

Fremantle Prison Engine House Excavation Report | 2014

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Masters of Professional Archaeology
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FREMANTLE PRISON ENGINE HOUSE EXCAVATION 2014

EXECUTIVE SUMMARY

In 2014 The University of Western Australia conducted an archaeological excavation of the Main and South Yards of the Fremantle Prison Engine House, as part of the university's five year Memorandum of Understanding with Fremantle Prison. The investigation was led by Site and Field School Supervisor Associate Professor Tom Whitley, and Assistant Supervisor Dr. Sean Winter, as a joint project between students enrolled in the Masters of Professional Archaeology program and those in the undergraduate Field Methods unit.

The excavation was carried out between 28th September and 10th October 2014. The aim of the investigation was to examine the technology and processes involved with the chimney and the Engine House. In order to achieve this goal, four trenches were placed across the site, with three in the Main Yard and one in the South Yard. Trenches 1 and 4 respectively aimed to locate the remains of the chimney structure and the flue which connected it to the Engine House, Trench 2 sought to locate the remains of the guard house in the Main Yard, and Trench 3 attempted to locate the well which was believed to be in the south east corner of the South Yard. The locations of the trenches were chosen based on the information provided by the available historical maps and plans of the area.

Trench 1 was able to locate the south east corner of the chimney structure, as well as part of the base of the chimney column itself. It was determined that the chimney structure was made up of a core of limestone blocks built onto the natural bedrock, with the brick chimney column built into the middle of this, and a brick extension covered by a concrete render being built around the outside of the core. Trench 2 was unable to uncover the intact remains of the guard house, though given that it was probably a fairly light structure, like most of the other guard houses around the prison; it was unlikely going to be found intact. However, the presence of an abundant amount of window glass and burnt timber beams does suggest that the trench was located over the original position of the guard house. Trench 2 did find a previously unknown set of stairs leading up from the Main Yard into the South Yard. This was a significant find as they were not shown in any plans, and it demonstrates the differences in the original heights of the ground. Trench 3 was the only trench which did not succeed in its aims, as no evidence of a well was found within its boundaries. Trench 4 succeeded in finding the remains of the arched, brick flue leading out of the northern wall of the Engine House, which would have connected to the chimney structure.

From the information recovered from the excavation and the historical documents it has been surmised that the burning of the fuel took place within the nearby boiler rooms, with the smoke being transported through the flue and vented out of the chimney. The resulting waste was then spread across the yards, resulting in a thick deposit of charcoal.

At the completion of the excavation the site was backfilled. Plastic and modern artefacts were placed at the concluding levels of the trenches so as to easily identify their extent and to help preserve them should further investigations be carried out. All artefacts recovered from during the investigation were sorted, catalogued, and bagged, with a preliminary analysis being carried out. All artefacts are currently in the possession of the Archaeology Department of The University of Western Australia, pending the final curation decisions of the Fremantle Prison staff.

As a separate part of the project the students also took part in recording graffiti within the prison cells. Comparisons to photos from 1991 showed that the condition of the graffiti had deteriorated over time, and at the present time there is no complete documented record of what graffiti is present within the cells. This aspect of the project was purely for recording purposes. No interpretations were carried out as part of this report. Over a six day period, 16 cells were recorded within Division 1.

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1.0 INTRODUCTION

In 2014 The University of Western Australia conducted an archaeological excavation of the Main and South Yards of the Fremantle Prison Engine House, located to the north and west of the Engine House respectively (Figure 1), as part of the university's five year Memorandum of Understanding with Fremantle Prison. The investigation was led by Site and Field School Supervisor Associate Professor Tom Whitley, and Assistant Supervisor Dr. Sean Winter, as a joint project between students enrolled in the Masters of Professional Archaeology program and those in the undergraduate Field Methods unit.

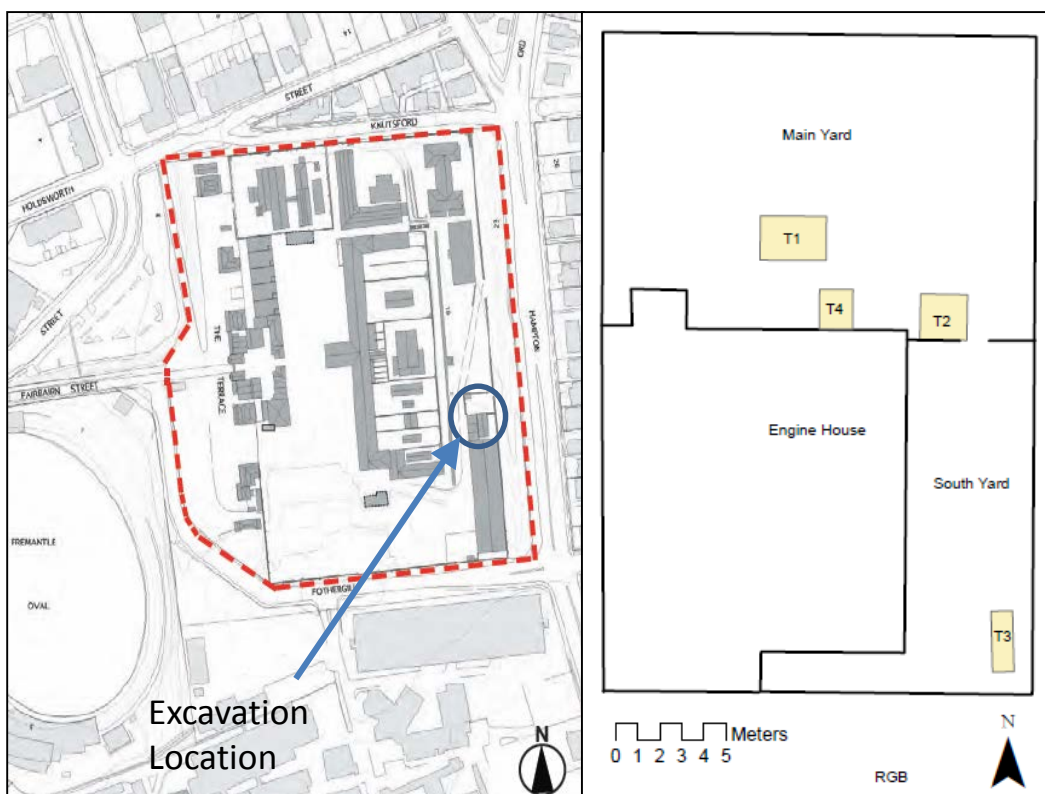


Figure 1: Engine house location plan showing trenches.

The excavation was carried out between 28th September and 10th October 2014. The aim of the investigation was to examine the technology involved with the chimney and the engine house. This was carried out by excavating the remains of the chimney structure to the north of the Engine House (Trenches 1 and 4), attempting to locate the guard house at the south east corner of the Main yard (Trench 2), and by attempting to locate a well in the south east corner of the South Yard (Trench 3).

2.0 BACKGROUND

Fremantle Prison is located in Western Australia on the south eastern edge of Fremantle city centre. Being located within the state of Western Australia's second largest city, the prison is close to developed road and rail transport. This makes the prison easily accessible by tourists and researchers (Figure 2 and Figure 3).



Figure 2: Location of Fremantle.

The prison site is enclosed by a six meter high prison wall which is bounded on its western side by a number of mid-19th century residential buildings. Inside the prison walls exists a number of cell blocks, other buildings and features, some dating from the 1850s.

Fremantle Prison is an example of a mid-19th century colonial gaol which operated from its construction in 1855 until its closure as a penal institution in 1991. Covering a such an extensive period of time from the early decades of the Swan River Colony (founded 1829), Federation (1901) and into the latter years of the 20th century the Fremantle Prison site with its range of intact convict buildings and below ground material culture provides a unique resource for the people of Western Australia.



Figure 3: Aerial photograph of Fremantle highlighting the prison.

The prison site is recognised as being historically significant and has been heritage listed on state, national and global registers. Recognised by UNESCO and receiving World Heritage listing, Fremantle Prison is the only built site to receive such international recognition in Western Australia. A detailed history of Fremantle Prison can be found in Bavin (1994) and Fremantle Prison Conservation Management Plan (DTF 2010).

The excavations carried out in 2014 were in the area associated with the “Engine House” which lies in the south east part of the prison, south of the old bathhouse and reservoir area and north of the eastern workshops. The Engine House is where the boilers and pumps were located for pumping water from a new well established between 1896 and 1898 as part of the Fremantle Water Scheme expansion. This is also where the present Tunnels Tour starts.

2.1 Fremantle and Prison Water System History Summary

The Fremantle water system initially began when between 1874 and 1888 water was pumped by hand to supply shipping in Fremantle from wells within the Prison (Fremantle Prison 2014). In 1884 Governor Broome approved the addition of some taps for Fremantle residents along the government main that ran to the wharf to supply the ships (Hunt 1980). Requests for additional supply of water from the prison saw a gradual expansion of the system.

In 1888 the construction of the tunnel system excavated by the convicts began. The tunnels serve as a catchment area for water draining through the Tamala Limestone. They also connect a number of wells located within the prison.

In 1890 a larger reservoir capable of holding 360,000 gallon was opened in the western side of the Prison. The pumping system then consisted of two Tangye steam pumps and a hand pump. At that time there were three wells, two in the eastern workshop area and one in the bathhouse (*Western Mail* 8 November 1890, p. 10).

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In 1892 the hand pump was replaced by a steam pump. A valuation of the Prison water system was conducted in 1894 (Fremantle Water Supply Valuation – 30 April 1894) and gave a value of £5680. It also had a detailed inventory of the pumps and boilers as shown in Table 1.

Table 1: Well Inventory 1894

Well	1	2	3
Location	Western Work Shop	Bath House	Old Engine House
Lining	unlined	unlined	unlined
Wall	rock	rock	rock
Size	6' 0" diam	6' 0" diam	10' x 8"
Water depth	5' 0"	5' 5"	7' 0"
Date			1892
Pump	Tangye 6" (no 9599)	Tangye 6"	Pearn 10"
Pumping Capability (gallons/h)	7,500	7,000	28,000
Boiler Type and Size	Tangye 8' 0" x 3' 8"	Tangye 8' 0" x 3' 8"	12' 0" x 5' 0"
Power (hp)	8	8	16
Pressure (psi)	50	50	80

Figure 4 is an 1897 plan showing the three old wells and the planned new well.

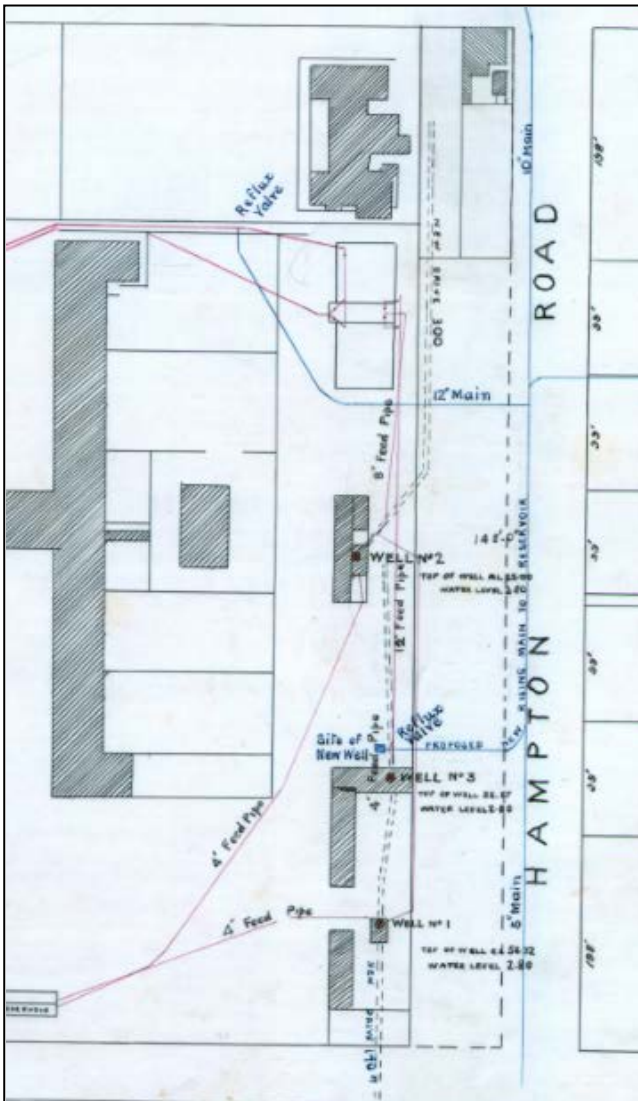


Figure 4: 1897 plan showing old and planned new wells.

In 1898 additional waterworks was completed by Water Supply Towns Branch of the Public Works Department. The older system only supplied the central part of the town. The new service extended the area reticulated and included new pumping machinery in a new well plus a 1,000,000 gallon reservoir at the top of Monument Hill.

The new plant consisted of two Worthington pumps and two Babcock and Wilcox boilers. The engines were 40 horse power each and could pump 62,500 gallons per hour. The pumping station was located in the New Engine House and was connected though the prison wall by a 14" main to the Monument Hill reservoir (*Western Mail* 4 November 1898, p. 8).

Figure 5 shows a plan of the works required for the new well including proposed walls, gates, engine house building and attached chimney. It shows that the building is divided into a boiler room with flue going to an outside chimney with a separate engine/pump room located over the new well. A new door into the engine house is also shown. The walls and the gates can all be seen on the site today.

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The original plan title includes the words “and proposed excision of pumping station from the prison grounds”. This new system would be run by the Water Board and not the Prison which therefore required the new walls and gates to Hampton Road for access of non-prison personnel and supplies.

