# Conservation Management Plan for the Blast Furnace Remains at Whitegate, Co. Clare

## History, survey and structural assessment

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*1. Introduction*

During the seventeenth and most of the eighteenth century the vast majority of iron used in Ireland was produced locally in blast furnaces. These monumental structures and their associated works would have dominated the landscape in the areas where they were active; economically, socially and visually. For a variety of reasons, Irish blast furnaces are preserved better than elsewhere and the surviving furnaces in the Sliabh Aughty area, on the Counties Clare and Galway shores of Lough Derg, present one of the finest collection of blast furnaces of that age anywhere worldwide.

The Sliabh Aughty Furnace Project was created in 2014 with the aim to study, conserve and educate about the iron industry in the Sliabh Aughty area.[1] In the Spring of 2015, a grant was obtained from the Heritage Council (Ref. CBH04830) to compose Conservation Management Plans for the four upstanding blast furnace remains in the Sliabh Aughty Mountains area. These Plans, consisting of the known historical information of the ironworks, detailed surveys of the structures and structural assessments of the same, the latter carried out by Architectural Conservation Professionals,[2] are seen as a first study of these furnaces and especially as documents which form the initial steps towards their future conservation.

This Plan concerns the blast furnace remains in the townland of Furnace in Whitegate, Co. Galway.[3] The furnace at Whitegate is exceptional as two of the walls were built substantially wider than usual so they could contain what is most likely a passage way. In fact, these two walls are the only surviving part of the structure together with the lower part of the wall corner located between the two arches. This furnace appears to be substantially higher than the other three, which is unusual as it is located in a flat landscape. This furnace is the only one with both upstanding remains and documentary evidence and can be dated to around the middle of the eighteenth century.

1 www.furnaceproject.org and https://www.facebook.com/pages/Sliabh-Aughty-Furnace-Festival/434485340026466
2 Grageen House, Cappanuke, Cappamore, Co. Limerick www.acpgroup.ie
3 Coordinates (ITM): 574493, 688491

*2. Historical background*

## 2.1 Iron smelting in Ireland in the 17th and 18th century

Until the late sixteenth century, iron ore in Ireland was exclusively smelted in so-called bloomery furnaces. These installations were generally clay-walled chimneys, about one to one and a half metres high with an internal diameter ranging between 30 and 60cm. In bloomery furnaces the heat was used to remove the oxygen from the iron oxides in the ore and to smelt the non-iron parts of the same, but the iron itself never became liquid. The products of these furnaces are known as blooms and weighed from 20 to 40kg.[4]

Around the thirteenth century, in an area stretching from Sweden over Germany to Switzerland, an altogether different type of furnace appeared. Now the bellows are no longer blown by hand but driven by water-power, the furnaces themselves are substantially larger stone-built square structures (side lengths and heights between 4 to 5m) and the product is now liquid iron. This liquid iron is characterised by a higher carbon content than bloomery iron.[5] The furnaces themselves are invariable equipped with two large arches, set in adjoining walls: one for the bellows ('blowing arch') and one for the removal of the iron and waste ('tapping arch'). The liquid state of the iron is not only due to a higher temperature as a result of the use of water-power, but also because of the use of more charcoal per fuel unit.

The liquid iron leaving the furnace could be poured into a mould resulting in cast iron objects. Because of their high carbon content, cast iron objects cannot be forged; they shatter upon being struck with a hammer. Alternatively, the iron could be cast into large bars of iron known as sows.[6] These sows are then brought to an installation known as a finery where the iron is re-melted in an oxidizing environment to remove the excess carbon. After further operations at the chafery (renewed reheating) and the hammer forge (shaping), so-called wrought iron is obtained which could then be further forged into a variety of shapes by the blacksmith. The finery, chafery and hammer forge all utilised water-power and were frequently part of the same plant.

As a blast furnace was expensive to build, required highly specialised labour and had a high

4 (Rondelez 2014): 245-246. Water-powered bloomeries could produce substantially larger blooms.

5 Iron produced in the bloomery can have a low carbon content or a medium one. In that latter case it can be considered as steel. In the blast furnace the iron has to be converted to wrought iron (low carbon content) after which carbon needs to be added to obtain steel.

6 From the late 18th century these are known as pigs of iron

strategic value, it spread only very slowly outside of its original heart-land. Only at the very end of the fifteenth century are the first installations of this kind built in England, in the south-eastern Weald counties of Kent and Sussex. Only when the woods in that area could no longer provide sufficient fuel for the furnaces, around the middle of the sixteenth century, did blast furnaces spread further afield, into northern and central England and Wales. This is the period when the Plantation of Ireland got under way and already in the 1560s we hear of proposals of establishing a blast furnace in the area around Carrigaline, Co. Cork as part of the Kerrycurrihy Plantation.[7]

It is unclear if this furnace was ever built and for the rest of the sixteenth century the sources mention only further proposals and unspecified ironworks working in Ireland, all in Counties Cork and Waterford. The earliest definite evidence of a blast furnace in Ireland is the one built by Sir Thomas Norris in Mallow, Co. Cork which operated from 1583 to 1589.[8] In beginning of the seventeenth century, during several decennia of relative calm, multiple blast furnaces were built in Ireland. Among the most proliferous were the ventures of Sir Richard Boyle, First Earl of Cork, in Co. Waterford and by Sir Charles Coote's ironworks in County Laois and the ones built by both in Leitrim.[9]

Many of these furnaces were destroyed during the Civil Wars of the 1640s but already in the 1650s new ones were built and surviving ones brought into production again. This is the period when the long-lasting works at Enniscorthy, Co. Wexford are constructed.[10] In the 1660s and 70s, William Petty established a substantial iron-producing industry in County Kerry,[11] but it was especially in the 1680s that new plants were started up, many in areas with no previous recorded blast furnaces, such as Counties Cavan, Mayo and Galway. In the eighteenth century we have many references to blast furnaces active all over Ireland, but the limited source material together with little research on the subject means that we cannot yet present a clear picture of the industry at that time. Many ironworks closed down around the middle of that century, with a handful continuing production up till about 1780. These then close down due to lack of fuel and competition from abroad.

