SPECIFICATIONS
COVERING
WATER SUPPLY
AND
WATER TREATMENT PLANT
FOR
TARAWA TERRACE
CAMP LEJUENE NORTH CAROLINA

PEIRSON & WHITMAN
CONSULTING ENGINEERS
RALEIGH, N. C.

TT Raw Transmitter

Builders Chronoflo.
Telemetric Transmitter
serial 4376 stock 1963
Mod C7U4X Volts 110 cycles 60

Tube install no. 26364 size 12" x 4.78'

test pipe signal 20.3 sec at 8.7 in. of H_2O receiving reading 3.8

interval 60 sec mercury 14lb. 1oz.

full scale period 53.33 sec compress or diff change 60.02"

may sig 53.33 sec compress or diff 60.02"

Approved By
NORTH CAROLINA
STATE BOARD OF HEALTH
Date 5-12-52
Serial No. 1901

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AND

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FOR

TARAWA TERRACE

CAMP LEJUENE NORTH CAROLINA

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C. D. SPANGLER CONSTRUCTION CO.

CHARLOTTE, N. C.

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PEIRSON & WHITMAN

CONSULTING ENGINEERS

RALEIGH, N. C.

1952

S P E C I F I C A T I O N S

WATER FACILITIES AND SEWAGE TREATMENT PLANT.

1. SCOPE OF WORK: The work to be performed hereunder includes the construction, installation and/or installation of (a) the required Water Facilities and (b) the Sewage Treatment Plant, all as shown on the plans and/or as specified herein.

2. PLANS: The plans showing and/or indicating the required features of the Water Facilities consist of the following:

Sheet No. W-1 - General Plan - Water Supply.
" " W-2 - Water Treatment Plant.
" " W-3 - Construction Details.
" " W-4 - 750,000 Gallon Reservoir.
" " W-5 - 250,000 Gallon Elevated Tank.

The plans covering the requirements of the Sewage Treatment Plant are as follows:

Sheet No. S-1 - General Plan - Sewage Treatment.
" " S-2 - Plant Layout.
" " S-3 - Operating Building.
" " S-4 - Sludge Digester.
" " S-5 - Primary Settling Basin.
" " S-6 - Trickling Filter.
" " S-7 - Chlorinating House
" " S-8 - Secondary Settling Basins.
" " S-9 - Miscellaneous Structures.

3. SPECIFICATIONS: The specifications describe the general features of the plants; the materials and construction methods and procedures to be used in construction; and the type, capacity and characteristics of the various items of equipment to be installed.

4. GENERAL REQUIREMENTS: The Contractor will be required to furnish all labor, materials, tools, equipment and all else required for and to construct, erect and/or install the Water Facilities and Sewage Treatment Plant in accordance with the plans and these specifications. Any minor details which may have been inadvertently omitted from either the plans or specifications, but which are generally known to be required and are usually furnished to complete the construction or installation, shall be furnished, constructed, erected and/or installed in a manner consistent with the true intent and meaning of the plans and specifications.

All materials, equipment, apparatus, supplies, etc., used in the project; the methods of manufacture and/or construction and the methods of handling, placing, installing and/or erecting same shall conform to the following specifications.

Special materials, special methods of manufacturing and/or construction and special methods of handling, placing, installing and/or erecting such special materials shall conform to the requirements stipulated herein.

In general, the following specifications covering materials and methods of construction apply to all items required for both the Water Facilities and the Sewage Treatment Plant. Where special materials or equipment are required, or where special methods of construction, erection and/or installation are required, specific note will be made of the location where such material, equipment or method is required.

5. SITE PREPARATION: Before starting the construction work, the site of the proposed Water Facilities and Sewage Treatment Plant shall be cleared of any existing structures, trees, undergrowth, debris, etc., which may in manner conflict with the progress of the work, or interfere in obtaining the required quality of the finished structure.

Where preliminary grading is required, the material obtained from such grading shall be removed to distance as will insure against interference with construction procedure and damage to the work being done.

All top-soil shall be removed and stock-piled separate from other excavated material so as to be readily available for use in the establishment of final grade.

6. EXCAVATION: All excavations for building foundations, equipment foundations and pipe trenches shall be made to the established lines and grades.

The widths of excavations for building and equipment foundations shall be sufficient to erect and brace the formwork in the proper manner. The width of trenches for sewer and water lines, and the depth of "bell holes" shall be sufficient to lay the pipe properly to the established line and graded and to properly joint the pipe in the specified manner.

The bottoms of excavated areas for building and equipment foundations shall be level, smooth and firm. All loose material must be removed before any concrete is placed. The bottoms of pipe trenches shall be rounded, to the curvature of the pipe, to provide a firm bearing the full length of the pipe barrel.

The finished subgrade for earth bearing slabs shall be obtained by fine grading to the established elevation. Where such slabs are sloped to drains, the subgrade shall be parallel to the required slope of the finished slab.

Excavated material shall be deposited at a sufficient distance from trenches or other areas to prevent backspilling into the trench or area, and to prevent cave-ins of trench or area walls due to the added superimposed load.

Where excavations are made in unstable soil, the side of such excavated area shall be properly shored and braced.

All finished subgrades should present surface of undisturbed earth. Any excavations carried below the established grade shall be brought back to the required elevation by depositing approved, selected material, in such low areas, and tamping and compacting the material to the required solidity. If the required solidity cannot be obtained in this manner, the low area shall be refilled with the lean concrete consisting of one (1) part Portland cement, four (4) parts sand and eight (8) parts stone.

Any soft or unstable material encountered at finished grade level shall be removed to a depth of not less than twelve (12) inches below the established grade and shall be replaced with approved, selected material which shall be tamped and compacted to a firm, stable condition. Where proper bearing conditions cannot be obtained in this manner, the void shall be filled with the lean concrete specified in the paragraph above.

All excavated material not required for backfilling and grading purposes shall be deposited at such point, or points, on the premises as the local authority may direct. This deposited material shall be levelled and smoothed off to such extent as not to appear unsightly.

7. BACKFILLING: Material for all backfilling shall be selected earth free of trash, mortar, brickbats, wood scrap or other debris.

Backfilling materials around footings, walls, equipment foundations, etc., shall be deposited in layers not exceeding twelve (12) inches in thickness and each layer shall be tamped and compacted to a firm, solid mass. Backfilling shall proceed in this manner to an elevation three (3) inches below the finished grade. The final three (3) inches shall be of top soil.

In backfilling pipe trenches, the material shall be deposited in layers not exceeding six (6) inches in thickness and each layer firmly tamped and compacted until the backfill has attained a height not less than two (2) feet above the top of the pipe. The remainder of the fill shall be deposited in layers not exceeding twelve (12) inches thick and each layer shall be thoroughly tamped and compacted. The final layer shall be mounded to a height of six (6) inches above the finished grade elevation and allowed to stand until the backfill has attained final settlement. After final settlement has then taken place, the material shall be levelled to the required elevation.

8. CONCRETE MATERIALS: All concrete used in the construction of the Water Facilities and the Sewage Treatment Plant shall be composed of the following materials:

(8-a) Cement. - All cement used in the construction of any item included in this project shall be Portland cement, Type 1, conforming to the requirements of A.S.T.M. Specification C-150-latest revision. (Where approval is given for the use of high early strength cement, such cement shall be Portland cement conforming to the requirements of Federal Specification SS-C-20.)

All cement shall be newly manufactured and of highest quality. It shall be well housed and kept dry. Cement injured by age or exposure shall not be used.

The cement shall be sampled and tested in the manner prescribed by the A.S.T.M. and the manufacturer shall furnish a certified copy of the test certificate showing the results of the test covering each shipment, as conducted by a reputable commercial testing laboratory.

The cement shall be shipped in either cloth or paper sacks. Each sack shall contain ninety-four (94) pounds, net, of cement. The use of cement shipped loose, or in open bulk, will not be permitted unless specific approval is given by the local authority.

(8-b) Fine Aggregate for Concrete. - The fine aggregate for concrete shall be sand which shall consist of the fine, granular material resulting from the natural disintegration of rock. It shall consist of clean, hard, sharp, durable particles free from vegetable or other deleterious materials or substances and excessive quantities of loam and clay.

The organic content of the sand shall be of such minimum that, when the sand is subjected to the A.S.T.M. Standard Test for such impurities, the color of the liquid, above the sand being tested, shall compare with the color of the standard color solution. In no case shall the loam and clay content exceed five (5) per cent, none of which shall be in lumps.

When the sand is mixed with Portland cement in the proportion of one (1) part cement to three (3) parts sand, by weight, according to the standard method for making briquets, the resulting mortar shall have a tensile strength, at the end of seven (7) and twenty-eight (28) days, at least equal that developed in the same time by mortar, of the same proportions and consistency, made from the same cement and Ottawa sand.

The grading of the sand shall conform to that given in Table 1, "Grading of Fine and Coarse Aggregate for Concrete".

If so required, the Contractor shall have a sample of the sand tested by an approved commercial testing laboratory.

(8-c) Coarse Aggregate for Concrete. - The coarse aggregate for all concrete shall be clean, hard, durable and uncoated crushed stone. The stone shall be free from vegetable and other deleterious matter, and free from soft, thin, flat, elongated, honeycombed or laminated particles. All coarse aggregate for concrete shall conform to A.S.T.M. Specification C-33, latest revision.

If so required, the Contractor shall have a sample of the stone tested by an approved commercial testing laboratory.

Unless otherwise specified or approved, the coarse aggregate shall be sized and graded in the following manner:

For reinforced concrete work, the maximum size shall not exceed one-fifth (1/5) of the minimum clear distance between forms or the minimum thickness of slabs; nor shall its maximum size be greater than three-quarters (3/4) of the clear distance between reinforcement and the face of the form; nor more than three-quarters (3/4) of the clear distance between reinforcing bars.

For unreinforced concrete work, the maximum size of the aggregate shall not exceed one-fifth (1/5) of the minimum distance between forms or minimum thickness of members; nor shall its nominal size exceed two (2) inches for any type of concrete work in this project, except for mass concrete for which special mixes using larger aggregate may be used when approved.

The gradation of the stone for the various nominal sizes shall be in accordance with that shown in Table 1. "Grading of Fine and Coarse Aggregate for Concrete".

(8-d) Water for Concrete. - All water used in concrete shall be fresh, clean, reasonably clear and free from alkali, oil, or other injurious. The water, preferably, shall be potable.

9. CONCRETE REINFORCEMENT: Unless otherwise indicated on the plans, all reinforcement for concrete shall be open hearth, billet steel bars, of intermediate grade, having a tensile strength of not less than seventy thousand (70,000) pounds per square inch; a yield point of not less than forty thousand (40,000) pounds

TABLE - 1 - GRADING OF FINE AND COARSE AGGREGATE FOR CONCRETE

Nominal Sizes	Percentage by Weight Passing Laboratory Sieves Having Square Openings											
	2½"	2"	1½"	1"	3/4"	1/2"	3/8"	No.4	No. 16	No. 30	No. 50	No. 100
Fine Aggregate							100	95-100	45-95	25-75	8-50	0.5-10
½"					100	90-100	40-75	0-15				
3/4"				100	90-100		20-55	0-10				
1"			100	90-100		25-60		0-10				
1½"		100	95-100		35-70		10-30	0-5				
2"	100	95-100		35-70		10-30		0-5				

per square inch; and the percentage of elongation, in eight (8) inches, shall be not less than fourteen (14). For bars under three-quarters (3/4) inch in diameter, the bending test shall be that the bar shall be bent cold one hundred eighty (180) degrees, around a pin having a diameter three (3) times the diameter of the bar under test, without evidence of fracture. For bars three-quarters (3/4) inch and larger in diameter, the bend test requirements shall be that the bar shall be bent cold ninety (90) degrees, around a pin having a diameter three (3) times the diameter of the bar under test, without evidence of fracture.

All bars shall conform, in every respect, to A.S.T.M. Specification A-15- latest revision, for billet steel reinforcement, intermediate grade.

Deformed bars must be used. Bars deformed by cold twisting, or bars from re-rolled stock, shall not be used.

Bars for slabs, beams and girders shall be of sufficient length to extend the full span of the member being reinforced, and splices for such members shall occur only over supports and such splices shall lap not less than forty (40) diameters, nor less than that indicated on the plans.

Horizontal bars in walls shall project to within two (2) inches of the outside face of adjacent or intersecting walls and shall then project along the outer face of such walls for the length indicated on the plans.

Temperature bars may be spliced at any location, provided the splice length be not less than forty (40) diameters.

Reinforcement shall be carefully formed to the dimensions indicated on the plans. Cold bends shall be made around a pin having a diameter of six (6) or more times the least dimensions of the reinforcement bars. Metal reinforcement shall not be bent or straightened in such a manner as to injure the material. Bars with kinks or bends not shown on the plans shall not be used.

Before placing, all bars shall be cleaned of mill and rust scale and other coatings that will destroy or reduce the bond. Whenever there is a delay in depositing concrete, after the steel has been placed in the form, the reinforcement shall be reinspected and, if required, cleaned again.

Metal reinforcement shall be accurately positioned and secured against displacement by using annealed wire of not less than No. Sixteen (16) gauge or suitable clips at intersections and shall be supported in a manner that will keep reinforcement the proper distance away from the exposed face of the wall. Nails shall not be driven into the forms to support the reinforcement. The clear distance between any bar and the face of the concrete shall be as shown on the plans but in no case less than one and one-half ($1\frac{1}{2}$) inches where the surface is exposed to the weather. The minimum cover at wall surfaces not exposed to the weather or to water shall be one (1) inch.

10. FORMS FOR CONCRETE: All concrete forms shall conform to the lines, shape and dimensions of the various members as shown on the plans. They shall be substantially constructed, well braced, and designed to resist the pressures to which they will be subjected. All forms shall be sufficiently water-tight to prevent the leakage of mortar. They shall be properly placed and substantially tied together to maintain position and shape, to insure safety to workman, to insure against failure and the consequent damage to adjacent completed work.

Temporary openings shall be provided, where necessary, to facilitate cleaning and inspection immediately before depositing concrete.

All forms shall be assembled and/or erected in a manner as will facilitate their removal without damaging the surfaces, edges or corners of the concrete.

An approved type of form tie shall be used. Preferably, the ties shall be of the rod type, adjustable in length, and of such type as will leave metal not closer than one and one-half (1½) inches to the surface and shall not be fitted with lugs, cones, washers, or other devices, to act as separators, which will leave a hole larger than seven-eights (7/8) inch in diameter or a depression, back of the exposed surface of the concrete, of greater depth than seven-eights (7/8) inch. Wire ties shall not be used except by specific approval from the local authority.

Tie rod clamps shall not be removed until the concrete has hardened sufficiently to permit the rods to be withdrawn, broken off, or otherwise removed without damaging the concrete.

The contact surface of wood forms shall be thoroughly soaked with clean water, immediately before depositing concrete. Where forms have been erected a sufficient length of time to permit drying out and the opening of joints sufficiently to permit the leakage of grout, the forms shall be soaked with water until the opened joints have closed. If this remedy is not successful, the forms shall be dismantled and re-erected in the proper manner. A thin coat of approved form oil shall be applied to the contact surfaces.

It shall be optional with the Contractor as to the type of material used by forms. It may be wood plank, ply-wood, or steel. Regardless of the material used, the requirements for concrete finish, as stipulated under "Finishing Concrete", will apply.

All forms, except those supporting beams, girders, slabs and columns, shall be removed as soon as the concrete has thoroughly hardened, but in no case in less time than forty-eight (48) hours. Forms supporting beams, girders, slabs and columns shall not be removed until the concrete has attained sufficient strength to withstand the loads to be imposed.