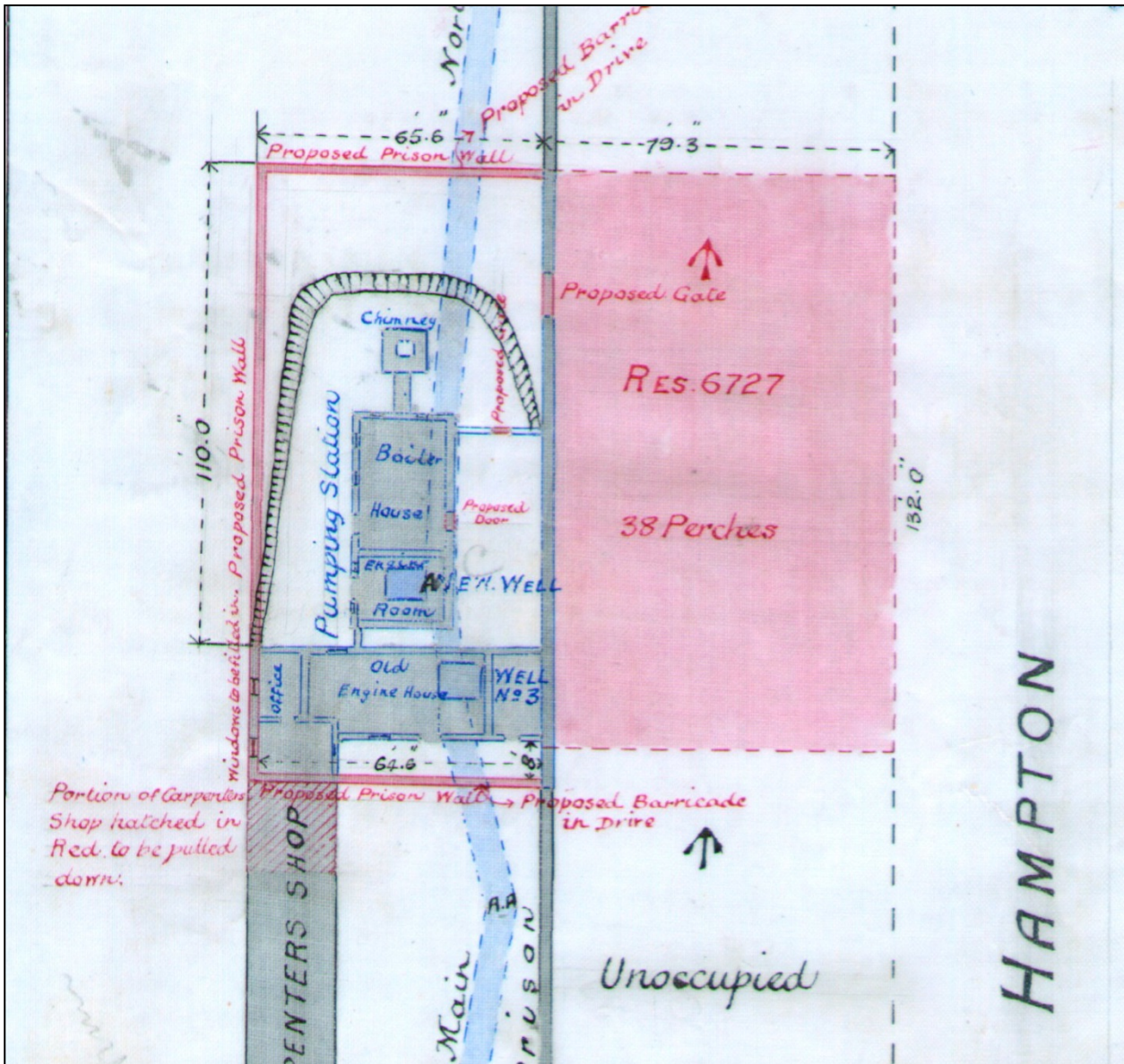


Figure 5: Proposed works for New Well and Pump Station.

The system ran until 1910 when the Prison and Fremantle were connected to the metropolitan water scheme, which received its supplies from Victoria Reservoir in the Darling Ranges east of Perth (Fremantle Prison 2014).

3.0 METHODS

3.1 Preliminary Work and Excavation Procedures

Prior to excavation, undergraduate students were provided with training on archaeological field work methodology, site background and the research aims of the project. This was followed by a two week excavation from 28 September to 10 October 2014, under direct supervision from Masters of Professional Archaeology Students who were in turn supervised by Site and Field School Supervisor Associate Professor Tom Whitley, and Assistant Supervisor Dr. Sean Winter.

The first stage of the excavation process was to select suitable locations for the placement of trenches. The selected locations were chosen by examining existing historical maps and aerial photographs, namely Figure 4 and Figure 5 discussed above, and Figure 6 which shows the Engine House on a 1919 plan. This plan shows a gate and path to the Engine House, the wall between the main and south yards, and the chimney and possible guardhouse. Also shown is an extra wall between the chimney and north wall of main yard.

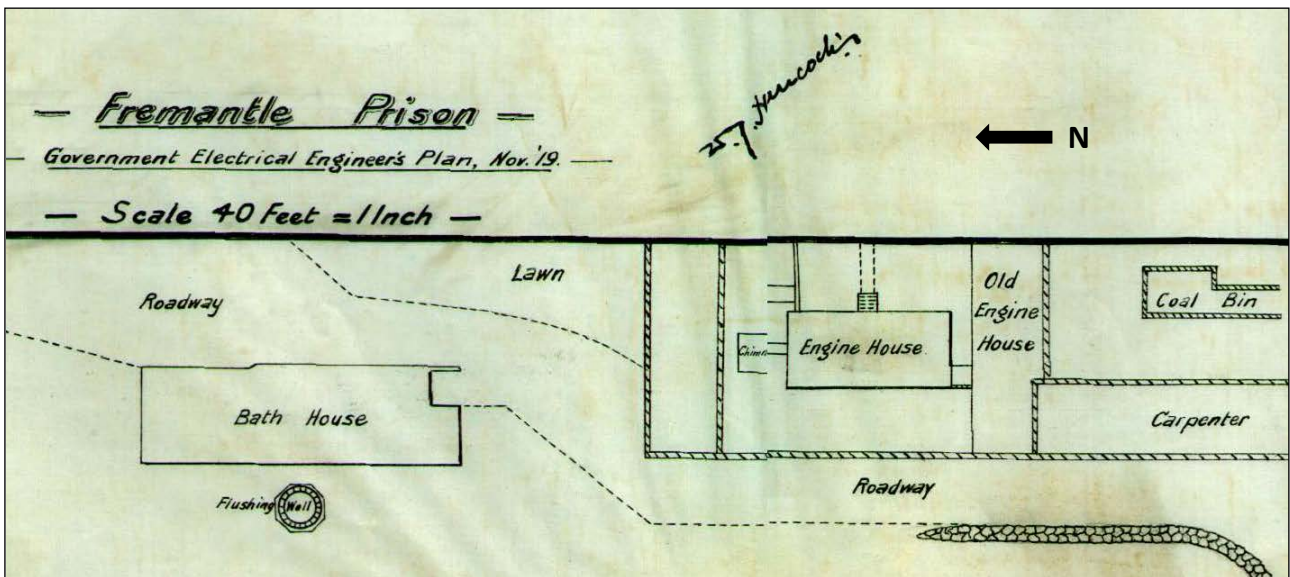


Figure 6: Plan Engine House 1919.

Figure 7 is a 1920 plan, providing a similar view to Figure 6 above, but with extra detail showing buttressing on the walls and the gate from the main yard to Hampton Road.

Figure 8 has detail from a 1935 aerial photo showing the Engine House, walls and chimney.

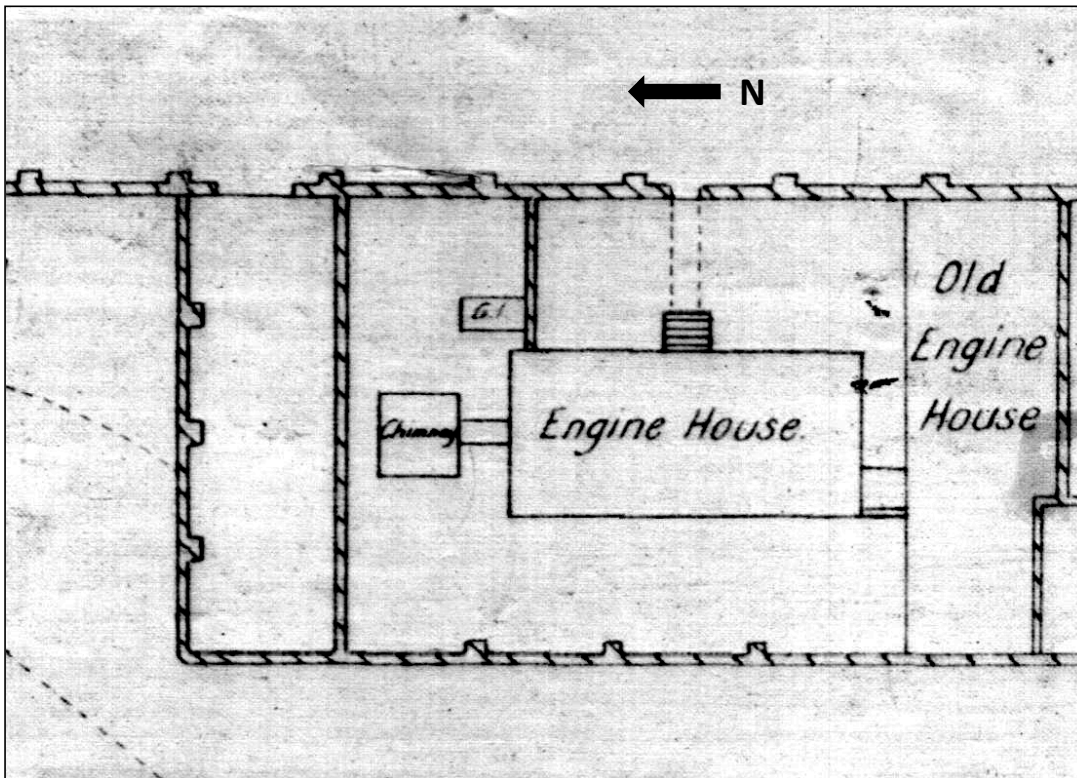


Figure 7: 1920 plan showing Guard House.



Figure 8: Detail from 1935 aerial photo showing Engine House and chimney.

Participants of the field school were then divided into three teams each with a Trench Supervisor (Jayden van Beek – Trench 1, Ross Bertinshaw – Trench 2, Stephen Wells – Trenches 3 and 4). Large scale trenches were used for excavating in accordance with the open area excavation strategy developed by the Museum of London for complex open air excavations (MOLAS 1994). A set of standard procedures for the recording process was set out prior to excavation detailing the following methodology.

3.1.1 Prior to Excavation

- A context number was allocated by the site manager from the site register.
- A context recording form was commenced for each context, recording as much detail as possible at that point in the excavation.
- Starting elevation levels were recorded using the dumpy level.
- Planning was conducted using the total station.
- Photographs were taken containing both photo board and scale.
- Where necessary scale plan drawings were made including its orientation and relation to the site grid.

3.1.2 During Excavation

- Changes or extra information was added to the context recording form.
- A bulk sample of sediment was taken for analysis.
- All excavated loose material was sieved.
- Recovered artefacts were placed in plastic bags with contextual information written on the bag with fragile items provided additional support in order to protect them.
- Important features were mapped or photographed as required during excavation.
- Point provenience recording of artefacts with the total station occurred as required.

3.1.3 Post Excavation

- Context recording forms were completed and checked for accuracy.
- Artefact bags were sealed and placed in central storage for duration of the excavation.
- End elevation levels were taken using the dumpy level.
- Planning was conducted using the total station and offset mapping.
- Scale drawings at 1:10 were made in both profile and plan of the trenches.
- Completed context recording forms were re-lodged with the central site folder.
- Plastic and modern items were placed at the end level of each trench, and were then backfilled.

3.1.4 Recording Process

Throughout the excavation detailed photos were taken to record the progress of each trench and what was discovered in each. These photos were supported by total station recordings detailing the location of the trenches and the features within them, along with plans of each trench and section drawings of key parts. Each context layer was further detailed by taking dumpy levels, recording descriptions of the soil and its contents, gathering bulk soil samples, and recording soil colour with a Munsell Colour Chart and pH levels.

Given the preservation level of the trenches, the potential for them to remain open or alternatively be re-excavated for display was considered by staff at Fremantle Prison. Given this potential backfilling was completed with care taken to preserve the intact structural features to allow for the possibility of re-excavation. Plastic and modern artefacts were placed at the bottom of each trench so as to easily identify the depth reached in each trench in the event that they are reopened at a later date.

As part of this report a set of appendices were produced:

- Appendix A – Provides a summary of the contexts which were recorded during the excavation.
- Appendix B – Provides a detailed listing of the digital data.
- Appendix C – Provides a note discussing the boiler technology used for the Fremantle and Coolgardie Goldfields Water schemes.
- Appendix D – Provides a summary spreadsheet of the catalogued artefacts.

3.2 Trench 1 Excavation

Trench 1 was placed over the suspected location of the western half of the chimney structure. The south east corner of the trench was placed roughly 3 m north from the centre of chimney flue inlet/outlet, and from there it measured 2 m north and 3 m west. With the maps suggesting that the centre of the flue lined up with the centre of the chimney, it was thought that Trench 1 would be able to locate the extent of the western half of the structure.

As with all of the trenches, excavation of Trench 1 started with the removal of the top layer of grass and soil, designated context (001). Beneath this was a dark brown loamy soil, designated context (004). Artefacts recovered from this layer were limited and were all contemporary, indicating that this layer was mostly just a continuation of the topsoil. This context gave way to a layer of mottled yellow sand. This new layer, context (011), appeared to be a fill layer which would have been used to level off the ground for the grass. As it was possible for this fill layer to be very thick, a 45 cm wide sondage, Sondage 1, was placed along the western wall of the trench to try and determine its extent. After reaching a depth of roughly 65 cm, the dark grey layer (015) which was found beneath (011) had not transitioned to another context. Material removed from this context included bricks, pipes, bars, and other structural material, suggesting that it was a demolition layer. Completing excavation of (011) exposed (015) throughout the trench (Figure 9). The transition from the two layers was not as neat as Sondage 1 suggested.



Figure 9: Pre-excavation of context (015), showing the yellow sand from context (011) still mixed in.

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Excavation of context (015) confirmed the hypothesis that it was a demolition layer, with much more structural material being recovered throughout the trench. As Sondage 1 suggested it was a thick layer, it was removed via mattocks and shovels so as to speed up the process. Excavation revealed a sizeable void which was found going into the wall at the south eastern end of the trench (Figure 10 and Figure 11). Considering the location of the chimney it was thought at the time that this might have been part of the structure. A large amount of the structural material was concentrated on the eastern half of the trench, suggesting that this demolition material was from the chimney which had been piled up towards the middle. Context (015) eventually gave way to context (021), a lighter grey than the previous layer, a result of an increased amount of ash. This context still appeared to be a part of the demolition layer, with more structural material being removed. Yellow sand from (011) was still found mixed in with this context. Further examination of the void in the south east corner of the trench suggested that it was just a gap underneath a sheet of metal held up by pipes, caused from the demolition rather than being a part of the structure itself.



Figure 10: Void in the east wall of T1, pre-excitation of context (021).



Figure 11: Void in the east wall of T1, post-excitation of context (021).

