13 October 1950

TECHNICAL REPORT AND RECOMMENDATIONS

FOR

ADDITIONS AND IMPROVEMENTS

TO THE

HADNOT POINT FRESH WATER SYSTEM

AT THE

MARINE BARRACKS, CAMP LEJEUNE, N. C.

201.012 5

Refer to: P. W. Dwg. No. 3556, "Expansion of Raw Water Supply System - Hadnot Point."

ENCLOSURE (4-5) - Report of
Camp Lejeune Development Board

TECHNICAL REPORT AND RECOMMENDATIONS ON ADDITIONS AND IMPROVEMENTS TO THE RAW WATER SUPPLY, RAW WATER TREATMENT, TREATED WATER STORAGE AND TREATED WATER DISTRIBUTION FACILITIES, HADNOT POINT, MARINE BARRACKS, CAMP LEJEUNE, NORTH CAROLINA.

SECTION 1. EXISTING PLANT.

1-01. Service. - The Hadnot Point water system delivers treated water to the following areas of Camp Lejeune:

(a) Regimental Area
(b) Post Troops Area
(c) Industrial Area
(d) U. S. Naval Hospital
(e) Paradise Point, Officers' Quarters
(f) Camp Lejeune Schools
(g) Midway Park Housing Project

1-02. Design Criteria. - The existing water supply system was designed on the following basis:

(a) Anticipated daily per capita consumption of 120 gallons, peak demand of 180 gallons.

(b) Raw water, obtained from wells within the Camp Area to be filtered, softened and chlorinated.

(c) Storage capacity of 24 hours supply of treated water.

(d) Distribution system of 12" cast iron mains, completely looped, with 8" grid system and 6" and 8" cross-overs at critical points.

(e) Domestic and fire flow up to 2,000 gallons per minute at any one location.

23-6/29

1-03. Midway Park. - The Midway Park Housing Project was originally served by an independent water system for which the supply was obtained from two wells within the Midway Park Area. The water was chlorinated, but otherwise untreated. A 200,000 gallon elevated storage tank was provided. In 1947 the Midway Park mains were connected to the Hadnot Point system by a 12" c.i. main paralleling Holcomb Boulevard, and a booster pumping station was constructed near the intersection of Holcomb Boulevard and Snead's Ferry Road. Midway Park is now served with treated water from the Hadnot Point Treatment Plant.

1-04. Supply. - The raw water supply for Hadnot Point is obtained from 23 wells of which one (no. 18) is used only in emergency, because it pumps a large volume of sand. A 22nd well (R) serves only as a standby for fire use and does not deliver water to the treatment plant but discharges direct into the treated water distribution system. Two of the wells are located in Midway Park. Seven (7) of the wells are equipped with dual drive (electric motors with standby gasoline engines). The others with electric motors only. Pumping tests run in April, 1948, on all the wells except No. 18 and (R) indicated individual maximum capacities totalling 3,730 gallons per minute and a combined

maximum delivery to the Treatment Plant of 3,350 gallons per minute with all wells pumping. The seven (7) dual drive wells, when operated with gasoline engine drive, indicated total individual maximum capacities of 1,470 gallons per minute and combined flow of 1,100 gallons per minute. The raw water is conveyed to the Treatment Plant in Asbestos-cement pipe, 8" to 18" in diameter, there being a total of 71,536 lineal feet of pipe in the raw water system. The raw water transmission system was designed to deliver 5MGD to the Treatment Plant with a friction loss of 4.09 feet per 1,000 feet of pipe, based upon C = 120, as applied to Hazen and Williams formula and hydraulic tables.

1-05. Well Production.

(a) Table I shows the results of tests made in 1941 when the wells were placed in operation, in 1944 and in 1949. When the 1949 tests were made Well No. 17 was out for repairs and could not be included. It was not possible to pump wells Nos. 18, 19, 20 and 21 against the optimum head of 20 pounds because of sanding. Well No. 18 sands so badly that it is no longer used except in an emergency.