In the Sliabh Aughty area, ironworks were active over a period of well over a hundred years (Fig. 1). The earliest furnace, at Ballyvannan, Co. Clare, possibly dates to before 1610.[12] The first furnace

7 BL, Cotton Titus B/XII f.10, Rondelez 2014: 99
8 Rondelez 2014: 108
9 Rondelez In Press
10 Barnard 1985
11 Barnard 1982
12 See the Conservation Management Plan for Ballyvannan furnace, Co. Clare (Rondelez et al. 2015)

for which we have solid evidence is the one built in 1630 at Scarriff, Co. Clare by English merchants. After legal problems and the onset of the civil wars of the 1640s, the same merchants crossed the Atlantic and were involved in the first functioning blast furnace in the Americas at Saugus, Massachusetts. Back in Ireland, the iron industry along Lough Derg was only started up again in the 1680s, in Scarriff and in Woodford, Co. Galway. About a decade later, a furnace was built near Feakle. We are badly informed about the eighteenth century, but it would seem likely that the remaining furnaces were built during the earlier part of that century. We know that Whitegate furnace was in use in 1760. If Lewis is correct, the industry in the Sliabh Aughty area ended in the late 1770s with the closure of the Woodford ironworks.[13]

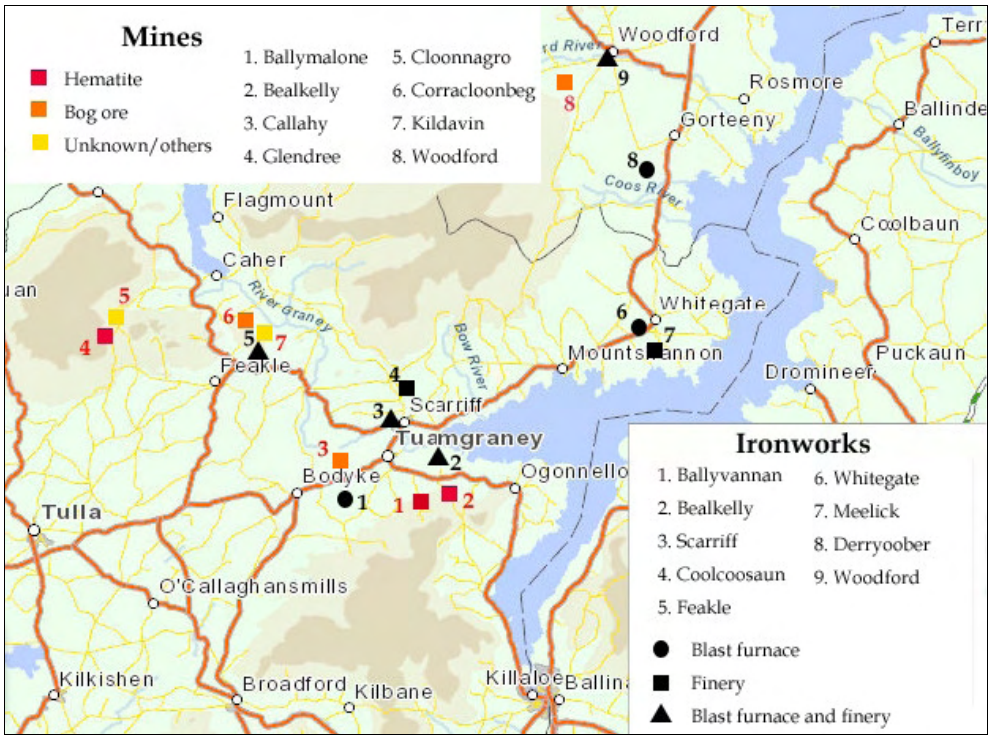


Fig. 1. The Sliabh Aughty ironworks and associated iron mines

13 See below for the history of Whitegate furnace

## 2.2 Historical background of Whitegate furnace

The furnace at Whitegate is the only one of the four remaining furnaces for which we have direct historical evidence. The start date of the Whitegate works is unclear but the 1740s has been suggested.[14] The ironworks of Woodford and Ballinruane, Co. Galway were for be let in 1758.[15] These are described as consisting of one furnace and three forges (or fineries). This could either mean that the furnace at Woodford was out of use at that time or that only the Whitegate (Ballinruane) forge (finery) was included. Proposals were to be sent to Henry Croasdaile of Renn, Co. Laois or Samuel Benton in Woodford. The latter could have been the manager of the works. In 1760 the Whitegate (Ballenruane) ironworks were leased out for a term of 31 years at a yearly rent of £65, together with the Woodford ironworks, to John Burke of Grallagh, Co. Galway.[16] The Ballenruane ones are specified as 'two severall Ironworks'. In the same deed it is specified that a coppice and underwood were growing on the lands between the Ballenruane ironworks and the river Shannon. The Topographical Dictionary of Ireland by Lewis, published in 1837, states that the works were discontinued about 60 years previously.[17] The remains of both the furnace at Whitegate and its finery in Meelick were mentioned by Kinahan in 1863.[18] This finery, where the iron made in Whitegate furnace was further processed, used the same river originating in Cregg lake, north of the furnace.

