

METAL CRAFT REPAIR, TREATMENT AND
MAINTENANCE PLAN PROJECT

SALEM PIONEER CEMETERY

SALEM, OREGON

FOR
THE CITY OF SALEM PARKS AND RECREATION SERVICES
PUBLIC WORKS DEPARTMENT

THE OFFICE OF
ROBERT DORTIGNACQ, AIA
ARCHITECTURE • HISTORIC PRESERVATION

APRIL 20, 2018

A REPORT ON EXISTING CONDITIONS TOGETHER WITH NEEDED REPAIRS, TREATMENT RECOMMENDATIONS, & LONG-TERM MAINTENANCE GUIDANCE FOR THE CITY OF SALEM PARKS AND RECREATION SERVICES PUBLIC WORKS DEPARTMENT

Acknowledgements: This report was prepared with matching grant assistance from the Oregon Commission on Historic Cemeteries made available to the City of Salem in 2017. The purpose of the grant was to provide the City, as owner and steward of the Salem Pioneer Cemetery, with design, repair or treatment solutions for each of seven historic iron burial plot enclosures in the cemetery. It is also to be used by the Friends of Pioneer Cemetery for their collective stewardship efforts. Except as noted, all photographs were taken by the firm in association with this work.

Background: The Metal Craft Repair, Treatment, and Maintenance Plan is a supplement to the Salem Pioneer Cemetery Maintenance and Restoration Master Plan prepared for the City of Salem Parks agency and its citizen support group, the Friends of Pioneer Cemetery, by consultants Sally Donovan and Bruce Howard of Donovan and Associates in 2004. The cemetery, founded in 1854 as the historic Odd Fellows Rural Cemetery, is a plat of seventeen-acres which has been managed by the City of Salem through its Parks and Recreation organization continuously under city ordinance since 1954. The City of Salem has owned the property in fee simple since title was formally transferred to the City by Chemeketa Lodge No. 1, Independent Order of Odd Fellows, on February 3, 1986.

Salem Pioneer Cemetery is a City of Salem Historic Landmark. In the 1990 local landmark designation, the cemetery was concurrently declared a Goal 5 resource by the City under Oregon's mandatory statewide land-use planning program, which, among other goals, aims to protect natural resources and conserve scenic and historic areas and open spaces. Subsequently, on September 11, 2013, the cemetery was formally enrolled in the National Register of Historic Places (NRIS No. 13000707). Consequently, the City plans and carries out repair, treatment, and maintenance projects on the grounds in conformance with the Secretary of the Interior's Standards for Treatment of Historic Properties. Accordingly, the relevant section of the Secretary's Standards relating to Rehabilitation as a Treatment is referenced.

Project Scope: Salem Pioneer Cemetery has seven burial plots that have metal enclosures requiring repair and maintenance. The project involved site review of these enclosures noting the construction, type of materials, conditions, and assessing the repairs needed. Where applicable, the enclosures' supporting stone or concrete base needed to be assessed as well. Work began in mid September, 2017 with a review of resources, prior data, and an initial site visit, and continued through the winter with assessments of missing-broken members, repairs needed and research into possible part sources and suppliers.

The report is sectioned into a specific description of the design and materials for each of the seven enclosures with illustrative plan drawings, photos, and the recommendation for specific repairs. Following the specific enclosure sections, the report offers a review and discussion of the various materials and recommended repair and treatment methodologies, options, as well as links for further reference. This provides more in depth review of information and is intended to supplement the enclosure descriptions where recommendations are kept brief. That section is then followed by a listing of applicable resources and suppliers, which were contacted in the course of the project.

Because most of the cast iron plot fences in the cemetery have not been maintained on a regular basis, the condition of the fences varies considerably. The object of the grant request was to gain a professional assessment of each fence that would identify and provide cost estimates for needed repairs and treatments. This concise planning document will guide the City in putting work out for bid to experienced contractors, and where appropriate placing certain work in the hands of skilled City personnel or experienced volunteers.

DESCRIPTION OF METAL CRAFT ENCLOSURES

DeVol: SW ¼ Plot #887

The DeVol Plot enclosure utilizes a fence using top and bottom rails spanning to the four ground mounted corner posts and the gate posts with infill of cast iron panel sections [8 sections in each direction]. The fence has patent marks from the Oregon Iron Fence Works.



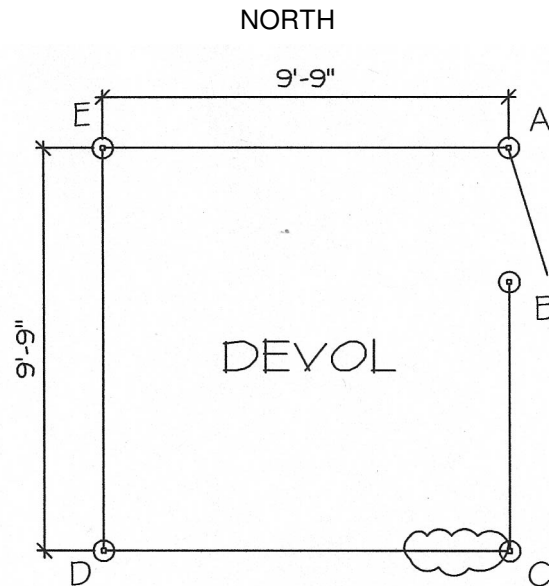
Enclosure Members:

- Iron Rails: 1¼" wide by 3/16" thick bar; top has 7/8" rounded member secured with small round head bolts at the panel joints; bottom rail has nibs to hold panels in place; midpoint ground support on east, south, north. The wrought iron is rusted.
- Cast Iron Posts: The ornamental posts are 1¼" x 1¼" with a 3¾" square x ¼" thick base plate. Posts are articulated with (4) sets of triple grooves and are topped with round finials. The base plate is bolted to a 6" diameter x 3/8" thick iron ground mounting plate that is welded to iron stakes driven into the ground. Posts have 1¾" mounting tabs to receive the rails for mounting with bolts.
- Cast Iron Panels: 14" wide 26½" high [8 sections in each direction] cast iron panel sections; single sided casting; The panels have (3) 5/16" high round spacers. The panel bottoms have 3/16" diameter x 5/16" high nibs to secure the panel to the rail.
- Gate: Currently not attached, is fabricated similarly to the fence and uses two panel sections.
- Finish: Black paint.