This layer eventually came down onto a layer of concrete, context (052), which covered most of the trench except for the south west corner where (021) continued. Cutting into this layer, from near the north west end of the trench through to the north east end, was a cut (032), with the fill (033) containing an in situ water/gas pipe (Figure 12). Continued removal of (021) in the south west section revealed a thin black lens of charcoal, which was briefly labelled context (038), before that entire section came down onto a layer of crushed limestone, context (042). The removal of the concrete layer (052) on the eastern half of the trench revealed a series of connected limestone blocks, which formed the core of the chimney structure (040), while excavation of the western half of trench transitioned to context (042). With the chimney structure having been found, the trench was reduced in size by pulling in the western end by one metre (Figure 13).

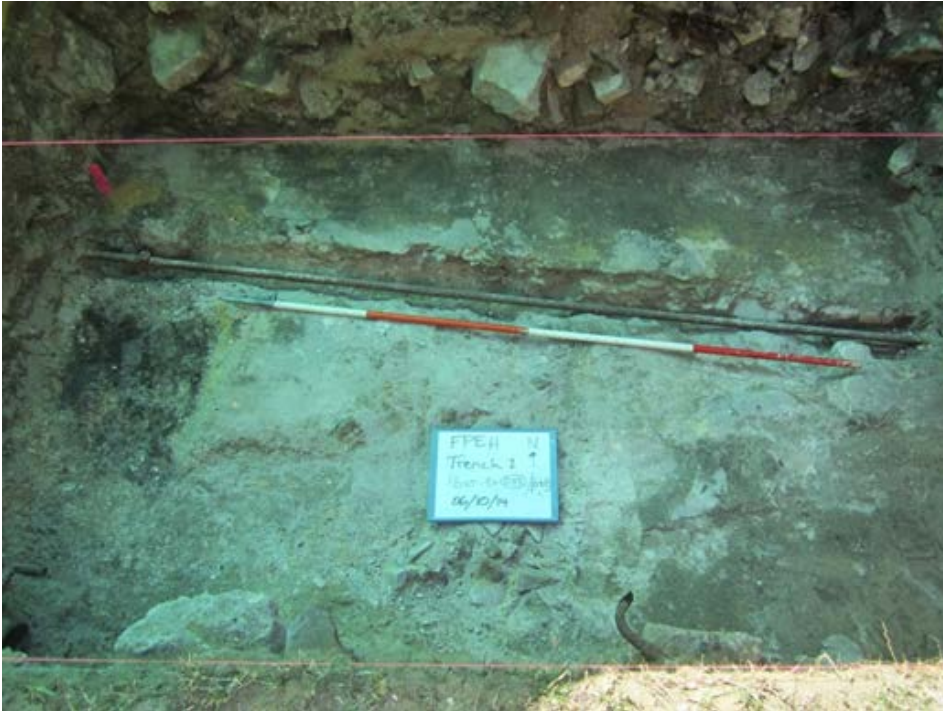


Figure 12: Post-excavation of cut through T1, with in situ gas/water pipe.



Figure 13: String line marking the extent of the reduced trench.

3.2.1 Trench 1 – Chimney Structure

The removal of the concrete layer (052) from the limestone core also revealed a series of in situ bricks (047), running south of the pipe (033) just off the eastern wall, with a different soil on the east side of these bricks (Figure 14 and Figure 15). With its location nearly lining up with the chimney flue, it was hypothesized that these bricks were the western wall of the chimney firebox (after the completion of the excavation this theory would change to these bricks simply being the base of the chimney column). Excavation of the soil on the east of the bricks, context (041), revealed a number of layers underneath, (044), (048), and (050), with the bricks continuing all the way down.



Figure 14: Limestone core of the chimney, with the base of the brick “firebox” visible in the south east of the trench.

On the western edge of the structure, excavation of the crushed limestone layer (042) revealed that the limestone blocks stepped down onto another flat platform roughly 30 cm wide (Figure 16). It appears that this extension was constructed of bricks, context (053), which was then covered by a concrete render, context (054).



Figure 15: Post-excavation of "firebox".



Figure 16: Chimney structure, with the brick extension and concrete render shown around the limestone core.

3.2.2 Trench 1 – Outside of Chimney Structure

The remainder of context (042) to the west of the chimney structure in the reduced trench was then excavated. During this more bricks were recovered, suggesting that this layer too was also fill. This context then transitioned into a charcoal layer (049) throughout the remainder of the trench, which was thought to be the waste from the burning process. After roughly 30 cm this context gave way to a layer of saprolite, context (055), which then shortly came down onto the natural limestone bedrock layer (029). It appears that the chimney structure was built straight onto the natural bedrock, with no added foundation layer except for a small amount of cement spread across the limestone.

In order to examine the extent of the added cement to the limestone bedrock, a sondage was placed in the recently excluded 1 m x 2 m at the western end of the trench. Sondage 2 was placed running east-west through the trench on the north side of the pipe (033). Excavation revealed the same context layers which had been found previously under (042) as discussed above (Figure 17). Upon reaching the bedrock in the sondage there was no evidence of any added cement, suggesting that it only extended a very short distance from the base of the chimney structure.



Figure 17: Post-excitation of Sondage 2.

3.3 Trench 2 Excavation

Trench 2, initially measuring 2 m x 2 m, was placed to the east of Trench 1 and slightly in front of the wall separating the main and south yards of the Engine House area (Figure 1). The trench was placed slightly away from the wall as it was believed that the foundations would be shallow and the trench width would be rapidly lost when they were exposed. The trench was located to find a suspected guardhouse that shows up in older plans (Figure 6 and Figure 7).

Excavation of the topsoil layer (001) revealed the start of a demolition layer intermixed with yellow builder's sand in the western corners of the trench. This context averaged a thickness of 5 cm.

Context (002) recovered some demolition material such as window glass and floor covering, perhaps from the Guardhouse with artefacts such as coloured plastic tape (probably for reticulation) and so suggesting that this context can be associated with levelling and cleaning up of the site. It averaged 3.5 cm in thickness.

The context beneath (002) was (009) and consisted of a layer of rubble featuring a mix of structural materials including window glass, fixtures and fittings and ceramic pipe. It also included some industrial material such as safety glass, gauge tubes and electrical insulators with a small amount of subsistence material such as bottles and cans.

There were also quantities of bricks, pieces of wood and a large burnt beam. It was decided to extend the trench in the south to the wall adding between 0.1 and 0.2 m to the trench width as no foundations had yet been found. Context (009) averaged 19 cm in thickness.

A new context, (017) was started based on a reduction in the brick, cement and metal excavated. However in the context an increase in slag showing the imprint of a grid, probably from furnace cleaning, occurred. Figure 18 is a post excavation photo of context (017) looking East. The thickness of this context averaged 14 cm.



Figure 18: Post-excavation context (017) looking east.

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At this point a cut stone appeared in the south east corner of the trench which became context (019) and in the rest of the trench context (018) was started. Context (018) contained evidence of demolition but also artefacts such as broken glass tubes, pieces of coal and small flakes of mica which suggested the operational refuse from the boilers. On average context (018) was 18 cm thick.

Under lying (018) was a black charcoal rich layer (020) which varied in thickness in the trench but averaged 8 cm. Under it was a lensing clay layer (023) thicker in the centre and averaging 9 cm overall. This context although thin contained a mix of artefacts of all the categories suggesting general refuse disposal. One interesting artefact was a revolver cartridge discussed further below.

Once through the clay layer, context (028) proved to be another black charcoal layer and quite thick averaging 30 cm.

This layer is probably the same as (020) and divided by the internal clay zone (023). Context (028) had fragments of coal, slag probably from boiler cleaning as it has the semi-circular indentations from the furnace grate. Within the zone are some bricks including a "Gartcraig" from Glasgow with a date range of 1876-1920. This is a fire brick so probably associated with the building of the chimney. There were also "Statham" bricks which was a local Perth brick company operating from the 1890's.

Other artefacts included bits of metal, leather, clay pipe fragments, machine belts and seals. Also found was a heavy duty iron rake head for cleaning out the boiler grate.

At the base of (028), a new context (030) of grey sand mixed with yellow and white limestone rubble appeared. This was the start of the basement layer. Context (019) now had three steps leading down into the trench with the final step lying on top of (030) (Figure 19).



Figure 19: Context (019) steps, leading out of Trench 2.

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The base of the trench was cleaned and at the south end, the foundation to the wall was found (043). The foundation was simply a narrow step out of about 18 cm wide and made of gravel mixed with mortar. This and the steps are shown Figure 20.



Figure 20: Post-excitation of Trench 2.

It was decided not to take the trench right both to the consolidated limestone floor as we had found the foundation of the wall and the trench depth was almost at the safe digging limit of 1.4 m without shoring.

Figure 21 is a cross section of the north wall of at the end of excavation. It shows the contexts and other features within the trench.

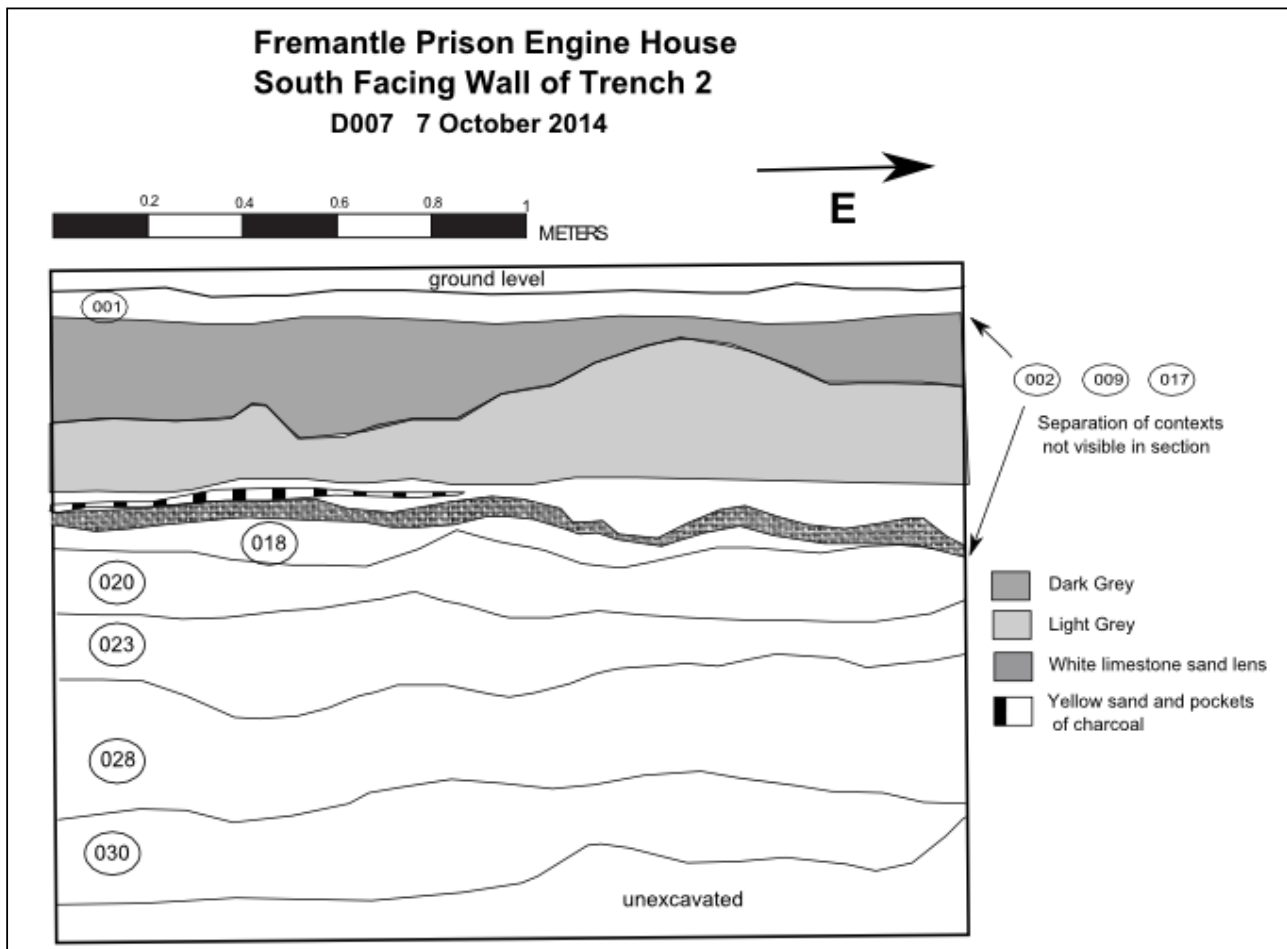


Figure 21: Post-excavation south facing section of Trench 2.

3.4 Trench 3 Excavation

Trench 3, measuring 3 m x 1 m, was placed in the south eastern corner of the South Yard (Figure 1). The trench is bounded to the south by the old engine house wall and to the east by the Hampton Rd. prison wall. The trench was placed approximately 1 m from any walls to ensure that it was not obstructed by building foundations.

The aim of Trench 3 was to look for evidence of an early well close to the south east corner of the South Yard. Given its position away from Trenches 1, 2 and 4, Trench 3 provided the potential to examine differential utilisation of this prison space compared to the other trench areas.

Context (001) consisted of vegetation, mainly roots within grey brown sand which was compacted in part due to underlying moisture content. This context revealed a mix of construction rubble which appeared to be of relatively recent origin. Some industrial rubble (slag) was also found.

Below (001), context (003) consisted of grey brown sand, limestone pebbles (< 2mm diameter) and particles of charcoal. Artefacts consisting of construction rubble, industrial fragments, structural and other (clear glass bottle neck) categories were excavated. Also noted were assorted small bird bones. This material appeared to have been deposited as rubbish from demolition with some material being intended for levelling purposes.

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Context (007) under (003) consisted of predominantly dark brown sand and patches of yellow sand containing charcoal. Evidence of burning was also indicated by charcoal deposits. Artefacts included structural and industrial categories along with assorted bird bones. This was essentially the same as found in the previous context.

Two cuts each running east to west crossed Trench 3. Excavation of [010] and [014] revealed intact PVC irrigation pipes (Figure 22). Charcoal and slag fragments, which were found within these two cuts, were likely to have been infill brought in from another location, possibly as waste associated with the Engine House. The southern pipe had intact insulated wires following it. These wires appeared to be associated with irrigation relays. Protruding into the trench from the west wall was a plumbing pipe. This was either a disused gas or water pipe.



Figure 22: Trench 3 looking east: bedrock floor with PVC and plumbing pipes exposed.

