1

Assigned

Name ELMER BANKUS

By Box 340 610

Address Brookings, Oregon 97415

Date filed February 10, 1966

Priority February 10, 1966

Action suspended until Ohsent

Returned to applicant

Date of approval August 19, 1966

CONSTRUCTION

Date for beginning August 19, 1967

Date for completion October 1, 1968

Extended to

Date for application of water October 1, 1969

Extended to

PROSECUTION OF WORK

Form "A" filed Started

Form "B" filed Oct 10, 1968

Form "C" filed 2/10/1970

FINAL PROOF

Blank mailed OCT 12 1978

Proof received

Date certificate issued NOV 17 1978

Application No. 41871

Permit No. 31224

Certificate No. 46861

Stream Index, Page No. 15-21

See R-41870
DAM FILE F-25

FEES PAID

Date	Amount	Receipt No.
2-10-66	$75.00	8489
8-12-66	5.00	From App R41870
11-2-78	$ Cert. Fee	7177

FEES REFUNDED

Date	Amount	Check No.

ASSIGNMENTS

Date	To Whom	Address	Volume	Page
2-10-70	Brookings Utilities Company	Brookings, Oregon	4	2113
3-8-74	City of Brookingsl	Box C, Brookings, OR 97415	5	389

REMARKS

167.4 af stored water from Ferry Creek Reservoir (Ferry Creek) (Chetco River) for municipal use

OCT 3 1968 CARD FOR B
OCT 30 1969 CARD FOR C
FEB 3 1970 FORM 100 ER
Form 131 sent 10-30-78

State Printing 45049

Ok
3 B.

Form B

Application No. R41870
41871

NOTICE OF COMPLETION OF CONSTRUCTION

I, Elmer Bankus, the holder of Permit No. R4720 31224

to appropriate the public waters of the state of Oregon, completed the construction of the works described therein on the 1 day of Oct, 1968

Remarks:

If the works have less capacity than described in the permit, or you have definitely abandoned part of the proposed development, you should so state in order that our records may not be unnecessarily encumbered.

RECEIVED
OCT 16 1968
STATE ENGINEER
SALEM, OREGON

IN WITNESS WHEREOF, I have hereunto set my hand this 10 day of Oct, 1968

(Signature of Applicant)

Brookings Ore Box 610
(Address)

Fill out, detach and mail to the State Engineer, Salem, Oregon 97310, when construction work is completed.

3M—8-64

Ok
3 B.

Form C

Received 2/10/70 m.B.

IMPORTANT—This form is a notice to the State Engineer that permittee is ready to make **final proof** to the extent to which the water has actually been applied to the intended use under the terms of the permit. Permittee is cautioned that Certificate of Water Right will be issued based on the extent of the quantity and use as determined by the **final proof** inspection and survey which will be made in response to the filing of this Form C.

NOTE: In the case of an irrigation permit, this Form C should not be mailed to the State Engineer until all of the land described in the permit, which it is intended to irrigate under this permit at any time, has actually been irrigated.

Fill out, detach and mail to the State Engineer, Salem, Oregon 97310, when all of the water has been applied.

Application No. 41871

NOTICE OF COMPLETE APPLICATION OF WATER TO A BENEFICIAL USE

I, Elmer Bankus, the holder of Permit No. 31224

to appropriate the public waters of the state of Oregon, completely applied the waters to a beneficial use in accordance with the terms of said permit, on the ..... day of July 8, 1968

Remarks:

IN WITNESS WHEREOF, I have hereunto set my hand this 10 day of Feb, 1970.

(Signature of Applicant)

(Address)

Permit R-5M-1-78

41871

SP*32956-690

STATE OF OREGON

COUNTY OF CURRY

Proof of Appropriation of Water

CITY OF BROOKINGS

of Box C, Brookings, State of Oregon, 97415,
has applied beneficially the waters of
Ferry Creek Reservoir constructed under Permit No. R-4720

a tributary of Chetco River for the purpose of
municipal

under Permit No. 31224 and that the use of said waters has been completed under the terms of said permit; that the priority of the right dates from
February 10, 1966
that the amount of water for the purposes aforesaid, has been actually beneficially used in the amount of
167.4 acre feet stored water

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the NE¼ NW¼, Section 32, T. 40 S., R. 13 W., W. M., 4023 feet North 1 degree 15 minutes 20 seconds West from the S¼ Corner, Section 32

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to ---------- of one cubic foot per second per acre,

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right, and to which such right is appurtenant, is as follows:

SEE NEXT PAGE

I have read the above and foregoing proof of appropriation of water; I know the contents thereof, and that the facts therein stated are true.