Repairs:

- The enclosure is damaged from being hit at the C-D section. This bent out of alignment, the top and bottom rails, and broke (2) panels [one is missing]. The rail pieces should be able to be suitably straightened, if not, they need to be re-fabricated.
- Replace (2) panels where indicated on diagram. These appear to be available and in stock from Lawler Foundry in Alabama; Pattern #8658.
- Posts A & D have base plates with portions broken off. These can be mended with newly fabricated material. Post A needs to be reinstalled.
- Post C has a broken ground mounting plate. This can be mended/replaced.
- The Gate has a broken lower corner that needs repairing. There is no apparent means to latch and secure the gate, This needs to be developed.
- Post and Rail Bolts: New bolts are required at various locations to secure the posts to the ground plates and for rails to posts after repairs are made. Approximately 75% of the small bolts on the rounded top rail piece are rusted out and need replacement. New bolts should be galvanized iron or stainless steel.

- The enclosure is rusted and requires cleaning, paint preparation and finishing.



Budget Cost Estimate:

- The Lawler Machine & Foundry Company has a stock panel that appears to match the DeVol panel. The cost of a single panel was quoted at \$24.48. Two panels and shipping should cost approximately \$100. There are assorted screws and bolts needed at a nominal cost. There is labor to repair the iron rails, gate, and posts. Total cost not including repainting: \$2,600.



View of Gate



Typical Cast Iron Panel



Countersunk Rail Fastener



Post A Broken Base Plate

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Munkers: Plot #074

The Munkers enclosure uses a fence design with two iron rails spanning between cast iron posts approximately eight feet apart. The rectangular enclosure is two bays wide [east-west] and three bays long [north-south]. An entry gate being centered on the east side then creates two bays to its north and south. Rails have sleeve ornaments on the ends and at midpoints, many of which are broken, with some missing.



Enclosure Members:

- Iron 'Gas' Pipe Rails: 1 $\frac{5}{8}$ " outside diameter (od) pipe. There are ornamental cast iron sleeves at the rail ends as post receivers, and midpoints having an organic motif. Those at midpoints are 9 $\frac{1}{2}$ " long, those at rail ends 5" long. These are cast with a small loop from which chain hung or was swaged. A few chain remnants are extant.
- Cast Iron Posts: The ornamental posts are 42 $\frac{1}{2}$ " with a 3 $\frac{1}{2}$ " square base. They are composed with base, middle, and top sections that are joined with couplers that receive the rails. The shaft portion of the 11 $\frac{3}{4}$ " tall lower and middle sections have a fluted design. The typical top features a 6 $\frac{1}{2}$ " tall finial. Those at the gate posts have 5" tall by 8" diameter flower urns with scalloped edges and small drain holes. The posts are mounted to 6 $\frac{1}{2}$ " wide stone piers, most of which are now under the turf and soil.
- Gate: The gate uses four iron pipe sections with plain cast iron corners. It has a decorative single cast 'scroll' top cresting. The center infill is missing, but it was mounted to the extant loops at the four corners and midpoint of the top rail.
- Finish: Black paint.

Repairs:

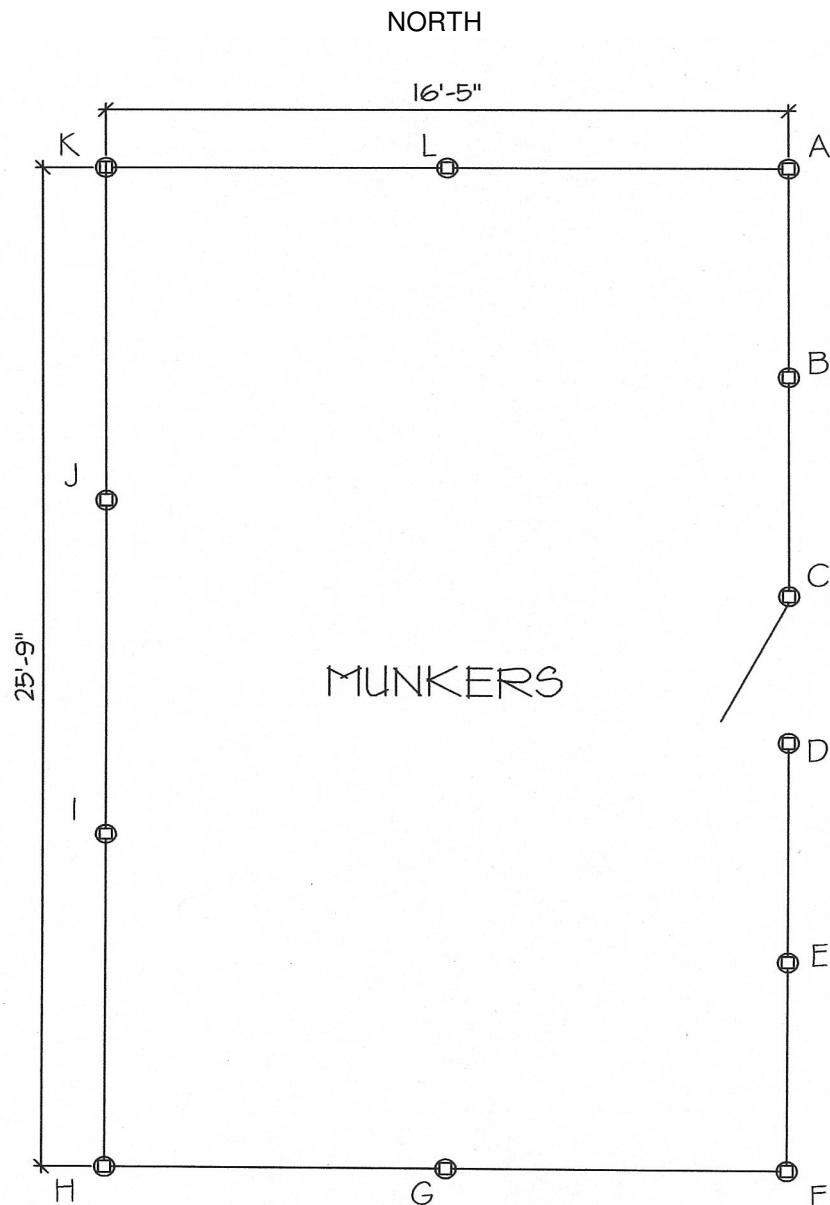
- The enclosure has significant rusting and damage to the cast iron decorative pieces. Rusting makes it not only very difficult to distinguish where one piece joins to another, but also unlikely to disassemble pieces. The AL bay has a bent top pipe rail. The lower rail at GH is disengaged from post H. This might be reconnected or stabilized using an insert.
- Post B is out of alignment; Post F has a break below the lower rail, and is missing its finial; Post I has a damaged finial. Replacement finial might be able to be found, or new ones cast. It might be best to repair the break at Post F by digging out the lower section and footing stone to allow it to move to the existing post location, installing a pipe insert to reconnect the post, and then bury the stone. All post bottoms are under lawn and soil so that their draining weep holes do not function. This makes rain water accumulate in the post with no way to get out. The solution is to remove the soil, open up the drain holes again, and use gravel drain material for the fill.
- Rail Sleeves: Many are broken or missing, 21 of 44 ends and 14 of 22 middles, as inventoried at the following bays:
 - AB: Ends: 3 broken; Middles: 2 broken