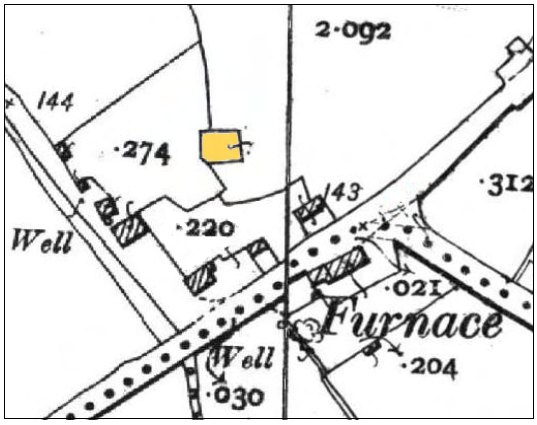


Fig. 2. Whitegate furnace (yellow) on the 1910s Ordnance Survey map.[19]

14 Elliot 2004: 24. This information, however, does not appear to be contained in the quoted deeds
15 Stokes 1893
16 NLI D. 23,185-23,215 Aliaga Kelly Papers (Croasdaile Papers) Not individually numbered, Croasdaile – Lambert Deed of 3 March 1760
17 Lewis 1837 Vol. II: 724
18 Kinahan 1863: 48
19 Unusually, the furnace is not depicted on the 1830s OS map

*3. Survey of Whitegate furnace*

Whitegate furnace is unusual as the building not only has the square structure with the two arches but on two sides has additional outer walls leaving what is most likely a passageway (Fig. 3). There is also an additional chamfered wall on the north east from which the passageway emerges. Whitegate is also the only of the four Sliabh Aughty furnaces to still have remaining contemporary walls abutting the furnace.

In plan, the furnace structure itself is an irregular square building with wall lengths varying between 7.0m and 7.8m. The upstanding remains have a maximum height of about 6.8m on its eastern wall. It is unclear if the wall on the opposing side would have reached the same height as this would have made loading the furnace much more complicated. Interior measurements given in Fig. Xxx should be seen approximate as several the location of several points had to be estimated.

