuli").

### 1.5.4 Inscriptions: (*see MAP n. 1 – Original construction technique – 1.5b Original inscriptions*)

Two different kinds of *inscriptions* have been found directly over the surfaces:

#### 1.5.4.1 painted inscriptions "*dipinti*"



Fig 79 - Tomb 17OS, East face, painted inscriptions.



Fig 80 - Tomb 17OS, detail of North face of the monuments with more painted inscriptions "*dipinti*".

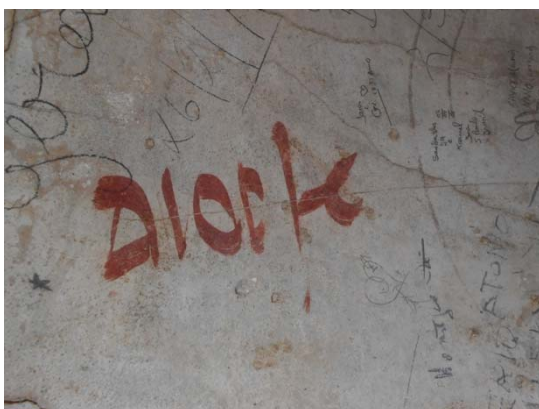


Fig 81 - Tomb 12EN, in RED original painted inscription ("*dipinti*"), in black several other modern inscriptions made with pencil, pen, etc



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### 1.5.4.2 scratched inscriptions or drawings



Fig 83 – Tomb 6EN , general view of the area with scratched drawings.



Fig 84– detail of the area indicated in RED in the previous image.



Fig 85 – Tomb 14EN, original ancient scratched inscriptions.



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1.5.4.3 A third type of *inscriptions* is also present on stone surfaces or on specific marble slabs, plastered onto the surface or attached through metal pins

- carved inscriptions on stone or marble



Fig 86 - Tomb 31OS –carved inscription on volcanic stone Fig 87 - Tomb 4EN – marble slab with carved inscription

1.5.4.4 On some stucco surfaces another kind of *incised drawings* are also visible, but they belong to the original construction technique of the three dimensional stucco decorations, which were first drafted through quick incisions, then covered with the plaster (made of lime and marble sand, and worked in relief freehand).

- preparatory drawings for the stucco reliefs (incisions)



Fig 88 - Tomb 30EN, remaining of the stucco decoration in which the preparatory drawing for the reliefs are still recognizable.



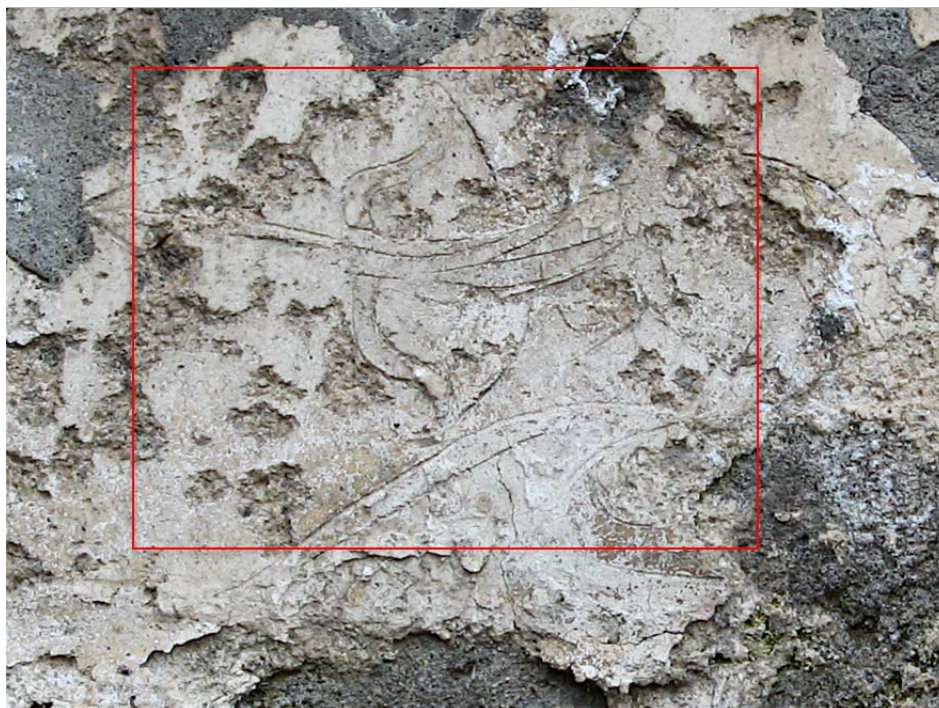
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Fig 89 - Tomb 30EN, detail of the previous image with the incised preparatory drawing for the stucco



Fig 90 - Tomb 34EN, stucco decoration with several incisions as preparatory drawing.



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Fig 91 - Tomb 34EN, detail of the previous decoration.

1.5.4.5 Modern *graffiti* are also visible, but please see chapter on State of Conservation.

### 1.6 Original decorations fragments laying around

(see MAP n. 1 – *Original construction technique – 1.6 Original architectural decoration fragments laying around (in October 2014)*)

During our different inspections of the site, we have found many fragments of the original surfaces laying over the ground, either they have been placed after the excavation close to the funerary monument to which they pertain, or because they collapsed and they remained in place.

The archaeologist Pia Kastenmeier has controlled most of these fragments comparing their actual position to what described in the De Caro-D'Ambrosio publication, but it is important to consider for the future actions and interventions, that maybe some of these fragments could be re-plastered in place, if old photos are available.

We have divided them according to the material, in three groups:

*stucco fragments*, *stone fragments*, and *masonry elements* (stones, bricks, etc).

The majority of fragments belong to the stucco finishing of the walls (see map).

They are very delicate and could be lost if exposed too long the weathering agents.

The masonry elements have to be collected and moved from the areas where the public is allowed, because they constitute a high risk for the visitors, who can easily stumble over them and be seriously injured.

The stone elements (or fragments) are generally well reported in the above mentioned publication, but some of them have been moved (in the same necropolis area or stored elsewhere, in one of the Soprintendenza's store rooms).

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### 1.7 Original metal elements

(see MAP n. 1 – *Original construction technique – 1.7 Original metal elements*)

Some original metal elements are still in place. We have divided them in 3 types: *hinges*, *nails* and *clamps*.

Hinges are still visible in 4 tombs (Tomb 11OS, Tomb 11ES, Tomb 17, Tomb 19ES)

Nails of two kinds were also used to hold the marble slabs for the inscriptions (Tomb 29OS, tomb 23OS)

Fig 92 -Tomb 23OS – marble slab with carved inscription hold in place by metal nails.



Clamps were used to hold together stone blocks. They are present in 4 Tombs (Tomb 31OS, Tomb 20EN and in Fondo Pacifico in Tomb FPNF)

Fig 93 –Tomb 20EN, original clamp to hold together two stone blocks...



## **Chapter II**

### **PREVIOUS INTERVENTIONS**

on structures and surfaces

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### 2. PREVIOUS INTERVENTIONS

It is not easy to recognize the different interventions which have been done on the monuments in the last years. The archaeologist Pia Kastenmeier is studying the images from the archives and comparing them with the present situation, but the work is still quite long.

We have recorded the following main visible works for the structures:

#### 2.1 Structural reconstructions

(see MAP n. 2 *Prev Interventions* – 2.1 *Reconstructions*)

To identify with certainty all the structural reconstructions, a detailed survey on each monument is definitively needed, to compare old photographs with the present situation

As an example, the detailed survey that Christina Elsässer has made on Tomb 14 EN has shown very clearly the line of the reconstructed masonry.