Metal Craft Repair & Treatment Report, Salem Pioneer Cemetery

- BC: Ends: 3 intact, 1 broken; Middles: both intact
- GH: Ends: 2 broken; Middles: 2 broken
- HI: Ends: 3 broken; Middles: 2 broken
- IJ: Ends: 3 broken; Middles: 2 broken
- JK: Ends: 3 broken; Middles: 2 broken
- KL: Ends: 1 broken, 1 missing; Middles: 2 broken
- LM: Ends: 4 broken; Middles: 2 broken

A source for the broken and missing sleeves or an appropriate mold pattern has not been located. New sleeves would need to be cast from new molds taken from intact pieces.

- Gate: The gate is not functional since the iron tabs on the post and gate used for swinging need repair. The upper tab on the post is broken and the lower tab on the gate is broken. These tabs should be able to be repaired. The design and nature of the infill is not known, possibly something similar to that of the Thompson gate.
- The enclosure is rusted and requires cleaning, paint preparation and finishing.



Metal Craft Repair & Treatment Report, Salem Pioneer Cemetery

Budget Cost Estimate:

- The cost for new castings is expensive [see budget cost information from Robinson Iron]. To make new molds and cast the ornamental sleeve pieces would cost over \$20,000. The first priority is for the repair of post and rails, possible rail straightening, gate repairs, and refinishing. Total repair cost not including repainting or new castings: \$2,000.



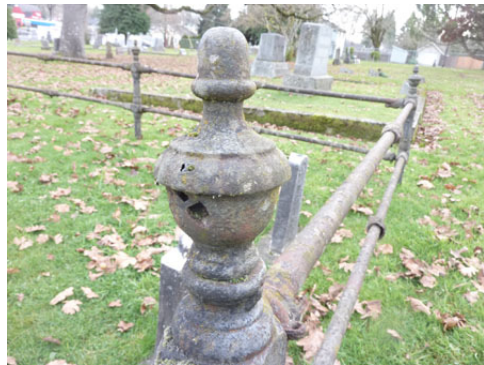
Post F and Rail Sleeve Ends



Middle Rail Sleeve Ornament



View of Gate



Post 'I' Finial

Thompson: N ½ Plot #592

The Thompson enclosure uses a fence design with two iron rails spanning between cast iron posts from five to six and half feet apart. The rectangular enclosure is three bays wide [east-west] and two bays long [north-south]. An entry gate being centered on the east side creates one bay to its north and south. Rails have sleeve ornaments only at their midpoints. The iron enclosure is similar to that of Munkers except that it is mounted to a stone curb. Overall, it is much better condition than the Munkers enclosure.



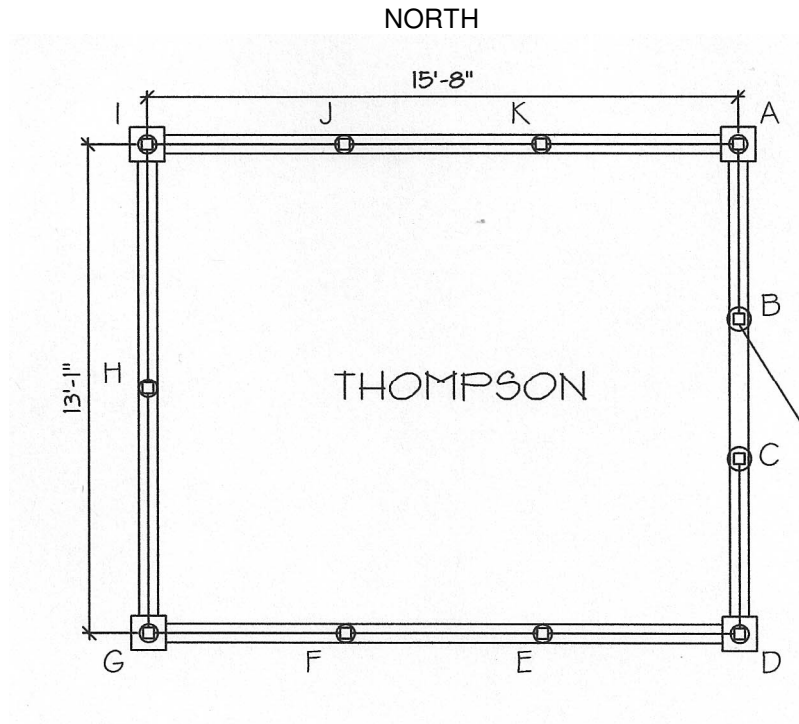
Enclosure Members:

- Iron 'Gas' Pipe Rails: 1¼" od pipe. There are 7½" long, ornamental cast iron sleeves at the rail midpoints having a 'Clasped Hands' motif. One is missing.
- Cast Iron Posts: Posts are 27¼" high with a 3⅞" square base. They are composed with base, middle, and top sections that are joined with couplers that receive the rails. The 8½" tall shaft portion of the lower and middle sections have an organic design. The base is a 3" high short piece that mounts to the curb. The post tops typically have 6½" high finials, those atop the entry posts have flower bowls measuring 5" high and 7" in diameter.
- Curb: Curbing is 6" x 11½" high of unmortared, sawn stone set on a rough rock base. The four corners measure 11" square. The curb continues across the gate.
- Gate: The gate uses four iron pipe sections with ornamental cast iron corners. It has diagonal flat, iron cross bars with a decorative cast iron emblem at their cross point.
- Finish: Black paint.