Analysis of the tests on Wells No. 1 to No. 16 inclusive indicates a 16% decrease in yield, a lower water table and increased drawdown as compared with the 1941 tests. Recovery averaged 79% in 3 minutes in 1941 and only 43% in 6 minutes in 1949.

Wells No. 5, 6 and 9 gave increased production and practically a static water table as compared with previous tests. These three wells are placed in a line running nearly North-South alongside Snead's Ferry Road and crossing Cogdels Creek. Well No. 7, which is about 2,000 feet West of No. 5 shows a greatly decreased yield but a higher static elevation. In 1941 the wells were tested individually and yield was logged against various heads ranging from Zero to 40 pounds. Since the working head is approximately 20 pounds, the results obtained at that pressure were used in all cases for performance comparison. No reports are available to show the procedure followed in making the 1941 and 1944 tests.

The 1949 tests were made February 7th to 25th. The wells were grouped for testing as follows:

Group I - 5, 6, 9, 10, 11, 12, 14, 15, 16 and 21.

Group II - 1, 2, 3, 4, 7, 8, 13, 18, 19 and 20.

Each group was rested 24 hours and then operated 24 hours, readings being taken as frequently as possible on GPM, drawdown and pressure. Pressures averaged 19.5 pounds for Group I and 18.7 pounds for Group II. Another 24 hour test was run February 14th with all 20 wells pumping for 24 hours. Pressure averaged 23.5 pounds on this test, and for all wells except 18 and 19 (which were throttled) varied from a low of 19 pounds to a high of 25. Another test was run with all wells pumping for 48 hours, February 23rd to 25th. Static water elevation was read on each well at the end of a 24 hour rest period. Figures shown in the table show average performances during the tests. Drawdown and static elevations are referred to mean sea level. It is estimated that each of the two Midway Park wells produces 150 GPM.

TABLE 1 – WELL PRODUCTION RECORDS

WELLS	GALLONS PER MINUTE			DRAWDOWN ELEVATION *			STATIC WATER ELEVATION*			RECOVERY	
										3 MIN.	6 MIN.
NOS.	1941	1944	1949	1941	1944	1949	1941	1944	1949	1941	1949
1	240	220	180 130	– 4.5	– 8.0	– 16.4	+ 15.4		+ 6.0	+ 9.0	– 3.5
2	140	150	130 98	– 12.0	– 22.0	– 25.9	+ 11.0		0.0	+ 5.0	– 4.5
3	265	220	175 150	– 14.2	– 37.5	– 30.9	+ 11.8		+ 9.0	+ 16.8	+ 9.0
4	150	155	90 115	– 20.8	– 23.0	– 21.5	+ 19.0		+ 1.5	——	+ 1.5
5	250	270	305 210	– 24.7	– 18.0	– 19.8	+ 19.0		+ 7.0	+ 12.3	+ 5.5
6	250	210	265 142	– 7.0	– 12.4	– 9.6	+ 18.0		+ 21.0	+ 19.4	+ 21.0
7	200	170	85 100	– 24.0	– 17.0	– 3.0	+ 15.0		+ 14.0	——	+ 14.0
8	190	205	185 162	– 11.9	– 20.0	– 19.3	+ 9.7		+ 5.5	+ 4.0	+ 5.5
9	205	210	235 146	– 14.5	– 17.0	– 13.7	+ 17.7		+ 18.0	——	+ 18.0
10	250	265	215 160	– 7.2	– 12.0	– 21.5	+ 12.3		– 1.0	+ 10.0	– 4.0
11	280	270	235 180	+ 7.0	– 0.2	– 5.5	+ 14.8		+ 8.5	+ 12.6	+ 8.5
12	220	240	180 59	– 1.3	– 11.0	– 6.4	+ 15.0		+ 11.0	+ 13.0	+ 6.0
13	290	305	195 95	– 13.8	– 24.0	– 10.8	+ 9.2		+ 9.0	– 8.5	+ 9.0
14	275	245	245 167	– 4.5	– 11.2	– 9.2	+ 14.2		+ 8.0	+ 13.4	+ 8.0
15	260	255	165 70	– 3.5	– 17.8	– 3.6	+ 14.7		+ 11.2	+ 14.7	+ 9.3
16	275	280	235 155	– 0.3	– 10.6	– 15.7	+ 15.7		+ 9.0	——	– 9.5
17	300	180	—— 64	– 31.0	– 17.0	——	+ 14.0		——	+ 7.7	——
18	260	115	26 35	– 18.2	– 11.0	+ 9.2	+ 18.8		+ 17.0	+ 8.3	+ 14.0
19	250	165	60 85	– 25.3	– 9.0	+ 4.7	+ 7.7		+ 15.0	+ 7.7	+ 14.5
20	265	185	155 80	+ 8.7	+ 12.0	+ 22.5	+ 14.0		+ 31.0	+ 14.0	+ 31.0
21	275	155	48 75	– .55	+ 7.0	+ 11.2	+ 9.8		+ 27.0	——	+ 19.0
AVERAGE 16 WELLS	234	229	195	– 9.83	– 16.36	– 14.55	+ 14.53		+ 8.61	79 %	43 %