In the possible future campaigns, the time and the work to find and compare the different old photos of each of the monuments will have to be considered. At present we can not give clear conclusion about the amount of reconstructions existing in the necropolis.

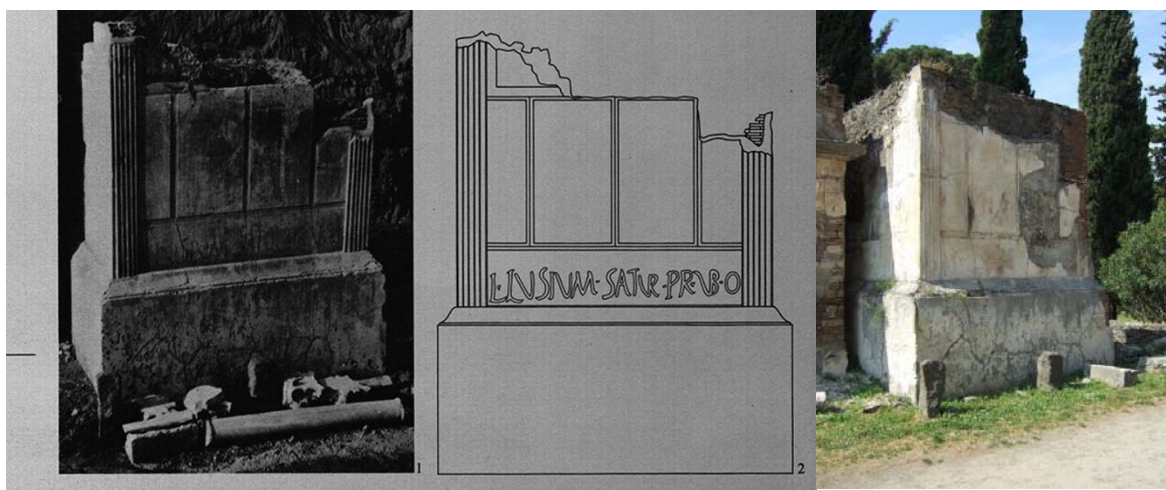


Fig 94 - 95 - Tomb 14EN, image and drawing from De Caro 1993 publication, and image 2014 with reconstruction of the right upper corner.



Fig 96 - 97 Tomb 14EN with the reconstructed part (photo and graphic by Christina Elsässer)



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### 2.2 Modern covering protections

#### 2.2.1 Temporary roofs (see MAP n. 2 Prev Int – 2.2 Modern roofing/covers)

Under this definition we have included different kinds of covers, built over the monuments to protect the surfaces from the weathering agents. From the archaeologist Pia Kastenmeier's archival researches, most of these coverings have been done in the 90's.

We have classified all the roofs as “temporary”, but also according to the more or less durable structure and materials used. There are short-term and medium/long-term roofs, as none of them seems to be completely valid, from the protection result and from the esthetical point of view. All of them suffer of being “short-edged” on the four sides, which leads to an insufficient protection of the surfaces in case of slanting rain.

##### **Short-term temporary roof :**

vertical structure - in metal “scaffolding tubes”  
cover - in thin ondulated metals sheets

BROWN in MAP n. 2.2 Modern roofing/covers



Fig 98 - Tombs FPNA and FPNB (East side of the Necropolis so called Fondo Pacifico).

##### **Long-term temporary roof :**

vertical structure: in wooden beams laying over the original wall

cover - with terracotta tiles



Fig 100 - Tomb 11ES GREEN in MAP n. 2.2 Modern roofing/covers

##### **Medium long-term temporary roof :**

vertical structure – in metal rectangular section tubes supporting a strong metal solded structure  
cover - strong metal ondulated sheets over a strong solded metal structure

water collecting system - no collector

GREEN in MAP n. 2.2 Modern roofing/covers



Fig 99 - Tomb 31OS.

##### **Medium long-term temporary roof :**

vertical structure – cement beams laying over the original walls and columns

cover - strong metal ondulated sheets

water collecting system - yes, gutters and descending water drain



Fig 101 - Tomb 13OS GREEN in MAP n. 2.2 Modern roofing/covers

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In the East part of the necropolis (next to the Via Nucerina (so called “Fondo Pacifico”))

Five monuments have been protected with very basic coverings. The vertical structures are made with metal tubes (normally used for scaffoldings, called in Italian “*tubi Innocenti*”), which are in relatively good conditions and can still accomplish their function.



Fig 102 - Tomb FPNA, temporary roofs, in relatively good conditions



Fig 103 - Tombs FPNA and FPND, temporary roofs from the south side in 2010

The horizontal metal covers are in worst conditions, deformed by the wind, or leaking because of holes in correspondence of the iron nails and iron wire bindings.



Fig 104 - Tomb FPN F, temporary roof in bad condition



Fig 105 - Tomb FPN D metal cover in very bad conditions

(see MAP n. 2 *Prev Interventions* – 2.2 *Modern roofing/covers*)

As visible in the map these coverings have been classified as “*Short-term protections*”, because they look as they were thought to be replaced with a longer-term structure.

Only one tomb has a good protection (*Tomb FPSGB*), while the metal cover of the other four tombs needs to be replaced: two of these covers are collapsed, deformed and very damaged (*Tomb FPNF* and *Tomb FPNG*), and the other two are leaking (*Tomb FPNA* and *Tomb FPND*).

In the Western part of the necropolis

No short-term roof is present. Medium/long-term duration roofs cover three tombs, *Tomb 31OS*, *Tomb 13OS*, *Tomb 34AEN*, the painted and stuccoed facades of *Tombs 11ES*, *Tomb 9ES* and *Tomb 19ES* and the large “storage area” where several pieces and fragments coming from the necropolis have been saved.



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All of these covers are in good conditions, unless the facade roofs of *Tomb 9ES* and *Tomb 11ES*, which are collapsing and have been propped with metal tubes and wooden planks, in recent time. These small protecting roofs are quite old, as they have lasted for almost 30 years. They have been made at the same time of the glass protections (see later paragraphs)



Fig 106 - Tomb 9ES in an image of 1970 -79 by Günther Einhorn.



Fig 107 - Tomb 11ES in 2014.



Fig 108 - Tombs 9ES and 11Es with modern propping of the tiles' roofs.

### 2.2.2 Impermeabilisation of the original covering structures

(see MAP n. 2 *Prev Interventions* – 2.2 *Modern roofing/covers*)

Keeping in mind that most of the monuments are no longer at their original height, we have included under the definition of “impermeabilisation”, those horizontal surfaces which were original, but have been repaired in modern time with different methods such as: modern “cocciopesto” layers, cement mortar layers, bitumen layers. Map n. 2.3 is only indicative, as only very few tombs are visible from above (from the street, or from the city walls) and the distance doesn't allow a perfect identification of the materials used.

Under this same definition we have also included the protection of the top of the walls “capping” (the Italian local term is “*colli di muro*”).



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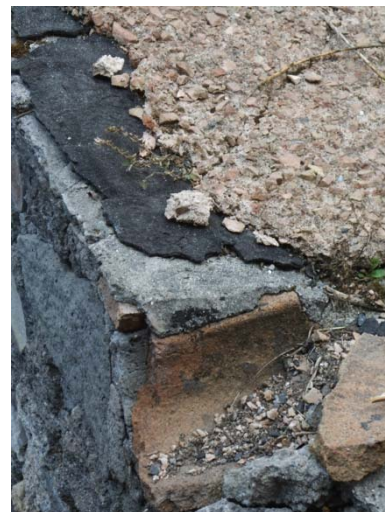


Fig 109, 110, 111 - Tomb 25OS General view and details of the modern impermeabilisation, which is repeated on many of the other tombs.