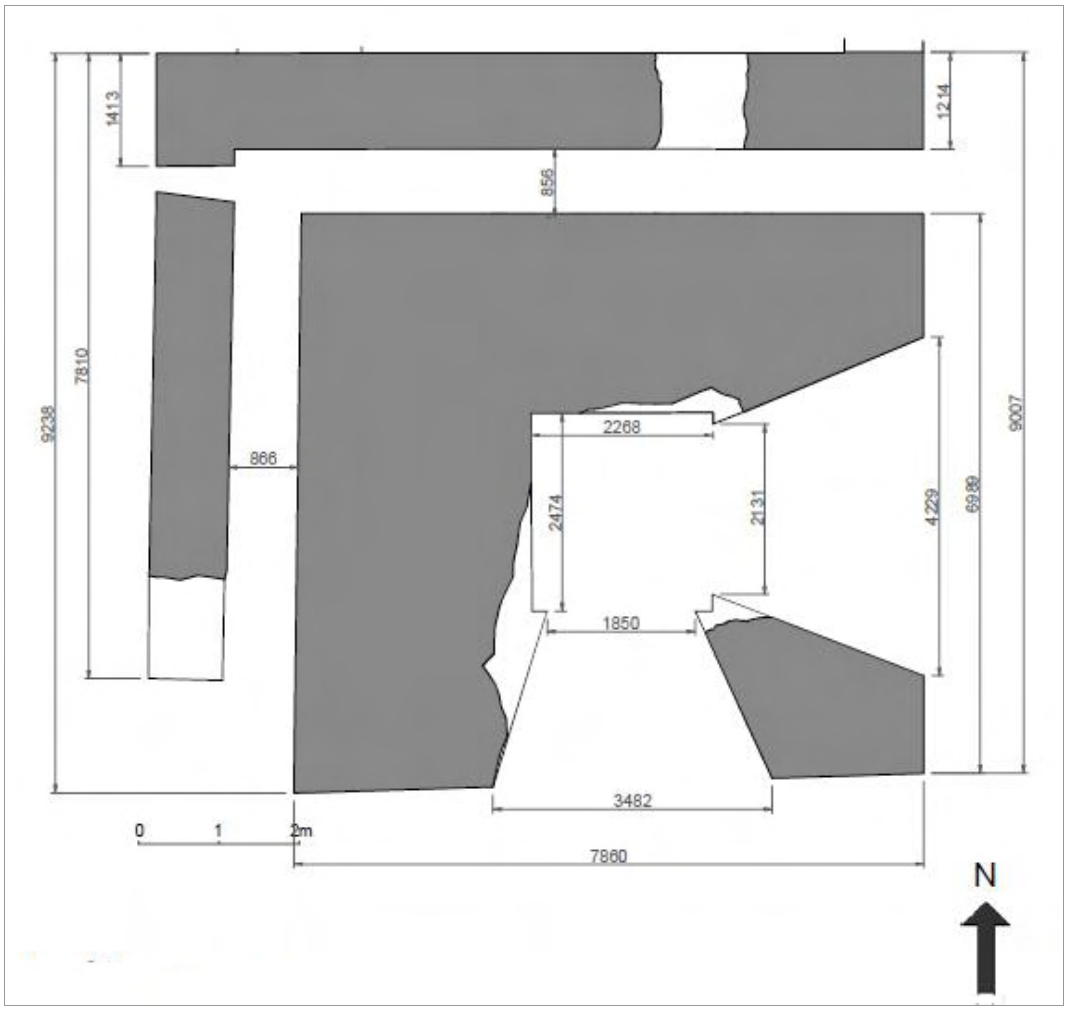


Fig. 3. Ground plan of Whitegate furnace

### 3.1 West and south-west walls

The west wall is just over 7.8m long and 6.8m high (Fig. 4 and 5). It is a plain wall with the exception of a window on its lower northern side connecting to the passageway (Fig. 6). This window is 0.68m high and 0.32m on its exterior. The window is splayed towards the south and is 0.48m wide where it meets the passageway. This passageway exits in the chamfered south west wall (Fig. 7 and 8).

Fig. 4. West and south west walls of Whitegate furnace

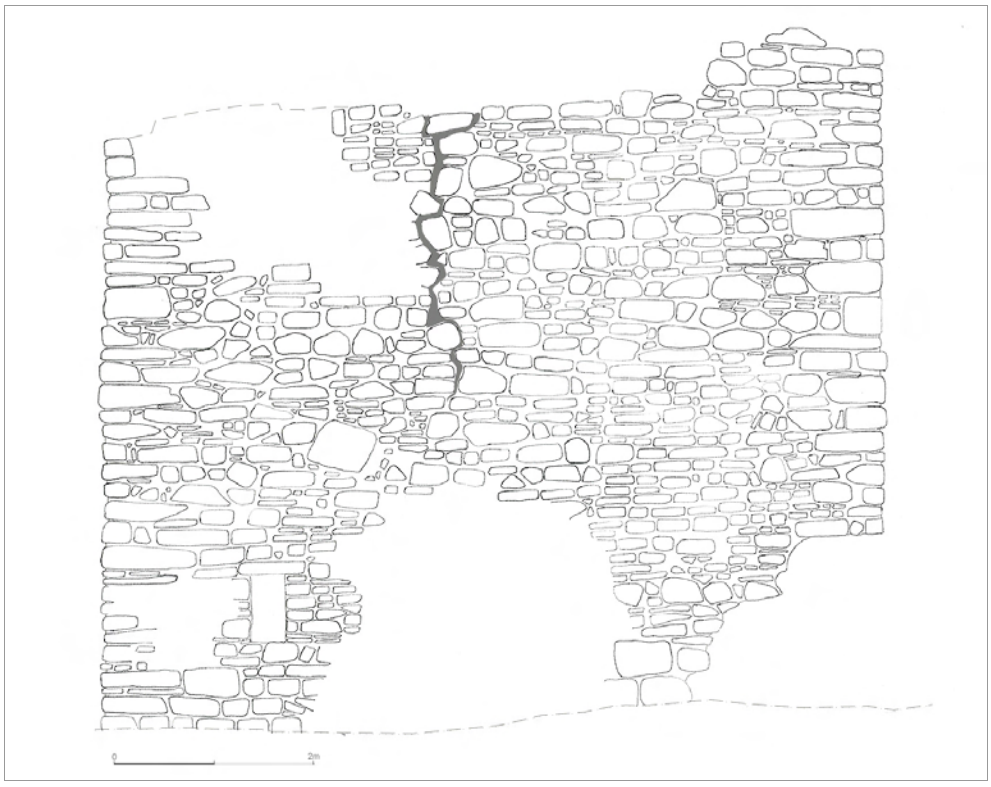

Fig. 5. Elevation drawing of the west wall

Fig. 6. Window in the west wall

Fig. 7. Passageway in the south west wall

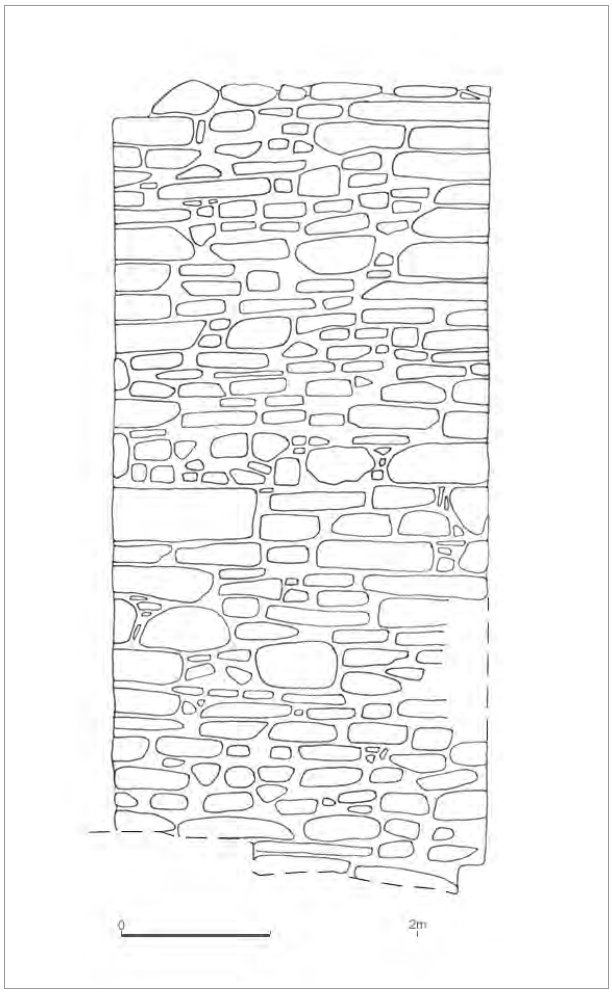


Fig. 8. Elevation drawing of the south west wall

### 3.2 North wall

The north wall is 9.8m long and just under 6m high at its western corner (Fig. 9 and 10). A wall, seeming part of the original design, protrudes to the north in the western half of the northern wall. This wall is about 1.8m wide at its base but is stepped on both sides.