Repairs:

- The enclosure is in much better condition than Munkers. There are damaged members and missing pieces, however.
- Post A is broken and displaced just below the lower rail coupler. The repair will require aligning the lower section that is mounted to the curb corner stone with the coupler and joining with an insert. Inspection reveals that the post anchorage used an inner pipe sleeve embedded in the curbstone with lead used to join it to its cast iron base. There is room to move the stone, but alignment will likely also require force on the iron enclosure.
- There is a crack in the finial at Post D; Post F has a hole in its finial; Post J has a missing finial.
- Rail Sleeves, as inventoried at the following bays:
 - AB: Ends: 1 upper broken; 1 lower cracked
 - GH: Ends: 1 upper broken;
 - JK: Ends: 1 upper broken; 1 lower cracked
 - KL: Ends: 1 upper broken; 1 lower broken

- Gate: The lower gate swing support at Post B is broken off. A replacement support tab should be able to be made. The lower cast iron gate corner is broken and missing. This repair is more challenging and will require a connection to the cross bar.
- NE corner curb stone is displaced. This can be reset in conjunction with the pipe repair.
- The enclosure is rusted and requires cleaning, paint preparation and finishing.



Budget Cost Estimate:

- The cost for new castings is expensive [see budget cost information from Robinson Iron]. To make new molds and cast the ornamental sleeve pieces would cost over \$6,500. Suitable replacement finials might be located rather than casting new members. The first priority is for the repair of post and rails, gate repairs, and refinishing. Total repair cost not including repainting or new castings: \$3,500.



Post A Damage



View of Gate

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Middle Rail Sleeve Ornament



Typical Post Finial

Kinney: Plot #588

The Kinney enclosure uses tapered square stone posts joined to one another with two square wrought iron rails turned 45 degrees approximately eight feet long. The rectangular enclosure is two bays wide [east-west] and three bays long [north-south]. There is no entry gate as such.

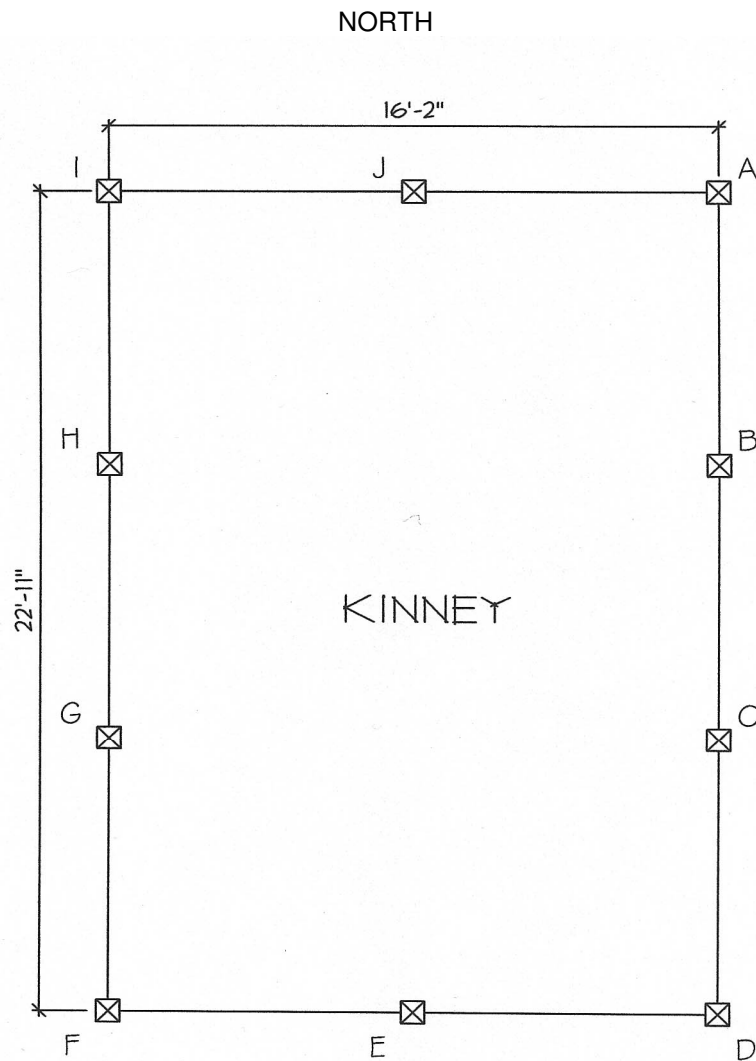


Enclosure Members:

- Wrought Iron Rails: Rails are 1¼" square section set at 45 degree angle. The rails are set 18" apart and 8¼" below the top. Rails are inset into the posts and secured with lead, except at Post E, which has been repaired and has non-shrink grout setting at the top rail. Rails have their natural wrought iron finish and do not appear to have been painted.
- Posts: The square sectioned, stone posts measure 7½" at the base, tapering to 6" at the top, which has a shallow 1 ¼" rise hip. The height of the posts ranges from 39½" to 42½" above grade.
- Post E has had a prior crack patch repair. The 'non-shrink' grout used to secure the rails has shrunk, and has allowed moisture into the joint.
- Finish: Natural stone and wrought iron.

Repairs:

- Upper AB and JA rails are loose at Post A where the top is broken; Lower AB rail is loose at Post B.
- Posts: Stone post A has a clean break at the upper rail. The top can be rejoined to the shaft with mortar, epoxy should not be necessary. First, clean the stone to base material, remove the white lead oxidation from the rail ends. Then, secure the rails with new lead, or a liquid elastomeric material.
- Post E: Weather proof the rail joints with new non-shrink grout or replace with lead per original.
- Finish: The posts are generally in good condition, and need only light cleaning if desired. The rusting on the rails appears stable. See alternatives in the materials discussion section.



Budget Cost Estimate:

Repairs are essentially labor costs, and not excessive. Total repair cost not including stone cleaning or wrought iron finishing: \$1,000.



View of Post 'I' Looking East



View of Post 'A' Top at Break

Metal Craft Repair & Treatment Report, Salem Pioneer Cemetery

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April 20, 2018

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Bush II: Plot #066

The Bush II enclosure uses tapered square stone posts joined to one another with three square wrought iron rails turned 45 degrees approximately eight feet long. The rectangular enclosure is two bays wide [east-west] and three bays long [north-south]. On the east side the two interior posts are of a more formal design and set closer together, 46½" clear, to form an entry.