Below (007), context (012) consisted of a charcoal layer. It contained industrial and construction category artefacts. Compared to the above mentioned contexts this layer was considered relatively sterile in terms of artefacts. The range of dates indicated from structural artefacts (various thicknesses of window glass shards) is suggestive of a mixed context along with burning, either in situ or else deposited.

Context (016) beneath (012) indicated a change from charcoal to a compact brown sand layer. This was the thickest layer so far with an average of 20 cm thickness throughout. Artefacts

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included industrial and construction categories. There was evidence of burning or else deposition of burnt material in this context.

Context (27) was below (016) and contained a mixture of soil and ash before transitioning to the natural bedrock layer of context (029). The soil became increasingly yellow and brown with large limestone rocks. Artefacts were similar to those described above for context (016). Finding window glass shards of varying thickness (suggesting different chronologies based on changing thickness of the glass over time) and the ash deposits was indicative of burning events and mixing of artefacts.

Context (029) consisted of a sterile layer of yellow sand and limestone bedrock. Upon reaching this layer the trench was discontinued (Figure 23).

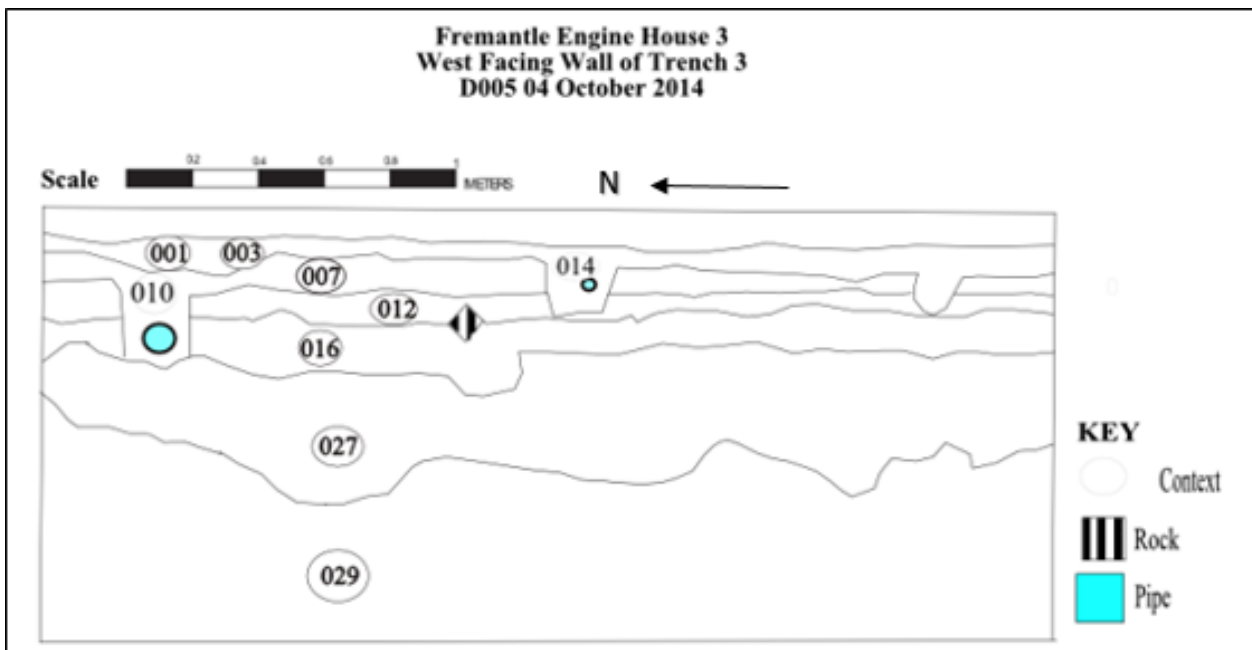


Figure 23: Post-excitation west facing section of Trench 3.

3.5 Trench 4 Excavation

Trench 4, measuring 2 m x 2 m, was placed between the south eastern end of Trench 1 and the chimney flue opening coming out of the northern wall of the Engine House (Figure 1). The south end of the trench abutted the arch flue structure which had provided a link between the Boiler Room and the chimney (Figure 24). The area under the arch had been bricked up to seal the entrance to the Boiler Room. Trench 4 was excavated with the intent to confirm the link between the chimney base which was located in Trench 1 and the Engine House (Figure 5). Finding remains of the connection between the chimney and Engine House would facilitate an understanding of the industrial processes at the site. In particular it might determine whether the chimney structure provided the heat to operate the boilers within the Engine House or else acted as an exhaust whereby gases and waste exited the boilers through the chimney.

Context (001) consisted of grass and roots in grey sand, and contained some industrial artefacts. This context was removed to reveal context (031) which consisted of sand, limestone and brick fragments. The fragments of limestone and brick increased in size as this context was dug out.

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More rubble was noted at the southern third of the trench i.e. that nearest the Engine House wall. A range of construction, industrial, recreational, subsistence and domestic artefacts were recovered. Given the range of artefacts, this context was considered to be infill or the remains of some nearby demolition.

A double brick wall (034) running north to south for the length of the trench was located at the end of (031) (Figure 24). This wall was up to eight brick courses high, largely intact and was constructed using an English Bond brick laying pattern. Cement rendering was still present on the top layer and eastern side of the wall. The rendering of the eastern side of the wall indicates it was the external side of the wall.



Figure 24: Trench 4 looking south: (034) partially excavated.

Context (031) transitioned into three separate contexts. To the east of (034) was context (035), a brown soil which contained a mix of domestic, structural, and industrial artefacts. In the northwest of the trench was context (036), which extended from the north end to approximately 3/4 the length of the trench to the west of (034). This was a layer of grey, white and brown mottled sand. Artefacts were mostly industrial (fragments of metal). At the south western corner of the trench was context (037), which was west of (034), and adjacent to (036). This context consisted of a thick moist, clay like charcoal deposit. Unlike previous contexts, there was little structural material recovered from (037). This is indicative of an in situ deposit and appears to link the heating processes between the chimney and the Engine House boilers. An alternative explanation would be that this deposit represents infill or dumping from the chimney when it was demolished and coal fired heating was replaced by gas or electrical heating.

A line of bricks running north to south in Trench 1 indicated the probable location of a second or western wall of the brick structure (034) in Trench 4. Because of this Trench 4 was extended by 30 cm to the west, and in doing so located a second double brick wall, which marked the western

extent of the flue (Figure 25 and Figure 24). This wall was also up to eight brick courses high, largely intact and constructed using an English Bond brick laying pattern.



Figure 25: Trench 4 looking west, extended 30 cm west revealing brick wall (034).

Between the two brick walls were a number of brick fragments, which may be either the collapsed or demolished remains of the brick structure. Cleaning of the top brick layer of both walls now making up (034) indicated the cutting of a 45 degree flange along the length of the inside brick layer of each wall. This may be associated with a roof, which could have been “seated” on the flanges.

Context (046) was beneath (035), and consisted of yellow sand taking up 2/3 of the area to the south of (045). This appeared to be building sand and some limestone rubble, and was considered to be infill.

Context (037) transitioned to (051), a layer of thick black charcoal and ash within the two brick walls (034). Context (051) came down onto a brick floor, labelled context (057), linking the two walls of (034). A collapsed domed brick and mortar feature at the northern end of (051) was considered to be the remains of the roof of the flue (Figure 26).

Context (057) was cleaned to reveal evidence of ash and burning remains on the bricks (Figure 27), similar to what was seen on the internal faces of (034).



Figure 26: Domed brick and mortar structure: Roof of flue.



Figure 27: Brick floor of flue.

3.6 Artefact Sampling and Laboratory Analysis

Artefacts recovered during excavation were bagged at site based on material type or individually if they represented a particularly interesting find. Artefacts representing construction were primarily omitted from collection based on curatorial limitations expressed by Fremantle Prison. During laboratory analysis artefacts were cleaned and washed as appropriate, sorted, weighed, and catalogued. Fragmentary and non-diagnostic pieces of metal and bone were bagged as a single artefact based on context/feature due to the material offering no diagnostic information. Artefacts were catalogued using a Microsoft Excel database recording weight, number of artefacts, general type, and functional category as a minimum, with extra information pertaining to specific use or datable attributes being added when available. Once analysed, artefacts were stored at the UWA Lab pending curation and permanent storage at Fremantle Prison.

4.0 STRATIGRAPHY AND INTERPRETATION

4.1 Trench 1

The purpose of Trench 1 was to attempt to locate the main chimney structure, and to investigate its construction. Having excavated down to the natural bedrock layer it was found that the structure was built on top of the bedrock, with minimal concrete being used to flatten the surface. The most likely order of construction would have been to lay the limestone blocks (040) to form the core of the structure, with the brick chimney column (047) being built in the middle of the core (Figure 28). The chimney inlet found in Trench 1 would have lined up with the flue found in Trench 4 which would have been used to transfer heat or smoke. A brick structure (053) was then built around the core, which was then covered over by a thin concrete render (054). The saprolite (055) which had been removed to reach the bedrock would then have likely been redeposited around the structure.



Figure 28: Chimney structure, showing limestone core, base of the brick chimney column, brick extension, and concrete render.

During the chimney's use it appears that the burnt material which resulted from the process was deposited into the Main Yard. This can be seen from the thick layer of charcoal (049) which was found built up around the chimney structure. As this same charcoal layer was found in the other trenches it suggests that the waste was deposited throughout the yard. This layer of charcoal built up over time, and likely would have created a lot of dust when it was disturbed. As a result it seems that a layer of crushed limestone (042) was deposited over the charcoal so as to help seal it, and to provide a potential walkway around the structure. This crushed limestone layer, at least around the immediate vicinity of the chimney, and the limestone core itself was covered by a thin layer of concrete (052) (Figure 29). The pipe (033) that runs through the trench, which is likely a gas pipe, cuts into the concrete layer. This means that it was put in afterwards, but it is underneath the demolition layer which suggests that it was put in before the chimney was knocked down. It is

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thought that the pipe was put in after the chimney was no longer being used, because if it was running through the chimney column while it was in use the pipe would have quickly deteriorated. Over time the chimney inlet has filled up with material such as soot and ash as due to the burning process. This has resulted in a number of different layers within the base of the chimney column, which were then covered over by the demolition material.

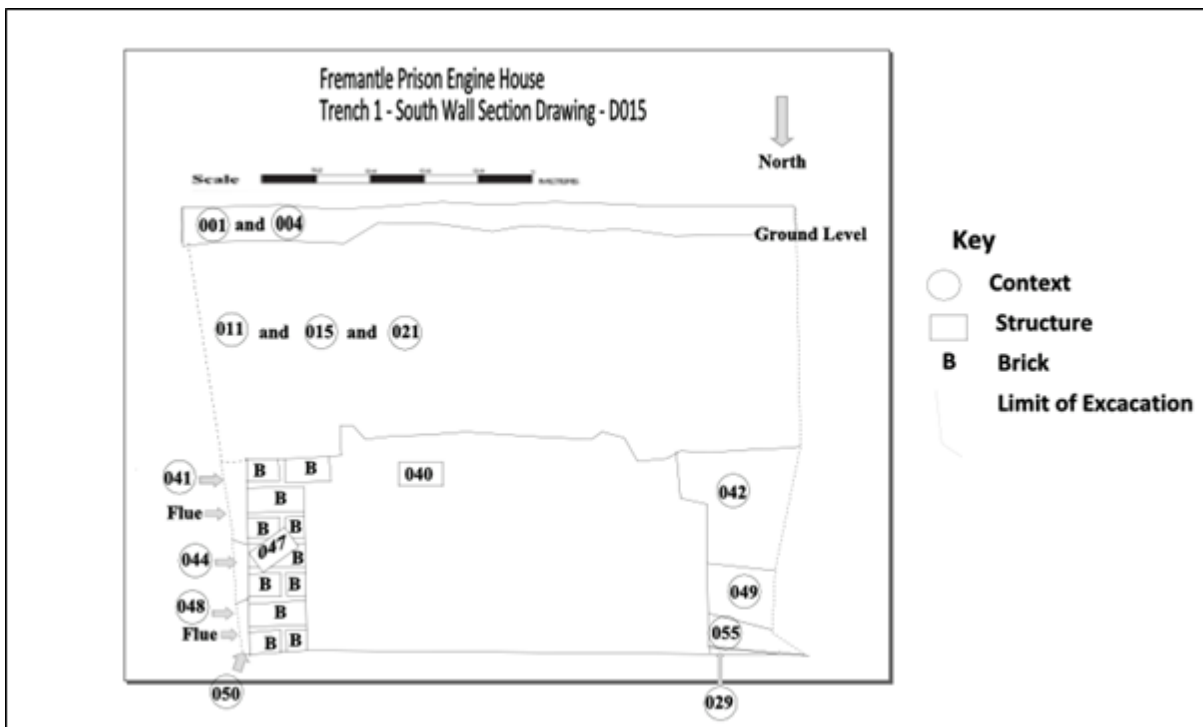


Figure 29: Section drawing showing contexts built up around the chimney structure.

After having been knocked down sometime after 1948, it appears that most of the structural material was piled up over the centre of the chimney. This is evident from the much heavier concentration of building rubble found in the east side of trench in contexts (015) and (021). It also appears that a large amount of the material which was still usable was reused elsewhere, as most of what was found in the trench was the fragmented remains of bricks, concrete, and metal pipes. If all of the material from the chimney demolition was left in place there would likely have been a substantially greater amount present within the trench. This demolition layer was then covered over by a layer of yellow sand (011) in order to level the ground off so that lawn could be placed on top (Figure 30). The yellow sand is also dispersed throughout the two demolition layers under it, suggesting that there was more than one episode of fill.



Figure 30: Profile view of Trench 1 east wall, showing yellow levelling sand over demolition layers.

During the excavation there were two hypotheses regarding the function of the chimney. The initial hypothesis was that the burning process took place within the chimney firebox. The heat would then have been transferred into the boiler room, via the flue found in Trench 4, in order to heat the water. This would mean that coal and other burnable material would have been shovelled into the firebox through an access door (thought to have probably been on the east side of the structure). The resulting waste would then have been removed and spread across the yards. The second hypothesis, and now the accepted case, is that the burning took place inside the boiler room. This would mean that the chimney was used to expel the smoke coming through the flue, and the “firebox” was there to collect the ash and other waste (in which case it is just the chimney inlet from the flue). This hypothesis is the more credible given the lack of burnt material which was found in the chimney column and the technology of the boilers themselves (see Appendix C). If it was used for burning it would be expected to find charcoal or other burnt fragments within the contexts at the base of the column. The fact that only ash and soot were found within these contexts, as well as the lack of fire damage to the bricks themselves, supports the hypothesis that no burning took place within the chimney.