In the eastern half of the northern wall the stones are missing and replaced by rubble nearly to the ground level of the passageway behind it. As the ground level on the outside is substantially higher this appears to have been built up, while the missing stones appear to indicate that there was an additional doorway or window into the passageway at this point. The masonry structure at the eastern corner of this wall indicates that there was another wall, 1.1m wide, protruding north at this point.

Fig. 9. North wall of Whitegate furnace

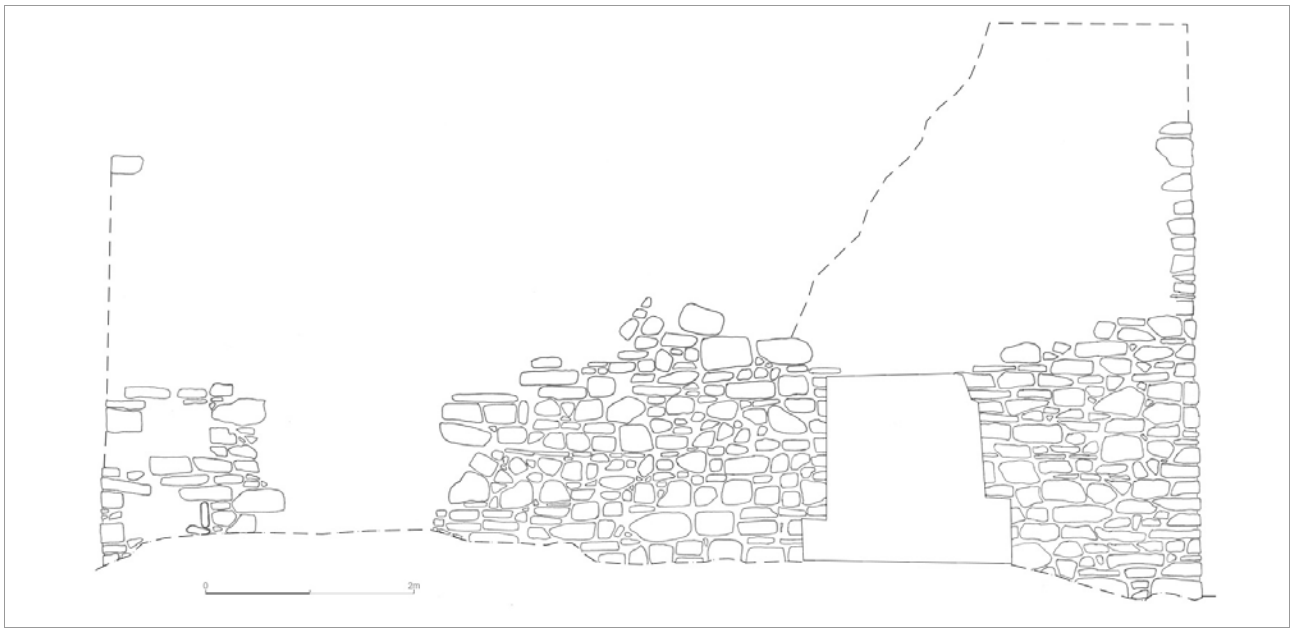

Fig. 10. Elevation drawing of the north wall

### 3.3 East wall

The best preserved part of the east wall is the part surrounding the passageway entrance which is currently 1.5m high and just over 0.8m wide (Fig. 11 and 14). At the southern end of this upstanding part the inner wall of one of the arches is preserved as well as several of the arch stones (Fig. 12). A recess between the doorway and the arch, above what appears to have been a wall protruding towards the east, could be related to a shelter built in front of the arch. At the southern corner of the eastern wall, the base of the pillar between the two arches is preserved. Several stones on the northern side of this pillar very likely represent the other inner wall of the same arch mentioned above (Fig. 13).