IN WITNESS WHEREOF, I have hereunto set my hand this 16th day of October, 19 78

Robert L. Kerr

Mayor, City of Brookings
Title

SW¼ NE¼
NE¼ NW¼
S½ NW¼
N½ SW¼
SW¼ SW¼
SE¼ SE¼
Section 31

SW¼
W½ SE¼
Section 32
T. 40 S., R. 13 W., W. M.

NE¼ SW¼
N½ SE¼
SE¼ SE¼
Section 36
T. 40 S., R. 14 W., W. M.

NW¼ NE¼
W½
Section 5

N½
N½ SW¼
SE¼ SW¼
SE¼
Section 6

N½ NE¼
Section 7

NW¼ NW¼
Section 8
T. 41 S., R. 13 W., W. M.

NE¼ NE¼
Section 1
T. 41 S., R. 14 W., W. M.

Get a field from
made up on these &
make note that ADMP
will inspect Res &
nothing required by our
field crew – secondary
in the usual manner
↑ noted

then see that cards set up
for March 16 (as well as survey)
Linda will do this for
al

A# A1871
P# 31224
City of Brookings

40S	13W	31	SW¼ NE¼ –
			NE¼ NW¼ –
			S½ NW¼ –
			N½ SW¼ –
			SW¼ SW¼ –
			SE¼ SE¼ –
		32	SW¼ –
			W½ SE¼ –
40S	14W	36	NE¼ SW¼ –
			N½ SE¼ –
			SE¼ SE¼ –
41S	13W	5	NW¼ NE¼ –
			W½ –
		6	N½ –
			N½ SW¼ –
			SE¼ SW¼ –
			SE¼ –
		7	N½ NE¼ –
		8	NW¼ NW¼ ✓
41S	14W	1	NE¼ NE¼

Make usual insp on Secondary
— no use map —

City of Brookings
Box C
Brookings Oreg 97415

Abstract of Permit No. 31224

Box

Application No. 41871 Certificate No.

Name: ~~Elmer Bankus~~ Assigned to Brookings Utilities Company

Address: Box 340, Brookings, Oregon

Source of water supply: Perry Creek Res. to be constructed under ~~Appl. No. [illegible]~~, Permit No. R-4720

Use: municipal

Point of diversion: ~~4023' N. 1° 15' 20" W. SE cor., Sec. 32~~, being within NE¼NW¼, Sec. 32, T. 40 S., R. 13 W., W.M., ~~county of Curry~~

Number of acres

4023', N 1° 15' 20" W, from S¼ cor Sec. 32

DESCRIPTION OF LAND TO BE IRRIGATED OR PLACE OF USE

Twp.	Range	Sec.	NE¼				NW¼				SW¼				SE¼			
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼
40S	14W	31															X	X
		32			X	X				X	X		X	X	X	X	X	X
	13W	33			X	X			X	X		X			X			
41S	14W	5		X	X		X	X	X	X	X	X	X	X				
		6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Priority date: February 10, 1966

Amount of water: 167.4 a.f. stored water

Time limit to begin construction: ~~August 19, 1967~~

Time limit to complete construction: ~~10-1-68~~ extended to ____ extended to ____

Time limit to completely apply water: ~~10-1-69~~ extended to ____ extended to ____

Remarks: Plan to abandon after 10-15-76

O.K. for 167.4 A.F.

A. M. Petska Engr.

Inspection 8-27-76 LHN

NOT HOUSE 2-6-75 LHN

Main-15, Vol. ____

SI*12996-119

Info: Al Hooten, City Manager

Source: Ferry Cr. Res. & Ferry Cr. trib Chetco Riv.

Div: 30" steel thru dam into 12" steel to city

Use: Municiple for City of Brookings including Industry & state parks

Remarks: Most info is in Engineering Report of the Water Distribution System, Brookings Oregon, June, 1976, CH2M

Mr. Hooten said the City plans to abandan Ferry Cr. Res. as city water supply when new water plant begins operation in Oct. 1976

Ties: Inspection of Figure III-4 in above report (water distribution system)

8-27-76

Larry H. Munn

Field Engineer

I CALLED BROOKINGS CITY HALL. THEY HAVE BEEN HAVING TROUBLES WITH THEIR NEW WATER SUPPLY FROM CHETCO RIVER & ARE STILL USING FERRY CR. RES. AS A SOURCE. THEY DO NOT PLAN ON DISMANTLING FERRY CR. RES. LINE AT THIS TIME, SO WE SHOULD PROB. ISSUE CERT. ON THIS

9-25-78 R.C.M.