Proper care shall be exercised in the removal of forms to prevent damage to the concrete.

Before any concrete is deposited, the forms shall be checked for alignment, dimensions and stability; reinforcement, conduit, utility inserts, etc., shall be checked for proper location and security of position; and all trash, wood scrap, saw-dust and other debris shall be removed.

11. CONCRETE; All concrete used in the construction of the various items included in this project shall be composed of Portland cement, sand and crushed stone conforming to the requirements for such materials as specified in Clause 8 - "Concrete Materials". The fine and coarse aggregates shall be proportioned by weight, upon suitable weighing devices. Portland cement in standard, unopened cloth or paper sacks, as packed by the cement manufacturer, may be considered as weighing ninety-four (94) pounds per sack. The nominal mixture shall be in the proportions stipulated for Class"D" concrete, in Table No. 2. "Approximate Proportions for Concrete". The mixture, together with the amount of water used, shall be subject to such adjustment as may be required to produce a concrete having an ultimate compressive strength, at the end of twenty-eight (28) days, of not less than three thousand (3,000) pounds per square inch.

TABLE 2 - APPROXIMATE PROPORTIONS FOR CONCRETE

Class Designation	Total water, gal. per bag	Average Min. Strength lb. per sq. in., 28 days	3/4-to 1-in. coarse aggregate: Cement, lb.	Fine aggregate, lb.	Coarse aggregate, lb.	Mixing water gal.	Cement factor bags per cu. yd.	1½ - to 2-in. coarse aggregate: Cement lb.	Fine aggregate lb.	Coarse aggregate, lb.	Mixing water gal.	Cement factor, bags per cu. yd.
A	5	4,250	94	147	233	3.8	8.0	94	158	273	3.7	7.4
B	5½	3,700	94	169	263	4.1	7.2	94	179	303	4.1	6.7
C	6	3,300	94	200	273	4.4	6.5	94	210	334	4.3	6.0
D	6½	3,000	94	221	314	4.6	6.0	94	242	364	4.6	5.5
E	7	2,750	94	253	334	5.0	5.6	94	253	394	5.0	5.1
F	7½	2,500	94	274	359	5.3	5.2	94	290	420	5.2	4.8
G	8	2,250	94	295	384	5.7	4.9	94	316	445	5.5	4.5

Where methods described under "Controlled Concrete" are not employed, the quantities of cement, aggregates and water given in Table 2 - "Approximate Proportions for Concrete" shall be used. The weights of fine and coarse aggregate have been calculated on the basis of damp weights. A saturated surface-dry specific gravity of 2.65 and average moisture conditions of 5 and 1 percent free surface moisture, respectively, for the fine and coarse aggregate were assumed. The proportions in Table 2 are based on a slump of four inches. The Engineers reserve the right to alter the weight of the fine and coarse aggregate and quantity of mixing water as may be required to produce concrete of desired quality and consistency.

All measurements of cement and fine and coarse aggregates shall be made separately. Measurements, by weight shall be based on actual, dry, loose weight per cubic foot of aggregate used. Proportioning aggregates for fractional sacks of cement will not be permitted unless the cement is weighed for each such batch. Weighing equipment shall be of a type which will permit making compensation for changes in the weight of moisture contained in the aggregates. The weighing equipment shall be accurate to within one (1) percent of the net load being weighed. Water shall be measured by a device capable of accurate measurement to within one (1) pint, plus or minus, of the total amount of water required per batch.

The proportioning of materials shall be based on requirements for a plastic and workable mix, with the use of not less than six (6) sacks of cement per cubic yard and not more than six and one-half (6½) gallons of water per sack of cement, including the surface water carried by the aggregates expressed in terms of the quantity of cement. The water in the aggregates must be in the quantity specified. Aggregate moisture content shall be determined at least once each day and at such other times as the appearance of the aggregate or the mixed concrete indicates a change in moisture content. The total water content of each batch, together with the graded proportions of aggregate, shall be such that the slump will not exceed four (4) inches when vibration equipment is used and, in no case, more than six (6) inches for concrete placed where it is impracticable to use vibration equipment.

Concrete, preferably, shall be mixed in a batch mixer and the mixing time shall be not less than one (1) minute after all materials have been placed in the mixer drum and as much longer as may be required to produce uniform distribution of the materials, uniformity of color, and a homogeneous mass.

Concrete from a central plant, or mixed in transit mixer trucks, may be used, provided it meets with the foregoing requirements. The concrete shall be transported in water-tight containers and, upon delivery, shall be uniform throughout the mass, with no evidence of segregation.

12 DEPOSITING CONCRETE: Before beginning a run of concrete, hardened concrete and foreign materials shall be moved from the inner surfaces of the mixing and conveying equipment. All conveyances, buggies, or barrows shall be thoroughly cleaned at frequent intervals during the placing of the concrete.

Concrete shall be handled from the mixer to the place of final deposit in carts, buggies or conveyors and shall not be spouted nor delivered by spout or trough from the hoists, nor dumped into carts or other conveyors from a height giving a free fall from the mixer of more than three (3) feet. Every possible precaution shall be taken to prevent separation or loss of the ingredients while transporting the concrete. Delivery carts or buggies shall be kept on temporary runways built over the floor system and runway supports shall not bear upon reinforcing steel or fresh concrete.

Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position, nor until the forms have been inspected and form ties at construction joints have been retightened, nor until all bucks, sleeves, hangers, pipes, conduits, bolts, wires and any other fixtures required to be embedded therein have been placed and anchored, nor until the forms and reinforcement have been cleaned.

Special care must be exercised to prevent accumulation of concrete on forms and reinforcement at points other than where the pour is being made and any such accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in such a way as to prevent all segregation. All concrete for walls, where the free fall exceeds four (4) feet, shall be placed through openings, in the form, spaced at frequent intervals, or through "elephant trunks" (heavy duck canvas or galvanized iron chutes) equipped with suitable hopper heads. Chutes shall be of variable lengths so that the free fall shall not exceed four (4) feet, and a sufficient number shall be placed in the forms to insure the concrete being kept level at all times. Sufficient illumination shall be provided in the interior of the forms so that the concrete, at places of deposit, is visible from the deck and runways. Concrete shall be spaded and rodded to thoroughly embed all reinforcement and fixtures. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb.

Concrete shall be placed with the aid of mechanical vibrating equipment and the vibrator shall be applied directly to the concrete unless otherwise approved by the Engineers. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures. To secure even and dense surfaces, free from aggregate pockets or honeycomb, vibration shall be supplemented by forking or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic under the vibratory action.

The placing of concrete shall be carried on continuously between construction and/or expansion joints shown on the drawings. If for any reason it shall become necessary to stop the placing of concrete at places other than those indicated on the drawings, such places and the manner of making the joint shall be approved by the local authority. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of the walls, a strip of 1" sheathing shall be tacked to the forms at the outside surface of the wall. The concrete shall be carried about one-half ($\frac{1}{2}$) inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the joint line shall be levelled off with a wood float and all laitance shall be removed. Wherever horizontal construction joints are made, ties or bolts shall be provided 3 to 6 inches below the joint with which to tighten the forms against the hardened concrete. Vertical stops shall be placed at interior corners only, unless otherwise shown on the drawings

Before depositing new concrete on or against concrete that has hardened, the forms shall be re-tightened, the surface of the hardened concrete shall be roughened as required, thoroughly cleaned of foreign matter and laitance, and moistened with water. The new concrete placed in contact with hardened or partially hardened concrete shall contain an excess of mortar to insure bond. To insure sufficient mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and mositened surface of the hardened concrete, including vertical and inclined surfaces, shall first be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its initial set. Concrete for the first six inches of the next layer shall consist of a mix having one-half the amount of coarse aggregate in the regular mix.

All exposed surfaces of concrete shall be protected from premature drying and freshly placed concrete shall be protected against wash by rain. All concrete shall be kept wet for a period of 5 days after placing, except that 2 days' curing shall be considered sufficient if high early strength Portland cement is used.

Concrete when deposited shall have a temperature not below 60 degrees F. In freezing weather, suitable means shall be provided for maintaining the concrete at a temperature not lower than 60 degrees F. for 3 days, or 50 degrees F. for 5 days after placing except when high early strength cement or concrete is used the temperature must be maintained at not less than 60 degrees F. for 2 days or 50 degrees F. for 3 days. The methods of heating the materials and protecting the concrete shall be approved by the local authority. Salt, chemicals, and other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing.

13. FINISHING CONCRETE: (13-a) Floors. - Immediately after the slab concrete has been placed and screeded to the required level, and before the initial set has taken place, it shall be topped with one (1) inch finishing course, consisting of one (1) part Portland cement and two (2) parts sand, which shall be trowelled to a smooth, hard, finish. This one (1) inch finishing course is included in total slab thickness dimension called for on the plans and, therefore, the finishing course must be placed and finished monolithic with the structural slab. Where floor drains are not installed, the finished floor surface shall be level and smooth, entirely free from low and high areas. The finished surface shall be protected until it is sufficiently hard to withstand traffic without marring.

(13-b) Walls, Etc. - Immediately after forms are removed, both interior and exterior exposed surfaces of walls, the underside of floor slabs and the exposed areas of beams shall be inspected for honeycombing and other imperfections and blemishes. All indications of form ties shall be removed. Honeycombed areas shall be cut out and all voids shall be solidly filled with 1:2 mix cement-sand mortar. Immediately after the patching mortar has hardened sufficiently to withstand working, all exposed ceilings and beams shall be rubbed with carborundum bricks until all areas of walls, evidences of form marks, patches and other surface blemishes are entirely removed. When completed, all the areas shall present a smooth, even textured appearance, with all corners straight and unbroken. Only clean water shall be used during the rubbing process. Surfaces finished by brush-coating with grout will not be accepted.

The tops of all basin walls shall be steel trowel finished to a smooth, hard surface. The edges shall be bevelled, or rounded, as called for on the plans.

(13-c) Equipment Foundations. - The exposed sides of all equipment foundations shall be finished in the same manner as specified, above, for "Walls, Etc.".

After equipment items have been set on their respective foundations and have been properly levelled and aligned by the equipment erector, the Contractor shall pour the grout indicated on the drawings. After the grout has set sufficiently, the edges shall be neatly bevelled and the exposed surfaces shall be trowelled to a smooth, hard finish.

Note. - It is the intention of these specifications to procure finished surfaces entirely free from all blemishes and imperfections. If, after removal of the forms, the concrete is found to be too hard to permit finishing by hand rubbing with carborundum brick, the Contractor will be required to use mechanical means for producing the required finish.

14. BRICKWORK: (14-a) Sand for Mortar. - Sand used as aggregate in mortar for brick and other masonry work shall consist, of the fine material resulting from the natural disintegration of rock. It shall consist of clean, hard, sharp, durable particles free from vegetable or other deleterious materials and substances and excessive quantities of loam and clay.

The sand particles shall be of such size that one hundred (100) percent will pass an eight (8) mesh screen and not more than twenty-five (25) percent will pass a fifty (50) mesh screen. The sand shall be uniformly graded from coarse to fine.

The organic content and seven (7) and twenty-eight (28) day strength tests shall be the same as specified in Clause 8-b - "Fine Aggregate for Concrete".

(14-b) Cement. - The cement used in mortar for brick or other masonry work, shall be Portland cement conforming to that specified under Clause 8 - (8-a) - "Concrete Materials".

(14-c) Mortar. - Unless otherwise approved by the local authority, all mortar used in brick and other masonry of one (1) part Portland cement and three (3) parts sand. Only a sufficient quantity of water to give proper density and workability shall be used.

When specifically approved by the local authority, other than for the construction of manholes and other underground items, the Contractor may use a prepared mortar such as "Brixment", "Wifco" or "Dewey". The prepared mortar shall contain an water-proofing ingredient; it shall require no soaking or slaking; it shall contain no ingredient which may cause efflorescence on wall surfaces, or the fading of mortar color; it shall contain less than one-half (½) of one (1) percent of soluble salts; when mixed with the same sand, it shall have the same strength as the sand-cement mortar specified above; and it shall require no other preparation for use than the mixing with sand and water in accordance with the manufacturer's directions.

(14-d) Brick. - All brick used in this project shall be sound, hard, tough, common brick of a quality conforming to A.S.T.M. Specification C-62 - latest revision, for Building Brick. The brick shall be made from clay or shale, and shall be dark red in color.

Overburned, brittle brick, or brick from the benches of kilns shall not be used. Salmon, soft or underburned brick will not be accepted.

The brick shall be of standard size; two and one-quarter (2¼) inches thick, three and three-quarters (3 3/4) inches wide and eight (8) inches long. Measurement tolerance shall not exceed one-sixteenth inch in thickness, one-eighth (1/8) inch in width and one-quarter (¼) inch in length.

Brick used in the exposed faces of walls, where faces are not to be plastered, painted, or otherwise treated, shall be selected for uniformity of size, color and texture. Such brick shall have sharp, unbroken edges and shall be free from cracks, blisters and other blemishes on the exposed face.

Before placing his order, the Contractor shall submit, for local authority approval, samples, of the brick he proposes to use in the work. The samples shall be representative of the brick that can be furnished and the Contractor will be required to furnish brick conforming to the approved sample.

(14-e) Brick Laying. - All brick shall be wet before laying and shall be laid in full mortar beds, with header joints completely filled. The brick shall be laid in stretcher and bond courses, with every sixth (6th) course a bond course. All brick courses shall be level, straight and true to the lines indicated on the drawings. Bed and header joints shall be one-half (½) inch thick.

Brick for window trim, soldier and row-lock courses, lintels, arches and other ornamental brickwork shall be laid to conform with the details shown on the plans.

Full brick shall be used throughout the work, except where cut brick are required for closures. Bats shall not be laid in the walls.

All interior mortar joints shall be pointed up flush, in a suitable manner for painting. Exterior joints shall be pointed up with a rounded tool to give a concave joint.

15. CAST STONE: The Contractor for this project is required to furnish and install all cast stone trim indicated on the plans, including wall coping, window sills, etc.

All materials used in the manufacture of cast stone shall conform to those specified under Clause 8 - "Concrete Materials", and the finished product shall conform to those requirements of Federal Specification SS-721. The necessary steel reinforcement shall be provided to insure against breakage in handling, to support loads, and to resist stresses.

The finished material shall have an ultimate compressive strength of not less than five thousand (5,000) pounds per square inch, and the absorption shall not exceed seven (7) percent.

Cast stone damaged in shipment or during the handling and laying process shall be removed from the project and replaced with first class material. Except where minor patchwork is approved by the local authority, damaged, imperfect or off-size material will not be accepted.

All cast stone shall be laid in mortar conforming to that specified in Clause 14-c - "Mortar".

All cast stone pieces shall be cleaned and drenched with clean water just prior to setting. The pieces shall be set level, plumb, square and true, with uniform joints, in full mortar beds, and vertical joints shall be flushed full. The thickness of bed joints shall conform to existing joints. Vertical joints shall be of uniform thickness, not less than one-quarter ($\frac{1}{4}$) inch nor more than three-sixteenths (3/16) inch wide.

After being set, all cast stone shall be fully protected to prevent damage to corners and edges, from mortar droppings and staining. Any stone damaged after being set shall be removed and replaced by undamaged and/or unstained material.

16. STRUCTURAL STEEL: All structural steel, and miscellaneous iron work composed of structural shapes and plates, shall conform to A.S.T.M. Specification A-9 - latest revision, for "Structural Steel for Buildings". Fabrication, including connections, and erection shall be in accordance with the requirements of the American Institute of Steel Construction. Shop connections shall be riveted. Field connections may be riveted or bolted.