4.2 Trench 2

Figure 32 is an end of excavation plan of Trench 2 in particular showing the steps in the south east corner and the foundation of the wall in the south end. The steps in particular were a surprise as they are not shown on any plan and were not known to the prison staff.

The likely sequence of events for Trench 2 is that between 1896 and 1898 the engine house and security walls enclosing and the south and main yards and the wall separating the yards were built. It is possible they were built initially without gates (as suggested by Figure 5) and these were added soon after to provide access for the water board personnel to operate and supply coal for the pumping facility housed in the engine house.

A gate was put through the wall separating the yards and as there was a substantial height difference between the yards (about 0.7 m) a set of three steps was built. The height difference is confirmed by the levels taken at the base of Trenches 2 and 3 which were in the limestone regolith material.

Once the boilers and pumping system began to operate a constant supply of fuel would have been required. This was certainly coal as pieces of it have been found in Trench 2. It is possible wood was also used as pieces of wood and charcoal were also found but they may be from the burning of refuse.

The wall between the chimney and northern wall of the main yard (shown in Figure 6 and Figure 7) is probably a low retaining wall. Coal would be bought in via the gate to Hampton road and dumped over the retaining wall to the north of Trench 2 so that it could be easily carried to the boilers. Figure 31 is a photo of the north wall of the engine house where the boilers would have been housed. It shows old entry ways that would have allowed coal to go in and refuse out.



Figure 31: North wall of Engine House.

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Refuse from the boilers and machinery would also be dumped around Trench 2. This is shown by the many gauge tubes and large quantities of slag from the thick charcoal and clay layers (i.e. (020), (023) and (028) which accumulate to almost 0.5m thickness.

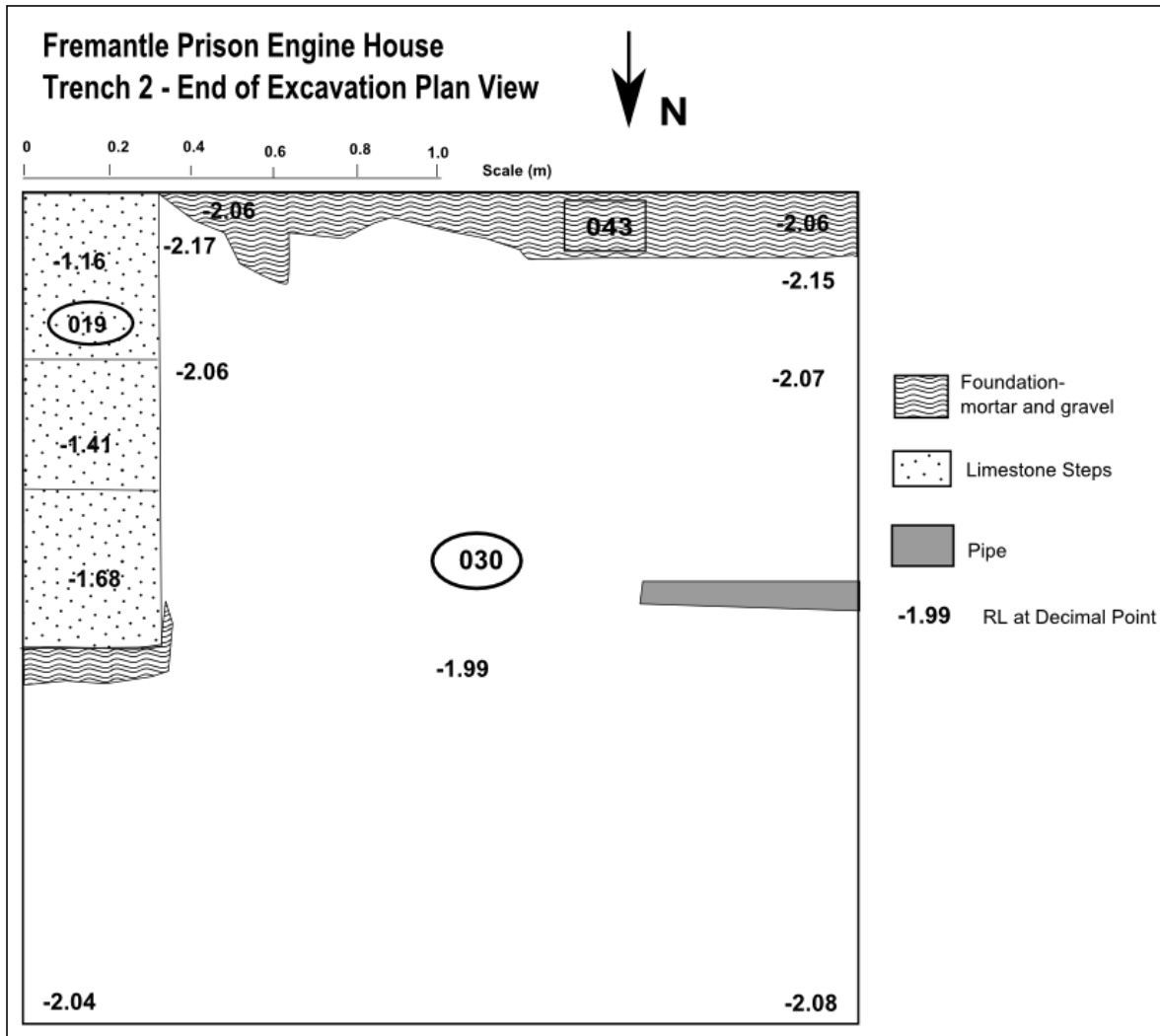


Figure 32: Post-excavation plan of Trench 2.

Figure 33 is an east facing section and photograph showing the various contexts. A number of artefacts from the charcoal and clay layers (revolver shell, clay pipe bulb and medicinal tonic bottle) suggest a 1900-1920 date range. This seems probable when considering the starting date of pumping operations in 1898 and a finish date after, but possibly close to when Fremantle was connected to the public water supply around 1910.

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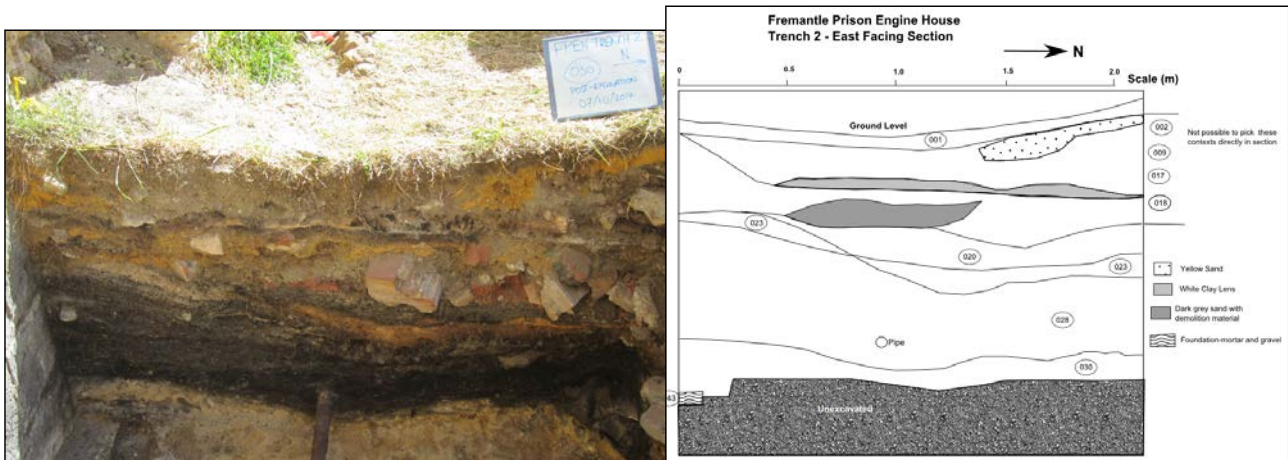


Figure 33: Trench 2 east facing section and photo.

The charcoal layers finish, presumably when operation of the pumping station stops or reduces. On top of this is a series of mostly demolition layers containing more structural rather than industrial material. The guardhouse must have been built after the pumping station was no longer required by the Water Board and returned to prison jurisdiction. This would have occurred between 1910 and 1919 when it is first shown on a plan (Figure 6). No guardhouse was required by the Water Board as there were few prisoners involved. However once this area became part of the prison again, a guardhouse between the north and south engine house yards would be required.

The guardhouse must have been destroyed when the chimney was demolished, sometime after 1948. No evidence of guardhouse foundations were found but this is to be expected as guardhouses around the prison are light structures made typically of wood, fibro, large glass panels which sit on wooden beams and concrete slabs. However, burnt beams, parts of concrete slabs, fibro-cement and lots of broken window glass suggest that we did find the location of the guardhouse.

4.3 Trench 3

Trench 3 presented as an area of burning events and likely deposition of large amounts material, possibly from nearby boilers or burning processes. Deposition was intended as both a means of disposing of rubbish and levelling the area. The contexts provided clear stratigraphy but this was attributed to human intervention rather than natural processes.

No evidence of an early well was found within the trench.

Subsequent comparison with artefacts from the other trenches provides insufficient evidence to differentiate use of the area around trench from the others.

4.4 Trench 4

Trench 4 located a rectangular double brick walled flue with a brick floor, which connected the Boiler Room to the chimney. The finding of a curved brick and rendered section of the roof of the flue (Figure 26) indicates that it was an enclosed structure. The external walls and roof of the flue were likely to have been rendered with cement.

The brick walls and roof consisting of the flue confirm schematic plans of the chimney and Engine House being connected. Finding a thick charcoal and ash layer (051) between the walls of (034) is indicative of a coal fired heating system. It seems likely that any flow of material or energy between the boilers and the chimney was directly through the brick flue rather than through any pipe structure which might have been positioned inside the flue. This explains the presence of burned or carbon deposits on the brick walls and floor of the flue. Deposits of ash and charcoal outside the flue structure (037) are most likely explained as infill from a series of Boiler House and chimney cleanings.

The finding of a range of rubble and building remains other than at (037/051) is explained as infill or rubbish from the demolition of the chimney (or other structures) when it was no longer used, due to the replacement of coal fired boilers with gas or electrical powered units.

Evidence of possible burning events at the site may be attributed to either infill or disposal of waste.

5.0 ARTEFACTS

5.1 Artefact Sampling and Laboratory Analysis

The artefacts have been cleaned and sorted and then catalogued based on functional category and artefact type to guide a preliminary analysis (see Appendix D). These are discussed below.

The following definitions were used as a basis for cataloguing the material by function:

Domestic: Materials used in a domestic setting, but not created to be a permanent feature in the landscape. These items included clothing and household items such as light bulbs and furnishings.

Structural: Material used in the construction of a permanent feature on the landscape such as those related to buildings and other general construction. This category included items such as nails, brick and window glass.

Industrial: Items to do with an industrial process including the machinery, infrastructure and energy supply.

Subsistence: Material related to the consumption of food or beverages including the remains of the food items themselves and the materials used in the consumption of the goods. This included remains of cutlery, bowls, plates, bottles, cans as well as faunal remains. As a convention, fragmented bone was assumed to be related to subsistence if otherwise unidentifiable.

Medicinal: Material related to health or healing, included surgical equipment and glass bottles and jars with diagnostic features indicating their use for medicinal purposes.

Recreational: Material related to activities completed for enjoyment. Included in this is items related to games and leisure activities. This included alcohol, tobacco, writing implements, and game pieces.

Other: Items identified but unable to be incorporated into the above categories.

Unknown: Items that had no identified function.

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The artefact types were based on a broad view of the function of the artefact. These were a subset of the category, aimed at giving a better understanding of the artefacts while making them easier to sort within the catalogue.

5.2 Preliminary Analysis

Table 2 summarises the weight of artefacts collected by function and trench. A more detailed table including material type and context is included as an Excel file in the digital data and a version is attached as Appendix C.

Table 2: Number of Artefacts by Trench and Function

Function	Trench 1	Trench 2	Trench 3	Trench 4	Total
Domestic	18	47	1	19	85
Industrial	122	379	170	50	721
Medicinal	1	4		1	6
Other	15	31	25	11	82
Recreational	7	27		2	36
Structural	220	485	86	188	979
Subsistence	137	80	24	187	428
Unknown	79	282	74	89	524
Grand Total	599	1335	380	547	2861

Figure 34 compares the distribution of the artefacts in the Trenches by number and weight. It shows some differences but that Trenches 2 has the most artefacts followed by Trench 1. Trench 1 was the largest Trench but because a significant portion of it was the structure itself, it did not contain as much removable material as Trench 2 over its whole area. Trench 3 was shallow, with Trench 4 having a limited depth and area.

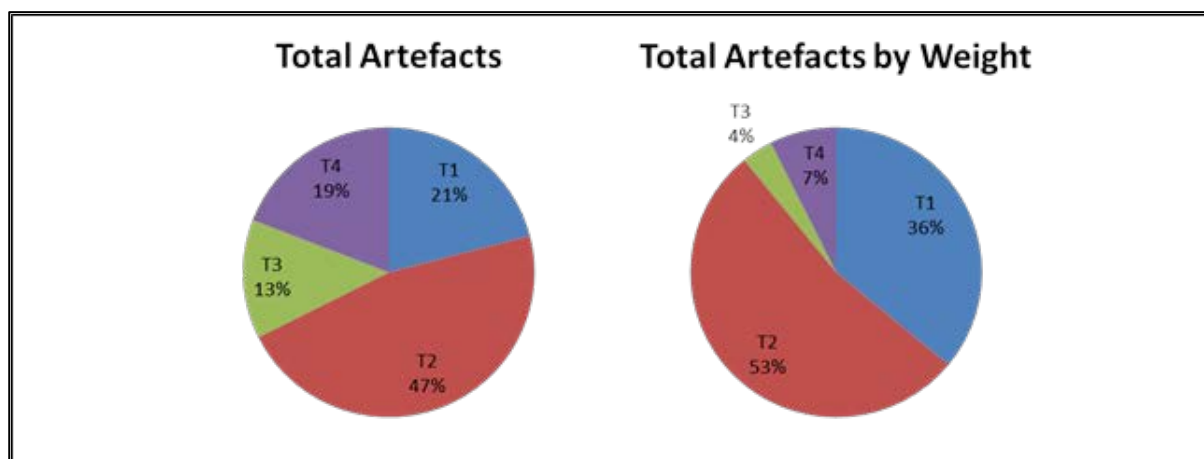


Figure 34: Trench artefacts by number and weight.

Figure 35 shows the functional distribution of artefacts by Trench. It shows that throughout all the trenches Structural and Industrial materials are predominant followed by Unknown and Subsistence. The Recreational, Domestic, Other and Medicinal categories all have only small numbers of artefacts and are usually represented in the surface layers which have been brought in for levelling purposes.