### 2.3 Modern water collection system

(see MAP n. 2 Prev Interventions – 2.3 Modern water collection systems)

#### 2.3.1 Big tubes (pipes) water collectors

We have yet no precise trace of the dates of this kind of intervention. Further archival work is necessary and will be done in next campaign.

Some very big tubes are located on the edges of the necropolis, below the bridge that leads to the amphitheatre and at the East side of the Via Nucerina Necropolis area.

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Fig 112 - Big pipes below the bridge to the amphitheatre.



Fig 113 - Big pipes in the area of the “Fondo Pacifico”.

### 2.3.2 Manhole covers and channels

#### In the West part of the necropolis

From the marks over the ground we can see that most of the water which comes from the North part of the ancient town, through Porta Nocera, follows the natural slope of the ground and turns to the West side of the necropolis.

In fact, only in this area (OS in the map) few other small modern water collectors are found, placed in front of *Tomb 31OS*, *Tomb 29OS*, *Tomb 27 OS*, *Tomb 25AOS* and *Tomb 17OS*.



Fig 114 - Water collector in front of Tomb 27OS.



Fig 115 - Water collector in front of Tomb 17OS.



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Fig 116 - Water collector in front of Tomb 25OS,



Fig 117 - Water collector on the north side of Tomb 27OS and Tomb 17OS

We could not find comprehensive information about this issue. For this reason it would be important to speak with the Municipality to know more about how, at present, the water is collected and managed in the area of the modern town of Pompeii and in Via Plinio, the road which runs along the necropolis. Further archival work is necessary and will be done in next campaign.

The archaeologists of Prof. Van Andringa's team<sup>6</sup>, told us that, also in ancient times, the extreme West side of the necropolis was an area with "flooding" problems. In fact, the recent excavation has shown that, at the time of the eruption, the ground surrounding *Tomb 17OS*, was already covered by several layers of mud and debris transported by the rain.

The same team of Prof. Van Andringa, also told us that, in a heavy rainy day, their excavation was flooded by a large amount of water coming out from the holes of the high wall which delimits the excavation on the South side (this wall divides the archaeological area from the modern city street Via Plinio). We were in Via Plinio in a very heavy rainy day and we saw that there are some problems of water collection (see images).



Fig 118 – 119 – 119a – in the first two images, the wall along Via Plinio, at the South boundary of the archaeological site. In the left and right images are also visible the glass barrier on the walkway, which runs over the wall, and the excavations of Prof. Van Andringa below.

<sup>6</sup> Prof. William Van Andringa, Professor of Archaeology at the University of Lille 3.

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Fig 120 - Via Plinio looking at the West side.



Fig 121 - via Plinio looking at the East side.



Fig 122 - the walk way below via Plinio.

We inspected the top of this wall, through a pedestrian path (walkway) from which visitors can see the Necropolis through large protection glasses. The water that runs over this path also falls into the Necropolis area, through small regular “water drains “.



Fig 123 – view from the West of the pedestrian path (walkway) between Via Plinio and the archaeological excavation.

As visible in the image, the slope of this walkway brings the water towards the left, to the boundary wall of the archaeological site



Fig 124 - view from the East of the slopes of the walkway, which run in two directions, both bringing the water towards the central part of the path, which corresponds (see next Fig.) to the upper area of the protective roofing which covers the “deposit” of statues and stone fragments (at the bottom of the ancient via di Porta Nocera)



Fig 125 – the water stays in the depression of this area and slowly descends into the archaeological area through the provided water outputs.



Fig 126 – one of the water outputs



Fig 127 – the protective roof over the statues deposit



Fig 128 – the modern water collectors: from the pedestrian path in RED, and from the deposit roof in BLUE



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Moreover, the large sidewalk of Via Plinio, on the side of the pedestrian path and of the excavation, has many large “flower beds” with trees and bushes, from which the water can easily infiltrate into the ground. This infiltration leaks out again into the excavation through the many vent holes done with this purpose, to allow the water contained on the back of the boundary wall to come out.



Fig 129 – water stagnation in Via Plinio, just above the area of the necropolis.

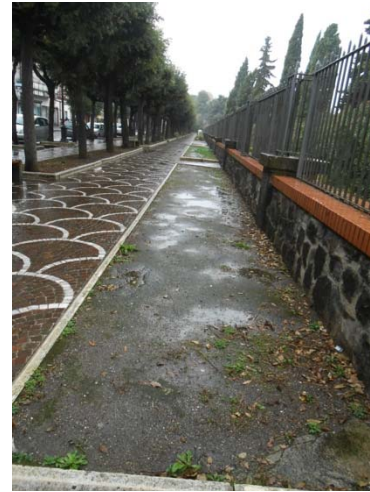


Fig 130 – water infiltration and stagnation in the flower beds along Via Plinio and beside the boundaries wall of the pedestrian path (over the excavation).



Fig 129 - North side of the pedestrian walkway wall. At the right of the image a phenomenon of erosion of the ground.



Fig 130 – detail of the previous Fig. The erosion of the ground is visibly linked to the water flow.

### In the East part of the necropolis (Via Nucerina).

In this area, only one manhole cover is visible, close to the big tube collector on the East side.

#### 2.3.3 Other kinds of modern “channels”

Around two sides (West and South) of *Tomb 2EN*, a 60 cm wide trench has been excavated (probably close to 20 years ago). At present the “channel” is closed by long terracotta slabs (Italian local term “*tavelloni*”) and a small manhole cover is visible on the South side. Fragments of the original marble decoration of the tomb are placed along the West side of this channel, to avoid visitors to walk over it.

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Fig 131 -132 -133 - Tomb 2EN, modern channels on the outside of the tomb. Is not clear if these channels have been made as a drainage, to reduce humidity in the inside chamber (decorated with mural paintings), or if they are used to simply collect and convey rain water.

### 2.3.4 Modern “rain drains” (and “water drips”)

(see MAP n. 2 Prev Interventions – 2.2 Modern roofing/covers and 2.5 Modern water collection system)

Many tombs have one or more “rain drains”, to collect the water run-off from the top of the monument. These are generally visible on the structures which have had an intervention of impermeabilisation of the top horizontal surface.

The water, collected and managed in this way, falls slightly far from the bottom surfaces of the monument, and can cause, along the time, future problems of salt migration, salt crystallization, detachment of plasters, disintegration of the mortars or the stone, etc etc.



Fig 134 e 135 – back of the Tombs 6EN and 10EN – modern rain drains to collect the water from the top surface of the monument

### 2.4 Modern glass protections and modern metal elements

(see MAP n. 2 Prev Int – 2.4 Modern glass protections and modern metal elements)

Entering to the necropolis from the “Porta Anfiteatro”, the modern glass protections are very visible on the facades of Tomb 11ES, Tomb 9ES and Tomb 19ES. In this last one a well preserved stucco and mural paintings decoration remains on the front wall and in the



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entrance sides. In *Tomb FPND* of the Via Nucerina Necropolis, a glass protection on the South wall preserves a painted inscription.



*Fig 136 – Tomb 19ES – glass protection applied over the most decorated tombs, where mural paintings or painted inscriptions were preserved.*



*Fig 137 –Tomb FPND (ex Fondo Pacifico), glass protection on the South side.*



*Fig 138 and 139 – Tomb 19ES – detail of the glass protection and its metal structure (left and right side). Due to the dust and humidity always present in the archaeological site, the glasses become dirty and opaque and the decoration is not visible anymore. Unfortunately it is not possible to clean the glasses, as they are not demountable.*



*Fig 140 - Tomb FPND, detail of the modern glass protection with the metal elements to hold the glass in place.*



*Fig 141 - Tomb FPND, detail of the modern glass protection which does not protect from the problems due to salt crystallization and mortar erosion.*

## **Chapter III**

### **STATE OF CONSERVATION**

of structures and surfaces



## POMPEII SUSTAINABLE PRESERVATION PROJECT

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### 3. STATE OF CONSERVATION

At a first superficial view, the general conditions of the Necropolis appear healthy. The area is kept clean and in order, as a careful cut of the vegetation is carried out regularly.