All columns shall be erected true and plumb. Standard wall bearing plates shall be provided at the wall bearing ends of beams, and the tops of beams shall be at the elevation indicated.

With the exception of those areas to be imbedded in concrete, all structural steel shall receive a shop coat of red lead or other approved metal protective paint. All steel areas to be exposed, after completion of the project, shall be given two (2) coats of approved quality, metal protective paint of a color to be selected by the local authority.

17. STEEL SASH: All steel sash installed in this project shall be of the commercial projected type similar and equal to those manufactured by Detroit Steel Products Co. or Truscon Steel Co.

Sash members shall be of hot-rolled, copper-bearing steel, and shall be especially shaped for steel sash construction. Jamb, head and sill members shall be flanged or finned for anchorage in the building walls, lintels and sills. The frame members at vents sills shall be provided with weep-holes to provide for drainage.

Vents shall project outward at the bottom and shall be provided with a solid, steel balance arm at each jamb. One end of the arm shall be pivoted to the vent jamb member and the other end to an integral bracket on the jamb weathering member. The vent position shall be held by means of friction shoes, sliding in the frame weathering channels, equipped with rustproofed compression springs and removable brass housings.

The sash shall be provided with weathering members spot welded to the sash members. Weathering members at sill ends shall be turned and mitered to form a watertight closure.

All vents shall be equipped with a cam type locking handle and pull pieces. Vents beyond normal reach, above the floor level, shall be provided with pull chains and spring catches.

The sash shall be installed solidly in the brick walls and sills, with the joints between masonry and steel completely filled with mortar on both sides. The sash shall be adequately anchored at sills and jambs and the head fin shall fit snugly between members of the lintels.

The sash shall be erected perfectly plumb and true and shall be entirely free from lateral distortion. Ventilator sections shall operate freely in all positions.

All sash and sash hardware shall be galvanized by the hot-dip process.

18. DOORS AND FRAMES: All doors shall be of the size and type called for on the plans and shall be constructed of white pine or fir. Stiles and rails shall be of one and three-quarter (13/4) inch stock. Lower panels shall be of the raised, bevel type and the upper panels shall be subdivided, for glazing, as shown. Double doors shall be provided with T-astragals.

Door frames shall be constructed from one and three-quarter (1 3/4) inch by five and one-half ($5\frac{1}{2}$) inch stock and shall be of treated, "Panderosa" pine. The frames shall be rabbetted for both main and screen doors.

All door frames shall be securely anchored to the brickwork, at each jamb, with mt less than three (3) metal anchors.

Trim for frames shall conform to that shown on the plans.

All doors, frames and trim shall be given one (1) prime coat and two (2) finsihing coats of high grade oil paint, color to be selected by the local authority.

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Trim for frames shall conform to that shown on the plans.

All doors, frames and trim shall be given one (1) prime coat and two (2) finsihing coats of high grade oil paint, color to be selected by the local authority.

19. DOOR HARDWARE: All doors shall be equipped with hinges, lock-sets, stay-bolts, etc., of the same type, make and style as specified for the Water Treatment Plant Building.

20. ROOF FRAMING AND SHEATHING: All lumber used for roof framing and sheathing shall be No. 1 common Southern Yellow Pine and shall be finished four (4) sides.

Rafters shall be of the sizes shown and shall be spaced as indicated on the plans. Cross-bracing shall be provided at the mid-span point.

All sheathing for roof and crickets shall be of tongue and grooved material and of the thickness shown. The sheathing shall be nailed to the rafters with not less than two (2) 8d. nails at each rafter.

The under side of all roof sheathing, all exposed areas of rafters and cross-bracing shall be given one (1) prime coat and two (2) finishing coats of high grade oil paint of the color selected by the local authority.

21. ROOFING: All roof areas shall be covered with built up roofing, of the tar-and-gravel type. Barrett Type "AA", equal to that guaranteed and bonded for twenty (20) years. The roofing material shall be applied in strict accordance with the manufacturer's specifications.

22. FLASHING: The intersections of all roof decks with parapet walls and roof openings shall be flashed, as shown on the drawings and/or as specified herein, with sixteen (16) ounce copper. The flashing shall be built into the parapet walls, as the brick is laid. Except where there is insufficient depth from the under side of the wall coping to the top of the roof deck, the flashing shall be not less than ten (10) inches deep. The imbedded section of the flashing shall extend not less than four (4) inches into the wall and shall then extend upward not less than two (2) inches. All bends shall be, preferably, machine made and shall be true, right-angle bends. The lower, exposed edge shall be doubled back one-half ($\frac{1}{2}$) inch to provide stiffness.

End joints of copper sheets shall be lapped not less than two (2) inches and shall be full soldered. All solder shall be half and half virgin lead and tin.

23. ROOF DRAINAGE: The scuppers, in the parapet walls of the Operating Building and Chlorinating House of the Sewage Treatment Plant shall be formed of sixteen (16) ounce copper. The scuppers shall be flared and flanged, on the roof side of the wall, to insure a perfect wall seal at the wall opening and for connection to and with the wall flashing and roof covering. The connection between the scupper and flashing shall be soldered in the manner specified for the flashing.

The scuppers shall project through the walls and shall extend a sufficient length into the conductor heads to insure against leakage at this connection.

Conductor heads and downspouts shall be of the form shown on the plans, and shall be of galvanized, copper-bearing steel, of not less than No. 22 gauge. The downspouts shall be not less than three (3) inches by four (4) inches in size and shall drain to the points shown on the plans. The conductor heads shall be of the size and general form indicated on the plans, and of a stock pattern meeting the approval of the local authority.

Downspouts and conductor heads shall be given two (2) coats of high quality, metal protective paint of a color approved by the local authority.

All other gate valves, three (3) inches and larger in size, shall be iron-body, bronze mounted, double disc, flanged end, O.S.& Y. gate valves, designed and constructed for not less than one hundred twenty-five (125) working pressure. These valves shall be equipped with operating hand wheels. Valve flanges shall be faced and drilled 125-pound standard. Gate valves two and one-half ($2\frac{1}{2}$) inches and smaller in size shall have bronze bodies, screw ends, designed for one hundred twenty-five (125) pounds working pressure, and shall be equipped with, operating hand-wheels.

All valves to be used for throttling purposes shall be globe type valves and shall be designed for one-hundred twenty-five (125) pounds working pressure. All globe valves shall be fully bronze mounted and equipped with operating hand-wheels. They shall have iron or bronze bodies and shall have either flange or screw ends, depending on size, in conformity with the sizes designated for gate valves.

Check valves shall be of the swing check type designed for one-hundred twenty-five (125) pounds working pressure fully bronze mounted, with iron or bronze bodies and end connections in conformity with the sizes designated for gate valves. The check leaf shall be of the balanced, non-slam type. All check valves shall be designed and constructed to operate in either a horizontal or vertical position.

(24-g) Pipe Jointing Material. - Jointing material for cast iron, bell and spigot pipe shall consist of lead and, at the Contractor's option, either hemp or jute. Hemp, if used, shall be of the braid type and of a quality permitting tight caulking. Jute, if used, shall consist of tightly twisted, tarred strands. The jute, or hemp, shall meet the standard requirements of the A.W.W.A. Lead shall conform to the requirements of Federal Specification QQ-L-156.

Gaskets for flanged connections shall be abestos, metallic-cloth, Grade 11, conforming to Federal Specification HH-G-76.

All screw connections shall be made up by coating the male thread with high grade, pipe jointing compound. The compound shall be of the lubricating, non-corrosive type.

(24-h) Hydrants. - Hydrants shall be installed, at the Sewage Treatment Plant, at the locations indicated on the plans. For the sake of uniformity and the convenience of interchangeability of parts, these hydrants shall be of the same size, type and make as those now installed in Tarawa Terrace, Project No. 1.

(24-i) Laying Underground Water Pipe. - All pipe for underground water lines shall be laid to a straight line or the curvature, indicated on the plans, and to a sufficient depth to give not less than thirty (30) inches cover over the top of the pipe. Abrupt changes in the line shall be made with the special fittings indicated. Tees, plugs, hydrants and other dead ends shall be securely anchored with concrete backing against solid earth.

Each length of pipe and each special casting, valve or other line insert shall be carefully inspected to see that it is clean, sound and free from defects, and that each valve, hydrant or other operating equipment is in perfect operating condition and properly lubricated. Valve and hydrants shall be tightly closed before being installed in the line.

Where it is necessary to cut cast iron pipe for closure pieces, the cutting shall be neatly done and extreme care shall be taken not to injure either the pipe or its cement lining.

After excavating and preparing the trench, in the manner specified in Clause 6 - "Excavation", the pipe shall be carefully lowered into the trench with hand ropes or mechanical means. Before connecting a new length of pipe with the pipe previously laid, both bell and spigot, forming the connection shall be thoroughly cleaned and dried. In making the connection, the spigot shall be suspended on a full length strand of hemp, or jute, which shall be carried into the joint when the spigot is forced home in the bell. The hemp, or jute, shall be of sufficient thickness to support and hold the spigot in a central position in the bell.

After the spigot has entered the full depth of the bell, the hemp, or jute, shall be tightly caulked around the entire periphery of the joint. Only sufficient hemp, or jute, shall be used to insure holding the spigot in its proper position in the bell and to prevent leakage of the hot lead into the barrel of the pipe.

After the hemp, or jute, has been properly caulked, the remainder of the annular space between the bell and spigot shall be entirely filled with hot lead; the lead being retained at the outer face of the bell by the use of a standard, pipe jointing "snake". The entire joint shall be completely filled in one (1) pouring. After the lead has cooled sufficiently to permit removal of the "snake", the lead shall be tightly caulked into the bell. The caulking process shall be performed with three (3) sizes of caulking tools, beginning with the smallest. The final caulking shall be done with a tool slightly smaller than the width of the joint and the finished surface of the lead shall be even with the face of the bell. The finished joint shall show a surface of uniform width around the periphery of the pipe, and the depth of the lead in the finished joint shall be not less than two and one-half ($2\frac{1}{2}$) inches.

As the installation of the line progresses, sufficient backfill shall be placed to hold the pipe in position, but leaving the joints exposed until the line has been tested. Each section of line, between valves or such other lengths as the local authority may designate shall be tested to a pressure of not less than one hundred (100) pounds per square inch, and this pressure shall be maintained for a period of not less than twnety-four (24) hours. All evidence of leakage, at any joint, shall be corrected by recaulking or, if so directed by the local authority, by remaking the entire joint.

The Contractor will be required to furnish proper testing equipment for producing and maintaining the required test pressure, and, where so required by the local authority, test plugs for locations where valves are not provided.

After each section of tested line has been approved, the backfilling of the trench shall proceed in the manner specified in Clause 7 - "Backfilling".

(24-j) Installation of Plant Water Pipe. - Plant piping consists of all pipe, fittings, valves, etc., within buildings, for connections to equipment and services, and all other water lines not classified as underground lines.

All plant piping, valves, fittings, etc., shall be installed in the locations and in the manner shown on the plans and/or as specified herein.

All lines shall be properly supported by means of hangers, stanchions or other approved supports. Special care shall be taken at equipment connections to prevent undue stresses being transmitted to the equipment.

All pipe shall be cut tp proper length and flanged or coupled at the points designated on the plans.

Steel pipe shall be threaded in an approved manner and the dies shall be unworn and in good condition. After threading, the ends of the pipe shall be reamed to remove all burrs and the finished ends shall be perpendicular with the barrel of the pipe.

Flanges and other couplings shall be made up tight. The bolt holes of the flanges on each end of the pipe shall be in the same relative position, to match equipment or other fixture connections. When ready for installation, the end of the flanged pipe shall show a slight recess back of the flange face.

After insertion of the gasket, the flange bolts shall be drawn up evenly so as to produce an even pressure over the entire surface of the gasket. The finished joint, when tested, shall be absolutely tight, with no evidence of leakage.

The threading of pipe, for screw connections, shall be done in the same manner as specified for flanged pipe. The length of the thread shall be just sufficient to make up to the full depth of the coupling or other piece to which the pipe is connected. Any exposed thread, after the connection is made, shall be given a heavy coat of metal protective compound or paint.

Small piping, with threaded joints shall be provided with a sufficient number of ground-joint unions to facilitate dismantling without disturbing any equipment, and to properly sectionalize the line to permit extensions and/or alterations.

25. CAST IRON SEWER LINES: All cast iron pipe used in the construction of the sewage force mains and the Sewage Treatment Plant lines shall be Class 100, bell and spigot pipe conforming to the requirements of Federal Specification WW-P-421. All fittings shall be A.W.W.A. Class D. Valves to be laid underground shall be of the same type and classification as specified for Water Mains.

All cast iron pipe, fittings, valves, etc., required for sewer lines shall be laid in the manner specified for Water Mains. These lines shall be laid, accurately, to the lines and grades established by the plans and/or directed by the local authority. Jointing materials shall be as specified for Water Mains. Where the gradient of any line is not established on the plans, the pipe shall be laid on a uniform grade established by the invert elevations of the connected manholes.

26. VITRIFIED CLAY SEWER AND DRAIN LINES: All sewer and drain lines constructed of vitrified clay pipe shall conform to the following specifications:

26-a) Pipe and Specials - All clay sewer and drain pipe and specials used in this project shall be salt glazed, vitrified clay, bell and spigot type manufactured in accordance with the requirements of A.S.T.M. Specification C-13, latest revision. The pipe and specials shall be of best quality, hard and thoroughly burned. Interior surfaces shall be smooth and both inside and outside surfaces shall be salt glazed. The walls shall be of uniform thickness and the hubs shall be properly shaped to receive the spigot of the adjoining pipe and the jointing material.

(26-b) Joint Material - The joint material for vitrified clay pipe and specials shall consist of hemp, or oakum, and hot bituminous compound. The bituminous material shall be "GK", "Jointite", or approved equal.

(26-c) Laying Pipe.- All pipe and specials shall be laid to established lines and grades. Each length of pipe and each special shall be carefully inspected before laying in the trench. Each piece shall be clean, sound and free from defects.

Spigot ends shall be carefully centered in the hubs and the annular space shall be maintained by means of a tightly caulked gasket of twisted hemp or jute. The strand of hemp or jute shall be of sufficient length to extend entirely around the perimeter of the pipe. The gasket shall fill not more than one-fourth (1/4) the depth of the hub.

After the gasket has been properly placed, the remaining space shall be entirely filled with the jointing compound. The compound shall be heated and poured in the manner prescribed by the material manufacturer, and the finished joint shall be water tight.

Before any pipe is laid in the trench, the trench bottom shall be carefully shaped to give a firm support for the barrel of the pipe. The prepared trench bottom shall conform to the established grade.

Backfilling material shall be carefully placed and compacted around the barrel of the pipe. The filling material shall be placed and compacted in successive six (6) inch layers until the pipe is covered to a depth of two (2) feet. The balance of the backfilling material shall be placed and compacted in successive twelve (12) inch layers. Proper care shall be taken during the entire backfilling operation to prevent displacement of the pipe from the required line and grade and to prevent injury to the pipe or specials.

27. PIPE SUPPORTED ON PILE BENTS: All sewer lines laid above ground level shall be supported on pile bents as shown on the plans. These lines, like those laid below ground, shall be laid accurately to the established line and grade. All pipe, jointing material, etc., used in the construction of these lines shall be as called for on the plans and/or as specified herein.