Fig. 11. East wall of Whitegate furnace with passageway entrance

Fig. 12. North side of the arch in the east wall

Fig. 13. South side of the arch in the east wall

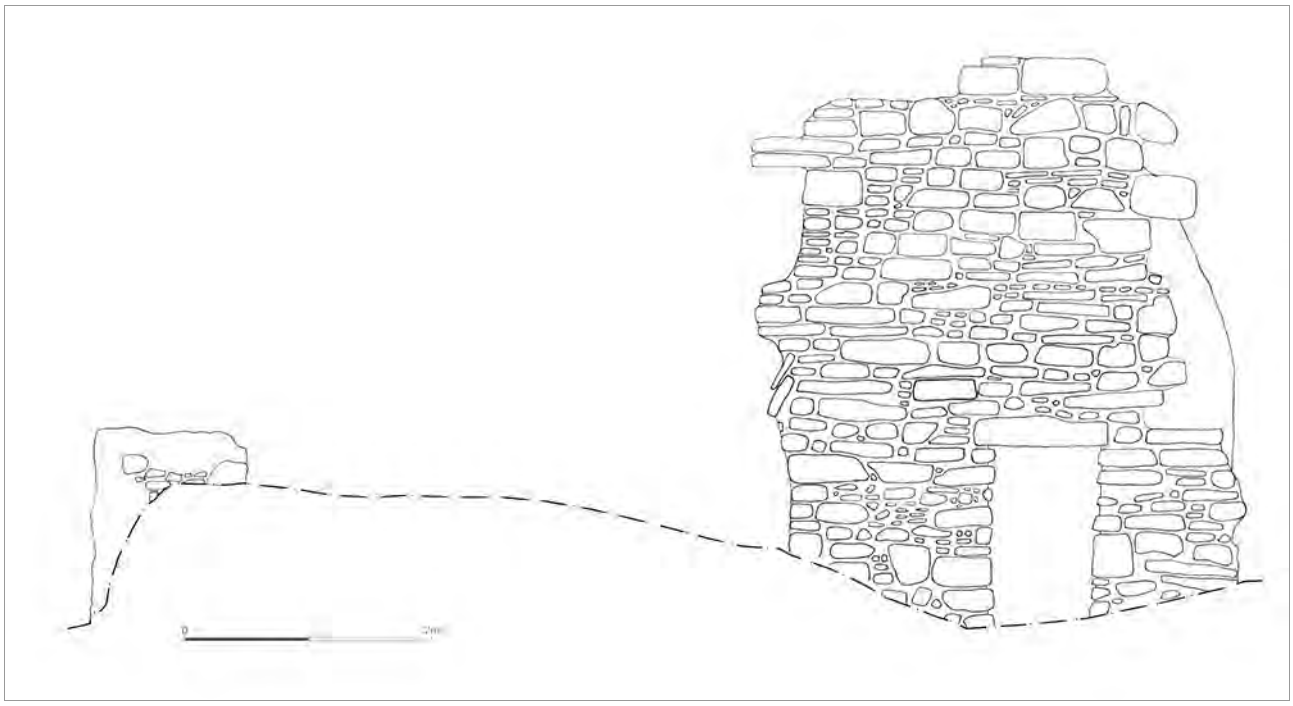

Fig. 14. Elevation drawing of the east wall

### 3.4 South wall and hearth area

Most of the upstanding southern wall consists of of large overhanging wall section attached to the south west wall (Fig. 15 and 16). In the lower part of this wall section is a rectangular recess above a badly preserved wall protruding to the south (Fig. 17). The recess is about 0.25m wide, 0.2m high and 0.25m deep and its function unknown. The same pillar described above has the remains of a third inner arch at the western end of its south facing face (Fig. 18). The lower part of the hearth area is taken up by a large tree trunk but two internal faces of the higher chimney are visible.

Fig. 15. South wall of Whitegate furnace


Fig. 16. Elevation drawing of the south wall

Fig. 17. West side of the arch in the south wall

Fig. 18. Recess in the south wall

*4. Structural Assessment of Whitegate furnace*[20]

The survey involved the visual inspection of each of the furnace structure and fabric elements within the site.[21] The purpose of the inspection is to identify works required to make the structure safe and to prevent further deterioration of the fabric. A more detailed assessment would be required to identify further works.

The data sheet assesses the condition of each building into five categories as follows:-

> **Dangerous** – Serious health and safety issue. Immediate work required to be carried out for the safety of the fabric and users/public.
> **Poor** - Health and safety issue. Urgent work required to prevent active deterioration of fabric, and safety of users/public
> **Fair** – Necessary work needed. Work could be carried out at a later stage.
> **Good** – There is no necessary work needed. Desirable work maybe carried out for aesthetic reasons or adaptive use.
> **Excellent** – There is no work needed but item should be kept under observation

### 4.1 West Wall

| | |
|---|---|
| Dangerous | |
| Poor | ✓ |
| Fair | |
| Good | |
| Excellent | |

The West wall, on inspection, looks to be structurally sound however it does show signs of structural stresses and cracks (Figs. 19). There is a band of well pointed masonry approx. 1m from the ground and extending 2m above. The pointing of the stone below and over this area has been mostly washed out. The wall top is uneven and there is a lot of vegetation growing from it. There is some damage apparent to the opening of the passageway where stone has been robbed out from the open arch. A crack is visible in the centre of the West wall running from the top down approx. 4m.

20 The information for this chapter was compiled from the relevant report composed by Architectural Conservation Professionals (Humphreys and Collins 2015)

21 The structure was surveyed on the 8th August 2015. The following schedules set out the survey notes of the individual buildings/elements. It must be noted that no opening up was carried out on walls etc., and that this report is based on a visual inspection. We can only comment on those items which were both visible and accessible at the time of our inspection. (ACP)

Works Required: Urgent

The West wall is structurally sound however works are required to prevent any further deterioration of the wall namely the wall top, passageway arch and the crack in the centre (Fig. 20). Much of the wall is also in need of re-pointing to prevent further washing out of the joints.