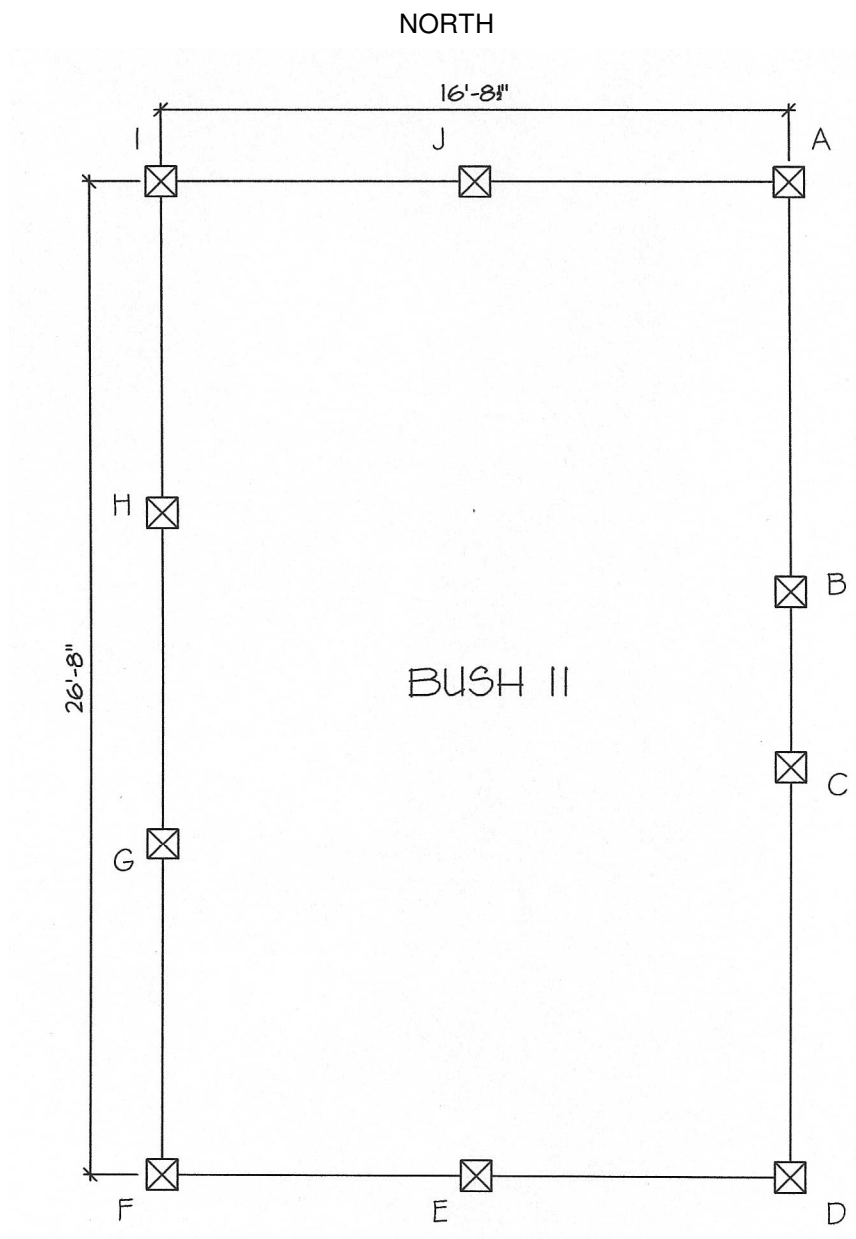


Enclosure Members:

- **Wrought Iron Rails:** Rails are 1¼" square section set at 45 degree angle. The rails are set 11½" apart and are 7½" below the top. Rails are inset into the posts and secured with lead. Between Post B and Post C the top two rails are not set secure which allows them to be removed for access. Rails do not have their natural black wrought iron finish and are rusted, but the rusting appears to be stable and has not stained the stone.
- **Posts:** The typical square sectioned posts measure 9½" at the base, tapering to 8" at the top that is minimally hipped with a ½" rise. The entry posts [Posts B & C] are not tapered, and instead have a base, shaft and cap. They measure 9½" wide at the base, a 7 ½" wide 20" high shaft, and a 8 ½" wide 6 ½" high cap. The height of the posts ranges from 40" to 44" above grade.
- There is an 6" high aluminum weed control border around the plot perimeter; some iron pipe stakes flush with the ground
- **Finish:** Natural stone and wrought iron (rusted)

Repairs:

- Middle FG rail is loose at Post G; Lower HJ rail is loose at Post H. The lead at these locations could be reworked to tighten those joints to make waterproof connections
- **Finish:** The posts are generally in good condition, and need only light cleaning if desired. The rusting on the rails appears stable. See alternatives in the materials discussion section.



Budget Cost Estimate:

Repairs are essentially labor costs, and not excessive. Total repair cost not including stone cleaning or wrought iron finishing: \$500.



View of Post 'F'



View of Post 'C' with Removable Rails

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Buren: S ½ Plot #496

The rectangular Buren plot enclosure consists of concrete curb with a single iron gas pipe railing on the four sides. It has three bays wide [east-west] and two bays long [north-south] as expressed only by the short pipe supports that are between five to six feet apart.

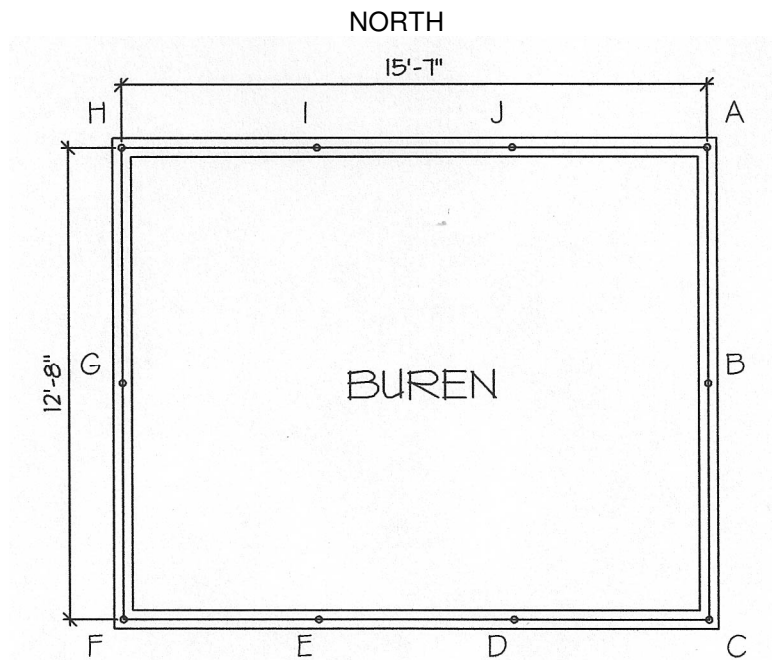


Enclosure Members:

- Iron Gas Pipe Rails: Rails are 1¼" od and connect with plain, threaded Tee's to the matching 12" high pipe post supports. The posts were embedded into the curb at the time of concrete pouring.
- Curb: The 6" x 12" concrete curb is installed on grade with no footing. The curb is cracked at most of the enclosure's supporting pipe post locations.
- Finish: Black paint.