All timber for stringers, walkways and braces shall be of yellow pine, pressure treated with a minimum retention of twelve (12) pounds of creosote oil per cubic foot. All piles shall conform to Federal Specification MM-P-371, Type II, Treated, Class C. All piles shall have a butt diameter of not less than ten (10) inches, a tip diameter of not less than six (6) inches, and shall be of such length that the actual earth penetration, after being driven to capacity, shall be not less than fifteen (15) feet. Each pile, after being driven, shall have a bearing capacity of not less than five (5) tons. The bearing capacity, "P", shall be determined by the following formulae:

For gravity hammers, $$P = \frac{2WH}{S + 1.0}$$

For single acting steam hammers, $$P = \frac{2WH}{S + 0.1}$$

For double acting steam hammers, $$P = \frac{2H(W-Ap)}{S + 0.1}$$

Where P = Safe bearing capacity, in pounds
W = Weight, in pounds, of the striking part of the hammer.

H Height of fall of hammer, in feet.
A Area of piston, in square inches.
p Steam pressure, in pounds per square inch.
S Average penetration per blow for the last five (5) blows for gravity hammers, and the last ten (10) blows for steam hammers.

All piles used in any one trestle shall be of as nearly uniform size as it is practicable to obtain, and the alignment of the driven piles shall be as close as practicable to that called for on the plans.

All pile cut-off points shall be at established elevations determined from the required grade of the pipe line supported.

28. MANHOLES AND MANHOLE CASTINGS: All manholes in sewer or drain lines, at the Water Treatment and Sewage Treatment Plants, shall be constructed in accordance with the details shown on the plans. The manhole barrels shall be truly circular in shape at all horizontal sections, and the taper of the upper section shall be uniform at all points along the perimter.

All bed and head joints, in the brickwork, shall be completely filled with mortar to exclude all infiltration of ground water.

Each manhole shall be provided with a cast iron manhole frame and cover. These frames and covers shall be of traffic type and of the same pattern and weight as those now installed in the project.

29. HYDRANTS: All hydrants installed at the Sewage Treatment Plant shall be of the same size and type and, to provide for standardization and interchangeability of parts, shall be of the same make as those now installed in the water distribution system.

DEEP WELL AND WELL PUMPS

2.01 REQUIREMENTS: The Contractor shall furnish all labor, materials, tools, equipment and perform all work required for the drilling and construction of the required preliminary Test Wells and the permanent Deep Wells indicated as Wells Nos. 6 and 7 on Drawing No. W-1. The Contractor is required, also, to furnish and install the Deep Well Pumps, including all appurtenances and accessories, of the type and capacity specified herein.

2.02 WELLS: (a) Test Wells - In order todetermine the availability of water of the required quantity and quality, the Contractor shall drill a test well, at each of the designated sites, before starting the the construction of the permanent wells. Each test well shall be of sufficient size to obtain all necessary information required for the construction of the permanent wells.

The well driller shall keep an accurate log, or record, of all materials drilled through and the depths at which changes in earth and rock formation occur. The records shall show, also, the depth and thickness of all water bearing strata and, when required by the local authority, the available quantity and quality of the water encountered.

Samples of the materials found in each stratum shall be obtained and preserved in approved containers and each sample shall be labeled to show the depth below ground surface and the thickness of the stratum from which the sample was obtained.

All water bearing strata shall be described in detail, noting whether the material is loose or compact, its color and, if gravel, whether water-worn or angular. Any evidence of clay shall be noted.

When so required by the local authority, samples of the water obtained from the various water bearing strata shall be analyzed for the following properties: Phenolphthalein alkalinity, total alkalinity, carbonates, bicarbonates, total hardness, chlorides, carbon dioxide, turbidity, odor and hydrogen ion concentration.

If water of sufficient quantity and suitable quality cannot be obtained at the sites designated, additional test wells shall be drilled at such alternate sites as may be designated by the local authority.

During the drilling of the test wells, and before any water samples are taken for analysis, all water bearing strata within twenty (20) feet of the ground surface shall be sealed off and proper provision shall be made to prevent surface water from entering the well. These precautions must be taken so that the water samples will be truly representative of the water to be obtained from the permanent well.

All test wells not incorporated in a permanent well shall be sealed in an approved manner to prevent contamination of the underlying ground water.

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If water of sufficient quantity and suitable quality cannot be obtained at the above depth(s), additional test wells shall be drilled at such distances also as may be designated by the local authority.

During the drilling of the test wells, and before any water samples are taken for analysis, all water bearing strata within twenty (20) feet of the ground surface shall be sealed off and proper precaution shall be made to prevent surface water from entering the well. These precautions must be taken so that the water samples will be truly representative of the water to be obtained from the permanent well.

All test wells not incorporated in a permanent well shall be sealed in an approved manner to prevent communication of the underlying ground water.

(b) Permanent Wells - After drilling the test well at a designated site and after it is determined that the specified quantity of water can be obtained from said site and the quality of the water to be obtained meets the approval of the local authority, the Contractor shall drill and construct a permanent well in accordance with the following specifications:

(b-1) Type - The permanent wells to be drilled and constructed under these specifications shall be of the "gravel wall" type.

(b-2) Capacity - Each of the finished permanent wells shall have a continuous stable production capacity of not less than two hundred (200) gallons per minute.

(b-3) Draw-down - The draw-down of the water level in the permanent well, during the time it is being pumped at the rate of two hundred (200) gallons per minute, shall be such that the water level, in the well, during the pumping period, will not be lower than Elevation minus twenty (-20.00).

(b-4) Well Construction - A pit casing shall be installed from an elevation of six (6) inches above ground level to and into an impervious stratum not less than twenty (20) feet below ground level. This pit casing shall be of proper diameter to accommodate the well casing and provide adequate annular space between the two casings to permit placing the required seal. The seal shall be of cement grout composed of Portland cement, Type 1, conforming to Federal Specification SS-C-192 and water. The mixed grout shall weigh not less than fourteen (14) pounds per gallon, and shall be placed under pressure. The well casing shall be of proper diameter to accommodate the pump and pump shaft casing and to permit the inflow of water from all approved intermediate water bearing strata. In no case shall the well casing be less than fourteen (14) inches in diameter. Both pit and well casings shall be of genuine wrought iron pipe conforming to Federal Specification WW-P-441a, Class A. The casing joints may be threaded and coupled with heavy recessed-type couplings permitting ends of pipe to butt, or they may be field welded.

Each approved water bearing stratum shall be developed in such manner that the water flowing into the well will carry a minimum of sand or other fine substrata material. Where the water-bearing stratum consists mainly of sand, an annular space, around the casing, shall be reamed, or washed out and filled with proper size gravel and the casing slotted or perforated to permit the passage of water into the well. The size of gravel required shall be determined by the size of sand grains encountered.

Where the water bearing stratum is fissured rock, the drilled hole shall be not less in diameter than that of the well casing above, and the annular space between the pump casing screen and the rock shall be filled with gravel, as shown on the plans. All loose material resulting from the drilling operation shall be removed before any gravel is placed.

The drilled well and all casings shall be as nearly vertical as practical and the pump and pump casing shall not bind against casing or rock at any point.

As stated above, the intent of these specifications is to obtain a well of the "gravel wall" type. Where the contractor's standard construction procedure differs from that outlined above, but will produce the required quantity and

(b) Permanent Wells - After drilling the test well at a designated site and after it is determined that the specified quantity of water can be obtained from said site and the quality of the water to be obtained meets the approval of the local authority, the Contractor shall drill and construct a permanent well in accordance with the following specifications:

(b-1) Type - The permanent wells to be drilled and constructed under these specifications shall be of the "gravel wall" type.

(b-2) Capacity - Each of the finished permanent wells shall have a continuous stable production capacity of not less than two hundred (200) gallons per minute.

(b-3) Draw-Down - The draw-down of the water level in the permanent well, during the time it is being pumped at the rate of two hundred (200) gallons per minute, shall be such that the water level, in the well, during the pumping period, will not be lower than Elevation minus twenty (-20.00).

(b-4) Well Construction - A pit casing shall be installed from an elevation of six (6) inches above ground level to and into an impervious stratum not less than twenty (20) feet below ground level. This pit casing shall be of proper diameter to accommodate the well casing and provide adequate annular space between the two casings to permit placing the required gravel. The seal shall be of cement grout composed of Portland cement, Type I, conforming to Federal Specification SS-C-192 and water. The mixed grout shall weigh not less than fourteen (14) pounds per gallon, and shall be placed under pressure. The well casing shall be of proper diameter to accommodate the pump and pump shaft casing and to permit the inflow of water from all approved intermediate water bearing strata. In no case shall the well casing be less than fourteen (14) inches in diameter. Both pit and well casings shall be of genuine wrought iron pipe conforming to Federal Specification WW-P-441a, Class A. The casing joints may be threaded and coupled with heavy recessed-type coupling pennitting ends of pipe to butt, or they may be field welded.

Each approved water bearing stratum shall be developed in such manner that the water flowing into the well will carry a minimum of sand or other fine substrata material. Where the water-bearing stratum contains mainly of sand, an annular space, around the casing, shall be reamed out and packed with gravel of proper size based on the casing slotted or perforated to permit the passage of water into the well. The size of gravel required shall be determined by the size of sand grains encountered.

Where the water bearing stratum is fissured rock, the drilled hole shall be not less in diameter than that of the well casing above, and the annular space between the pump casing screen and the rock shall be filled with gravel, as shown on the plans. All loose material resulting from the drilling operation shall be removed before any gravel is placed.

The drilled well and pit casings shall be as nearly vertical as practical and the pump casing shall not bind against casing or rock at any point.

As stated above, the intent of these specifications is to obtain a well of adequate capacity, but the contractor shall employ such construction procedure differs from that outlined above, but will produce the required quantity and

maintain the required quality of water, he may use such standard procedure, provided the method and materials used are approved by the local authority.

(b-5) Sterilizing - The well shall be sterilized by adding chlorine or hypo-chlorite solution to the gravel as it is placed. A sufficient amount of chlorine or hypo-chlorite shall be used to obtain not less than fifty (50) PPM to the water used.

(b-6) Testing - Upon completion of a permanent well, the Contractor shall furnish and install a temporary test-pump having a capacity of not less than three hundred (300) gallons per minute, and approved testing equipment for measuring the rate of flow and the water level in the well. After determining the static water level in the well, the test shall begin at a pumping rate of one hundred (100) gallons per minute, and draw-down measurements shall be taken at fifteen (15) minute intervals until the water level becomes stabilized. Pumping shall then be continued, at this rate, for a period of two (2) hours, with water level measurements being taken at thirty minute intervals. The pumping rate shall then be increased to one hundred fifty (150) gallons per minute and the above procedure repeated. This procedure shall be repeated, increasing the pumping rate in increments of fifty (50) gallons per minute, until the actual stable capacity of the well has been determined.

After the above test has been completed and the safe maximum yield of the well has been determined, a continuous thirty-six (36) hour test shall be run and the draw-down recorded at hourly intervals to confirm that the safe maximum yield, as determined above, can be produced continuously.

Pumping rates and water level measurements, determined during the test of each well, shall be recorded and a characteristic curve showing the draw-down at each rate of pumping shall be plotted. Triplicate copies of these curves shall be presented to the local authority for final approval of the well as to quantity of water available.

After the pumping test of each well has been completed and the well approved for quantity, samples of the water, in approved containers, shall be provided for chemical and bacterial analyses. The chemical analysis shall be made by an approved testing laboratory and the bacterial analysis shall be made by the N. C. State Board of Health. Certified copies of all analyses shall be furnished to the local authority.

2.03 PUMPS: (a) General - The Contractor shall furnish, install and place in service operation, in each approved well, a turbine type deep well pump, with vertical, hollow-shaft, electric motor drive. In addition to the motor, one (1) of the pumps shall be provided with a right angle gear transition and an auxiliary gasoline engine. This dual drive shall be so arranged that either motor or engine may be used independent of the other.

(b) Pumping Conditions - Each pump, together with its driving unit shall be capable of delivering not less than one hundred fifty (150) gallons of well water per minute against a total dynamic discharge head, above the pump discharge connection, of sixty-eight and one-half (68.5) feet. The pumps shall operate at a speed not in excess of eighteen hundred (1800) revolutions per minute.

maintain the required quality of water, he may use such standard procedure,
provided the method and materials used are approved by the local authority.

(b-5) Sterilizing - The well shall be sterilized by adding chlorine
or hypo-chlorite solution to the gravel as it is
placed. A sufficient amount of chlorine or hypo-chlorite shall be used
to obtain not less than fifty (50) PPM to the water used.

(b-6) Testing - Upon completion of a pumping well, the Contractor
shall furnish and install a temporary test-pump
having a capacity of not less than three hundred (300) gallons per minute,
and approved testing equipment for measuring the rate of flow and the
water level in the well. After determining the static water level in
the well, the test shall begin at a pumping rate of one hundred (100)
gallons per minute, and draw-down measurements shall be taken at fifteen
(15) minute intervals until the water level becomes stabilized. Pumping
shall then be continued, at this rate, for a period of two (2) hours,
with water level measurements being taken at thirty minute intervals.
The pumping rate shall then be increased to one hundred fifty (150)
gallons per minute and the above procedure repeated. This procedure
shall be repeated, increasing the pumping rate in increments of fifty
(50) gallons per minute, until the actual stable capacity of the well
has been determined.

After the above test has been completed and the safe maximum yield
of the well has been determined, a continuous thirty-six (36) hour test
shall be run and the draw-down recorded at hourly intervals to confirm
that the safe maximum yield, as determined above, can be produced
continuously.

Pumping rates and water level measurements, determined during the
test of each well, shall be recorded and a observation data curve showing
the draw-down at each rate of pumping shall be plotted. Triplicate
copies of these curves shall be presented to the local authority for
final approval of the well as to quantity of water available.

After the pumping test of each well has been completed and the well
approved for quantity, samples of the water, in approved containers, shall
be provided for chemical and bacterial analyses. The sample shall
shall be made by an approved testing laboratory and this bacterial analysis
shall be made by the U. S. State Board of Health. Certified copies of
all analyses shall be furnished to the local authority.

(b) Pumping Conditions - Each pump, together with its delivery main
[illegible]
total dynamic discharge head, above the pump discharge [illegible]
sixty-eight and one-half [illegible]
based not in excess of eighteen [illegible]

The final pump settings shall be twenty (20) feet below the water level in the well when the pump is operating at the specified capacity. Final pumping conditions shall be determined by the Contractor and approved by the local authority.

(c) Pump Head - The pump head shall be of closed grained cast iron, of heavy duty type and designed for mounting the vertical, hollow shaft motor (and for the right angle gear on one (1) of the heads). A flanged, above ground, discharge connection, not less than four (4) inches in size, shall be provided. The flange shall be 125-pound standard, with 125-pound standard drilling.

(d) Discharge Column - The discharge column shall be of the material recommended by the pump manufacturer for the water conditions encountered. It shall be of proper diameter to eliminate undue friction when the pump is operating at designed capacity, and shall be in sections not exceeding ten (10) feet in length.

The column bearing retainers shall be of bronze with the center hub carefully bored to receive the bearings. The bearings shall be of the revolvable, spiral groove, water lubricated, rubber type designed to revolve in the bearing retainer and to permit the shaft to revolve in the bearing. The bearings shall be fluted to allow adequate water lubrication and their spacing shall be not greater than ten feet.