In reality, looking at the monuments with major attention and detail, the state of conservation of some structures give a different impression and the conditions of the surfaces appear definitively bad, with a very high risk of losing the remains of decorations.

A view of the archive images, give us an idea of how beautiful was the appearance of these monuments in their origin. To preserve them, means also to take into consideration this loss and work to allow the visitors to understand it and to be able to appreciate, as much as still possible in our days, how perfect and well-conceived were the techniques for the surface decorations and coverings of these structures.



*Fig 142 – Archive image during the excavation of 1954. South-West view of Tombs EN04, EN06, EN10 and EN12, which came out in extremely good conditions?*



*Fig 143– Same view of the tombs in present time, 2014. All the funerary monuments (Tombs 10EN, 12EN and 14EN) have lost almost all the decorative (and protective) original stucco coating.*



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Fig 144 – Archive image during the excavation of 1954. North-West view of Tombs ES\_13, ES\_15, ES\_17 and ES\_19. Also in this case the surfaces still preserve a great amount of surface covering, plasters, stucco and paintings. At the extreme right, the Tomb 13ES, which is also in the images below.

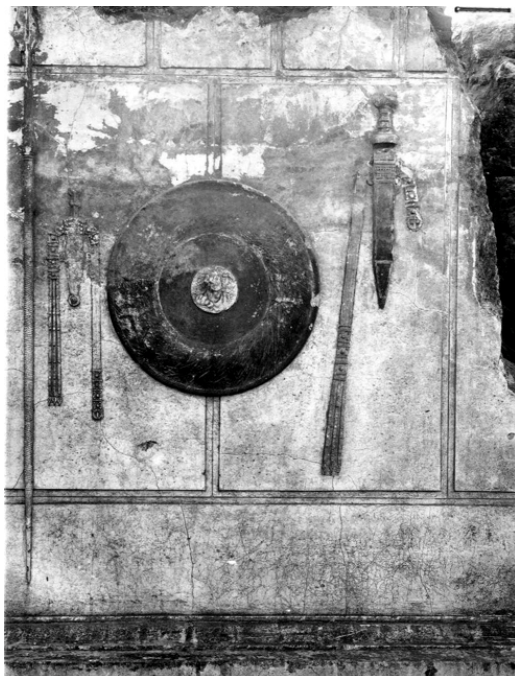


Fig 145 - Detail of the north face of Tomb ES\_13. The decoration is not only a relief in stucco, but has also finishing and details in mural painting

A wrong decision in the final phases of the intervention on this monument, could ruin it forever, producing a definitive loss of the few details which still tell us how the decoration was. A very careful and well thought final presentation has to be foreseen, for any operation that concerns the integration of the stucco missing portions ("lacunae"/ losses)



Fig 146 - Tomb 13ES, same view with what remains today of such a beautiful and elaborated decoration.



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(see MAP n. 3. State of Conservation – 3.3 Structural problems and MAP n. 3. State of Conservation – 3.4 Surface instability)

### 3.1 Danger and risks for visitors and surfaces

(see MAP n. 3. State of Conservation – 3.1 Danger and Risks for visitors and original surfaces )

To ensure safety conditions for our team work, we have mapped all the possible situations of risk. These risks have been considered in regard to the visitors (from above or on the ground), considering loose stones ready to fall, depressions, holes or materials on the ground and the resulting need of barriers or warning panels. But also situations in which damage could occur to the decorated surfaces, which can be broken or scratched by fragments falling from above.

### 3.2 Loss of height (see MAP n. 3. State of Conservation – 3.2 Loss of original height)

As already stated in point 1.2 (*Original construction technique – 1.2 Original structure masonry components*), most of the monuments do not have today their original height. We have two very different situations, which we have defined as *close to the original height*, in the case of lack of only few ranges of stones, and *loss of original height* in the case of an entire register missing, or 1-2-3 meters missing, and even more.

Even though the descriptions of the De Caro-D'Ambrosio's publication are generally comprehensive, this loss of height is not always measurable, as we don't have certain knowledge of the original aspect of the monument. However it seems to be quite important in many cases (from 2 mt to 4 mt).



Fig 147 - Tomb 31OS “close to the original height”.



Fig 148 - Tomb 19OS “loss of original height”.

### 3.3 Structural problems (see MAP n. 3. State of Conservation – 3.3 Structural problems)

In the Necropolis of Porta Nocera, the general impression is that structures are in quite good conditions, and that structural problems are localized in limited specific areas (corners of the building, upper parts of the walls or for some heavily cracked and displaced stones). But the difficulty in Pompeii's archaeological sites is that structures and surfaces don't give clear sign of alert for a possible weakness, they simply suddenly collapse. If we consider what recently happened to the wall of *Tomb 24EN*, in March 2014, and how the wall looked in the photographs of previous years, we can imagine that a careful and thorough inspection by a structural engineer is definitely advisable.

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Fig 149- 150- 151- 152 - Tomb 24EN, the wall before and just after falling down, in March 2014.  
It is probable that the foundations have been slowly eroded by the rising damp and the rain.

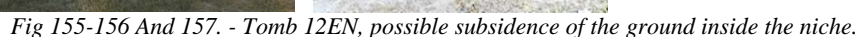
To our restorers' eyes, concerning the problems linked to **statical stability**, only Tomb 28EN has a visible situation of apparently, possible, collapse of the whole monument, because the two remaining walls are propped and there is evidence of possible **subsidence of the ground** on the back side.

A similar problem of possible shift or sinking of the land, could be in act also near Tomb 31OS, between Tomb 19OS and Tomb 17OS, on the back of Tomb 11OS (on its South West part), in a light way in the niche of Tomb 12EN and on the back of Tomb 30EN).



Fig 153 and 154- Tomb 28EN, front and back face with the long propping.





Only few structures, (11%) have really “*collapsing*” parts (**RED** in MAP).

(see Annexes. - Scheme of relations between Structural problems and Surface instability)

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### 3.4 Surface instability (see MAP n. 3. State of Conservation – 3.4 Surface instability)

This is the most important problem for the necropolis.

A close and careful inspection has shown that almost all the layers of renderings, stucco or plaster are detached from the building structure or between the layers themselves.

We have identified four levels of damage for the decorative layers:

- *collapsing*
- *very unstable*
- *unstable*
- *medium unstable*

Among these, *collapsing* of the renderings is the more diffused damage, present on the 58% of the tombs, together with *very unstable* and *unstable* renderings, which are both present on the 45% of the tombs. *Medium unstable* areas are definitively very few, only on the 8% of the monuments.

Observing some recent photos (included in the Soprintendenza project of emergency works, planned for 2010), is extremely clear that **the loss of a consistent amount of decorated surfaces, can be considered a certain risk in a very close future.**



Fig 158 - Tomb 14EN in 2005.  
The basement is complete.



Fig 159 - Tomb 14EN in 2014.  
A big part of the left corner of the basement is gone.