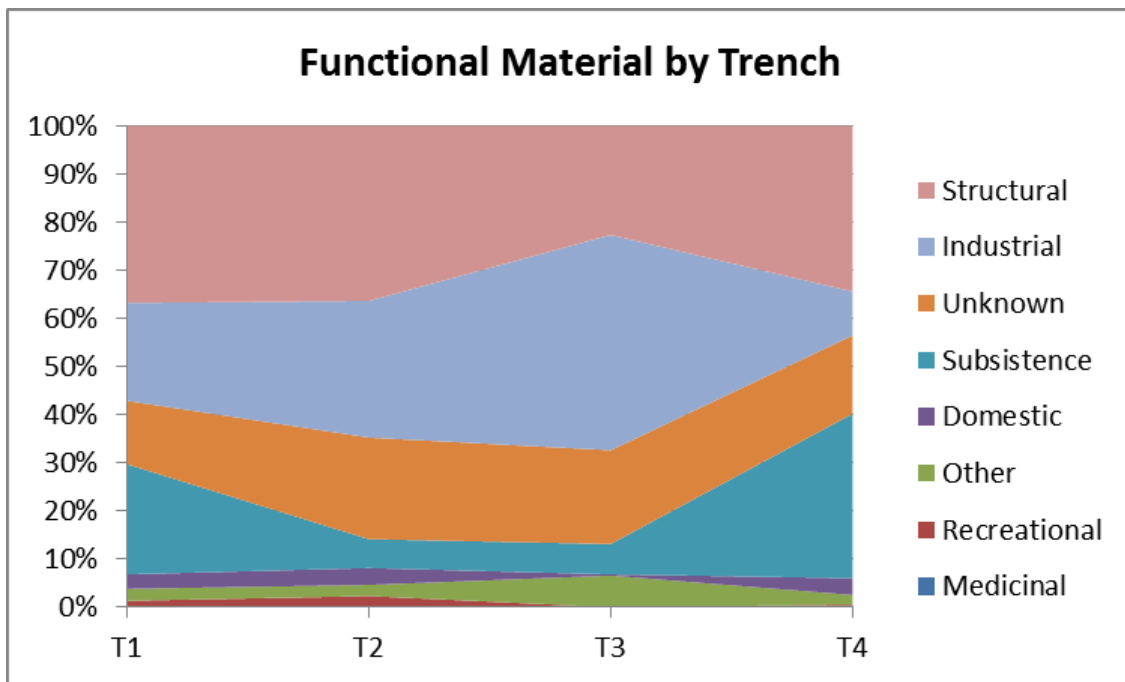


Figure 35: Functional distribution of material by trench.

5.3 Discussion of Artefacts

A number of the more interesting artefacts recovered during the investigation are discussed below.

5.3.1 Revolver Shell

Figure 36 shows the shells recovered from context (023) in Trench 2. It is a 0.38" straight rimmed revolver shell about 16.5mm (0.66") long with a rim diameter of 10.9 mm (0.44") and an outside shell diameter of 9.8mm (0.39").



Figure 36: Revolver shell.

The shell is badly corroded but on the base there is a partly legible inscription of "M 38 UMC". The 38 stands for the nominal bullet size of 38". UMC stands for the Union Metallic Cartridge. This headstamp was used from the 1860s for the company until 1911 when it was purchased by Remington (Ball 1997). After that UMC still appeared on cartridges but usually as REM UMC. The bullet itself was perhaps for a Smith and Wesson revolver as the sizing appears close to that given in Ball (1997: 121).

5.3.2 Gauge Tubes

A great number of gauge tubes were excavated from Trench 2. These are typically used in boilers and other machinery to show fluid flow. For high pressure installations the gauges are contained within very thick glass casings in case of tube breakage. A substantial amount of very thick glass (>10mm thick) was found during excavation which was probably from these safety enclosures.

Figure 37 is an example of some of the glass tubes found. These are inscribed with the name "BISHOPS ADAMANT".



Figure 37: Gauge tubes.

Figure 38 is the trademark listing for Bishops Adamant (from <http://www.glass.co.nz/trademarks.htm>). It gives the company and location information. This company appears to have operated from the late 19th to 20th century.

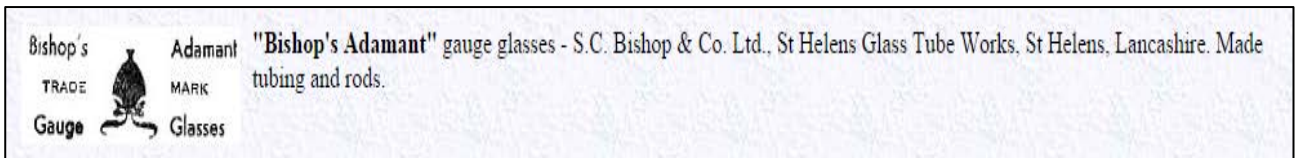


Figure 38: Trademark listing for Bishops Adamant

5.3.3 Medicinal Tonic Bottle

Figure 39 is a fragment of a medicinal tonic bottle with the part inscription “:C TONIC”. It was found in context (028) of Trench 2.



Figure 39: Medicinal tonic bottle.

5.3.4 Boiler Rake

Figure 40 is a rake probably used to clean out the boiler grate. It was found in context (028) with boiler slag and other industrial refuse in Trench 2.



Figure 40: Boiler rake.

5.3.5 False Spindle

Figure 41 is a false spindle, possibly belonging to a fire hydrant unit which would have been kept nearby. It was found within the demolition context (015) of Trench 1.



Figure 41: False spindle.

5.3.6 Turn Key

Figure 42 is an industrial turn key. It worked by placing the open square end over a spindle, and then inserting a handle through the top section, which would then allow it to be more easily turned. It was found within the demolition context (015) of Trench 1.



Figure 42: Turn key

5.3.7 Bricks

During excavation, only those bricks which were in good condition and showed different manufacturers were kept. Figure 43 shows bricks from two identified brick manufacturers (Statham and Gartcraig). The Gartcraig are heat resistant fire bricks and have been discussed above but set a date before 1920.

Statham was a Perth brick producer who operated from the 1890s to 1960s (Leighton 1997). They produced a standard firebrick plus special shapes for Babcock-Wilcox firebox linings and boiler seatings and flue covers for example.

The varying manufacturers suggest that the prison did not rely upon any one source, and the fact that most of the bricks which were found were fragmented suggests that the intact ones were reused elsewhere.



Figure 43: Statham and Gartcraig bricks

Figure 44 shows some additional brick that have not been definitely identified by manufacturer.



Figure 44: Assorted bricks

5.3.8 Clay Pipes

Pieces of clay pipe were excavated in Trenches 1, 2 and 4. Photographs of two bowls and a stem are shown in Figure 45.

For Trench 2 the pipe came from the charcoal rich contexts (020), (023) and (028), which are presumed to be from 1898 to sometime before 1920.

For Trench 1 the pipe is in the top demolition layer (015), just below the sand levelling layer (011). It is possible it has been bought in from outside during covering and levelling of the demolition surface which is after 1948.

The pipe piece from Trench 4 was found near surface during the trench opening.



Figure 45: Assorted clay pipes.

6.0 GRAFFITI RECORDING

As part of the 2014 Field School, each team spent two days recording graffiti in the main prison block. These teams used the same recording procedure as developed for previous studies. This included filling out recording forms and taking photographs of each motif within cells. This part of the project was purely for recording purposes, and as such no interpretation was carried out as part of this report.

Seventeen cells were recorded of which 16 were different (Table 3). Cell F73 was recorded by two different teams. The recording forms and photographs are provided as part of the digital data package from the Field School.

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Table 3: Cells Recorded for Graffiti

Floor	Cell
1	C4
1	D68
1	D70
1	D71
1	D73
2	E4
2	E7
2	E10
2	F71
2	F73
2	F73*
3	G6
3	G7
3	H67
3	H70
3	H71
3	H72

* Note: Cell F73 recorded by two different teams

7.0 MANAGEMENT DISCUSSION

Fremantle Prison is a heritage listed site with significant cultural heritage of national and international significance. The prison is a repository of resources which can shed light on the past life of the prison and its occupants. Archaeological detail may also offer a unique opportunity to gain insight into how the prison and its inmates were perceived by local society.

Excavation of the Engine House site indicated the remains of the base of the chimney and flue inlet. The remains of a flue were also located, linking the chimney to the Engine House boilers. Limestone steps, which do not appear on any known plans, linking the Main and South yards were located.

A range of artefacts was also recovered. The majority of these were degraded through corrosion, natural processes or burning.

All finds require cataloguing into three broad categories (along with other standards descriptors):

- Public interest and worthy of display;
- Research interest and worthy of curation;
- No apparent display or research capacity.

Consideration is required by the Fremantle Prison Board about what criteria would be used to classify an artefact as meeting the first category “worthy of display”. Considerations for classification of “research interest and worthy of curation” will be determined by future researchers but guided by the student archaeologists in consultation with their academic supervisors.

Given the above, two broad areas for future management need to be addressed:

- What to do with what was found during the current investigation; and
- Should future excavation or other investigation of the areas be considered?

7.1 Artefact Management

Upon completion of cataloguing, those artefacts deemed worthy of display, and which are in accord with the Fremantle Prison policies, should be prepared for display for the public. This work is to be carried out by appropriately qualified Fremantle Prison staff or their associates. Those artefacts deemed as worthy of research and curation are to be archived on site at the Fremantle Prison.

Those artefacts deemed as being of no immediate use for display or research purposes should be reburied on site where possible.

7.2 Management of Architectural Structures

7.2.1 Chimney Structure

There is the potential for the structure to be placed on display for the public. While this would require significant excavation and preparation, it would enable the public to gain a sense of past activity and to highlight the past use of the site as more than just a prison.

7.2.2 Flue Structure

As indicated above any public display of the chimney could include a section of the flue to indicate its structural remains and to give the public a sense of how the chimney and boilers within the Engine House were linked.

Sections of the roof of the flue are relatively intact. These could be conserved for public viewing either as part of any interpretative display involving excavated elements of the chimney and/or flue or else as part of a display within the Engine House.

7.2.3 Limestone Steps

These could be excavated and prepared for display. This display would also enable the public to gain a sense of the ongoing fill/dumping activity which has taken place during the site's use.

7.3 Future Excavations and Investigation

The situation may change over time regarding what to do in the future so any recommendations given should be considered as preliminary.

Unless there is a specific purpose or research question which requires additional detail to what has been found and documented from the current investigation then no invasive or destructive further investigation should take place.

Non-intrusive methods to map the extent of the building or other unknown structures may be undertaken. Again the only reason for undertaking this research would be to investigate a clearly defined research questions or themes requiring site specific information.

Given the recommendation for a cautious approach to any further investigation, the following areas may be worthy of consideration:

- As only the south west corner of the chimney was found, there is potential for further excavations to be carried out in order to examine the rest of the structure. Future excavations would likely focus on two areas: the east side of the chimney structure, and the south east corner and column of the chimney. A focus on the east side will potentially show if there was an access doorway on that side, which would be suspected if the burning took place within the chimney itself. Examining the south east corner and column of the chimney will help to identify how the structure was connect to the flue, and will also help to identify whether any burning activity took place within the chimney itself. As the current hypothesis is that the burning took place within the boiler room, future excavations showing that there was no access door way to the chimney and that there was no evidence of burning in the column would support this theory.
- Plans from 1919 and 1920 show the existence of a wall running east to west to the north of the chimney. No evidence of this wall was seen during the current investigation. An investigation to locate this wall could be warranted. It is expected that the area to the north of the retaining wall would be free of charcoal rand refuse but might have pieces of coal and a prepared surface for trucks to drop their loads.
- A detailed study of the industrial process taking place at the Engine House site may necessitate further investigation of the extent of the chimney structure and its physical connection to the flue (and the flue connection to the Engine House boilers). This may involve further excavation should it not be possible to obtain such information from archival sources.

8.0 ACKNOWLEDGEMENTS

The authors would like to acknowledge the work of all the people who made this project possible. In particular we wish to thank the excavation teams who worked on the site, and supervisors Associate Professor Tom Whitley and Dr. Sean Winter. We would also like to thank Olympia Cullity Head Curator and Luke Donegan Heritage Conservation Manager from Fremantle Prison for their assistance and advice.

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APPENDIX A CONTEXT LISTING

Number	Type	Description	Trench	Comment
001	Surface	Turf and attached soil all trenches	all	
002	Deposit	Mixed fill under (001) T2	T2	
003	Deposit	Mixed fill under (001) T3	T3	
004	Deposit	Mixed fill under (001) T1	T1	
005		VOID		
006		VOID		
007	Deposit	Light yellow separated by (008) T3	T3	
008	Deposit	linear dark feature T3	T3	
009	Deposit	mottled grey under (002) T2	T2	
010	Cut	Pipe cut for (008) T3	T3	
011	Deposit	yellow sand in T1	T1	
012	Deposit	black charcoal under (007) T3	T3	
013	Deposit	Fill of pipe trench [014] T3	T3	
014	Cut	Cut for pipe T3	T3	
015	Deposit	demolition layer under (011) T1	T1	
016	Deposit	brown soil under (012) T3	T3	
017	Deposit	deposit under (009) T2	T2	
018	Deposit	deposit under (017) T2	T2	
019	Structure	stone block SE corner T2	T2	
020	Deposit	black charcoal under (018) T2	T2	
021	Deposit	demolition layer under (015) T1	T1	
022		VOID		
023	Deposit	clay underlying (020) T2	T2	
024	Deposit	brown soil under (012) arc shaped T3	T3	
025	Deposit	ash N end of trench T3	T3	
026	Deposit	mottled brown, ash, charcoal T3	T3	
027	Deposit	S end trench ash layer T3	T3	
028	Deposit	deposit under (023) T2	T2	
029	Deposit	deposit under (023-027) T3	T3	
030	Deposit	deposit under (028) T2	T2	
031	Deposit	Opening trench - T4	T4	
032	Cut	linear EW cut T1	T1	
033	Fill	fill of [032] T1	T1	
034	Structure	NS brick linear feature T4	T4	
035	Fill	Fill of [034] brick drain T4	T4	
036	Deposit	Limestone surface E of [034] T4	T4	
037	Deposit	Charcoal at SE corner of T4	T4	
038	Deposit	Black fill at W end T1 under (021)	T1	
039	Deposit	Yellow/charcoal over (037) T4	T4	
040	Structure	Limestone platform T1	T1	
041	Fill	Fill of chimney firebox T1	T1	
042	Deposit	Fill at west end of {040} chimney T1	T1	
043	Structure	Wall and foundation T2	T2	
044	Deposit	Darker fill under (041) in firebox T1	T1	
045	Deposit	Limestone white fill W of {034} under [035] T4	T4	
046	Deposit	yellow fill W of [034] under (035) T4	T4	
047	Structure	Brick structure firebox T1	T1	
048	Deposit	Fill of [047] under (044) T1	T1	
049	Deposit	black charcoal under (042) T1	T1	same as (037) & (028)