Repairs:

- The rail between Post C and Post F is a little out of plane. It would be difficult to correct the situation.
- Post B is rusted out at its base. Others are also heavily rusted, and in some places rusted through the pipe walls. Connections are rusted heavily. Where completely rusted, the member, or portion of it, could be removed and a new iron section inserted provided the new material matches the size. New welds should be ground flush with existing. If the concrete at the interior of the posts is near the top of curb, weep holes could be drilled into the posts to allow water to drain out. Alternatively, a surface mounted pipe base could be installed.
- Curb: The curb is generally in fair to good condition, but is cracked in several locations due to stresses from the rusting of the embedded pipe posts. This occurs at Posts D & E. At Post J there is a large crack through the curb. The rusting and stress on the curb will continue, unless the pipe section is replaced. Some relief can be achieved by making the iron to exterior concrete joint waterproof. That does not, however, address interior moisture effects. At severely damaged posts and curbs, a section of curb could be removed and new pipe installed with the new concrete curb section as an alternative solution. This curb section could be doweled into the existing concrete curbs for future stability.
- The railing enclosure is rusted and requires cleaning, paint preparation and finishing.



Budget Cost Estimate:

The cost for new pipe and concrete repairs are essentially labor costs, and not excessive. Total repair cost not including repainting: \$1,800.



View of Rusted Out Pipe & Cracked Curb



View of Typical Rust Damage at Posts

E.N. Cooke: Plot #116

The E. N. Cooke enclosure was rehabilitated in 2012 with work including straightening and repairing the curb, repairing the iron fence enclosure, surface preparation and painting. The three sided enclosure surrounds the entry court and with a short overlap of the mausoleum's front corners.



Photo Courtesy of E. Potter

Enclosure Members:

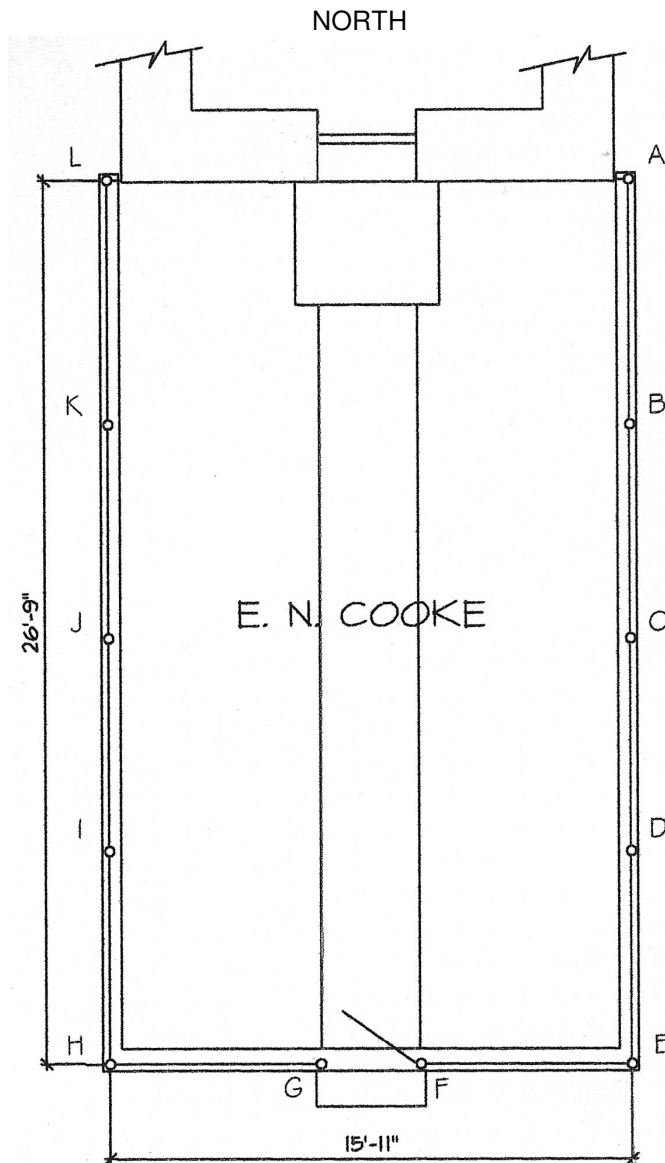
- The enclosure utilizes cast iron panels attaching to one another and to the cast iron posts from which they are supported. The original anchorage of the posts is not determined, but most likely utilized an interior iron rod inserted into the stone curb that was then tightened with the finial. Inspections revealed that some of the existing posts do not have this interior rod, while Post 'E' does. It appears that the rod at Post 'E' is now rusted tight into the finial and to the curbstone and not easily removed.
- The posts are mounted to the stone curb. These stones retain a small amount of soil and do not have a footing. Soil pressures tend to push the curbstones out of alignment over time.
- Extra materials are possibly stored in the vault.

Repairs:

- The repair of the post anchorages is involved. Ideally the posts would be removed from the panel sections so that a new anchorage system could be designed and installed. The design of the anchorage to the stone should use non corrosive materials to avoid rust jacking on the stone. If there is prior rusted iron in the stone, it should be removed to limit future stone damage.
- The NE corner post 'A' is wobbly and does not have sufficient anchorage. The post is mounted close to the exterior face of the curbstone causing stress on the outer section of stone. This previously repaired curbstone that has a broken corner under the post needs new repairs, and the stone is out of alignment resulting in a 2" gap to vault wall. The repair needed is for mechanical anchoring of the broken stone corner using interior stainless steel anchors and new bonding, mortar or epoxy, of the broken piece to the stone. The stone should be reset in the dirt to align closely to the vault wall. An anchor at the top of the fence to the vault wall would reduce future stress on this repair.
- The SE corner post 'E' has an interior threaded rod that may or may not be original. It is not known how this rod is anchored to the curb, likely with an iron or steel rod set into the stone curb. There is a gap between the finial and the post body that allows water inside. The gap should be lessened as possible and the gap filled with a suitable, paintable caulking to deter water entry. It would be difficult to shorten the rod without disassembling the post.
- The west post 'G' at the gate latch has a horizontal crack in its cast iron at the top of the base portion that extends half way around perimeter. This post does not have an interior anchoring rod. The crack should be able to be repaired. If not welded continuously, gaps should be

filled with a suitable, paintable caulking. The gate posts receive stress from the gate's operation. A small discrete rubber bumper would lessen the gate's closing impact.