### SURFACE INSTABILITY

n. of Tombs	% on the total n. of tombs	Tombs number or name
35 tombs have “collapsing” parts (RED in MAP)	55%	<b>Tombs in the Porta Nocera Necropolis:</b> <b>OS side:</b> 29OS, 27OS, 25AOS, 25OS, 23OS, 19OS, 17OS, 13OS, 9OS, 7OS, 1OS, <b>ES side:</b> 3ES, 5ES (piccole nicchie interne), 7aES, 9ES, 13ES, 17ES, 19ES <b>EN side:</b> 2EN, 4EN, 6EN, 10EN, 12EN, 14EN, 16EN, 20EN, 26EN, 30EN, 38EN <b>Tombs in the Via Nucerina Necropolis, N side:</b> FPN AN, FPN FN, FPN HN, FPN IN, FPN GbS
27 tombs have “very	42%	<b>Tombs in the Porta Nocera Necropolis:</b> <b>OS side:</b> 17OS, Tomb 3OS (on the back of 1OS), 4EN, 6EN,



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unstable” portions ( <b>ORANGE</b> in MAP)		14EN, 16EN <u><b>Tombs in the Via Nucerina Necropolis</b></u> , N side: FPNB, FPND, FPNE, FPNGB
27 tombs have “unstable” parts ( <b>BLUE</b> in MAP)	42%	<u><b>Tombs in the Porta Nocera Necropolis</b></u> : OS side 31OS, 23OS, 13OS, 11OS, 9OS, 7OS, 5OS ES side: 19ES, 13ES EN side: EN6, 36EN, 38EN <u><b>Tombs in the Via Nucerina Necropolis</b></u> : FPND, FPNF, FPNH, FPNI
5 tombs have “medium unstable” areas ( <b>YELLOW</b> in MAP)	8%	<u><b>Tombs in the Porta Nocera Necropolis</b></u> : 13OS, 1OS, 5ES <u><b>Tombs in the Via Nucerina Necropolis</b></u> : FPSGb, FPNA, FPND

Some of these preparatory or finishing layers are crumbling apart not only due to structural problems, but also due to the effect of salts crystallization. (*see MAP n. 3. State of Conservation – 3.7Salt presence or effect*)

We have tried to overlap the map of surface instability with the one about salt presence. A perfect matching of the two problems is not immediately visible, but it appears clearer only for some of the Tombs:

- on the EN side (12EN, 14EN, 20EN, 22EN, 26EN, 30EN, 36EN, 38E)
- on the ES side (19ES, 17ES, 7ES, 3ES)
- on the OS side (32OS, 29OS, 27OS, 23OS)

A direct relationship between the deterioration of the layers and the presence of vegetation is not visible today, but we can easily understand that some of the renderings have been detached by the penetration of roots and climbing plants, as parts of these organisms still remain attached to the wall surface.



Fig 160 -161 - 162. - Back of Tomb 12EN. with long remains of climbing plants. In the detailed at the right, the roots are below a very unstable fragment of stucco, “pushing it out” from the surface.

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Fig 163 - 164  
– Tombs  
12EN and  
15OS, more  
died climbing  
plants,  
pushing out  
the plasters in  
the right Fig.  
and over the  
surface which  
has totally  
lost the stucco  
covering.

### 3.5 Direct contact between structures and ground

(see MAP n. 3. *State of Conservation – 3.5 Direct contacts between structures and ground*)

As water is one of the major causes of deterioration for walls and decorations, we have inspected the monuments considering how close to them is the presence of water, through infiltration from the ground or infiltration from leaking covers and walls in general. We have considered three typical situations:

- *modern land slide*
- *partially buried*
- *too excavated* (foundations visible and exposed to weathering)

Many of the monuments today appear to be “*partially buried*”, as they visibly don’t start from the present level of the road. But the recent excavations by Prof. Van Andringa showed that also at the time of the eruption, the lower part of some monuments was already partially buried (*Tomb 31OS, Tomb 29OS, Tomb 27OS, Tomb 25AOS*).



Fig 165 and 166 – in the lower part of the excavation cut the layers of fine sand transported by the rain before and at the time of the 79 AD eruption.

Only three monuments present situations of *MODERN LAND-SLIDE*, where portions of the structure are in contact with the collapse of the adjacent ground. These monuments are all in the Eastern area of the necropolis, in the Via Nucerina Necropolis: *Tomb FPNB, Tomb FPNI*.

In fact, as visible in the map, all the West side of this part of the archaeological area has a serious problem of *land-sliding*.



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Fig 167 - Tombs FPN, general view with MODERN LAND SLIDING



Fig 168 - Tomb FPNB land sliding at the left side.



Fig 169 - Tomb FPN1, slope of the excavation.

We have identified as *PARTIALLY BURIED*, the structures in proximity of the archaeological cut of the excavation: *Tomb 19ES*, *Tomb 17ES*, and some other tombs which have small/big amounts of ground over them (which can be easily removed): *Tomb 7OS*, *Tomb 17OS* and *17bOS*.



*PARTIALLY BURIED*  
Fig 170 - Tomb 19ES



*PARTIALLY BURIED*  
Fig 171 - Tomb 7OS



*PARTIALLY BURIED*  
Fig 172 - Tombs 17a and 17b

We have also found that some monuments (7 in the whole necropolis) present a problem of *foundations* now out of their original ground level and today *visible* and therefore exposed to the weathering agents. This is not good as these masonries were supposed to be protected by the ground. And this can have possibly been the cause of the recent collapse of the wall of *Tomb 24EN*.

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Fig 173 - Tomb 10S, part of the foundation are exposed



Fig 174 - Tomb 20EN, the foundations are exposed at the bottom of the front side.

### 3.6 Water presence (see MAP n. 3. State of Conservation – 3.6 Water presence or traces)

In the dry season it is difficult to understand how the water will move inside the necropolis during the winter. Few marks are visible on the ground at the entrance to the necropolis (from the amphitheater side), and along the central road, on the south side (some traces of the water movement are visible in front of Tomb 14EN).

Also at the intersection with the Via di Nocera, coming down from the gate of Porta Nocera, is very clear that the water comes down from the gate with a certain force, as many debris are left in the area around the *cippus* of Titus Suedius Clemens and towards the West side of the necropolis.



Fig 175 - view of Porta Nocera from the South. The strong slope of Via di Nocera is evident, as well as the amount of debris left by the running water in the area of the necropolis.



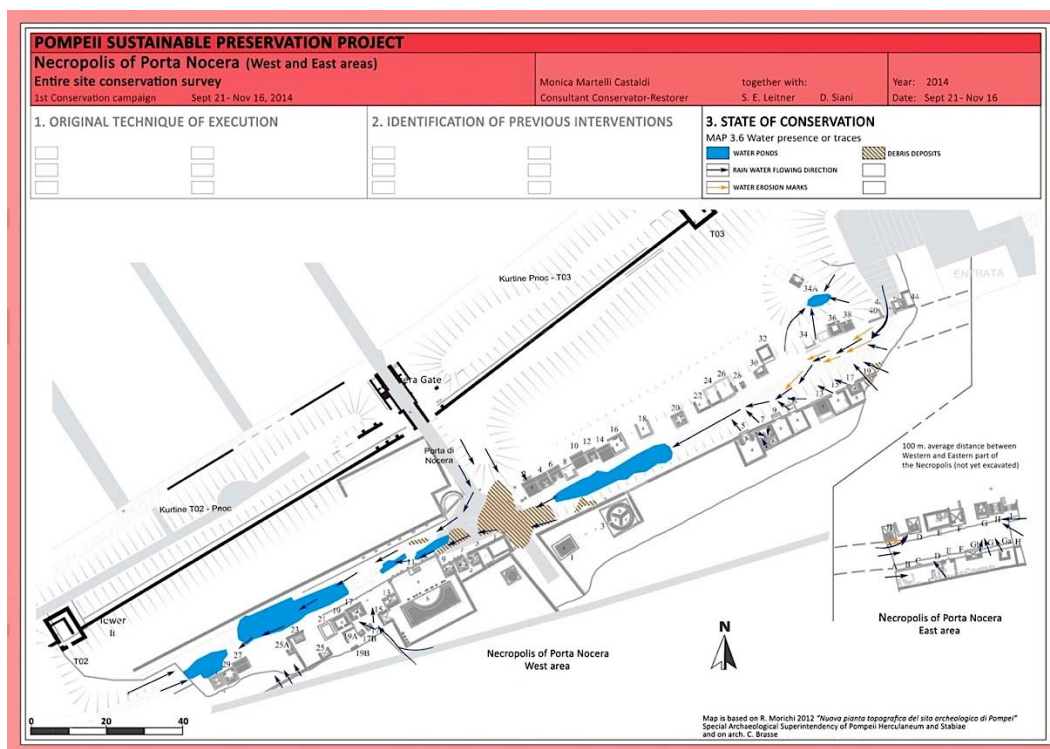
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Fig 175 and 176 – view of the crossroad area with the debris and their detail at the left. This material comes from the very sloping Via di Nocera but also from the rain water erosion of the East part of the street of the necropolis (Via delle Tombe)

We know that since the antiquity the West area of the necropolis has been the natural place where the water was gathering, due to the natural slope of the ground, bringing sand and different kinds of debris.