050	Deposit	Clay under (044) in [047] T1	T1	
051	Deposit	Charcoal layer under (045) within [034] T1	T1	
052	Structure	Cement floor under (021) T1	T1	Previously recorded as [024]
053	Structure	Brick covering on exterior [040] chimney T1	T1	
054	Structure	Cement render exterior [053] T1	T1	
055	Deposit	Deposit under (049) T1	T1	
056	Structure	Deposit under (055) T1	T1	
057	Structure	Floor of flue (brick) T4	T4	
058	Cut	Cut for PVC pipe west wall T4	T4	

APPENDIX B

DIGITAL DATA LISTING

#	Item	Description	File
1	Context Register	Spreadsheet with context register	Context_Register_FPEH.xlsx
2	Context Sheets	Scanned original context sheets for Trenches 1, 2, 3 and 4.	FPEH Context Forms.pdf
3	Photo Register	Scanned register of important photos (see item below)	Photo_Rec_Forms_FPEH.pdf
4	Trench Photographs	Directory with photos taken during excavation. Important ones are cross referenced by photo number in photo register. Photos are in JPG format	Directory – Trench_Photos Sub-Directories T1, T2, T3, T4, Guardhouses
5	Drawing Register	Register of drawings	Drawing Register_FPEH.xlsx
6	Drawings	Each drawing is in JPG format which is a scan of the original pencil plans. The SVG files are vector plans digitised from the original pencil drawings for some of the pencil plans.	Directory - Drawings
7	Artefact Summary Data	Spreadsheet summarising the count and weight of artefacts by Trench, context, function and material type.	Spreadsheet – FPEH_Catalogue_Final.xlsx
8	Artefact Photos	Photos of the artefacts in the report in JPG format.	Directory – Artefact_photos
9	Graffiti Photographs	Photos of each cell and the motifs in them. Referenced to the graffiti sheets	Directory – Photos_Graffiti with sub-directories for each cell.
10	Graffiti Motif Sheets	The motif sheets for each cell collected by sub-directory	Directory – Graffiti_Sheets

APPENDIX C
DISCUSSION ON BOILERS AND
PUMPS

Appendix C

Discussion on Boilers and Pumps

This appendix is a discussion on the type of boilers and pumps that were used at Fremantle Prison as part of the Fremantle Water Supply and also at the larger though similarly equipped Coolgardie Goldfields Water Scheme.

What is a boiler?

A boiler is a closed pressure vessel in which steam is generated and then used for various processes. During the Victorian period boilers were typically made of high grade wrought iron panels assembled using rivets. In the 20th century, steel was used as it was stronger, cheaper and was good for welding. The downside was steel could be more susceptible to corrosion and pitting.

Types of Boilers

A simple boiler type is shown in Figure 1. It consists of a fire placed under a long cylinder. The heat transfer is therefore limited to the outside walls of only part of the boiler. Figures 1, 2 and 3 below are from Subbarao (2014).

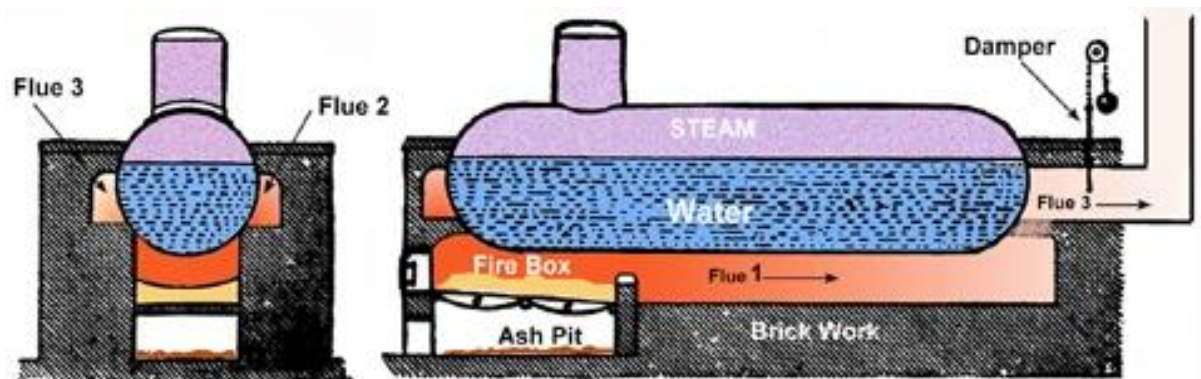


Figure 1: Simple boiler

An improvement on the simple boiler was the Cornish boiler, which is shown in Figure 2. In order to get greater efficiency, the fire is placed in the centre of the cylinder with water now surrounding it. This is the type of boiler used in the older pumping installations (Wells 1, 2 and 3).

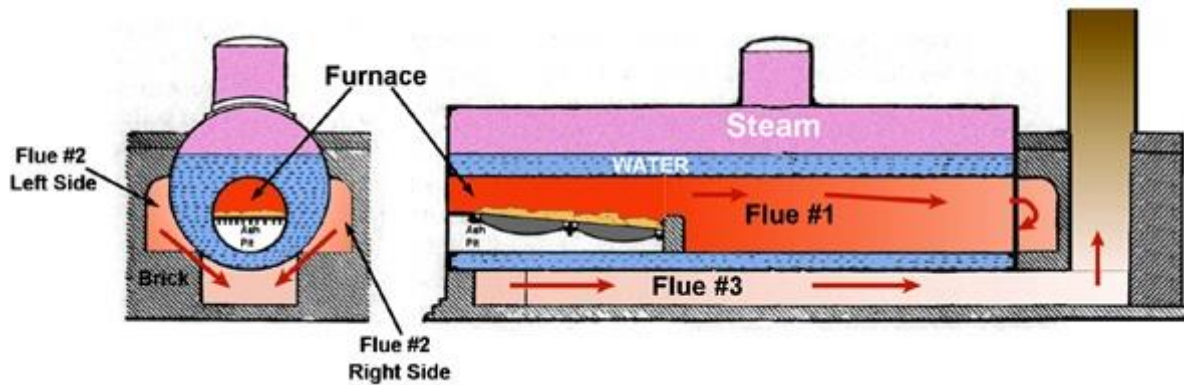


Figure 2: Cornish boiler.

A further development was to put two separate furnaces in the boiler, which helped improve efficiency.

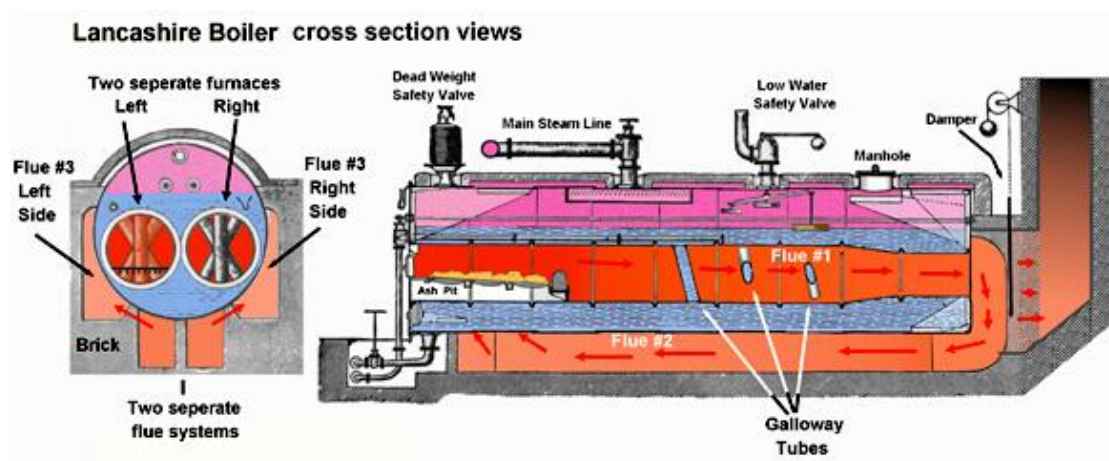


Figure 3: Lancashire boiler.

A further development was the water-tube boiler as shown in Figure 4. This is an example of a Babcock-Wilcox boiler which was used on both the Fremantle and Goldfields water projects.

In the water-tube boiler, water flows through a set of pipe which is surrounded by the hot gases. This is a more efficient system with easier maintenance as individual water tubes can be easily replaced. It is possible that the water pipes found in such a mess in Trench 1 and from the boiler.

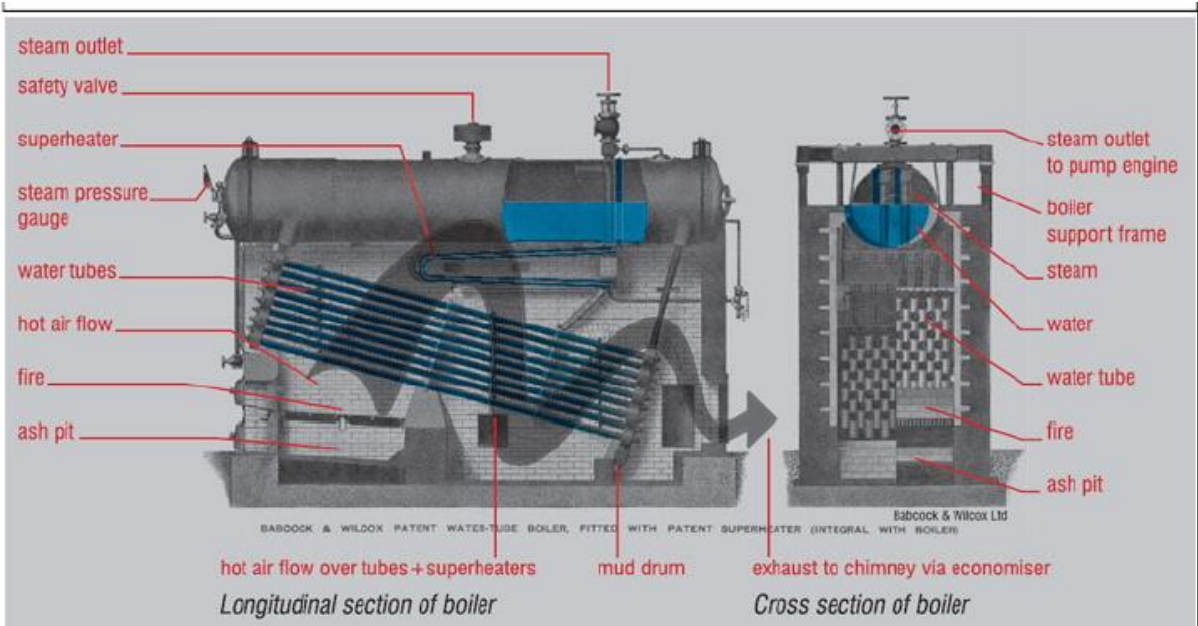


Figure 4: Water-tube boiler.



Figure 5: Piping in Trench 1.

A number of other design additions were often added to boilers to further increase efficiency. These included but were not limited to:

Air Preheater – This was used to recover heat from the exhaust flue gases and was installed between the economiser and the chimney. It heated the new air required for combustion before it flowed to the boiler furnace.

Economiser - They are a device fitted to a boiler which saves energy by using the exhaust gases from the boiler to preheat the cold water used to fill it. The Goldfields pump station all had economisers fitted.

Super Heater - This is a device used to convert saturated wet steam into dry steam before use in pumping or other processes. Dry steam contains more thermal energy and improves overall efficiency while being less likely to condense on engine cylinders. Both the Fremantle Prison and Goldfield boilers used super heaters.

Fremantle Prison Water Supply

The contract for the supply for the pumping system was given to James Simpson and Company who manufactured Worthington Pump in England under license. The Simpson and Worthington companies were to merge in 1903. The pumping system details below are taken from the Daily News of 29th January 1898.

“The plant consisted of two triple expansion vertical surface condensing Worthington pumping engines and two Babcock and Wilcox water tube boilers fitted with “Schwoerer” superheaters. The depth at which the water was tapped necessitated the pumps being fixed about 45 feet below the engine house floor, the pump plungers being connected by wrought iron spears direct to the engines which are placed above the engine house floor while special arrangements have been made for balancing the weight of the rods. Each pump is arranged with internal double acting plungers working in gunmetal sleeves which give an even flow water. After leaving the pumps, the water is taken up through the delivery pipe into the surface condenser and passes round the outside of the tubes into the delivery main. The air pumps are arranged directly beneath the low pressure cylinders to draw the condensed steam from the surface condenser. The steam cylinders are placed in tandem; the high pressure cylinder on top, then the intermediate cylinder and both rest on the low pressure cylinder, which is rigidly fixed to the main girders. This arrangement of cylinders makes the whole of the working parts very accessible and an upper platform is arranged to enable the valves, valve gear, etc. to be well within the reach of the driver.

This arrangement of cylinders makes the whole of the working parts very accessible, and an upper platform is arranged to enable all the valves, valve gear et cetera to be well within the reach of the driver. All the steam cylinders are steamed jacketed. Steam is supplied at a pressure of 100 lb per square inch and after leaving the boiler passes through the “Schwoerer” superheater. By this apparatus an additional 120°F is imparted to it so that the steam reaches the high pressure cylinders at a temperature of 450°F and perfectly dry. J. Simpson and Co have found by experiments with super heating that a great economy is obtained and they have already fitted a great number of boilers with these super heaters.

The engines are a 40 horse power each and with a 15 inch stroke the pumps are capable of pumping at 62,500 gallons of water per hour.”

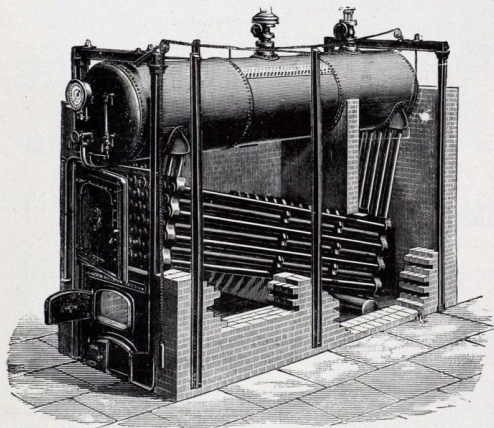
Figure 6 are advertisements for Babcock-Wilcox boilers and Worthington pumps.