- Stone Curb: All corners except the northwest have cracked stone bases, but are intact. This may be due to rust expansion from an interior iron support rod, or from forces on the fence that are transmitted to the curb. The posts are mounted close to the exterior face of the curb rather than being centered on the top, which reduces the amount of stone available to resist forces.
- Finish: Flat black paint has turned grey, but is intact and not rusting. Recoating is due.



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Budget Cost Estimate:

The cost for new curb and other repairs are essentially labor costs, and not excessive. Total repair cost not including repainting: \$1,000. A more extensive repair involving disassembly of the posts and revision of the anchorage would be complex.



View of Typical Crack at Curb Corner



View of Misalignment at SE Corner of Vault



View of Crack at Gatepost 'G'



Gap at Finial of Post 'E'

METAL CRAFT & FOUNDATION MATERIAL REPAIRS

The following is a brief, consolidated discussion of considerations for the materials used for the iron burial enclosures at the Salem Pioneer Cemetery.

Other useful information, sources and treatment guidelines include:

- National Park Service (NPS) Preservation Brief 27; The Maintenance and Repair of Architectural Cast Iron, provides background and an overview of issues.
See: <https://www.nps.gov/tps/how-to-preserve/briefs/27-cast-iron.htm>.
- Secretary of the Interior's Standards for Rehabilitation as a Treatment:
<https://www.nps.gov/tps/standards/four-treatments/treatment-rehabilitation.htm>.
- Chicora Foundation, Inc. Cemetery Ironwork; See: <https://www.chicora.org/cemetery-fences.html> for further information.
- "Conservation Talk" by Michael Trinkley, AGS Quarterly (Bulletin of the Association for Gravestone Studies), Vol. 35, No. 4, Fall, 2011. A discussion of the top five cemetery fence problems.
- Iron Fence Repair, Video # 2007-03 by the National Center for Preservation Technology and Training (NCPTT) gives an overview on fence repair and painting; search their website: <https://www.ncptt.nps.gov/blog/category/product-catalog/>, or call 318-356-7444.

Discussion of the Materials Used

Cast Iron: Is used in the burial enclosures for posts, and decorative elements that were made by casting. Being a very brittle, hard material, it does not bend and will remain rigid until it breaks. It is more difficult to repair, drill, saw and weld than usual steel alloys or wrought iron. The cast iron used as part of the enclosures were mostly fastened together or to other elements using bolts passing through preformed holes. Some of the mounting plates that are now broken can be mended by welding the broken off part to the existing cast iron, allowing the repaired base plate to be rebolted. If the broken off piece is missing, then the welder will need to build up the area so that a serviceable connection can be accomplished. Where the above is not feasible, an intermediate steel plate or member might be an option that for the connection. Cracks in the cast iron may also be mended with welds. If welded in the field, the contractor may desire to use tungsten arc welding [GTAW or TIG] to make the repair. If the piece is able to be repaired in the welding shop, the contractor may instead use traditional stick welding [SMAW] with a nickel NiRod Ni-99 electrode. Successful welding requires preheating and post heating and protection from quick cooling to minimize the risk of fracture. In general, cast iron pieces should be repaired as individual parts so that they can be assembled as they were originally intended, with bolts and fasteners as opposed to welding the individual members to one another. Threaded parts that are rusted may not be able to be taken apart without breaking. If the connection is through bolted, the existing bolt can be cut off and a new steel bolt used. If the connection is threaded into a cast iron member removal requires cutting off the member and partially drilling out the embedded material sufficiently to allow new anchorage or cutting off a portion that can be then be attached to a new member. One cannot re-thread cast iron as with steel. Cast iron that is damaged appears to have occurred as a result of either excessive force (post base plates), or from the loss-thinning of material from long term corrosion (ornamental rail sleeves). The former can be repaired as noted above, and in the repair sections for the enclosures. The later requires creating a new casting or locating a replacement. New castings cannot be accomplished if there are no longer intact pieces from which to make a mold, something of a concern for the Munker enclosure rail sleeves.

Wrought Iron: Was used extensively on historic fences where softer, more malleable metal was needed to create shapes such as scrolls, and twisted bars. It can be hammered, bent, twisted and shaped without breaking. It can, therefore, be welded, cut and drilled readily. The iron has slags that protect it from rusting. It can, however, rust, especially if the original scale has been removed (sand blasting for instance), though at a slower rate. Wrought iron has not been commercially available since before WWII, so new replacement and repair material is typically

mild steel obtained or cut to match dimensions required unless there is a source for salvaged material. With exception of the finish, steel may be an acceptable replacement. It can be made to fit the original conditions and attachment details. If welded, the repair should be full depth and continuous for best long term durability and minimized rusting. While wrought iron may not need painting, steel or iron does. Often this results in everything being painted, especially if there are repairs scattered about the project or if the assembly is composed of both wrought and cast iron.

Miscellaneous Metal Parts: The enclosure fences and their contemporary repairs may result in a variety of metals and materials. One consideration for alternative metals is to be aware of rust corrosion and possibly galvanic reaction. The later is caused by dissimilar metals, primarily white metal (iron, steel) to yellow (copper). One should be aware of this when choosing fasteners. Stainless steel can be used for repairs including bolts and anchors. It has the advantage of minimal corrosion. This also allows bolts to be readily removed in the future. It has the disadvantage of being non historic in appearance (or historic use) and more difficult to paint to match original black members. A common alternative to stainless steel is hot dipped galvanized steel. Such bolts and fasteners are readily available, inexpensive, and easily painted.

Stone: Typically, stone members such as posts, are low maintenance and durable. Very occasional mild cleaning is all that should be needed (refer to NPS Preservation Briefs and noted resources and start with gentlest methods). Most stone used here appears to be a sandstone and it is generally in good condition. Problems areas include physical damage and more common, fractures from embedded fence iron that has rusted, and expanded. Sandstone can be absorptive to moisture, a trait that increases as it ages. The long term solution in these situations is to remove the rusted member and replace it with something that does not readily rust, or provide a different anchoring detail. A shorter term solution is to clean the rusted member as best as possible, coat to minimize future corrosion, seal the iron post parts and seal it to stone (or concrete as occurs) to minimize moisture (remember to allow a means for drainage if moisture does enter or condensation occurs) and repair the stone. When repairing the stone, reuse the broken piece if possible and reset with a cementitious slurry patch that allows moisture vapor passage. Anything but the smallest patch probably needs some embedded stainless steel anchorage. If no stone piece is available, the repair must use either new matching stone cut to fit, or a patching medium formed to match the original member. These later repairs are only for experienced personnel.