(e) Line Shaft - The line shaft shall be of high-grade, ground and polished steel and of proper size to transmit the full horsepower of the driving unit without distortion or vibration. The shaft shall be furnished in sections not more than ten (10) feet in length and the sections shall be connected by means of threaded steel couplings having a strength not less than one hundred (100) per cent of the shaft. The ends of the shaft sections shall be machine finished and undercut for proper butting. All threads shall be lathe cut. A Monel or stainless steel sleeve shall be provided on the shaft, at all bearing points, to prevent corrosion.

(f) Bowls - The pump bowls shall have properly designed guide vanes and the water passages shall provide a smooth path to reduce friction to a minimum. The bowls shall be of suitable thickness and heavily ribbed to withstand the full shut-off pressure of the pump.

(g) Impellers - The impellers shall be of the semi-open type, of bronze, having a suitable number of blades to meet the pumping conditions. Each impeller shall be carefully machined and finished, accurately fitted, and perfectly balanced both dynamically and hydraulically. The impellers shall have non-overloading characteristics, and shall be so designed that an increase or decrease in the operating head will not cause an excessive increase or decrease in pump capacity. The impeller shall be locked to the impeller shaft with tapered sleeves and lock nuts. Keyways and keys shall not be used.

(h) Impeller Shaft - The impeller shaft shall be of stainless steel, carefully finished. Threads shall be lathe cut. The shaft bearings shall be of rubber, Goodrich cutless type or equal,

The final pump setting shall be twenty (20) feet below the water level in the well when the pump is operating at the specified capacity. Final pumping conditions shall be determined by the Contractor and approved by the local authority.

(c) Pump Head - The pump head shall be of closed grained cast iron, of heavy duty type and designed for mounting the vertical, bollow shaft motor (and for the right angle gear on one (1) of the heads). A flanged, above ground, discharge connection, not less than four (4) inches in size, shall be provided. The flange shall be 125-pound standard, with 125-pound standard drilling.

(d) Discharge Column - The discharge column shall be of the material recommended by the pump manufacturer for the water conditions encountered. It shall be of proper diameter to eliminate undue friction when the pump is operating at designed capacity, and shall be in sections not exceeding ten (10) feet in length.

The column bearing retainers shall be of bronze with the center hub carefully bored to receive the bearings. The bearings shall be of the revolvable, spiral groove, water lubricated, rubber type designed to revolve in the bearing retainer and to permit the shaft to revolve in the bearing. The bearings shall be fitted to allow adequate water lubrication and their spacing shall be not greater than ten feet.

(e) Line Shaft - The line shaft shall be of high-grade, ground and polished steel and of proper size to transmit the full horsepower of the driving unit without distortion or vibration. The shaft shall be furnished in sections not more than ten (10) feet in length and the sections shall be connected by means of threaded steel coupllngs having a strength not less than one hundred (100) per cent of the shaft. The ends of the shaft sections shall be machine finished and undercut for proper butting. All threads shall be lathe cut. A Monel or stainless steel sleeve shall be provided on the shaft, at all bearing points, to prevent corrosion.

(f) Impellers - The impellers shall be of the semi-open type, of bronze, having a suitable number of blades to suit the pumping conditions. Each impeller shall be carefully machined and finished, accurately fitted, and perfectly balanced both dynamically and hydraulically. The impellers shall have non-overloading characteristics, and shall be so designed that an increase or decrease in the operating head will not cause an excessive increase or decrease in pump capacity. The impeller shall be locked to the impeller shaft with tapered sleeve and lock nuts. Keyways and keys shall not be used.

(g) Impeller Shaft - The impeller shaft shall be of stainless steel, carefully finished. Threads shall be lathe cut.

cemented in place. The bearings in the discharge fitting above the top impeller and in the suction fitting below the first impeller shall be extra long to provide for steady operation of the pump under all conditions. Proper provisions shall be made for impeller adjustment and to prevent by-passing.

(i) Suction Pipe and Strainer - A suitable suction pipe, of proper diameter and length, shall be provided. A galvanized, steel strainer having a net inlet opening of at least four (4) times the area of the suction pipe shall be provided at the lower end of the suction pipe.

(j) Pressure Gauge - A four (4) inch pressure gauge, with brass case, having a range of 0 to 100 pounds per square inch, shall be furnished and installed at the pump discharge connection.

(k) Water-level Testing Device - A three-eighths (3/8) inch diameter, seamless, brass tube shall be furnished and installed, in each well, at the proper elevation, for measuring the water level in the well. The tube shall be fitted with an air valve and a connection for attaching an air pump. A six (6) inch altitude gauge, with brass case, shall be provided. The entire installation shall be air tight. A hand operated air pump shall be included with the equipment.

(l) Motors - Each pump shall be driven by a vertical, hollow-shaft, drip-proof, electric motor, of the squirrel-cage induction type, designed and constructed to operate on 3-phase, 60-cycle, 208-volt current. The motor shall have ample capacity to operate the pump throughout the entire head-capacity range without exceeding its rated capacity. The designed speed of the motor shall match that of the pump. The motor shall conform to N.E.M.A. standards. The motor shall have normal torque, normal or low starting current characteristics. The motor shall be provided with a built-in, non-reversing ratchet to prevent the shaft from being unscrewed by accidental phase reversal and reverse rotation of the pump when shut down. The motor shall be designed as a separate unit, apart from the pump head.

(m) Motor Controls - Each electric motor shall be controlled by means of a fused disconnecting switch and a push-buttuon operated cross-the-line magnetic starter. The disconnecting switch and its fuses shall conform to Code requirements for the motor controlled. The magnetic starter shall include overload and low voltage protection. The controls shall include a "Manual-Off-Automatic" selector switch correctly wired for manual and off positions. The automatic position is for future carrier or pressure control. The controls shall be steel case enclosed and wall mounted.

(n) Right Angle Gear Drive - As noted under Clauses (a) and (c), one of the pumps shall be dual driven. The right angle gear drive shall have adequate power to drive the pump under all service conditions. It shall be of suitable ratio to provide the proper pump impeller speed when the gasoline engine is operating at its most efficient speed. It shall have gears of the highest quality gear steel, machine cut, with spiral or skew teeth, hardened and mounted on substantail ball bearings, oil lubricated and cooled. A suitable ball thrust bearing shall be incorporated in the drive and it shall be designed to carry the entire thrust load of the pump. The drive shall be so designed that the gears will not rotate when the electric motor is driving the pump.

cemented in place. The bearings in the discharge fitting above the top impeller and in the suction fitting below the first impeller shall be extra long to provide for steady operation of the pump under all conditions. Proper provisions shall be made for impeller adjustment and to prevent by-passing.

(i) Suction Line and Strainer - A suitable suction pipe, of proper diameter and length, shall be provided. A galvanized, steel strainer having a net inlet opening of at least four (4) times the area of the suction pipe shall be provided at the lower end of the suction pipe.

(j) Pressure Gauge - A four (4) inch pressure gauge, with brass case, having a range of 0 to 100 pounds per square inch, shall be furnished and installed at the pump discharge connection.

(k) Multi-Level Testing Device - A three-eighths (3/8) inch diameter, seamless, brass tube shall be furnished and installed, in each well, at the proper elevation, for measuring the water level in the well. The tube shall be fitted with an air valve and a connection for attaching an air pump. A six (6) inch altitude gauge, with brass case, shall be provided. The entire installation shall be air tight. A hand operated air pump shall be furnished with the equipment.

(l) Motors - Each pump shall be driven by a vertical, hollow-shaft, drip-proof, electric motor, of the squirrel-cage induction type, designed and constructed to operate on 3-phase, 60-cycle, 208-volt current. The motor shall have ample capacity to operate the pump throughout the entire head-capacity range without exceeding the rated capacity. The designed speed of the motor shall match that of the pump. The motor shall conform to N.E.M.A. standards. The motor shall have normal torque, normal or low starting current characteristics. The motor shall be provided with a built-in, non-reversing ratchet to prevent the shaft from being unscrewed by accidental phase reversal and reverse rotation of the pump when shut down. The motor shall be designed as a separate unit, apart from the pump head.

(m) Motor Controls - Each electric motor shall be controlled by means of a fused disconnecting switch and a push-button operated cross-the-line magnetic starter. The disconnecting switch and fuses shall conform to Code requirements for the motor controlled. The magnetic starter shall include overload and low voltage protection. The control shall include a "hand-off-automatic" selector switch correctly wired for manual and automatic positions. The automatic position is for full range pressure control. The controls shall be steel case enclosed and wall mounted.

(n) Right Angle Gear Drive - As noted under Clauses (a) and (c), one of the pumps shall be dual driven. The right angle gear drive shall have adequate power to drive the pump under all service conditions. It shall be of sufficient ratio to provide the proper pump impeller speed when the gasoline engine is operating at its most efficient speed. The shall have gears of the highest quality gear steel, machine cut, with spiral or skew teeth, hardened and mounted on substantial ball bearings, oil immersed and cooled. A suitable ball thrust bearing shall be incorporated in the drive and it shall be designed to carry the rating thrust load of the pump. The drive shall be so designed that the engine will not idle when the pump

(o) Auxiliary Gasoline Engine - The auxiliary gasoline engine shall be a complete, self-contained, multi-cylinder, heavy duty power plant having a horsepower rating at least thirty (30) per cent in excess of the maximum brake horsepower required by the pump, and its normal service operating speed shall be that required to operate the pump, through the right angle gear drive. The engine shall be arranged for hand starting and shall be equipped with a magneto ignition system. The equipment and accessories shall include an adjustable governor, heavy duty clutch power take-off, fan, radiator and water pump; carburetor, gasoline filter and air cleaner; ignition switch, spark plugs and ignition wiring and cables; full pressure lubricating system, oil filter and oil pressure gauge; starting crank, and exhaust pipe and muffler. A metal instruction plate giving the manufacturer's recommendations for lubricating oil and other pertinent information shall be attached to the unit. The engine shall be "Climax", or approved equal.

The engine shall be mounted on a sturdy cast iron or welded steel base. It shall be connected to the right angle gear drive by means of a drive shaft provided with flexible couplings.

The exhaust pipe, from the engine, shall be extended through the pump house wall, in an asbestos-cement sleeve, and the muffler shall be mounted on the end of the exhaust pipe at a distance of one (1) foot from the wall.

A fifteen (15) gallon gasoline supply tank shall be furnished and mounted, on the pump house wall, at the most convenient point for filling and for running the gas line to the engine.

The Contractor shall place the engine in service operating condition, fill the gasoline storage tank, flush out the cooling and lubricating system, and fill the cooling system with clean water and the crank case with the proper grade of oil.

2.04 PUMP PIPING: The Contractor shall furnish all materials required for connecting the pumps to the raw water main and he shall install them in the manner shown on the plans and as specified herein. (See Drawing No. W-1.)

All gate valves shall be iron body, bronze mounted, double disc gate valves, with rising stems and operating hand wheels. The valves shall be Chapman, List 59½, or equal.

All check valves shall be iron body, bronze mounted check valves, of the tilting disc, non-slam type. They shall be Chapman, List 23, or approved equal.

The meters shall be of the flanged-tube type, suitable for installing in the horizontal run of the pump discharge piping. The meter tube and body shall be of cast iron and all parts subject to water contact shall be designed and constructed for a pressure of not less than one hundred twenty-five (125) pounds per square inch. The meters shall be four (4) inch in size and shall be capable of measuring a minimum of not more than fifty (50) gallons per minute and a maximum of not less than three hundred (300) gallons per minute, with an accuracy of not less than ninety-eight (98) per cent of the actual flow. The meters shall be equal in every respect to those manufactured by Sparling Meter Co.

All flanges on pipe, fittings, valves, meters, etc., shall be 125-pound standard, with 125-pound standard drilling. Gaskets shall be 1/8" thich, red rubber, cut gaskets especially designed for cold water service. All bolts shall have square heads and hexagon nuts.

2.04 PUMP PIPING: The Contractor shall furnish all materials required for connecting the pumps to the raw water main and be shall install them in the manner shown on the plans and as specified herein. (See Drawing No. W-1.)

WATER TREATMENT PLANT.

3.01 REQUIREMENTS: The Contractor for this Section will be required to furnish all labor, tools, equipment, etc., required for the construction of, and he shall construct, the Water Treatment Plant in accordance with the plans and these specifications.

The water treatment plant building shall be constructed in accordance with the Architect's plans and specifications. All treatment plant equipment, including the detailed construction items appurtenant thereto, shall be constructed and/or installed in accordance with these specifications and the accompanying plans.

3.02 CONSTRUCTION: All construction items included hereunder shall be constructed in accordance with the details shown on Drawings Nos. W-1 to W-3, inclusive, and the requirements as set forth in Clauses 1 to 29, inclusive, of these specifications.

3.03 TREATMENT PLANT EQUIPMENT : (a) General:- The major items of equipment to be furnished and installed in this plant shall be designed and constructed for the specific purpose of softening, filtering and sterilizing the water obtained from the deep wells now in operation and supplying water to the project and from the additional wells to be drilled by others. The softening and filtering equipment, together with other required appurtenant equipment and accessories shall be as called for on the plans and/or as specified herein.

(b) Plant Capacity.- The water treatment plant shall be capable of softening, filtering and sterilizing not less than one million (1,000,000) gallons of the specified water per day.

(c) Softening Unit.- The water softening unit shall be of the catalyst filled tank type utilizing lime hydrate as the softening agent and trisodium phosphate to retard precipitation of the calcium carbonate before reaching the catalyst contact surface. The softening tank shall be of the general shape and size indicated on the plans and shall be equal to the "Spiractor" softener manufactured by The Permutit Co.

The softening tank shall be of the gravity type and shall be equipped with the following accessories and appurtenances:

1. A complete charge of catalyst granules - not less than 310 cubic feet.
2. Tank cover with access manhole - Manhole to have hinged cover.
3. Ladder from foundation slab to top of tank.
4. Catalyst storage tank and hopper.
5. Eductor for introduction of catalyst and necessary piping from storage tank to softening tank.
6. Softening tank drain valves and special piping.

7. Two (2) lime mixing and feeding tanks designed for 12-hour charges.

8. One (1) phosphate mixing and feeding tank designed for a 12-hour charge.

9. Three (3) chemical pumps for feeding lime and phosphate solutions to the softening tank. These pumps to be Milton-Roy, or equal.

10. The necessary piping required for the interconnection of the chemical tank, the feed pumps and the softening tank.

11. One (1) eight (8) inch, venturi type rate of flow controller for regulating the flow of water to the softening tank. This controller to be equal to that manufactured by the Simplex Valve & Meter Co.

In order to obtain a well coordinated softening system it is preferred that all items listed above, except those otherwise designated, shall be manufactured, fabricated and/or assembled by one company specializing in the manufacture of water softening equipment. This equipment shall conform to the manufacturer's design standards. All other items, i.e., those where a particular manufacturer's name is mentioned, shall be of the highest quality obtainable and shall be designed and manufactured especially for the service and conditions under which they will operate.

The main softening unit, together with its appurtenances and accessories shall be capable of reducing the hardness of the well water to a hardness not exceeding sixty (60) parts per million when operated in accordance with the manufacturer's directions.

The following is an analysis of the water delivered by one of the existing wells now in operation at the project.

Total Hardness, calculated as	$CaCO_3$	181	p.p.m.
Calcium Hardness,	"	153	"
Magnesium " ,	"	28	"
Alkalinity,	"	182	"
Chlorides,	"	8	"
Sulphates,	"	5	"
Free CO_2,	CO_2	11	"
Iron,	Fe	0.4	"
Manganese,	Mn		
Organic Matter,	O_2		
Turbidity			
Color			

7. Two (2) lime feeding and feeding tanks designed for 12-hour charges.

8. One (1) phosphate mixing and feeding tank designed for a 12-hour charge.

9. Three (3) chemical pumps for feeding lime and phosphate solution to the softening tank. These pumps to be Milton-Roy, or equal.