* ELEVATIONS REFERRED TO MEAN SEA LEVEL

(b) No precipitation reports are available for the immediate area. Chart No. 1 shows the annual precipitation for 19 years at Wilmington and for 5 years, 10 months at Cherry Point. Line "A" shows average annual precipitation for 19 years at Wilmington, 50.61 inches; Line "B" shows average annual precipitation for 5 years, 10 months at Cherry Point (52.64 inches); and line "C" shows average precipitation for 6 years at Wilmington. Both curves show a peak in 1946 and a falling off since that time. Wilmington reports 1.56 inches for January and 3.70 for February, 1949 - the norms being 3.29 and 3.26 respectively; indicating a probability that at the time the 1949 tests were made we were short approximately 2 inches of rainfall for the year. The Wilmington reports show that precipitation was below average from 1938 to 1943, indicating that the ground water supply at the time the original tests were made was low. From 1943 to the present time Wilmington precipitation has been consistently above the 19 year average.

(c) Design of the well system was based on an anticipated 50 inches of annual precipitation with 25% percolation, which would make available 600,000 gallons per square mile per 24 hours. Based on this assumption wells were grouped to yield an average of 208 G.P.M., it being presumed that they would be operated 12 hours in each 24. The 1949 tests show that 16 of the wells are averaging 94% of the designed G.P.M. yield, but only 83% of the 1941 yield. One (20) produces 57% of its 1941 yield. Wells 18, 19 and 21 produce less than 25% of the 1941 yield and are sanding badly.