Concrete: The concrete found in the cemetery is used for curb members. It shares many of the characteristics of stone regarding moisture content and resulting iron corrosion. Concrete is readily repairable or replaceable. Only low strength, normal, unreinforced concrete is needed. Its finish should match that of the original. It can be more easily and economically replaced than stone. So where iron fence posts are rusted, small sections can be removed, the iron treated and repaired, a new moisture isolation separation membrane installed, and finally the concrete repoured.

Painting and Finishing: Wrought iron has an intrinsic surface protection, a low sheen black color, that resists corrosion. In practice, the metal is often painted since it is used in conjunction with other metals, cast iron and various fasteners, that do corrode. Sometimes the rusted parts are stripped or sandblasted. This can remove or diminish wrought iron's natural protection and it will remain in a rusted looking, but somewhat stable state (e.g. Kinney, Bush II above), or partially rusted, partially intact. While the rusted rail members at Kinney, Bush II are fairly stable, one may wish an alternative. One alternative is to lightly brush the iron with a steel brush or wool to remove loose material and then apply the product 'Penetrol' which then coats the iron and forms a more stable agreeable looking finish; if considered, a small sample should be first applied as a test. Cast iron always needs the integrity of good paint to protect all of its surfaces. The heavily rusted cast iron pieces on the cemetery plot enclosures have lost much of their original detail, and in some cases, a loss of the piece itself. For repainting, most cemetery conservators recommend a flat black paint finish that better matches the original finish. However, one drawback is that a flat black, oil (alkyd) based paint oxidizes fairly rapidly, more so than those with a semi-gloss finish, becoming grey in color. There is quite a variance in the quality of paints and their resultant longevity. Longer lasting paints have high quality solids, and a higher percentage of those solids

to the amount of liquid carrier. Painting always requires preparation such as removal of dirt, bio matter and loose paint or finish or corroded metal. For rusted cast or wrought iron a rust deterrent is recommended such as Phosphoric Acid, or a product like Rust-Oleum's 'Rust Reformer'. This acts as a primer over which top coating finish paint can be applied.

Maintaining original finishes is one of the most difficult and labor intensive (expensive to hire out) maintenance tasks for cemetery iron work, particularly in our local climate. Assemblies become soiled with biological matter and dirt quickly. This retains moisture that then promotes the corrosion. Particular problem areas include the joints, connections, and portions with ornamental iron detail, where material accumulates and paint preparation is most difficult. Caulking is an expedient means to assist in the prevention of water entry into an assembly. Only high grade, paintable sealants should be used. While silicone caulk is long lasting, it cannot be painted. The current most available appropriate caulk is polyurethane based. These are available in several brands, and in stock colors that can be chosen to best match the material. The caulking should be painted after curing.

Substitute Materials: Various alternative materials could be used not only for the repair of damaged iron fences, but also as replacement for original elements and ornament. The suitability and long term viability of those needs to be considered when electing their use. Sometimes an overriding economic consideration is the availability of a local fabricator. A few of the important considerations are here noted. When creating new castings, the largest cost is often the effort to create the molds of the original pieces. If there are numerous pieces needed, that cost diminishes as a percentage of the whole cost. The cost of the actual material used in casting is usually not a large factor. Castings made using aluminum are more difficult to paint and keep painted. Potential galvanic reaction between cast iron and aluminum can be minimized by coating the contact surface of one or the other. Aluminum can replicate detail well, but as cast, it has a lower strength and therefore thin or detailed portions may break off. Synthetic materials, such as resins and fiber glass, have the benefit of low maintenance, minimal moisture absorption, and good paint adhesion, but they may need to be assembled differently than the original cast or wrought iron. Glass reinforced concrete (GFRP) is another potential material. It may be useful for certain castings, and has relatively low maintenance, but it has less ability to replicate fine detail, and since it absorbs moisture, it should be separated from direct contact with the iron.

PRODUCT SUPPLIERS & RESOURCES

The foundries and iron companies contacted as listed below have worked on previous rehabilitation projects and are knowledgeable in the work required. They typically do not have stock items for purchase, except for overruns from prior projects. Rather, they are able to make new parts after creating a pattern and casting mold. A few of the companies as noted below do have some stock available. This is by far the most expeditious and economical solution.

Lawler Machine & Foundry Company, Birmingham, Alabama; 800-624-9512, 205-595-0596; Sales: Melissa@lawlerfoundry.com; The company has various ornamental cast iron in stock, does not cast new custom parts; order pieces through a distributor such as: TS Distributing in Chicago, 800-535-9842; www.tsdistributors.com; Orleans Ornamental Iron Castings in New Orleans, 800-824-3608;

Stewart Iron Works, Earleer, Kentucky, 800-414-0753, 859-431-1985; Contact Sheri Bomkamp, Architect, sbomkamp@stewartironworks.com; The old company used to supply many other distributors around the nation and allowed them to market and use their name on their products; they have some stock and can cast new pieces. Nothing was readily available for our needs.

Robinson Iron, Alexander City, Alabama, 800-824-2157, 256-329-8486; Contact Scotty Howell, scotty@robinsoniron.com; They do not stock many pieces but can cast new parts.

Historical Arts and Castings, Inc, West Jordan, Utah; 800-225-1414; 801-280-2400; www.historicalarts.com; Contact: David Teague dt@historicalarts.com; restoration and reproduction of cast architectural metal ornamentation [directed toward buildings, some sitework.

James O'Neil, OK Foundry, Richmond, Virginia; 804-239-1133; Can cast new iron parts, a reference from Lawler Foundry.

Wiemann Metalcraft (Heritage Iron), Tulsa, Oklahoma; 918-592-1700; Sales: Teresa; sales@wmcraft.com; They do not have stock, but can make or facilitate fabrication.

Architectural Iron Company, Milford, Pennsylvania, 800-442-4766; www.architecturaliron.com.

King Architectural Metals, Los Angeles, Dallas, Baltimore, 800-542-2379; www.kingmetals.com. They stock or import many items, cast, forged and in a variety of base materials.

W.F. Norman Corporation, Nevada, Missouri; 800-641-4038; The 1892 est. company stocks and fabricates sheet metal ornaments and roofing in a variety of base materials including copper and zinc.