10. The necessary piping required for the interconnection of the chemical tank, the feed pumps and the softening tank.

11. One (1) eight (8) inch, venturi type rate of flow controller for regulating the flow of water to the softening tank. This controller to be equal to that manufactured by the Simplex Valve & Meter Co.

In order to obtain a well coordinated softening system it is preferred that all items listed above, except those otherwise designated, shall be manufactured, fabricated and/or assembled by one company specializing in the manufacture of water softening equipment. This equipment shall be the manufacturer's design standards. All other items, i.e., those where a particular manufacturer's name is mentioned, shall be of the highest quality obtainable and shall be designed and constructed to operate under which they will operate.

The softening unit, together with the appurtenances and accessories shall be capable of reducing the hardness of the well water to a hardness not exceeding sixty (60) parts per million when operated in accordance with the manufacturer's directions.

The softening is an analysis of the water delivered by one of the existing wells now in operation at the project.

Total Hardness, calculated as $CaCO_3$ ---------- 182 P.P.M.

Calcium Hardness, " " " ---------- 152 " "

Magnesium " " " ---------- 30 " "

Chlorides, " " " ---------- 8 " "

Free CO_2, " " " ---------- 22 " "

Iron, " " " Fe ---------- 0.4 " "

Organic Matter, " " " ---------- " "

Color ---------- " "

Before designating the amount of lime and phosphate to be used in the preliminary treatment of the water, the Contractor shall have a composit sample of the waters of all the wells analyzed. The results of this analysis shall be used as a guide for placing the plant in operation.

(d) Manufacturer's Drawings and Service - The manufacturer of the water softening unit and its auxiliary equipment shall furnish the Contractor with three (3) complete sets of detail drawings showing the equipment furnished. The drawings shall be accompanied by complete instructions for installing the equipment and getting it ready for operation.

Upon receipt of notice, from the Contractor, that the equipment is ready, the manufacturer shall furnish the services of a field representative who shall inspect the installation, notify the Contractor of any corrections required, assist the Contractor in placing the equipment in operation, and instruct the plant operator in the proper methods of operation and maintenance.

(e) Filters - The filtering unit of the water treatment plant consists of four (4) one hundred eight (108) inch diameter, steel, pressure type filters, together with their appurtenances and accessories, and the filter piping. Three (3) of the filters were purchased under a previous contract and the fourth (4) unit shall be a duplicate of those now on order. The filtering media and the underdrainage system shall be as previously specified.

(f) Filter Piping - The filter piping, consisting of the piping, valves, fittings, etc., for the influent, effluent, wash, rewash and waste lines, shall be installed as shown on the plans and in accordance with the requirements set forth in Clause 24 of these specifications.

(g) Filter Rate Controllers - A filter rate controller shall be furnished and installed in the effluent line from each filter. Each controller shall have an effective controlling range of from eighty-five thousand (85,000) to four hundred fifty thousand (450,000) gallons per day. The controllers shall be not less than four (4) inches in size and shall be equal, in every respect, to Type S, No. 42, as manufactured by Simplex Valve and Meter Co.

(h) Wash Water Rate Indicator - There shall be furnished and installed in the wash water header, between the wash pump and the first filter, an orifice plate suitable for actuating a wash water rate indicator. The indicator may be of the mercury manometer type as furnished by International Filter Co., or that furnished by the Permutit Co. The indicator shall be of the direct reading type, with scale graduate for 0 to 1,000 gallons per minute. The installation shall be complete with the required incidental piping and isolating valves.

Before designating the amount of lime and phosphate to be used in the preliminary treatment of the water, the Contractor shall have a composite sample of the waters of all the wells analyzed. The results of this analysis shall be used as a guide for placing the plant in operation.

(d) Manufacturer's Drawings and Service - The manufacturer of the water softening unit and its auxiliary equipment shall furnish the Contractor with three (3) complete sets of detail drawings showing the equipment furnished. The drawings shall be accompanied by complete instructions for installing the equipment and getting it ready for operation.

Upon receipt of notice, from the Contractor, that the equipment is ready, the manufacturer shall furnish the services of a field representative who shall inspect the installation, notify the Contractor of any corrections required, assist the Contractor in placing the equipment in operation, and instruct the plant operator in the proper methods of operation and maintenance.

(e) Filters - The filtering unit of the water treatment plant consists of four (4) one hundred eight (108) inch diameter, steel, pressure type filters, together with their appurtenances and accessories, and the filter piping. Three (3) of the filters were purchased under a previous contract and the fourth (4) unit shall be a duplicate of those now on order. The filtering media and the underdrainage system shall be as previously specified.

(f) Filter Piping - The filter piping, consisting of the piping, valves, fittings, etc., for the influent, effluent, wash, rewash and waste lines, shall be installed as shown on the plans and in accordance with the requirements set forth in Clause 24 of these specifications.

(g) Filter Rate Controllers - A filter rate controller shall be furnished and installed in the effluent line from each filter. Each controller shall have an effective controlling range of from eighty-five thousand (85,000) to four hundred fifty thousand (450,000) gallons per day. The controllers shall be not less than four (4) inches in size and shall be equal, in every respect, to Type B, No. 42, as manufactured by Simplex Valve and Meter Co.

(h) Wash Water Rate Indicator - There shall be furnished and installed in the wash water header, between the wash pump and the first filter, an orifice plate with the [illegible] a wash water rate indicator. The indicator may be of the mercury manometer type as furnished by International Filter Co., or that furnished by the Permutit Co. The indicator shall be of the direct reading type, with a scale graduated for 0 to 1,000 gallons per minute. The installation shall be complete with the required incidental piping and isolating valves.

(i) Loss-of-Head Gage.- Each filter shall be equipped with a six (6) inch, dual needle, loss-of-head gage, with brass case and red and black hands, arranged to indicate the loss of head through the filter. The gage shall be properly connected to the filter influent and effluent lines, and each connection shall be provided with an isolating valve.

(j) Wash Indicator.- A visual filter wash indicator, of the sight-glass type, shall be installed in the wash line of each filter. A sampling cock shall be provided on each indicator, and the line connections shall be equipped with isolating valves.

(k) Chlorinators.- The Contractor shall furnish and install two (2) chlorinators for applying chlorine at the points indicated on the plans. The first point of application is in the raw water between the spirator and the filters. The second point of application is in the pump suction line leading from the reservoir.

The chlorinator for applying the chlorine in the raw water line shall be Wallace & Tiernan's Type MASV-M, or approved equal, and shall have a capacity rangeing from 0 to 50 pounds per 24 hours. This chlorinator installation shall be complete with the necessary differential converter and disc orifice for automatic control of the chlorine in proportion to the quantity of water flowing in the line.

The chlorinator for applying the chlorine in the pump suction line shall be Wallace & Tiernan's Type SASV-M, or approved equal, and shall have a capacity rangeing from 0 to 50 pounds per 24 hours. This chlorinator shall be of the semi-automatic type with provision for optional automatic start and stop.

The chlorinators shall be of the solution feed, visible, vacuum type. They shall be pedestal mounted and the working parts shall be mounted in a hard rubber tray under a glass bell jar provided with a water seal. These parts shall be plainly visible, readily accessible and shall be easily disassembled for inspection, cleaning and repairing. The chlorine pressure reducing valve shall be of the float operated type, utilizing water as the diaphragm, and shall operate to maintain a constant vacuum ahead of the chlorine meter. The valve shall automatically shut off the flow of chlorine gas in the event of any interruption taking place in the water supply to the chlorinator or any stoppage occuring in the chlorine solution discharge line. To further prevent the possibilty of chlorine leakage, all parts of the control apparatus conducting chlorine, between the pressure reducing valve and the injector discharge, shall be under partial vacuum.

The chlorinator shall be provided with a vacuum relief, of the float operated type, which shall limit the vacuum within the chlorinator and provide a positive vent to atmosphere.

The chlorine meter shall be of the fixed orifice type having no moving parts and shall be constructed entirely of glass. The rate of flow indicator shall consist of a double wall glass tube with a sealed-in scale reading directly in pounds of chlorine per twenty-four (24) hours. The design of the chlorinator shall be such as to permit easy installation of the meter and indicator with out the use of tools. The meter and scale shall be accurate to within four (4) per cent of the true rate of feed on all flows within the graduated range.

(i) Loss-of-Head Gage.- Each filter shall be equipped with a six (6) inch, dual faced, loss-of-head gage, with brass case and red and black bands, arranged to indicate the loss of head through the filter. The gage shall be properly connected to the filter influent and effluent lines, and each connection shall be provided with an isolating valve.

(j) Wash Indicator.- A visual filter wash indicator, of the sight-glass type, shall be installed in the wash line of each filter. A sampling cock shall be provided on each indicator, and the line connections shall be equipped with isolating valves.

(k) Chlorinators.- The Contractor shall furnish and install two (2) chlorinators for applying chlorine at the points indicated on the plans. The first point of application is in the raw water between the agitator and the filters. The second point of application is in the pump suction line leading from the reservoir.

The chlorinator for applying the chlorine in the raw water line shall be Wallace & Tiernan's Type MAV-M, or approved equal, and shall have a capacity ranging from 0 to 50 pounds per 24 hours. This chlorinator installation shall be complete with the necessary differential converter and disc orifices for automatic control of the chlorine in proportion to the quantity of water flowing in the line.

The chlorinator for applying the chlorine in the pump suction line shall be Wallace & Tiernan's Type SASV-M, or approved equal, and shall have a capacity ranging from 0 to 50 pounds per 24 hours. This chlorinator shall be of the semi-automatic type with provision for optional automatic start and stop.

The chlorinators shall be of the solution feed, vitalic, vacuum type. They shall be pedestal mounted and the working parts shall be mounted in a hard rubber tray under a glass bell jar provided with a water seal. These parts shall be plainly visible, readily accessible and shall be easily disassembled for inspection, cleaning and repairing. The chlorine pressure reducing valve shall be of the float operated type, utilizing water as the diluent, and shall operate to maintain a constant vacuum placed of the chlorine meter. The valve shall automatically shut off the flow of chlorine gas in the event of any interruption taking place in the water supply to the chlorinator or any stoppage occurring in the chlorine solution tubing. A vacuum relief valve shall be provided to prevent the possibility of chlorine leakage, all parts of the control apparatus conducting chlorine, between the pressure reducing valve and the injector discharge, shall be under partial vacuum.

The chlorinator shall be provided with a vacuum relief, of the float operated type, which shall limit the vacuum within the chlorinator and provide a positive vent to atmosphere.

The chlorine meter shall be of the fixed orifice type having no moving parts and shall be constructed entirely of glass. The meter shall consist of a double wall glass tube with a sealed-in scale reading directly in pounds of chlorine per twenty-four (24) hours. The design of the chlorinator shall be such as to permit easy installation of the meter and its operation with the use of tubing. The meter and scale shall be mounted on a suitable panel, complete with all fittings and connections for the proper operation of the chlorinator within the graduated range.

The chlorinator shall be equipped with a water-operated injector which shall develope the operating vacuum for the chlorinator and produce the discharge the chlorine solution to the point of application. The injector shall be corrosion resistant, with a separate throat of ceramic material, and shall be so designed that it may be readily disassembled for cleaning and replacement of parts. The injector shall be equipped with a suction check valve to prevent the back flow of water into the control apparatus.

The automatic proportioning of the chlorine feed from the Type MASV-M chlorinator shall be accomplished by the control of the vacuum produced by the injector, utilising an aspirator tube and a separate pressure type converter. The converter shall be of the lever and adjustable fulcrum type and shall convert the difference in pressure, on each side of the disc orifice, into a proportional vacuum. The converter shall be capable of adjustment to give maximum chlorine meter readings for a wide range of flows through the disc orifice. The chlorinator shall be so designed and constructed as to permit manual operation simply by shutting off the vacuum line from the converter and regulating the height of the vacuum adjusting tube.

There shall be furnished with the chlorinators the following necessary accessories and spare parts:

(a) - Flexible chlorine gas connections.
(b) - Auxiliary cylinder valves.
(c) - Hose for chlorine solution, overflow and vacuum relief.
(d) - Diffusor or solution tube for point of application.
(e) - Extra chlorine pressure reducing valve.
(f) - Extra glass parts including an extra chlorine meter and scale.
(g) - A complete set of extra gaskets and packing for all joints and connections.
(h) - A set of open end wrenches to fit all union connections.
(i) - A supply of ammonia for testing for chlorine leaks.
(j) - Lubricant for hard rubber threaded joints.
(k) - Three (3) bound copies of operating and maintenance instructions.

The chlorinator manufacturer shall furnish the services of a field representative to supervise the installation of the equipment and place it in permanent operation.

A beam type scale, with an 18"x 27" platform, suitable for weighing three (3) 150-pound cylinders of chlorine, was odered under a previous contract. This scale shall be uncrated and install, in its proper position, by the Contractor.

The entire chlorinator installation shall conform to the requirements of the chlorinator manufacturer and in accordance with the manufacturer's layout as approved by the local authority. The installation shall include all conduit for encasement of hose and all water connections. Instrument drains shall be provided in accordance with the requirements of the equipment manufacturer.

(1) Pumping Equipment.- The Contractor shall furnish and install, at the location indicated on the plans, an electric-motor driven, centrigugal, high duty pump. This pump shall be capable of delivering not less than seven hundred (700) gallons of treated water per minute, to the distribution system, against a total discharge head, including friction, of one hundred fifty-seven (157) feet. The suction lift will vary from four (4) feet to fifteen (15) feet.

The pump shall be single- or multi-stage, horizontally split case, double suction type, fully bronze mounted. The pump shall be designed and constructed

The chlorinator shall be equipped with a water-operated injector which shall develope the operating vacuum for the chlorinator and produce the discharge the chlorine solution to the point of application. The injector shall be corrosion resistant, with a separate throat of ceramic material, and shall be so designed that it may be readily disassembled for cleaning and replacement of parts. The injector shall be equipped with a suction check valve to prevent the back flow of water into the control apparatus.

The automatic proportioning of the chlorine feed from the Type MASV-M chlorinator shall be accomplished by the control of the vacuum produced by the injector, utilizing an aspirator tube and a separate pressure type converter. The converter shall be of the lever and adjustable fulcrum type and shall convert the difference in pressure, on each side of the dise orifice, into a proportional vacuum. The converter shall be capable of adjustment to give maximum chlorine water readings for a wide range of flows through the dise orifice. The chlorinator shall be so designed and constructed as to permit manual operation simply by shutting off the vacuum line from the converter and regulating the height of the vacuum adjusting tube.

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(c) - Hose for chlorine solution, overflow and vacuum relief.
(d) - Diffuser or solution tube for point of application.
(e) - Extra chlorine pressure reducing valve.
(f) - Extra glass parts insuring an extra chlorine meter and scale.
(g) - A complete set of extra gaskets and packing for all joints and connections.
(h) - A set of open end wrenches to fit all union connections.
(i) - A supply of amsonia for testing for chlorine leaks.
(j) - Lubricant for hard rubber threaded joints.
(k) - Three (3) bound copies of operating and maintenance instructions.

The chlorinator manufacturer shall furnish the services of a field representative to supervise the installation of the equipment and place it in permanent operation.

A beam type scale, with an 18"x 27" platform, suitable for weighing three (3) 150-pound cylinders of chlorine, use covered under a previous contract. The scale shall be erected and tested, in the proper position, by the Contractor.