G-5869
R-41870

41871

April 11, 1974

City of Brookings
Box C
Brookings, OR 97415

Gentlemen:

The assignment of permits numbered R-4720 and 31224 and application numbered G-5869 from Brookings Utility Co. to you has been recorded in the records of the State Engineer. Our records have been changed accordingly, and the original is enclosed.

Our receipt numbered 38972 covering the $2.00 recording fee along with a copy of this letter is being sent to Brookings Utility Co.

Very truly yours,

VESTAL R. GARNER
Assistant

VRG:tml
Enclosure
cc: Brookings Utility Co.
Boc 610
Brookings, OR 97415

R-41870
41871
G-5869
37091

April 9, 1974

City of Brookings
Box C
Brookings, OR 97415

Gentlemen:

Acknowledged is the assignment of water right permits numbered R-4720, 31224, and 27160, and water right application numbered G-5869, and the assignment recording fee of $2.00.

State statutes provide that the assignment recording fee is $2.00 per page, therefore, we are recording the assignment of permits R-4720 and 31224 and application G-5869.

We will withhold further action on the assignment of permit numbered 27610 until receipt of the assignment recording fee of $2.00.

Very truly yours,

VESTAL R. GARNER
Assistant

VRG:tml

July 7, 1972

R-41870
41871
Dam File
F-25

Mr. Elmer Bankus
P.O. Box 610
Brookings, OR 97415

Dear Mr. Bnakus:

Would you please advise as to the status of your construction regarding the spillway of your Ferry Creek Dam. I will be in the Brookings area sometime in July, 1972, and will contact you at that time for an inspection.

Very truly yours,

A. M. PETSKA
Engineer

AMP:cd

December 3, 1971

R-41870
41871
Dam File
F-25

Mr. Elmer Bankus
Box 610
Brookings, OR 97415

Dear Mr. Bankus:

In August of 1971 I performed an inspection of your Ferry Creek Reservoir. At that time, the foreman who accompanied me on the inspection advised you intended to complete the project prior to the winter rains.

Would you please advise the status of your construction, particularly the area of the spillway. I intend to be in the Brookings area sometime early in 1972 and will contact you at that time.

Very truly yours,

A. M. PETSKA
Engineer

AMP:cd

October 27, 1971

R-41870
41971
Dam File
F-25

Mr. Elmer Bankus

Brookings Water Company
Box 610
Brookings, OR 97415

Dear Mr. Bankus:

In August of this year, I performed an inspection of your Ferry Creek Reservoir. At that time your foreman who accompanied me on the inspection, advised that you were preparing to start construction and complete this project in accordance with the plans and specifications. I advised your foreman, and also advised you by letter on August 24, 1971, that I felt it necessary that this work be completed this year. Would you please advise as to the status of the work on this project and your estimated completion of construction date. Again, this back-fill and the construction of this spillway differential according to the plans and specifications must be completed this year prior to the onset of the coming precipitation season. As you well know, we can expect the rains at any time.

Very truly yours,

A. M. PETSKA
Engineer

AMP;cd

August 24, 1971

R-41970
41871

Mr. Elmer Bankus, President
Brookings Water Company
Box 610
Brookings, OR 97415

Dear Mr. Bankus:

The morning of August 17, 1971, accompanied by your foreman, I performed an inspection of your Ferry Creek Reservoir. At that time your foreman advised that you were preparing to start construction and complete this project in accordance with the plans and specifications. I advised your foreman that I felt it necessary that this work be completed this year. He advised that this was your intention.

Would you please advise when this work is in progress so that engineers from this office might schedule an inspection of this project at the completion of construction. Again, this backfill and spillway differential construction must be completed this year prior to the onset of the coming precipitation season.

Very truly yours,

A. M. PETSKA
Engineer

AMP:cd

August 12, 1971

R-41870
41871
Dam File
F-25

Mr. Elmer Bankus
Brookings Utilities Co.
Box 610
Brookings, OR 97415

Dear Mr. Bankus:

I intend to be in the Brookings area either late Monday or early Tuesday, August 16 or 17 and would like, at that time, to inspect your Ferry Creek Reservoir and Dam. If you would advise your people that I will be in the area in order that they may unlock the gate, I would appreciate it.