Fig. 19. Crack in the west wall

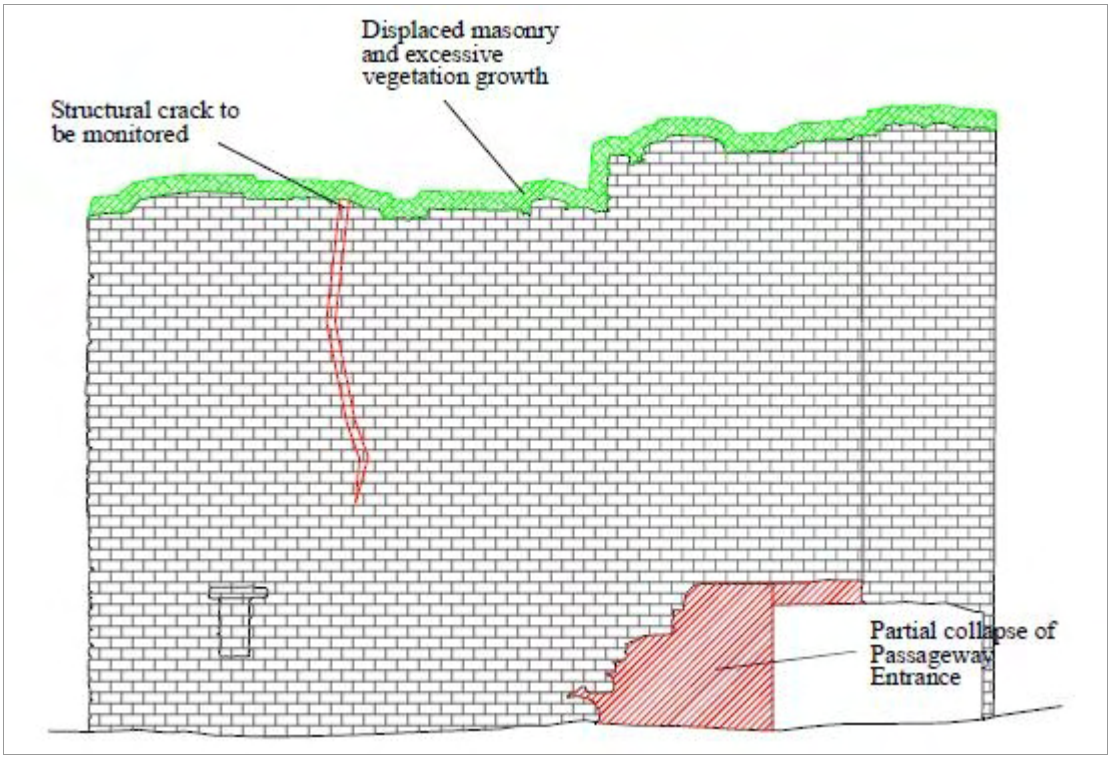


Fig. 20. Problem areas on the west wall

## 4.2 North wall

| | |
|---|---|
| Dangerous | |
| Poor | ✓ |
| Fair | |
| Good | |
| Excellent | |

The North wall has suffered major structural failure in the past. This is probably due to the growth of tree roots displacing the stone above (Fig. 21). There is an opening to the passageway from the breach in the North wall. Quite a substantial amount of stone is being displaced by ivy growth and is in danger of falling at the north east corner (fig. 22). At the north west corner the rear of the West wall can be seen to be very overgrown with ivy and vegetation. The height of the North wall has been greatly reduced compared to the West.

Works Required: Urgent

The North elevation is very overgrown and has seen much structural collapse (Fig. 23 and 24). The north east corner stones are being dislodged by vegetation and are in risk of falling. The removal of vegetation from the rear of the West wall top is necessary also to assess any existing structural issues. The trees growing on the furnace top and off the North elevation need to be further assessed to investigate the amount of structural damage being done and the best treatment for each one. The breach into the passage way should be made good to prevent any further collapse.