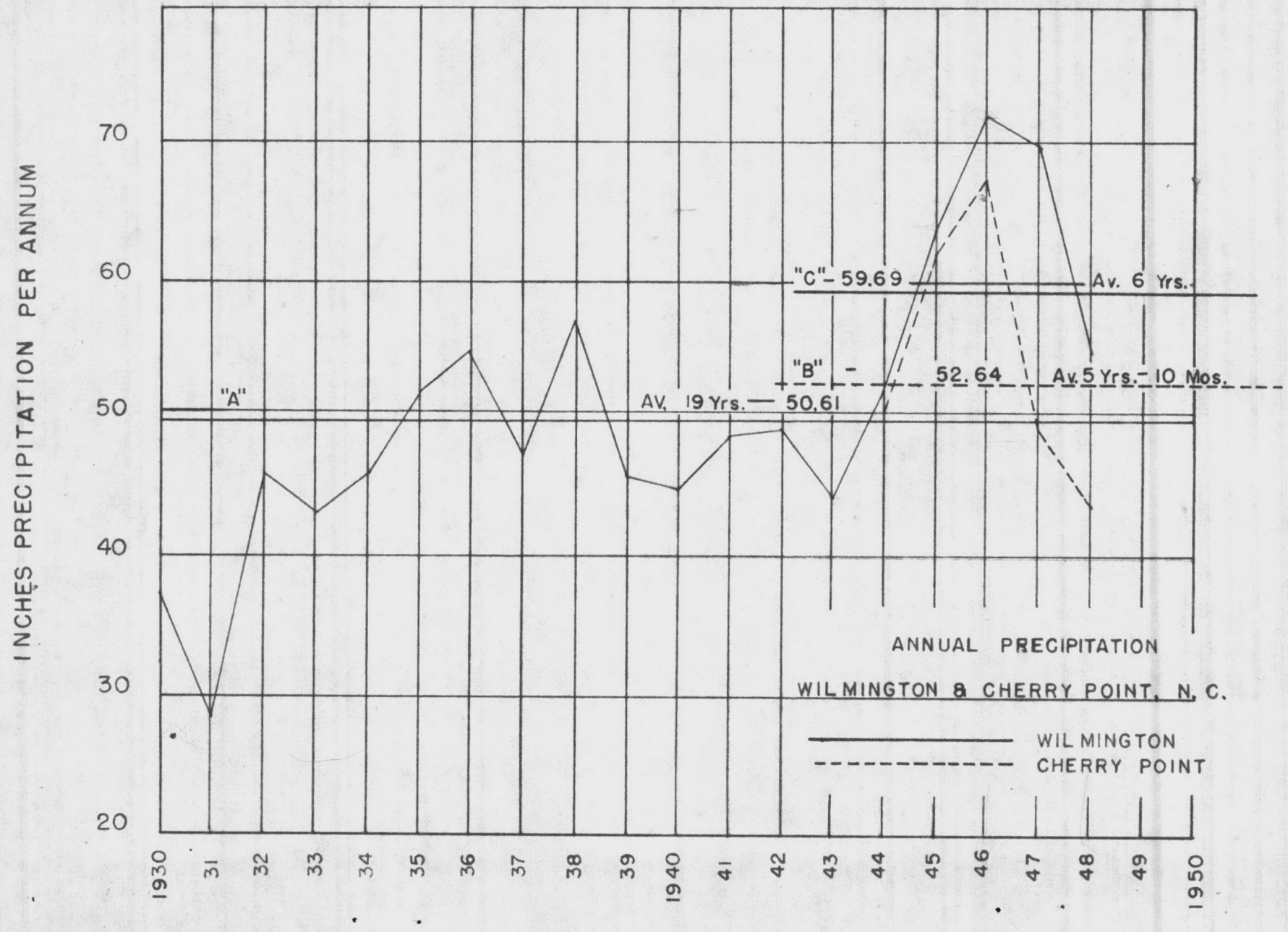
(d) The above data indicates that the designers were sufficiently conservative in their estimate of ground water resources. The 12 hours rest anticipated by them, however, has never been realized; and the per capita demand has been much higher than expected. Operating records show that groups of the wells have been pumped for as much as 85% of the time over yearly periods and as much as 99.5% of the time for monthly periods. Operating personnel report that individual wells have been pumped continuously since installation, except when halted for repairs. The lower static elevations and increased drawdown indicate that overpumping has greatly accelerated the normal decrease of ground-water head. Demand is constantly increasing and there is every reason to anticipate that conditions will grow steadily worse.

1-06. Analysis. - While there is some fluctuation in the chemical characteristics of the raw water, plant laboratory records reveal no cause for worry. Hardness has averaged slightly below and alkalinity slightly above 150 p.p.m. Chlorides range from 10.0 to 10.9 p.p.m., and the pH is practically constant at 7.3. The greatest variation is in iron. Whenever any of the wells is rested the iron content on starting is always high. No bacterial analysis of raw water is made.

1-07. Raw Water Supply Mains. - At the time of the 1945 survey of wells by Carr and Greiner they expressed the opinion that certain sections of the asbestos-cement raw water line were obstructed by bacterial growths, causing an undue loss of head. Much of the line was dug up and inspected and was found to be exceptionally clean. The loss of head in the 3000 foot of pipe nearest the plant probably results from turbulence at the juncture of the 18" and 14" raw water lines.