Very truly yours,

A. M. PETSKA
Engineer

AMP:cd

STATE OF OREGON
STATE ENGINEER
WATER RESOURCES DEPARTMENT
516 PUBLIC SERVICE BUILDING
SALEM 97310

REFER TO FILE NO. 41871

February 20, 1970

Brookings Utilities Company
Brookings, Oregon 97415

Gentlemen:

This will acknowledge receipt of your notice to the effect that complete application of water has been made under permit No. 31224.

Pursuant to your report and in line with the general practice of this office, a survey will be made at a later date.

After this survey, proof may be made and certificate issued covering the actual use of water as found by the engineer. In case of irrigation, any lands described in the permit that have not been irrigated will be automatically eliminated from the water right.

In the meantime, the permit which you hold will be valid evidence of the water right in question so long as you continue to use the water.

Very truly yours,

Chris L. Wheeler

CHRIS L. WHEELER
State Engineer

Form 128 C
reo

R-41870
41871

February 16, 1970

Brookings Utilities Company
Brookings
Oregon 97415

Gentlemen:

Enclosed is the assignment of Permit numbers R-4720 and 31224 from Elmer Bankus to you. This has been recorded in the Records of the State Engineer, and our records have been changed accordingly.

Very truly yours,

Myron V. Bish
Assistant

MVB:cjs

Enclosure

STATE OF OREGON
STATE ENGINEER
WATER RESOURCES DEPARTMENT
516 PUBLIC SERVICE BUILDING
SALEM 97310

REFER TO FILE NO. R-41870
41871

February 3, 1970

Elmer Bankus
Box 61 D
Brookings, OR 97415

Dear Sir:

According to the terms of your permit Nos. R-4720, 31224, for storage of 167.4 acre feet of stored water from Ferry Creek Reservoir and Ferry Creek for municipal use,

complete application of water was to have been made by October 1, 1969.

Complete application of water means the application of water to beneficial use under the permit to the full extent intended. In the case of irrigation, it means beneficial irrigation of all the lands the permittee intends to cover under the terms of the permit. If water has been used, you should promptly submit notice describing the extent of completion as set forth in the letter accompanying your permit and also in our postal card of October 30, 1969.

ORS 537.260 provides that: "Whenever the time within which any appropriation under a permit should have been perfected has expired and the owner of the permit fails or refuses within three months thereafter to submit to the State Engineer proof of completion of the appropriation as required by ORS 537.230 and 537.250, the State Engineer may, after 60 days' notice by registered mail, order the cancelation of the permit.****"

In accordance with the provisions of ORS 537.260, you are hereby notified that unless proof of beneficial use is received within 60 days from the date of this letter, the permit(s) may be canceled without further notice.

If for any reason you are no longer interested in the project described by the permit, we would appreciate it if you would so advise. If the property involved has changed hands and any part of the project has been completed, you should immediately assign the permit to the new owner and advise us of his name and address. An assignment form will be furnished upon request.

Very truly yours,

Chris L. Wheeler

CHRIS L. WHEELER
State Engineer

Form 100
Certified
Return receipt requested

STATE OF OREGON
STATE ENGINEER
WATER RESOURCES DEPARTMENT
516 PUBLIC SERVICE BUILDING
SALEM 10

October 10, 1968

R-41870
REFER TO FILE NO. 41871

Elmer Bankus
Box 610
Brookings, Oregon 97415

Dear Sir:

This will acknowledge the notice of completion of construction under the terms of permit No.s R-4720 and 31224.

Under the provisions of the permit, the time limit for completion of the appropriation by accomplishing the authorized beneficial use of water to the full extent intended will expire October 1, 1969. (In the case of irrigation completion of the appropriation means at least one beneficial irrigation of all the land to be irrigated under the subject permit.)

Very truly yours,

Chris L. Wheeler

CHRIS L. WHEELER
State Engineer

Form 119
ks

R-41870
41871

August 26, 1966

Elmer Bankus
Box 340
Brookings, Oregon

Dear Mr. Bankus:

R-41870, Permit No. R-4720, Application No. 41871, Permit No. 31224 with blueprints.

R-41870
41871

August 22, 1966

Mr. Elmer Bankus
Box 340
Brookings, Oregon

Dear Mr. Bankus:

This is to advise that your applications numbered 41871 and R-41870 have been approved by issuance of permits authorizing the construction of a reservoir and the storage of 167.4 acre feet of water from Ferry Creek and the appropriation of 167.4 acre feet stored water from the reservoir for municipal purposes.