BABCOCK & WILCOX, L^D._c

ENGINEERS and MANUFACTURERS of

WATER TUBE STEAM BOILERS,

2,000,000 HORSE POWER IN USE.



EUROPEAN WORKS AND OFFICES:

RENFREW, near GLASGOW.

LONDON: 147, Queen Victoria Street, E.C. GLASGOW: 21, St. Vincent Place.
 MANCHESTER: 28, Deansgate. PARIS: 15, Rue de la Chaussée d'Antin.
 BRUSSELS: 68, Boulevard du Nord. MILAN: 7, Via Dante.
 Australasian Office—SYDNEY: 83, Pitt Street.

“STEAM,” a valuable Treatise Free on Application.

WORTHINGTON PUMPING ENGINE CO.

153 QUEEN VICTORIA STREET, LONDON, E.C.

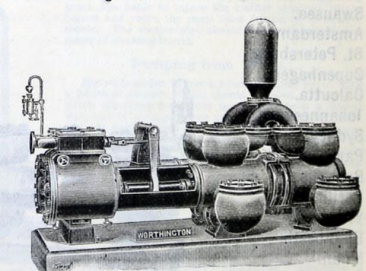
WORTHINGTON.

TELEGRAMS: ‘PUMPING, LONDON.’ TELEPHONE: 614, BANK.

TRADE MARK.

2,100 PUMPS IN STOCK.

Branches: Double the number of
 Pumps sold and working
 than that of
 any other maker.



WORTHINGTON PACKED PLUNGER PUMPS.

WORTHINGTON PUMPS FOR ALL SERVICES.
 CATALOGUES AND ESTIMATES ON APPLICATION.

Figure 6: 1898 advertisements for Babcock-Wilcox and Worthington.

Figure 7 is the US patent image for the Schwoerer Super Heater and a photo of what appears to be one from the Engine House excavation site. A similar artefact was also left in the NW wall of Trench 2.

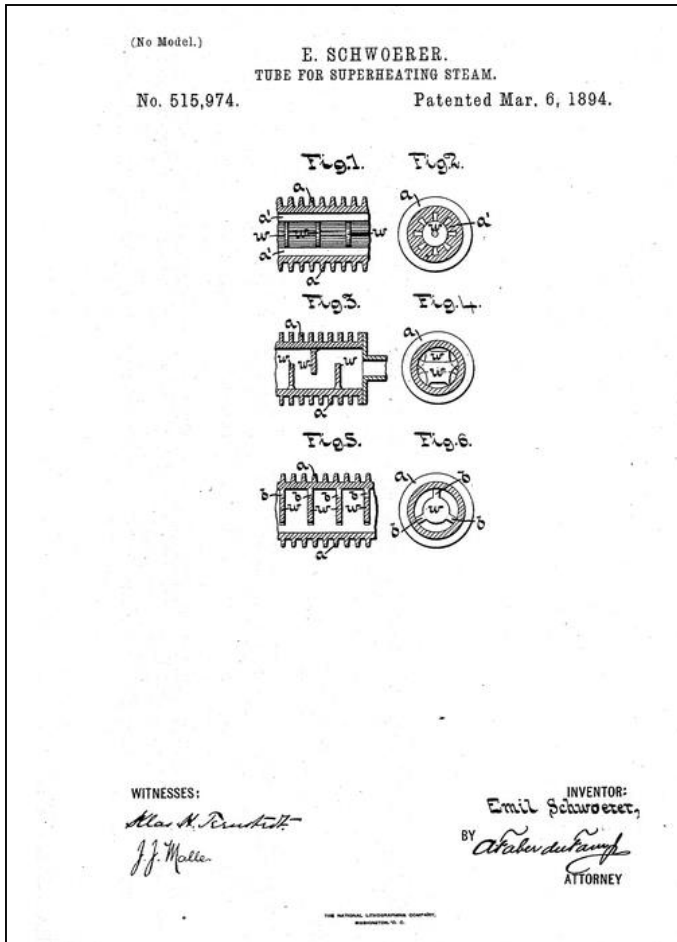


Figure 7: Schwoerer super heater

Coolgardie Goldfield Water Scheme

It is interesting to also look at the Coolgardie Goldfield Water Scheme as much of the equipment, although on a much larger scale, used similar equipment which was supplied by Simpson and Co. C.Y. O'Connor visited the prison in 1898 no doubt to investigate the new prison pumping system.

The material below is from on the Institute of Engineers nomination of the Coolgardie Water Scheme as a National Historic Landmark (1986).

The Coolgardie Scheme was based on a flow rate of 5,600,000 gallons per day through 30" pipes using a total of eight pumping stations,

The first four stations each had a lift of 450' with the next four having an average lift of 225'. This was accomplished by each of the first four stations having a group of three of machines and the next four each having two. So overall there were required 20 pumps and boilers each of the same specification.

Each group had 303 HP including extra for contingencies meaning that the system had over 6000 hp of installed capacity.

Tenders went out in April 1899, which eventually went to James Simpson in March 1900. This is the same company that provided the Fremantle equipment.

The pumping plant was the same throughout except the first four stations with 450' head had 15" pump plungers while the second four had 21" pump plungers. The engines were horizontal, six cylinder, high-duty, triple expansion surface condensing engines of the Worthington duplex, direct acting type. The diameters of the high, intermediate and low pressure cylinders were respectively 16", 25" and 46" with the normal stroke of the pump plungers 36" and the piston speed 150 ft per minute. Pump plungers are externally and centrally packed and directly connected with steam pistons.

Each Babcock-Wilcox water-tube boiler supplied one engine. Each boiler had 81 tubes, each tube 18' long and 4" in diameter, a single drum 23' 7" long and 4' in diameter with superheater placed between water-tube and drum. A Green economiser was provided for each installation. The chimney stacks made of steel and are 5' in diameter. Those at the first two stations are 130' high at the third and fourth 100' high and at the last four 90' high.

The layout of a two pump station is shown in Figure 8.

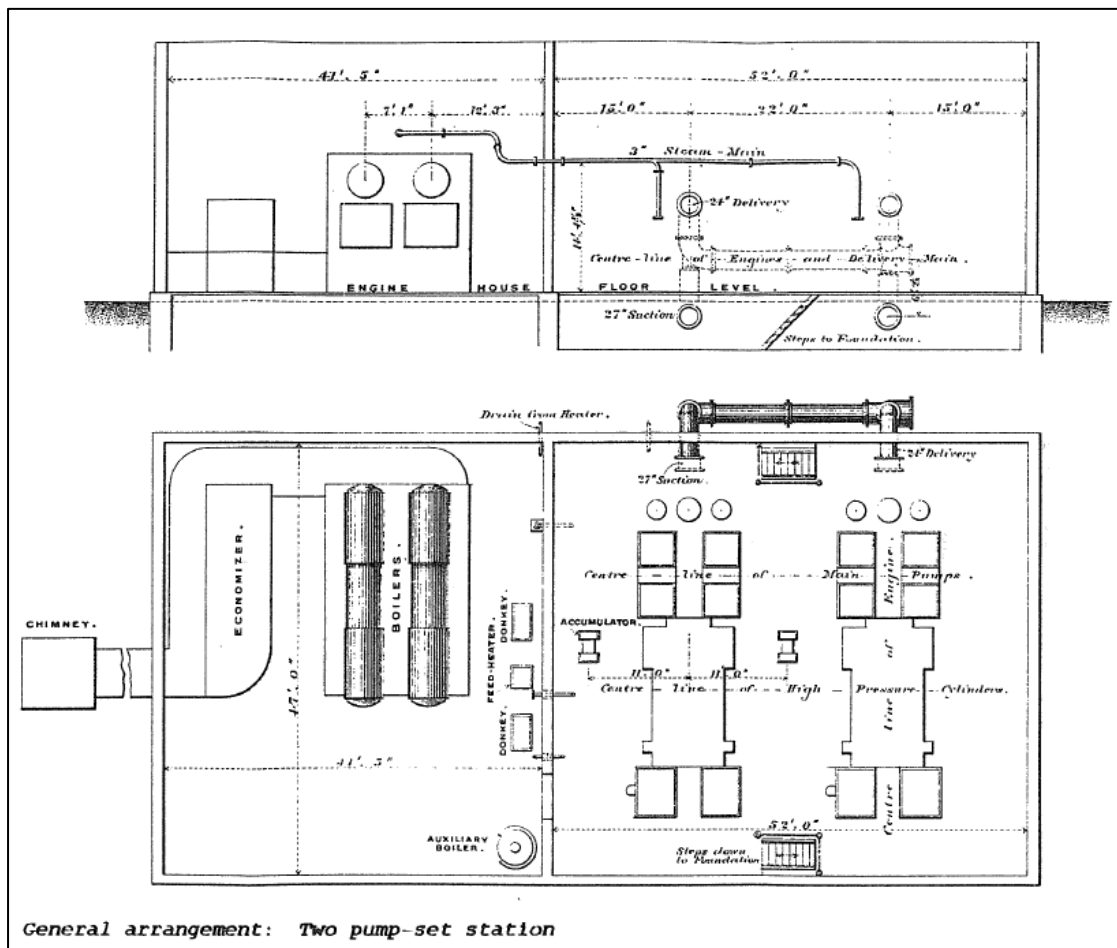


Figure 8: Coolgardie Scheme two pump station layout.

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APPENDIX D

ARTEFACT SPREADSHEET

Column Labels										Total Sum of	Total Sum of Weight
Row Labels	T1	T2		T3		T4				Number of artefacts	(gms)
	Sum of Number of artefacts	Sum of Weight (gms)	Sum of Number of artefacts	Sum of Weight (gms)	Sum of Number of artefacts	Sum of Weight (gms)	Sum of Number of artefacts	Sum of Weight (gms)			
Domestic	18	622.6	47	160.1	1	15.0	19	96.2	85	893.8	
Brass			1	1.2					1	1.2	
Ceramic	8	557.8	2	40.3					10	598.1	
Cloth	3	33.0							3	33.0	
Copper			1	5.6					1	5.6	
Fabric			4	16.3					4	16.3	
Glass	3	2.9	30	31.9			15	5.9	48	40.7	
Linoleum	1	7.7	2	6.8					3	14.5	
Metal	2	20.9	5	56.6			2	56.0	9	133.5	
Metal and glass					1	15.0			1	15.0	
Mother of Pearl	1	0.3							1	0.3	
Plastic			2	1.5			1	0.7	3	2.1	
Rubber							1	33.6	1	33.6	
Industrial	122	16,608.3	379	25,258.2	170	1,487.3	50	2,735.9	721	46,089.7	
Brass			2	42.2					2	42.2	
Ceramic	16	1,588.5	5	324.5	1	39.0			22	1,952.0	
Charcoal	19	57.2	3	7.6	44	47.8	4	21.1	70	133.7	
Coal			14	140.8	4	37.5	5	55.7	23	234.0	
Composite			3	28.5					3	28.5	
Fabric			17	211.5					17	211.5	
Fibre			8	30.6					8	30.6	
Glass	9	144.1	40	339.6	22	119.6	4	17.4	75	620.7	
Metal	58	10,602.6	120	20,717.4	24	411.1	14	2,270.5	216	34,001.6	
Mica			2	0.1					2	0.1	
Paper (compressed)			17	153.7					17	153.7	
Plastic	3	18.2	5	46.1			2	1.8	10	66.1	
Rubber	9	2,161.5	2	20.2					11	2,181.7	
Rubberised cloth	5	206.1	3	83.8	1	34.3	4	86.9	13	411.1	
Slag	2	9.7	123	1,891.7	74	798.1	17	282.5	216	2,982.0	
Tenacotta	1	1,820.4	15	1,219.9					16	3,040.3	
Medicinal	1	37.2	4	50.3			1	121.6	6	209.1	
Glass	1	37.2	4	50.3			1	121.6	6	209.1	
Other	15	31.8	31	252.6	25	172.4	11	59.0	82	515.8	
Glass	8	28.4	23	201.6	9	59.9	11	59.0	51	348.9	
Metal			4	13.3	16	112.5			20	125.8	
Shell	7	3.4	4	37.8					11	41.2	
Recreational	7	100.2	27	513.3			2	43.6	36	657.1	
Clay	2	9.7	3	11.3			1	1.3	6	22.3	
Glass	4	72.8	23	501.8					27	574.6	
Graphite			1	0.2					1	0.2	
Rubber	1	17.7					1	42.3	2	60.0	
Structural	220	12,986.1	485	11,570.1	86	749.3	188	1,945.8	979	27,251.3	
Asbestos			1	40.3					1	40.3	
Brick	8	746.7	12	4,757.1			6	866.7	26	6,370.5	
Ceramic			2	62.1					2	62.1	
Concrete			4	1,142.2					4	1,142.2	
Copper			1	17.0					1	17.0	
Fibreboard			7	127.8					7	127.8	
Fibro-cement	4	38.7							4	38.7	
Glass	143	4,373.5	176	1,511.1	22	118.1	125	584.3	466	6,587.1	
Linoleum	6	93.2							6	93.2	
Metal	50	5,856.9	269	3,465.8	63	591.7	47	337.7	429	10,252.1	
Mortar	1	367.3							1	367.3	
Plastic			1	0.7					1	0.7	
Slate	1	69.2	11	275.6	1	39.4	5	32.5	18	416.7	
Wood	7	1,440.6	1	170.4			5	124.6	13	1,735.6	
Subsistence	137	444.6	80	584.0	24	12.0	187	236.3	428	1,276.8	
Bone	115	19.9	56	185.4	23	6.3	175	55.1	369	266.7	
Ceramic	1	6.7	7	89.0			5	89.3	13	184.9	
Glass							2	76.2	2	76.2	
Metal	20	417.3	17	309.6			4	13.9	41	740.8	
Plastic	1	0.7			1	5.7	1	1.8	3	8.2	
Unknown	79	3,499.8	282	12,233.8	74	885.1	89	1,815.8	524	18,434.5	
Chalk			1	1.0					1	1.0	
Fabric			8	7.7			1	0.9	9	8.6	
Glass	1	0.8	29	49.2	4	5.1	2	1.5	36	56.5	
Lead			6	2,008.9	1	0.6			7	2,009.5	
Leather			1	0.6					1	0.6	
Metal	74	3,482.6	235	10,165.1	68	878.5	87	1,814.3	464	16,350.5	
Plastic	3	6.1	2	1.4					5	7.5	
Stirofoam	1	0.4							1	0.4	
Grand Total	599	34,330.5	1335	50,622.5	380	3,321.0	547	7,064.1	2861	95,328.1	