1-08. 1945 Survey. - In February, 1945, a study of Camp Lejeune wells was made by Carr and J. E. Greiner Company, Architect-Engineers, who recommended

CHART NO. 1


INCHES PRECIPITATION PER ANNUM
70
60
50
40
30
20
"C" - 59.69
Av. 6 Yrs.
"B" - 52.64
Av. 5 Yrs. - 10 Mos.
"A"
AV. 19 Yrs. — 50.61
ANNUAL PRECIPITATION
WILMINGTON & CHERRY POINT, N. C.
WILMINGTON
CHERRY POINT
1930
31
32
33
34
35
36
37
38
39
1940
41
42
43
44
45
46
47
48
49
1950

that new pumps be installed at wells No. 17, 18, 19, 20 and 21, and that the wells be regrouped (for control) in accordance with a schedule submitted by them. The pumping equipment was not changed because records indicate that the wells are already overpumped with the present equipment, operating at less than capacity. Various groupings of the wells have been tried by operating personnel without much change in the yield, the simple fact being that too much water is being taken from the system. There is no reserve capacity and no reason to expect anything but still further decrease in future yield.

1-09. Treatment Plant. - The Hadnot Point Water Treatment Plant is designed to deliver a maximum of 5.0 MGD of treated water and has the following equipment:

5 - Rapid sand filters with capacity of 700 GPM each.

5 - Spiractors of 700 GPM capacity, with two lime dosing tanks and necessary pumps.

2 - Chlorinators - 100# capacity each.

2 - Ground Storage Tanks for treated water, combined capacity 1,300,000 gallons.

3 - High Lift Pumps - 1,500 GPM each.

1 - High Lift Pump - 700 GPM.

The plant laboratory is well equipped but is crowded into too small a space. The plant office is little more than a windowed closet and entirely inadequate. The lime dosing tanks are located on the second story and all lime used at the plant must be hoisted to this level, making this a costly and inefficient operation. There is no provision for bathing. Many man-hours are lost because of lime burns which might be prevented if showers were available.

1-10. Distribution. - The distribution system in the Regimental areas is well designed, consisting of a 12" loop completely encircling the area, with 8" grid and 8" and 6" cross-overs. The outlying areas with the exception of the Hospital are not looped. The housing area at Paradise Point is dependent upon one 12" main, failure of which would leave the Officers' Quarters destitute of water except for that in the elevated storage tank. The Industrial area, Trailer Camp, Camp School and Midway Park are all dependent for water supply upon one 12" main. Provision is made for pumping raw water into the distribution mains in event of serious fire hazard coupled with failure of the treated water supply; but this is a desperate remedy which should never be other than a last resort. It would largely defeat its own purpose by effecting an immediate and hazardous reduction in pressure, and the necessity of sterilizing the system in the wake of such an operation would entail much expense and inconvenience. There are in the distribution system three 300,000 gallon elevated storage tanks and two of 200,000 gallons capacity. With the ground storage facilities at the Water Treatment Plant this gives a total storage capacity of 2,600,000 gallons of treated water, approximately 24 hours supply.

Through the summer months peak demands are experienced which are such that treated water storage capacities cannot be maintained, and reserves for fire protection are dangerously lowered.

SECTION 2. ANTICIPATED REQUIREMENTS.

2-01. It is anticipated that the normal population of the area served by the Hadnot Point water supply system upon completion of the Five Year Construction Program will be as follows:

Barracks	20,000
Paradise Point Housing	2,700
Naval Hospital	700
Midway Park	5,500
Shift Population (1500)	750
Married Enlisted Qtrs.	3,375
Married Warrant Officers	675
Total	33,700
Say	35,000

In emergencies with the barracks double bunked, this figure might be increased by 20,000.

Records covering operation of the plant to date show a normal per capita demand of 143 gallons per day. It is, therefore, essential that before completion of the Construction Program we must be prepared to meet a regular demand for 5.0 MGD of treated water. No further expansion of the distribution system should be contemplated without careful consideration of the adequacy of existing facilities and proper provision for the increase in anticipated load.

Except in regard to supply, the necessity is not immediately pressing. The raw water wells are being abused and measures for their relief should be undertaken at the earliest possible date.