MAP n 3.6 Water presence or traces – MAP of the necropolis with the water flowing and the water ponding over the ground. The map is based on the drawings done by Christiane Brasse in context of her publication of the city wall

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Fig 177 - a very comprehensive image of the necropolis during a rainy day. The direction of the water flow is more than clear.

1. From the East side of the necropolis (Porta Anfiteatro modern entrance to the site), the water moves along the Via delle Tombe towards the
2. central crossroad at Porta Nocera, and continues from there towards the end of the excavated tombs.
3. After Tomb 310S, another slope (artificial) comes along the small path from the West entrance to the site.



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Fig 178 - View of the area preceding the crossroads of Porta Nocera.

The heavy problems of salt crystallization of the surfaces of these tombs are due to the water impregnating the ground continuously during the rainy season.

The tombs are also totally exposed to sun irradiation which increases the process of evaporation of the water through the surfaces.

Problems of rain water infiltration from the roofs are also cause of decay for the upper parts of the walls and decorative features.



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### 3.7 Salt presence or effects

(see MAP n. 3. *State of Conservation – 3.7 Salt presence or effect*)

Currently<sup>7</sup> the presence of salts is visible only in very few tombs, mainly as white efflorescences on stone surfaces.

The action of their crystallization is instead very visible on the stucco surfaces which appear terribly damaged, both as detachment of the plasters from the masonry and between the preparatory layers. Almost all the layers of renderings, stucco or plaster show problems of detachment from the structure or from the underneath layers, as well as disintegration, pulverization and “explosion” of the finishing layers, with a more aggressive or a less damaging effect.

The several different visible typologies of damage can appear on the same area and at the same time, as they are one the consequence of the other.



Fig 179 - Tomb 12EN, salt crystallization as:

1. “Esfoliation” - the very thin and superficial finishing of the stucco curls off and detaches from the rough layers below
2. The exposed internal material of the rough layers is eroded by wind and rain and by salt re-crystallization
3. The materials starts to powder out forming large cavities
4. The masonry is exposed and starts to suffer of the same problems



Fig 180 – Tomb 14EN, large portions of the external finishing layer of the stucco start to be pushed out from the surface.

The below preparatory layers start to be exposed to the weathering agents

<sup>7</sup> A warm and sunny October 2014.



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Fig 181 - Tomb 14EN, detachment of the final stucco layer + the 2nd preparatory mortar layer

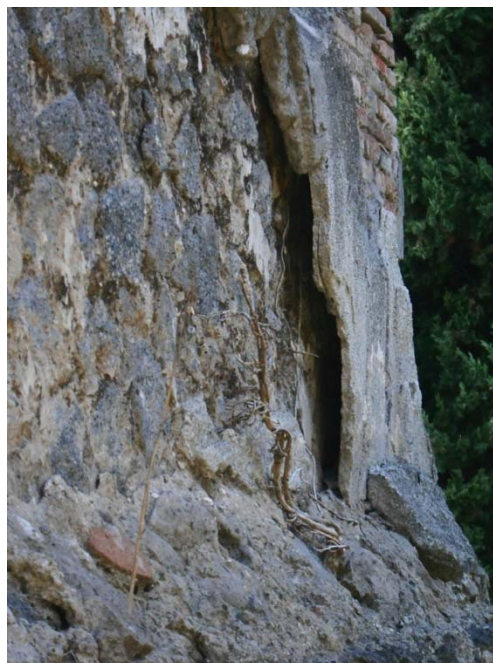


Fig 182 - Tomb 14EN, East side, detachment of the whole structure of the stucco covering: 1st+2nd+finishing external layer

### DETACHMENT OF THE SURFACE FINISHING



Fig 183 - Tomb 14EN surface of the "lesena" in stucco with a dramatic deterioration due to salts' efflorescences



Fig 184 - Tomb 14EN detail of a detachment similar to those in the previous image.



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DSCN6921 - SALTS

DSCN6920 - SALTS

DSCN6919 - SALTS

Fig 185 – 186 - 187- Tomb 14EN a different appearance of the phenomena of salts crystallization, more superficial and curly,



Fig 187a – 187b - Tomb 14EN, another area of the same surface. This kind of decay can happen when the surface has been treated with a protective coating, such as a wax or a resin, as visible in certain areas of the necropolis.



## HARD SUB-FLORESCENSES



Fig 187c – 187d – a different typology of damage due to salts. The crystallization happens just below the external surface of the stucco and has a hard consistency, sometimes pushing out small portions of surface.



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### EROSION OF THE INTERNAL PREPARATORY LAYERS



*Fig 187e – Fig 187f - Tomb FPN.... erosion and powdering of the internal preparatory mortars, leaving the external finishing layer (more compact) totally unprotected*

The same kind of damage occurs also on the structural materials once they have been exposed to the weathering agents, because of the loss of their covering layers (the stucco decoration).



*Fig 188 - Tomb 10EN, “explosion” of the external surface of the bricks due to salts crystallization*



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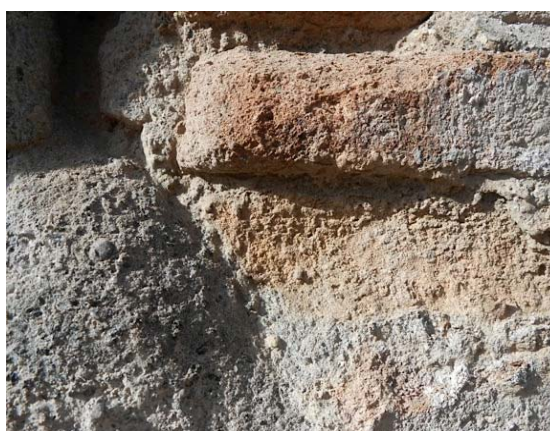
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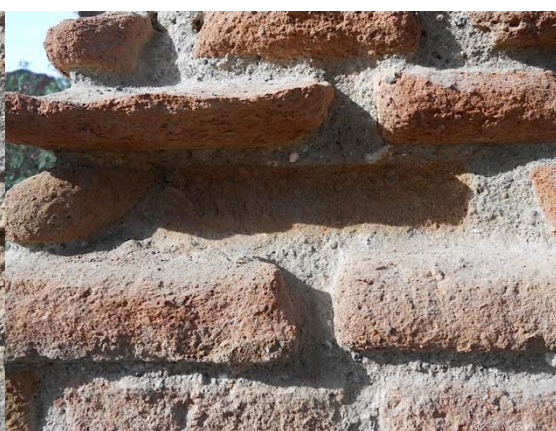
*Fig 189 - Tomb 10EN, strong salt crystallization below the external surface of the bricks*



*Fig 190 - Tomb 10EN, detail of the same area*



*Fig 191 - Tomb 10EN, powdering of the brick because of salt's disintegration*



*Fig 192 - Tomb 10EN, same situation in a more advanced decay*



*Fig 193 - Tomb 17ES, the decay slowly leads to the loss of the brick*



*Fig 194 - Tomb 14EN., the loss of the single bricks can lead furtherly to structural problems, especially in the corners of the monuments*



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As described in the previous paragraphs (point n. 3.5), the graphic maps show a clear connection between the salt presence and unstable or collapsing surfaces, only for the tombs with plaster or stucco decoration<sup>8</sup>.