Fig. 21. Trees on the north wall

Fig. 22. North east corner

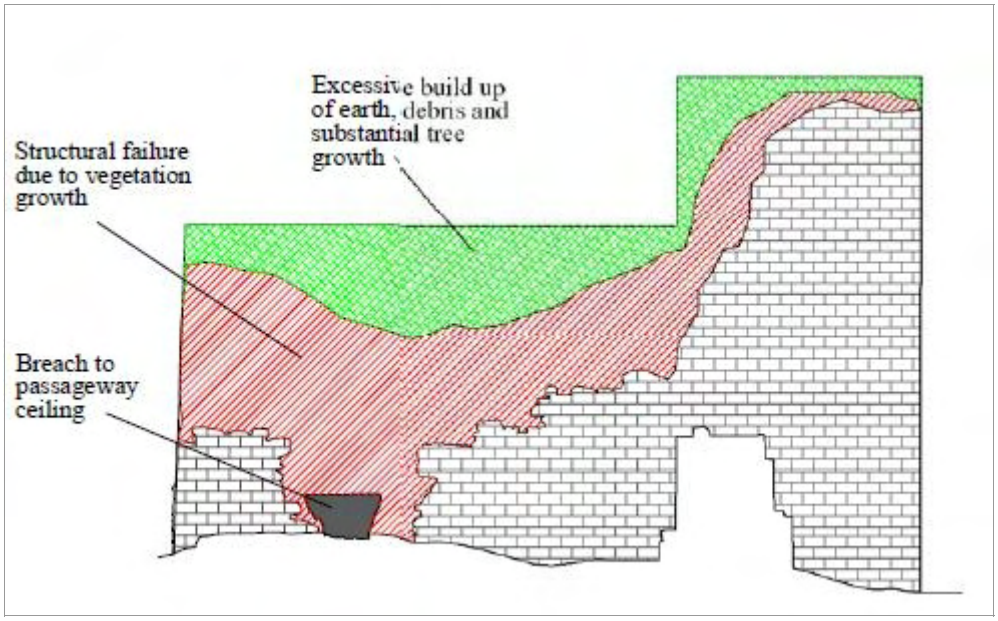


Fig. 23 Problem areas on the south wall

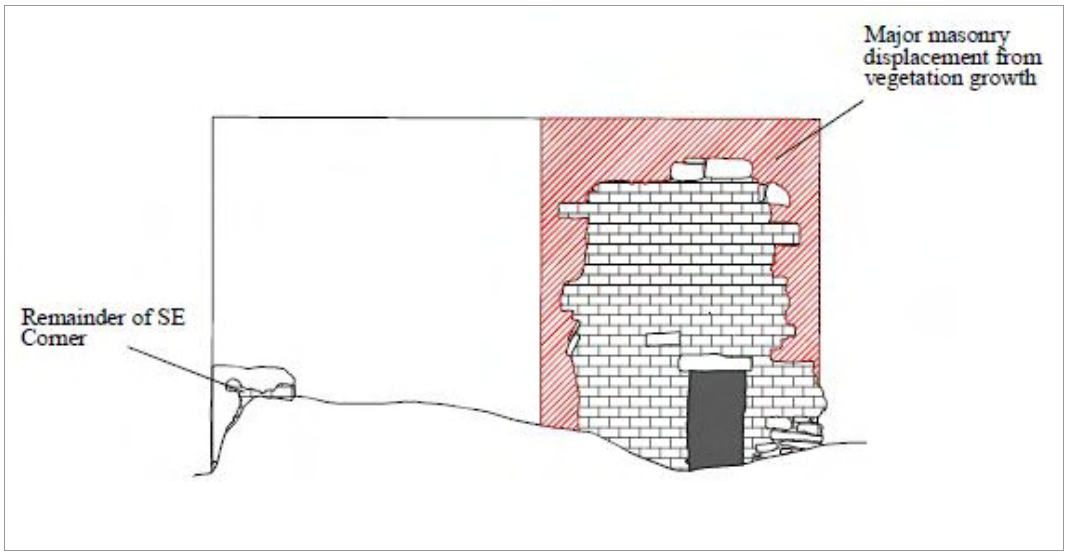


Fig. 24. Problem areas on the east wall

### 4.3 South East Elevation

| | |
|---|---|
| Dangerous | ✓ |
| Poor | |
| Fair | |
| Good | |
| Excellent | |

The south east elevation features the exposed inner lining of the furnace chimney (Fig. 25) and the remains of the two arches used to work the furnace. The base of the south east corner (where both

arches would have met) is still in place but both arches have been completely removed. Part of the original lime render lining is still present. The stone in the centre of the structure is burnt and brittle. Much of the interior of the furnace has been robbed out/collapsed and there is a lot over overhanging stones and vegetation. No major structural cracks are evident.

Works Required: Urgent

Urgent works are required to secure the loose and overhanging stones in danger of falling (Fig. 26). The removal of vegetation from the south east elevation and re-pointing and re-bedding of loose masonry is necessary.

Fig. 25. Exposed inner lining of the furnace

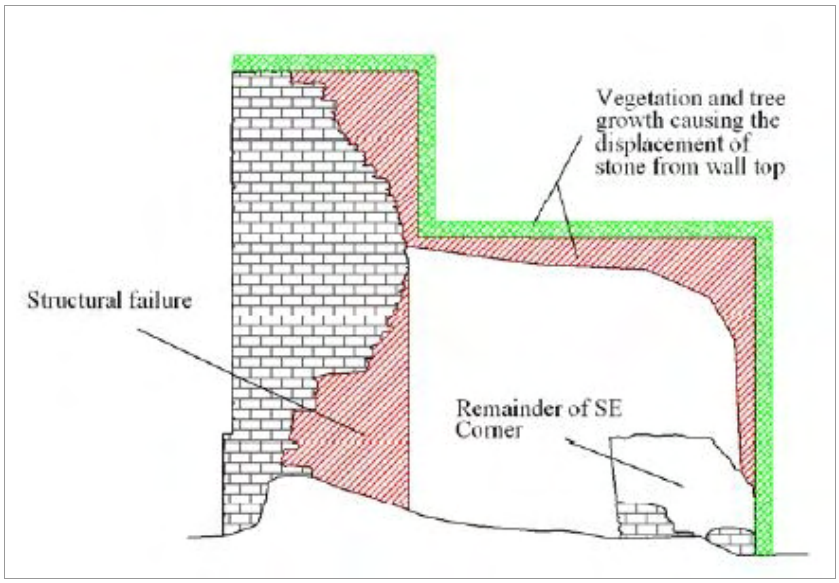


Fig. 26. Problem areas in the south wall

**4.4 Recommended and Urgent Repair Works**

The following works are required to prevent any further deterioration of the structures fabric and prevent also any further structural failures.

Urgent

- Securing of all loose and dislodged stones from the wall tops and inner chimney areas. The removal of some stones may be necessary to remove excessive vegetation. The trimmed back vegetation should be treated prior to the stones being re-bedded in lime mortar.
- Removal and treatment of the trees growing on the furnace top. Further investigations are necessary prior to removal of any tree to be certain it is not providing any structural support to the stone structure.
- Re-point and make good the North wall breach in the passageway to prevent any further collapse. A temporary cover to prevent water ingress to the passageway may be beneficial to the structure.
- A crack monitor should be placed on the West wall crack to determine if there is any existing movement. Results should be monitored periodically and action taken if necessary.
- Further archaeological excavations are necessary around the base of the remaining structure. This is necessary to assess the structural stability of the remaining furnace elements and the design and footprint of the original furnace.

Necessary

- Clear out passageway of all debris and rubbish.
- Re-pointing in lime mortar of the West and East Facing walls to prevent further deterioration of the fabric.
- Re-pointing of the arch of the passageway at the SW corner of the structure to prevent any further collapse.

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