SECTION 3. CONCLUSIONS AND RECOMMENDATIONS.

3-01. Supply. - On the basis of the foregoing facts, it is recommended that the water supply system be expanded by the addition of six (6) new 8 inch deep wells of 250 g.p.m. capacity, located approximately as indicated on P.W. Drawing No. 3255. The final location of new wells shall be such that not more than 600,000 gallons of water per 24 hours per square mile shall be drawn from the underground source. Each of the new wells to be equipped with Electric-gasoline driven pumps and housed in buildings conforming to the present design. It is anticipated that the two Midway Park wells will produce 150 g.p.m. each.

3-02. Treatment. - Examination of the figures set forth in this report will show that the anticipated demand at the conclusion of the Five Year Construction Program will equal the maximum capacity of the present Treatment Plant, leaving no reserve. Despite this fact, no increase in treatment facilities is recommended until a concerted effort has been made to reduce the per capita water consumption. The community served by the Hadnot Point Water System uses a very small percentage of its water consumption for industrial purposes. Probably 80% of the water goes for domestic consumption and waste. Serious consideration should be given to the savings that could be accomplished by metering the quarters. A survey should be made to locate leaks. It is beyond the scope of this report to indicate possible action of the Camp Administration to accomplish the desired result; but due recognition should be given the obvious fact that our water consumption is unreasonable and every possible effort made to reduce the demand rather than perpetuate it by premature increase of facilities. At such time as our normal water consumption reaches 4.0 million gallons per day (80% of plant capacity) consideration should be given to the matter of increasing plant capacity to meet future needs, either by expanding the existing plant or constructing an auxiliary.

3-03. Water Storage. - It is recommended that a two (2) million gallon concrete reservoir be constructed for ground storage of treated water. This will give a total treated water storage capacity of 4.6 million gallons or approximately a 24 hour supply. Two (2) new 1500 GPM high lift pumps should be installed to care for this additional storage. The pumps to be housed in a new building adjacent to the reservoir. The proposed location of the reservoir and pump house is shown on P. W. Dwg. No. 3255. The storage basin will be filled from the treatment plant by gravity flow and water may be pumped into the 12 inch mains on River Road and G Street.

3-04. Laboratory. - It is recommended that more commodious quarters be found for the plant laboratory, which is now confined in too small a space for efficient operation. A suitable building could be constructed at small cost in rear of the storage building, between the clear water storage basin and G Street and this is probably the simplest solution of the problem.

The present laboratory space is well located for the plant office and, if the above recommendation is adopted, could be used for that purpose. Showers could then be installed in the present office room, which adjoins the head. These changes would cost little and would result in increased operating efficiency.

3-05. Distribution. - It is recommended that a 12 inch line be installed from the 300,000 gallon elevated storage tank near the Artillery Park to the Industrial Area at Gum Street and Michael Road, the proposed location being shown on P. W. Dwg. No. 3255.

SECTION 4. ESTIMATE

4-01. The cost of the recommended improvements is estimated as follows:

6 wells @ $3,000.00	$18,000.00
6 Pumps & motors @ $2,000.00	12,000.00
6 pump houses @ $2,500.00	15,000.00
3 miles elec. transmission @ $5,000.00	15,000.00
11,900 lin.ft. of 8" cem.asb. or CI pipe @ $4.00	47,600.00
7,700 lin.ft. of 10" Cem.Asb. or CI pipe @ $5.00	38,500.00
5,000 lin.ft. of 12" cem.asb. or CI pipe @ $7.00	35,000.00
2,800 lin.ft. of 18" cem.asb. or CI pipe @ $15.00	42,000.00
2,000 lin.ft. of 16" C.I. @ 12.00	24,000.00
2 million gal. underground, conc. reservoir @ .044	88,000.00
High lift pump house	15,000.00
2 - 1,500 g.p.m. pumps @ $3,000	6,000.00
Laboratory building	20,000.00
Total Estimated Cost	$376,100.00

Material	$188,050.00
Labor	$153,859.00
Contingency	$ 34,191.00
Total	$376,100.00