But we have found the possible reason for the very heavy salt decay of the surface of Tomb 14EN, when we saw a photo of the South surface after a heavy rain<sup>9</sup>. The road in front of the tomb appears completely filled with water. This water will of course penetrate into the structure, and re-emerge from the surfaces bringing a great amount of salts which will remain on the surfaces.



Fig 195 - Tomb 14EN, ponds due to water stagnation



Fig 196 - water pond in front of tomb 14EN

### 3.8 Vegetation (see MAP n. 3. State of Conservation – 3.8 Vegetation)

As already said, the site is controlled, with a regular mowing of grass and bushes.

In the map, the existence of trees doesn't create conservation problems as they are planted always far from the walls.

Big oleander bushes do not create problems with their roots, but more with their branches, which sometimes scratch the surfaces (Tomb 20EN, on its West side).

### 3.9 Biodeterioration (see MAP n. 3. State of Conservation – 3.9 Biodeterioration)

There is a large diffusion of microorganisms, which grow over all the surfaces which can grant them enough humidity. For this reason their presence is more visible on the North facing walls, where the sun is less present, both in the Western part of the necropolis and in the Eastern part (Via Nucerina Necropolis) (see map)

There are different kinds of microorganisms, some of them can be roughly recognized as algae, fungi, mosses and lichens, but only a correct biological analysis can identify them in the proper way. However, there is not a real emergency in this, as the fight against these organisms is definitively less urgent than the rest of the conservation issues arised during the survey.

For Tomb 14EN, Christina Elsässer has done an interesting first recognition, through with micro-photographs, in which some of the microorganisms are clearly recognizable (please refer to her comprehensive analysis).

<sup>8</sup> on the North-East side of the necropolis: Tomb 12EN, Tomb 14EN, Tomb 20EN, Tomb 22EN, Tomb 26EN, Tomb 30EN, Tomb 36EN, Tomb 38E.

on the South East side of the necropolis: Tomb 19ES, Tomb 17ES, Tomb 7ES, Tomb 3ES

on the South West side of the necropolis: Tomb 32OS, Tomb 29OS, Tomb 27OS, Tomb 23OS

<sup>9</sup> Photo from the Soprintendenza project for emergency works on the necropolis (2009), courtesy of Stefania Giudice

## **Chapter IV**

### **OPERATIONS TO BE DONE**



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### 4. FUTURE SITE PRESERVATION

#### Evaluation of the emerged needs and proposals for possible actions

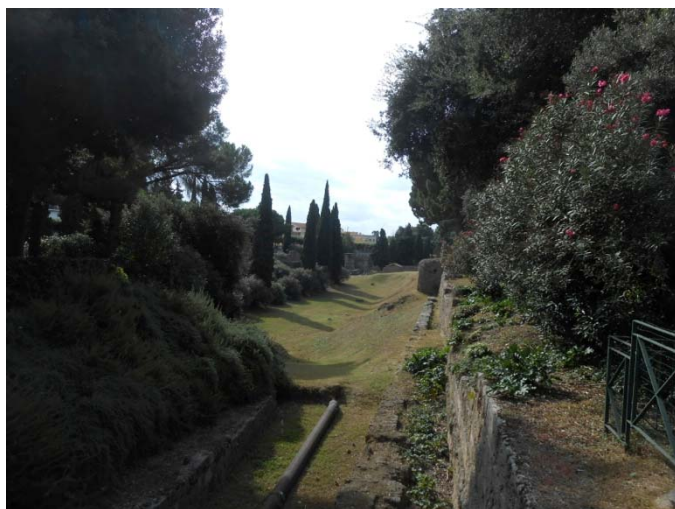
As said, the site looks apparently well and healthy, as the control of the vegetation is regularly done, fact which gives a real good impression to the visitor. The difference with old times is very visible in the photos below, where this area of the site appears definitively neglected.



*Porta Nocera - general view with vegetation in the years 1970 - 1979 (Photo Gunter Einhorn from Pompeiinpictures)*



*Porta Nocera - general views without vegetation in the years 2000 and 2014 (below)*



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Nevertheless, the PSPP survey has shown the real situation of the conservation of the site, which is definitively serious. If there is a wish to ensure the preservation and transmission to the future of the monuments, together with their surface decorations, it is absolutely necessary to enact a certain number of measures, immediately.

These different measures depend, of course, on time and on the economic resources available for the necropolis. For this reason, to organize the information collected during the survey and to be able to establish priorities, we have divided the data as follows:

In regard to the possible needs, we have established three types of activities:

- a) **Actions** - these refer to the execution of a concrete practical intervention on site (conservative or preventive)
- b) **Consultancies** - these reflect the need of inspection and more competent advice, by a specialist
- c) **Research** - include the suggestions for possible fields of investigation, extremely needed to enact the two previous measures, or just useful to bring knowledge for the future conservation and preservation of the necropolis.

In regard to time, we have considered only two possible moments:

- a) **Emergency** - which include evaluations as *urgent, very urgent, immediate*, etc, for interventions or for the inspections prior to them, to be carried out on site as soon as possible, by expert consultants specialists in the different topics
- b) **Important** - which include all the other actions advisable and recommended to protect the monuments or to restore them. This can mean short-term, medium-term, long-term actions, to be discussed and planned but only once the site has been secured with emergency measures.

Combining the above established parameters, we have tried to obtain a list of proposals as “ideal work plan” for the possible future PSPP campaigns. You find here below the considerations in relation to the three main subjects of interest of the project: Conservation / Education / Research. Following, a summary table indicates in detail the different possible activities, with their PRIORITY level (from 1 to 3).

This short list is the result of detailed schemes prepared for each of the conservation topics as previously analyzed through the maps. The schemes can be seen in *annexes*.

### Emergency interventions and Education

To study the necropolis without considering the need of first ensuring its surfaces, would be a great risk.

In addition, emergency works can be an important opportunity for the project PSPP as they can be linked to the possibility to develop education projects.

All archaeological site suffer from the difficulty to provide regular maintenance to the surfaces, which sadly leads to the loss of most of the remains of the original exterior aspect of the monuments. It leads also to the most common aesthetical appearance of archaeological sites, as “simple walls, with no trace or information of the decorated or simply protective coatings which were applied over their surfaces”.

Very few conservation schools and universities provide in our days specific studies for the “*Conservation of decorated surfaces in archaeological sites*”, but all of these schools and universities are obliged to offer to their students real worksites on which to realize their practices (the proportion of the time devoted to practice has been defined at European level<sup>10</sup> as at least the

<sup>10</sup> E.C.C.O.-ENCoRE statement on Education, approved by the General Assembly of E.C.C.O. (Brussels 7. March 2003) and by the General Assembly of ENCoRE (Torun 9. May 2003) - [www.encore-edu.org/ENCoRE-documents/ECCO-ENCoRE.pdf](http://www.encore-edu.org/ENCoRE-documents/ECCO-ENCoRE.pdf) (accessed 5.08.13)



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50% of the total course time: 50% theoretical lectures + 50% practice).