The entire chlorinator installation shall conform to the requirements of the chlorinator manufacturer and in accordance with the manufacturer's layout as approved by the local authority. The installation shall include all conduit for encasement of hose and all water connections. Instrument drains shall be provided in accordance with the requirements of the equipment manufacturer.

(f) Pumping Equipment.- The Contractor shall furnish and install, at the location indicated on the plans, an electric-motor driven, centrifugal, high duty pump. This pump shall be capable of delivering not less than seven hundred (700) gallons of treated water per minute, to the distribution system, against a total discharge head, including friction, of not less than fifty-seven (57) feet. The suction lift will vary from (4) feet to fifteen (15) feet.

The pump shall be single- or multi-stage, horizontally split case, double suction type, fully bronze mounted. The pump shall be designed and constructed

for continuous, heavy duty operation under the capacity and head conditions specified above.

The pump casing shall be of best quality gray iron of ample thickness to withstand, with proper factor of safety, all stresses and strains likely to be imposed under the specified conditions, including water hammer. Suction and discharge openings shall be located on opposite sides of the pump and in the bottom half of the casing.

Pump bearings may be of either the split sleeve or ball bearing type. If of the split sleeve type, the bearings may be either bronze or babbit lined. The bronze or babbit shells shall be made in halves to facilitate easy removal and replacement. If of the ball bearing type, they shall be of enclosed cartridge type so designed and arranged that the rotating element may be removed without disturbing the balls or their mounting. Each bearing shall be provided with a large oil storage reservoir and oil guard arranged in such manner as to provide immersion of the oil rings and to prevent leakage of oil along the shaft. The bearings shall be supported on brackets either cast integrally with the lower half of the casing, or dowelled and bolted thereto. The bearings shall be protected by water slingers to prevent entrance of water into the oil chambers. Thrust bearings shall be provided to take care of any unbalancing hydraulic thrust in the direction of the longitudinal center line of the shaft.

Water-sealed stuffing boxes, of large diameter and depth, shall be provided. The boxes shall be equipped with bronze water rings with sealing water connections of either the internal channel type or external pipe and valves to permit seal water to be taken from the pump casing or external source. The stuffing boxes shall be packed with high grade, impregnated, braided asbestos packing.

The pump impeller shall be of bronze, of the enclosed type, and shall be properly designed and accurately machined for perfect hydraulic balance and highest efficiency. The impeller shaft shall be of forged alloy steel, of high tensile strength and of ample diameter to prevent whipping. The shaft shall be accurately groung to gauge. Where the shaft passes through the stuffing boxes, it shall be protected from wear by renewable bronze sleeves.

The pump shall be fitted with sealing rings between the impeller and casing. The rings shall be of the self-adjusting, float ring type designed to give minimum clearance and easy adjustment.

Air-vent and drain cocks shall be provided in the upper and lower halves of the casing. Oil reservoirs shall be equipped with oil gauges and drains for cleaning.

The pump shall be direct connected to the motor through a flanged coupling of the flexible pin and rubber bushing type. The coupling shall be accurately machined and turned to gauge on the outside to permit its use in lining up the unit.

The motor for driving the pump shall be of the horizontal, normal torque, low starting current, squirrel-cage, induction type, wound for reduced-voltage starting, designed and constructed for full load continuous duty, and rated at 40 deg. C. rise above a 40 deg. C. ambient temperature, with a 15% service factor. The motor shall be designed and constructed in accordance with the latest rulings of the A.I.E.E. and the standards of the N.E.M.A., for operation on 3-phase, 60-cycle, 220-volt current. The motor speed shall correspond to that of

for continuous, heavy duty operation under the capacity and head conditions specified above.

The pump casing shall be of best quality grey iron of ample thickness to withstand, with proper factor of safety, all stresses and strains likely to be imposed under the specified conditions, including water hammer. Suction and discharge openings shall be located on opposite sides of the pump and in the bottom half of the casing.

Pump bearings may be of either the split sleeve or ball bearing type. If of the split sleeve type, the bearings may be either bronze or babbit lined. The bronze or babbit shells shall be made in halves to facilitate easy removal and replacement. If of the ball bearing type, they shall be of enclosed cartridge type, so designed and arranged that the rotating element may be removed without disturbing the balls or thrust mounting. Each bearing shall be provided with a large oil storage reservoir and oil guard arranged in such manner as to provide lubrication of the oil rings and to prevent leakage of oil along the shaft. The bearings shall be supported on brackets either cast integrally with the lower half of the casing, or bolted and bolted thereto. The bearings shall be protected by water slingers to prevent entrance of water into the oil chambers. Thrust bearings shall be provided to take care of any unbalancing hydraulic thrust in the direction of the longitudinal center line of the shaft.

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The pump impeller shall be of bronze, of the enclosed type, and shall be properly designed and accurately machined for perfect hydraulic balance and highest efficiency. The impeller shaft shall be of forged alloy steel, of high tensile strength and of ample diameter to prevent whipping. The shaft shall be accurately ground to gauge. Where the shaft passes through the stuffing boxes, it shall be protected from wear by renewable bronze sleeves.

The pump shall be fitted with coupling rings between the impeller and casing. The rings shall be of the pull-adjusting, floating ring type designed to give minimum clearance and easy adjustment.

Air-vent and drain cocks shall be provided in the upper and lower halves of the casing. Oil reservoirs shall be equipped with oil gauges and drains for cleaning.

The pump shall be direct connected to the motor through a flanged coupling of the flexible pin and rubber bushing type. The coupling rings shall be machined and turned to gauge on the outside to permit ike use in lining up the unit.

The motor for driving the pump shall be of the horizontal, normal torque, squirrel-cage, induction type, wound for reduced-voltage starting, designed and constructed for full load continuous duty, and rated at 40 deg. C. rise above a 40 deg. C. ambient temperature, with a 15% service factor. The motor shall be designed and constructed in accordance with the latest rulings of the A.I.E.E. and the standards of the N.E.M.A., for operation on 3-phase, 60-cycle, 220-volt current. The motor speed shall correspond to that of

of the pump, i.e., not to exceed 1750 revolutions per minute.

Motor bearings shall be of the ball bearing type.

The motor shall be equipped with a conduit terminal box, and the motor leads shall be so anchored that any strain on the leads will not be transmitted to the windings.

The pumping unit, consisting of pump and motor, shall be mounted on a cast iron, or fabricated structural steel, box type base common to both pump and motor. The base shall be provided with the required pump and motor supporting pads which shall be accurately machined to guarantee perfect alignment of the pump and motor. Both pump and motor shall be dowelled and bolted to the base. The outer edge of the base shall have a raised lip for collecting drippage. The base shall be provided with a grout hole in the top, and bosses or lugs cored for the proper size foundation bolts.

The pump casing, motor frame and base shall be properly smoothed up and given one coat of filler and an enamel finish before shipment from the factory. The filler coat shall be sanded before the enamel is applied.

The motor control and starting equipment shall consist of a fused safety switch, Westin Type AB-1, or equal, and a magnetic reduced voltage starter, push-button operated, Westinghouse Type 11-400, or equal.

All equipment included in this unit shall be guaranteed from defects in material and workmanship for a period of one (1) year from the date it is placed in service operation.

(m) Existing Pumping Units.- The following motor-driven and engine-driven pumping units were purchased under a previous contract and are on hand at the site of the project:

1 - 750 GPM, motor-driven, filter wash pump.
2 - 300 GPM, " " , service pumps.
1 - 500 GPM, engine-driven, fire-service pump.

The above pumps shall be installed at the locations indicated on the plans.

(n) Installing Pumping Equipment.- All pumping equipment to be furnished and/or installed in this project shall be installed on their respective foundations in accordance with the details shown on the plans. The materials for pump piping and the manner in which the connections are to be made shall be in accordance with the plan details and the specifications covering "Piping".

The pumping units shall be properly mounted on their foundations, perfectly levelled and aligned. After the piping connections have been made and the pumps relieved of all strains due to piping weight, the foundation bolts shall be properly tightened and the bases grouted in.

Immediately after installation, all pumping units shall be tested for capacity and head conditions as guaranteed by the manufacturer. The oil reser- shall be flushed out and refilled with new oil, motor bearings shall be properly lubricated and the units shall be placed in service operation.

of the pump, i.e., not to exceed 1750 revolutions per minute.

Motor bearings shall be of the ball bearing type.

The motor shall be equipped with a conduit terminal box, and the motor leads shall be so anchored that any strain on the leads will not be transmitted to the windings.

The pumping unit, consisting of pump and motor, shall be mounted on a cast iron, or fabricated structural steel, box type base common to both pump and motor. The base shall be provided with the required pump and motor supporting pads which shall be accurately machined to guarantee perfect alignment of the pump and motor. Both pump and motor shall be doweled and bolted to the base. The outer edge of the base shall have a raised lip for collecting drippage. The base shall be provided with a grout hole in the top, and bosses or lugs cored for the proper size foundation bolts.

The pump casing, motor frame and base shall be properly smoothed up and given one coat of filler and an enamel finish before shipment from the factory. The filler coat shall be sanded before the enamel is applied.

The motor control and starting equipment shall consist of a fused safety switch, Westin Type AB-1, or equal, and a magnetic reduced voltage starter, push-button operated, Westinghouse Type 11-A00, or equal.

All equipment included in this unit shall be guaranteed from defects in material and workmanship for a period of one (1) year from the date it is placed in service operation.

(m) Existing Pumping Units - The following motor-driven and engine-driven pumping units were purchased under a previous contract and are on hand at the site of the project:

1 - 750 GPM, motor-driven, filter wash pump.
2 - 300 GPM, " " , service pumps.
1 - 500 GPM, engine-driven, fire-service pump.

The above pumps shall be installed at the locations indicated on the plans.

(n) Installing Pumping Equipment - All pumping equipment to be furnished and installed in this project shall be installed on their respective foundations in accordance with the details shown on the plans. The materials for pump piping and the manner in which the connections are to be made, shall be in accordance with the plan details and the specifications covering "Piping".

The pumping units shall be properly mounted on their foundations, perfectly levelled and aligned. After the piping connections have been made and the pumps relieved of all strains due to piping weight, the foundation bolts shall be properly tightened and the bases grouted in.

Immediately after installation, all pumping units shall be tested for capacity and head conditions as guaranteed by the manufacturer. The oil reservoirs to be drained out and refilled with new oil. Motor bearings shall be lubricated and the units shall be placed in service operation.

ELEVATED STEEL WATER STORAGE TANK AND FOUNDATION.

5.01 REQUIREMENTS: The contractor for this item shall furnish all labor, materials, tools, equipment and all else required for the fabrication and erection of the 250,000 Gallon, Elevated Steel Water Storage Tank and he shall fabricate and erect said tank, on its foundation, complete in every respect and ready for use, all in accordance with the plans and these specifications.

5.02 GENERAL: The elevated tank shall be of the type and design shown on Engineers Drawing No. W-5, and the proportions and general appearance shall adhere thereto. Where the tank manufacturer's standard fabrication practice requires minor changes, and where such changes will not detract from the safety or the general appearance of the finished structure, the manufacturer may make such minor changes, provided approval is first obtained from the local authorities.

The tank shall be of the ellipsoidal bottom type, as shown on the plans; the top of ellipsoidal or oval design; and the tank shall be supported on tubular columns as shown.

Tank plate thicknesses, size and metal thickness of supporting columns and column braces have been indicated on the plans. However, the tank manufacturer shall check all members and, where any discrepancies occur, which may prove detrimental to the safety of the structure, the manufacturer shall provide such additional metal and guarantee the safety and stability of the finished structure under any or all of the load conditions to be imposed thereon.

5.03 DESIGN: Unless otherwise specified herein, the design, fabrication and erection of the tank shall conform to the standard specifications of the American Water Works Association for Elevated Steel Water Tanks, latest revision. The structure shall be designed to safely support the loads and forces, hereinafter listed, acting separately or in combination:

1. Weight of the structure
2. Weight of the water-tank full
3. Stresses incurred by wind blowing at the rate of one hundred (100) miles per hour, from any direction, and when the water level in the tank is at any elevation from empty to full.

5.04 DEAD LOAD: The dead load shall consist of all permanent construction, including bolts, rivets, fittings, etc. The weight of steel shall be considered as four hundred ninety (490) pounds per cubic foot, and the weight of concrete as one hundred forty-four (144) pounds per cubic foot.

5.05 LIVE LOAD: The live load shall include the weight of all the water contained in the tank, when full to the overflow elevation, and the wind load as hereinafter specified. The unit weight of water shall be considered as sixty-two and one-half (62.5) pounds per cubic foot. The wind pressure on the vertical plane surface shall be assumed to be thirty (30) pounds per square foot. In calculating the wind load on the tank and riser, six-tenths (6/10) of the wind pressure shall be applied to the total area of the vertical projection. The point of application of the load shall be at the center of gravity of the projected area.

5.06 STRESS ALLOWANCE FOR WIND: Permissible working stresses may be increased twenty-five (25) percent when the wind load is included in calculating the stresses, provided that the resulting section is not less than that required for dead and live loads.

5.07 MATERIALS: (a) General - Unless otherwise noted herein, all steel shall conform to A.S.T.M. Specification A7, latest edition.

(b) Dished Plates - Dished plates shall be in accordance with A.S.C.E. Specification A-10, Grade A, latest edition.

(c) Rods - Rods shall conform to A.S.C.E. Specification A-141, latest edition.

(d) Pipe - Pipe used as structural members shall be in accordance with A.S.T.M. Specification A-53, Grade A, latest edition.

(e) Roof Plates - All roof plates shall be of copper bearing steel.

(f) Welding Wire - Welding wire shall be coated for use in the shielded-arc process of welding.

(g) Mill Test Reports - The tank manufacturer shall furnish the Owner with mill test reports showing the quality of the steel used. The Owner reserves the right to have additional physical and chemical tests made, at his own expense, at any time he may elect.

5.08 ALLOWABLE UNIT STRESSES: (a) General - Unless otherwise specified herein, all unit working stresses shall be in accordance with those specified by the A.W.W.A.

(b) Tension in Plates - Except as otherwise specified herein, the tension in the net section of plates shall not exceed 12,000 pounds per square inch.

The tension in the net section of the bottom shell ring of the tank shall not exceed 10,000 pounds per square inch where the tower posts connect to this shell ring.

The tension in the net section of the bottom plates shall not exceed 10,000 pounds per square inch.

(c) Tension in Structural Shapes and Rods - Exclusive of the initial tension stress, the tension in the net section of rolled structural shapes and tower rods shall not exceed 15,000 pounds per square inch. The initial stress in adjustable tension members shall be assumed to be 3,000 pounds per square inch.

(d) Compression Members - The allowable compression on the gross section of columns and struts shall be calculated by the A.I.S.C. Formula,

$$S = \frac{18{,}000}{1 + \frac{l^2}{18000\, r^2}}$$

The maximum value of S shall not exceed 15,000 pounds per square inch. The $\frac{l}{r}$ value for main compression members shall not exceed 100, and for secondary compression members shall not exceed 150.

(e) Bending Stress - The bending stress in the extreme fibres of the net section of rolled shapes and built-up sections shall not exceed 18,000 pounds per square inch. Bending stresses in extreme fibres of pins shall not exceed 27,000 pounds per square inch.

(f) Bearing Stresses - Bearing stresses in rivets shall not exceed the following:

Power driven tank rivets ----------18,000 lbs. per sq. in.
Power driven tower rivets ----------24,000 lbs. per sq. in.