To organize different kinds of courses and practical activities to be hosted in the necropolis of Porta Nocera, would achieve the dual purpose of solving both problems:

- the universities would have their practice worksites
- the necropolis would be maintained

The universities would provide a regular presence of students on the site, covering and providing, for at least 3-4 months a year,<sup>11</sup> maintenance and emergency works, whereas a series of previously agreed and well-structured seminars and courses can give to the students the theoretical support to the important experience they would do, both on the site and in Pompeii, and as specific specialization in “*Conservation of architectural surfaces in archaeological sites*”.

Living for a while in Pompei and being able to touch the specificities of roman building techniques, can be for the students a unique experience, without equal.

### Study and researches

The most important research to be done for the necropolis concerns the **surface decay** (for paintings, stucco finishing, stone or brick surfaces, etc). This study has already been started in 2007 and 2009, during the Herculaneum Conservation Project<sup>12</sup>, but no conclusion or results were reached. To continue this study, would be important, as the collection of information and experimentations which could be today gathered by PSPP, would help to solve one of the most critical problems for any archaeological site (not only in Pompei, but everywhere in the world).

A second kind of study which could be extremely useful for the conservation in archaeology, would be the collection of data about **consolidation materials**, many of which have been certainly used in Pompei in the past. To identify the types of consolidates and their chemical composition, together with scientific information about their behavior in time, will be of great help for the treatment of detached and decayed renderings and superficial layers.

A third study, which could be of immense help for the conservation community, and absolutely essential for the conservation in archaeological sites, is a **new approach to salt presence and decay mechanisms** (useful both for the decorative features, and for the mobile artifacts found during the excavation). A necessary and not really existing way of considering the problem, as this subject has been generally approached as a “battle against a very dangerous enemy”....

This is not a winning approach. Salts are there and they will be there forever, because we can not extract them from the internal core of the walls. Humidity and sun will also continue their action, even if possibly moderated by new roofs and by a correct control of the water flow over the ground. The general condition of an archaeological site, from the conservation point of view, can be improved, but what is definitively needed is a specific approach. A different way of looking at these objects considering to provide and ensure for them the most important tool and methodology available: human presence. A regular and competent human action, for control and intervention.

### Specific consultancies

The need of specialized consultancies for the structural problems, could be integrated with the

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<sup>10</sup> E.C.C.O. “Competences for Access to the Conservation-Restoration Profession” (2011), © European Confederation of Conservator-Restorers’ Organizations (E.C.C.O.) A.I.S.B.L., ISBN 978-92-990010-6-6:  
[http://www.skr.ch/fileadmin/skr/pdfs/Grundlagentexte/ECCO/Competences\\_for\\_access\\_to\\_the\\_profession\\_ECCO.pdf](http://www.skr.ch/fileadmin/skr/pdfs/Grundlagentexte/ECCO/Competences_for_access_to_the_profession_ECCO.pdf)  
 (accessed 5.08.13)

<sup>11</sup> In general from February to March, before the Spring or Summer exams

<sup>12</sup> See M. Martelli Castaldi “*Studio del degrado e dei possibili sistemi di consolidamento e adesione della pellicola pittorica*” 2007 (with N. Laino), and subsequent HCP “*Remedial treatments of cohesion and adhesion failures in paint layers at the archaeological site of Herculaneum*” Trials and study days SGS 2009-2010.

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studies and researches field, as it would be important to understand what has been done until now and what could be improved for the future in this specific area of intervention.

All the other possible consultancies (for the biodeterioration, for the water presence, etc) can also be a starting point for specific studies, to be linked with tests on site and other experiments, which can be of great interest for the educational point of view.

### FINAL REVIEW

Here below a **scheme of the priorities and usefulness of the different actions.**

The name of well-known consultants (experts in the single field, but specifically competent for its application in conservation) can be provided if requested.

MAP	PRIORITY			ACTION	CONSULTANCY	RESEARCH
<i>MAP n. 1.2</i> <b>Original structure</b> (masonry components).			<b>3</b>			<b>USEFUL</b> Study on the different behavior to the weathering agents in relation to the internal construction materials.
<i>MAP n. 3.1</i> <b>Dangers and risks</b> (for visitors and surfaces)	<b>1</b>			<b>EMERGENCY</b> Remove risks for visitors	<b>IMMEDIATE</b> Inspection of specialist for structural stability	
<i>MAP n. 3.2</i> <b>Loss of original height</b>	-	-	-			More studies about this topic, in vision of new temporary roofs
<i>MAP n. 3.2bis</i> <b>Original ground level</b>	-	-	-			More studies about this topic
<i>MAP n. 3.3</i> <b>Structural instability</b>	<b>1</b>				<b>IMMEDIATE</b> Inspection by structural engineer specialized in archeological structures	
<i>MAP n. 3.4</i> <b>Surface instability</b> (see also MAP n. 3.7)	<b>1</b>	<b>2</b>		<b>IMMEDIATE</b> Consolidation of collapsing preparatory layers	<b>URGENT</b> Verify infiltration of water from above	<b>EXTREMELY USEFUL and URGENT</b> Follow up of HCP study on damage of paint layer and surface finishings
	<b>1</b>	<b>2</b>		<b>EMERGENCY</b> Consolidation of surface decay due to salts	<b>URGENT</b> Verify infiltration of water from below	<b>EXTREMELY USEFUL and URGENT</b> Study on consolidants and protective coatings used on archeological surfaces
	<b>1</b>		<b>3</b>	<b>EMERGENCY</b> Rescue of fragments fallen at bottom of structures		<b>IMPORTANT</b> Research of other fragments already in deposits
			<b>3</b>			<b>IMPORTANT</b> different behavior to the weathering agents in relation to the decorations and the internal construction materials.



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MAP n. 3.5 <b>Direct contact between structures and ground</b>			<b>3</b>	<b>USEFULL</b> Consolidation of excavation-cut surfaces to avoid material sliding over excavated surfaces	<b>IMPORTANT</b> Verify areas with land-slide situation	A small search in archive about photos of excavation moment
		<b>2</b>		<b>IMPORTANT</b> Reburial of exposed foundations (if they do not have a specific archaeological need to remain visible)		
MAP n. 3.6 <b>Water presence or traces</b>	<b>1</b>			<b>URGENT</b> Repair or re-activate existing water collectors	<b>URGENT</b> Study in detail management of water through: a. drainages b. trenches c. open channels etc	Research about active or passive measures to reduce impact of moisture on monuments and walls
	<b>1</b>	<b>2</b>		<b>IMPORTANT</b> Re-establish the ground surface at the entrance to the necropolis (from the amphitheater side)	<b>IMPORTANT</b> Inspection of specialist and/or study in detail of movement of rain water on ground surfaces	Geological study of the ground water in modern and ancient Pompeii.
MAP n. 3.7 <b>Salt presence or effects</b>	<b>1</b>			<b>VERY URGENT</b> Repairs or new impermeabilisation of existing covers (directly on the masonry or as temporary roofs)	<b>VERY URGENT</b> Verify all covers to understand water penetration	
	<b>1</b>			<b>VERY URGENT</b> Repair existing temporary roofs or build new ones		<b>VERY URGENT</b> For many tombs, analyze possibility of new construction of temporary roofs
	<b>1</b>					<b>VERY URGENT</b> Continue HCP study on problems of the paint layer and surface finishings
MAP n. 3.8 <b>Vegetation</b>	<b>3</b>	-	-			Research on plants for the soft capping of walls to prevent water uptake.
MAP n. 3.9 <b>Biodeterioration</b>	<b>1</b>			<b>URGENT</b> Apply a biocide to reduce damage on painted surfaces	<b>URGENT</b> For painted rooms, need of study of microbiological growths to define biocide and times of application	Research on the type of organisms and methods to prevent growth in the future

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