(g) Shearing Stresses - Shearing stresses shall not exceed the following:

Power driven rivets in tank ---------- 9,000 lbs. per sq. in.
Power driven rivets in tower ---------12,000 lbs. per sq. in.
Pins ----------12,000 " " " "

(h) Efficiency of Welds - The assumed joint efficiency of butt welded and double lap welded joints shall not exceed 85 percent.

5.09 CONSTRUCTION: (a) General - All materials used, the methods of construction and the workmanship shall conform to the best practice in modern tank construction. Except as otherwise specified herein, the tank and its supporting tower, preferably, shall be of the all welded type. Where riveted and pin connections are required, these connections shall be held to a minimum and in no case shall rivets be used in the jointing of water contact plates, except where specific authorization is granted by the local authority.

(b) Welding - All welding must be done by properly qualified and experienced welders who have been qualified within the past six months in accordance with the American Welding Society's Standard Qualification Procedure. The tank erector shall assign each welder an identification number which shall be stamped along all welds he makes at intervals of not more than six feet. The welding edges of plates shall be properly prepared, by chipping, machining, shearing, or otherwise, to obtain a finished welded connection of maximum efficiency.

Welded members and their component parts shall be straight and free of excessive buckles or warping. Misalignment of adjoining plates for butt joints subject to primary stress shall not exceed ten (10) percent of the thinner plate thickness, or one-sixteenth (1/16) inch, whichever is the least, and for butt joints subject to secondary stress, such misalignment shall not exceed twenty (20) percent of the thinner plate thickness, or one-eighth (1/8) inch, whichever is the least. The separation of plates in lap joints, shall not exceed one-sixteenth (1/16) inch.

The field welding of the tank and tower shall be done by the shielded arc process. Shop welding may be done by either the shielded arc or submerged arc process.

Plates and other component members of the tank and tower shall be assembled and welded following a procedure which shall result in a minimum of distortion from weld shrinkage.

The weld metal shall be sound throughout and shall be free from an excessive amount of oxides, non-metallic inclusions and gas pockets.

Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint and other foreign material.

Trepanned plugs shall be cut from the welded seams, as the work progresses, in accordance with the American Welding Society's Rules for Field Welding of Steel Storage Tanks.

(c) Rivet Holes - Where rivets are used, the holes shall be accurately spaced. Holes in plates 5/8" or more in thickness shall be drilled from the solid. Punched holes shall be punched 1/32" less than the diameter of rivet to be used and reamed to proper size, in the field, after the work is assembled.

(d) Scarfing of Plates - Where permission is granted to rivet water contact plates, the edges of the plates shall be scarfed.

(e) Water Tight Joints - Riveted seams in the tank shell, tank bottom and riser shall be made water tight by caulking only. No foreign substance may be used on the laps between the plates.

5.10 TANK: (a) Description - The tank shall be cylindrical in shape and shall have a suspended type bottom with or without beams. If beam supported, the beams shall be built integral with the bottom plates to eliminate contiguous surfaces inaccessible for painting.

(b) Plate Thickness - The minimum thickness of any plate in contact with water shall be one-fourth (¼) inch.

(c) Balcony - The tank shall be equipped with a balcony, around the circumference, at the bottom of the cylindrical portion of the tank. The balcony shall be not less than thirty (30) inches wide and shall be provided with a substantial railing not less than thirty-six (36) inches high.

(d) Tank Roof - The tank roof shall be elliptical or oval in shape and shall be of such proportions as will present a pleasing appearance and be capable of supporting the specified loads. The roof plates shall be not less than one-fourth (¼) inch thick.

A 20" x 32" manhole shall be provided in the roof and the manhole shall be equipped with a rain-proof cover.

The roof shall be equipped with a screened ventilator. The opening shall be of sufficient size to vent the tank during the filling with or the withdrawal of water. The ventilator shall be screened with ten (10) mesh copper screen.

5.11 RISER: - A steel riser of the diameter indicated on the plans shall be provided as shown. This riser shall extend from the foundation level to the bottom of the bottom of the tank. The riser shall rest on a concrete pier and shall be attached directly to the bottom of the tank, without the use of an expansion joint. The riser shall act as a settling basin for any sediment that may be carried in the water. The riser shall be provided with a manhole, at the bottom, having a clear opening of not less than twelve (12) inches by sixteen (16) inches. The manhole shall be equipped with a suitable cover which shall seat against the inside face of the riser. The cover and its seat shall be so constructed that it will maintain its position,

assisted by the water pressure, in the event of the clamps being inadvertently loosened.

5.12 TOWER - (a) Columns - The tank shall be supported on a steel tower consisting of six (6) columns and such secondary members as may be required to stabilize the structure under any and all load conditions. The columns shall be cylindrical in shape and of the size indicated on the plans. Metal thicknesses shall be not less than those shown. Column splices shall be located as near as practicable to the horizontal struts so as to secure the greatest rigidity.

(b) Struts and Braces - Struts and braces shall be provided as shown on the plans. The struts shall be of rolled structural shapes and shall be of the open type to facilitate painting. Diagonal braces shall be of the rod type equipped with turnbuckles to assist in plumbing the tower and to provide the proper initial tension.

(c) Column Bases - All columns shall be provided with steel base plates of a type that can be cleaned and painted easily and will not collect water or dirt. The bases shall be of such size and so constructed as to properly distribute the load on the foundation piers. The bearing pressure on the foundation shall not exceed four hundred (400) pounds per square inch.

(d) Anchor Bolts - The tank manufacturer shall furnish the necessary foundation bolts required for anchoring the structure to the foundation. The bolts shall be of sufficient size to resist the uplift due to the wind pressure on the tank, riser and tower, when the tank is empty.

NOTE: The anchor bolts shall be delivered to the site of the project prior to the time set for construction of the foundation.

5.13 LADDERS, ETC: Access to the balcony shall be provided by means of a ladder and walkway, as indicated in the plans. The ladder shall extend up the outside face of the riser, from foundation level to a suitable point under the tank, and a suspended walkway shall extend from the riser to a point below the balcony. A flight of steps shall extend upward from the walkway to the balcony. The side bars of the ladder shall be of two and one-half ($2\frac{1}{2}$) inch by three-eights (3/8) inch bars and the rungs shall be three-quarters (3/4) inch square. The ladder shall be provided with a standard safety cage the full height of the ladder from an elevation of seven (7) feet above the foundation level. The walkway and stair shall be of substantial construction and shall be provided with handrails.

Three-quarter (3/4) inch diameter step irons, suitably spaced shall be welded to the outside face of the tank and its cover, for access to the roof manhole and the painters sling connection at the finial. Similar step irons shall be provided on the inside of the riser and tank.

5.14 BLOW-OFF, INLET AND OVERFLOW PIPES: Proper provision shall be made for blowing off and/or washing out the tank and riser, and a washout valve, not less than three (3) inches in size shall be provided, at the base of the riser, for this purpose.

A twelve (12) inch inlet-outlet assembly shall be furnished and installed as shown on the plans. The assembly shall consist of a twelve (12) inch, flanged, base ell and a twelve (12) inch riser. The riser shall extend upward, in the riser, a distance of not less than six (6) feet above the bottom

of the riser, to provide the necessary sedimentation basin. The base ell and the riser flange shall be of cast iron, two hundred fifty (250) pound standard.

A six (6) inch overflow line, including the necessary base ell, shall be installed as shown on the plans.

5.15 PAINTING: The tank, tower and accessories shall receive one shop coat of red lead, applied to all surfaces except those which are to be welded. All interior surfaces shall receive one finish coat of red lead, and all exterior surfaces shall receive two finish coats of aluminum paint.

Before applying any field paint, the erector shall go over the entire structure and touch up all places not covered by the shop coat, or which may have become damaged in handling and erection.

5.16 TESTING: After completion of erection, the erector shall fill the tank with water and inspect the tank, riser and all pipe connections for leaks. All leaks and any other defects which may appear shall be repaired and the tank, etc., shall be retested. Testing and repairing shall continue until the structure is watertight. All water required for testing will be furnished by the Owner.

5.17 STERILIZATION: After all tests and repair work have been completed and the tank is ready for service, the contractor shall wash down all interior surfaces with a strong solution of H.T.H., thoroughly rinse with clean water, and leave the tank in a sterile condition ready for use. Sterilization work shall be done under the supervision of the North Carolina State Board of Health. All water required for sterilizing the tank will be furnished by the Owner.

5.18 OBSTRUCTION LIGHTS: The tank manufacturer shall furnish and install a complete system of obstruction lights, including all necessary conductor wire, conduit, conduit fittings, lamps, lamp receptacles, switches, regulators, etc. All material and the manner in which it is installed shall be in full compliance with the specifications and requirements of the Civil Aeronautics Administration. The system wiring shall etrminate in a junction box located on one of the columns, at a suitable elevation, ready for the power connection.

5.19 DRAWINGS: Before any shop fabrication is done, the tank manufacturer shall submit complete shop drawings for the Engineers approval. In addition to the shop drawings, the Engineers shall be furnished a certified layout of all foundation bolts, and a copy of the stress and loading diagrams.

5.20 GUARANTEE: The tank manufacturer shall guarantee the structure he furnishes for a period of one (1) year from the date of acceptance by the Owner. Any defects due to faulty design, material and/or workmanship, which may appear during the guarantee period, shall be repaired, by the manufacturer, at no additional expense to the Owner.

5.21 TANK FOUNDATION: (a) General. - Engineer's Drawing No. W-5 shows the tentative design and arrangement of the tank foundation, both for the standard pier type and the pile supported type.

Before any construction work is started on this item, the Contractor shall verify, from information to be furnished by the tank manufacturer, the exact foundation requirements for the elevated tank to be erected. This information, together with data obtained from soil bearing tests shall be used to determine the type of foundation to be constructed.

(b) Soil Bearing Test. - A standard soil bearing test, conducted in accordance with the requirements of the local authority, shall be made at the tank site. If the results of the test indicate that the soil has a safe bearing capacity of not less than five thousand (5,000) pounds per square foot, without any measureable indicated of settlement, the standard pier type foundation may be used and the footing area of the piers shall be so proportioned that the maximum unit pressure transmitted to the soil, under any or all loading conditions, shall not exceed four thousand (4,000) pounds per square foot. In the event of the soil bearing test showing settlement under the five thousand (5,000) pound per square foot loading condition, then the pile supported type of foundation shall be used.

(c) Pier Type Foundation. - The pier type foundation shall be constructed of concrete having an ultimate compressive strength, at the end of twenty-eight (28) days, of not less than three thousand (3,000) pounds per square inch. All concrete ingredients shall conform to those specified under Clause 8 - "Concrete Materials". All formwork and the mixing, placing and finishing of the concrete shall conform to the requirements stipulated under Clauses 10, 11, 12 and 13.

(d) Pile Supported Foundation. - All piles used in the construction of the tank foundation shall be of Southern Yellow Pine and shall be creosote oil treated. The piles shall be cut from live, sound, solid trees and shall contain not less than one-third (1/3) summer wood. They shall contain no unsound knots, decay or other defects which might impair their strength or durability. The piles shall have a minimum of two (2) inch sap ring.

All piles shall be butt cut above the ground swell and shall taper from butt to tip. A line drawn from the center of the butt to the center of the tip shall not fall outside the body of the pile and shall not fall outside the center of the pile at any point more than one (1) per cent of the length of the pile.

The piles shall be stripped of bark immediately after cutting and all permissible knots shall be trimmed close to the body of the pile.

Piles shall have a minimum diameter at the tip, under the bark, as follows:

Length of Pile	Diameter
Less than 40 feet	8 inches
40 feet to 60 feet	7 "
Over 60 feet	6 "

The minimum diameter of the pile, under the bark, at a section four (4) feet from the butt shall be as follows:

Length of Pile	Diameter
20 feet and under	11 inches
20 feet to 40 feet	12 "
Over 40 feet	13 "

The diameter of the pile at the butt shall not exceed twenty (20) inches.

All piles shall be treated to not less than eighteen (18) pounds of creosote oil, and the treatment process shall conform to the latest Standard Specification of the American Wood Preservers Association for "Preservative Treatment of Southern Pine Piles by Pressure Processes".

All piles shall be driven, accurately, to the spacings called for on the plans. Each driven pile shall have a safe bearing capacity of not less than fifteen (15) tons. The driven pile bearing capacity shall be determined from the formulae given in Clause 27.

The Contractor shall determine the length of piles required by driving one, or more, test piles. The number of test piles required to be determined by the local authority. When so directed, a driven test pile shall be permitted to "set" for a period of twenty-four (24) hours and shall then be re-driven for a check of its bearing capacity.

Concrete piers, mats and/or caps for pile supported foundations shall conform to the layout and arrangement indicated on the final plan. The concrete shall conform, in all respects, to that specified for "Pier Type Foundation".

(e) Foundation Bolts. - The foundation bolts, to be furnished by the tank manufacturer, shall be accurately set, both to line and elevation, to the dimensions called for on the plans. Proper precautions shall be taken to prevent their disturbance during the concrete pouring period.

750,000 GALLON RESERVOIR.

6.01 GENERAL REQUIREMENTS: The Contractor for this item will be required to furnish all labor, materials, tools, equipment, etc., required for the construction of, and he shall construct, the 750,000 Gallon Reservoir, complete in every respect, in accordance with the details shown on Drawing No. W-4 and as specified herein. The work to be performed by the Contractor includes all excavation, backfilling, piping connections, clearing up, sterilizing and allelse required to complete the reservoir ready for service use.

6.02 MATERIALS: All materials used in the construction of the reservoir shall conform to those specified in Clauses Nos. 1 to 29, inclusive, of these specifications.

6.03 CONSTRUCTION: The methods of handling the materials required for the construction of the reservoir and the manner in which they placed, installed and/or erected shall be in accordance with the requirements for such work as outlined in Clauses Nos. 1 to 29, inclusive, of these specifications and/or as hereinafter specified.

6.04 ROOF FRAMING AND SHEATHING: All framing and sheathing lumber used in the construction of the reservoir roof shall be No. 1, common, Souther yellow pine. All framing and sheathing shall be creosote treated in the manner specified for "stringers, walkways and braces" in Clause No. 27 of these specifications.

6.05 ROOFING: The entire area of the reservoir roof shall be covered with a five (5) ply, built-up roof of asphalt, felt and slag. The weight of the felt, the amount of asphalt and slag and the manner in which these materials are applied shall conform, in every respect, to the standard twenty (20) year bonded roof, as required by the material manufacturer.

The roofing material shall be applied by a roofing contractor certified for the application of bonded roofs.

6.06 WATER DEPTH GAGE: The Contractor shall furnish and install, in the reservoir, a direct reading water depth gage of the float and counterweight type, with a vertical gage board, reading in feet and inches, mounted on the reservoir roof. The gage board shall be not less than six (6) inches wide, painted white, with all markings in black.

The gage installation shall be complete with all necessary cables, sheaves, pulleys, counterweights and gage pointer. The float shall be of copper and shall be arranged to ride a guide rod which shall be installed to hold the float in the proper vertical position at all elevations.

6.07 STERILIZING: Immediately before filling the reservoir with water to be used for domestic purposes, all trash and debris of every nature shall be removed and all interior surfaces of the reservoir shall be thoroughly scrubbed with a solution of H.T.H., or chlorinated lime, having an available chlorine content of not less than fifty (50) parts per million. If, after the first scrubbing, there is any trace of contamination in the reservoir, the sterilizing process shall be repeated, as often as necessary, until all evidence of contamination has been removed. The sterilizing process and the results obtained shall conform to all regulations and requirements of the North Carolina State Board of Health.