You may use this letter as your authority to begin construction of the project authorized by the permits pending your receipt of the permits. The permits will be mailed to you as soon as the necessary entries have been completed in the records of this office.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
Trevor Jones, Assistant

TJ:py

41871
R-41870

August 12, 1966

Elmer Bankus
Box 340
Brookings, Oregon

Dear Mr. Bankus:

This will acknowledge receipt of the additional $5 fee required for application No. 41871 for which our receipt No. 122 is enclosed.

This application is in satisfactory form for approval by issuance of a permit.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
Larry W. Jebousek
Assistant

LWJ:dly
Enclosure

41871
R-41870

July 14, 1966

Elmer Bankus
Box 340
Brookings, Oregon

Dear Mr. Bankus:

During the final inspection, I found application No. 41871 required $5 additional recording fee.

We will withhold further action on these applications pending the receipt of the fees.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
Larry W. Jebousek
Assistant

LWJ:dly

R-41870
41871
F-25

Mr. Carl Rohde
Engineer
654 Ridgeway Road
Oswego, Oregon

Dear Mr. Rohde:

This letter is to advise you that the permits have been issued for the Bankus Dam, Ferry Creek Reservoir, Brookings, Oregon. Since this project is over the statutory limits, it will be necessary that the construction be supervised by a registered professional engineer to insure compliance with these approved plans and specifications. Since you were the design engineer, we shall assume that you will be the engineer responsible to insure that this construction is in accordance with these plans and specifications.

Engineers from this office will be available to work with you covering any changes made necessary by conditions discovered during construction if you will so advise.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
A. M. Petska
Engineer

AMP:jb

cc: Elmer Bankus
Brookings Water Company
Brookings, Oregon

R-41870
41871
F-25

Mr. Carl Rohde
Engineer
654 Ridgeway Road
Oswego, Oregon

Dear Mr. Rohde:

This letter is to advise you that the permits have been issued for the Bankus Dam, Ferry Creek Reservoir, Brookings, Oregon. Since this project is over the statutory limits, it will be necessary that the construction be supervised by a registered professional engineer to insure compliance with these approved plans and specifications. Since you were the design engineer, we shall assume that you will be the engineer responsible to insure that this construction is in accordance with these plans and specifications.

Engineers from this office will be available to work with you covering any changes made necessary by conditions discovered during construction if you will so advise.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
A. M. Petska
Engineer

AMP:jb

cc: Elmer Bankus
Brookings Water Company
Brookings, Oregon

CARL ROHDE
CONSULTING ENGINEER
654 RIDGEWAY ROAD
OSWEGO, OREGON
NEptune 6-4469

May 31, 1966

Mr. A. M. Petska
The State Engineer's Office
Water Resources Dept.
516 Public Service Bldg.
Salem, Oregon 97310

Re: File Nos. 3311, 5114,
5705, 7364, 22928

Dear Al:

Transmitted herewith are my plans and specifications for increasing the height of Bankus Dam on Ferry Creek. I trust you will find everything in order; and if I have missed anything or you require additional information, please let me know.

Sincerely,

Carl Rohde

CARL ROHDE

Encl: 1 set prints of 3 drawings
1 set reproducibles of same
2 sets specifications

cc: Elmer Bankus
w. encl. (prints & specs.)

May 31, 1966

State Engineer
Salem, Oregon

Gentlemen:

This will authorize you to make any changes on the application to agree with the plans and specifications as submitted by Carl Rohde, Engineer, on May 31, 1966.

Elmer Bankus

3311
5114
5705
7364
22928
R-41870
41871
F-25

MEMORANDUM

May 20, 1966

On Monday, May 16, 1966, I visited the Ferry Creek Reservoir owned by the Brookings Water Company.

I found that since my previous visit in March, the dam and spillway had been raised five or six feet. The upstream slope appeared to have been towed at the end of the conduit. The tower had been erected over the conduit entrances with the valve operating wheels well above the proposed high water. The new spillway contemplated around the left abutement had not been accomplished.

David B. Hall
Engineer

DBH:jb

3311
5114
5705
7364
22928
R-41870
41871
F-25
May 19, 1966

MEMORANDUM

Via a telephone call this morning to Carl Rohde. Advised Mr. Rohde that plans and specifications were to be submitted to this office prior to June 1, 1966 as action towards drawing this reservoir down to its permit level would be taken that date.

A. M. Petska
Engineer

AMP:jb

3311
5114
5705
7364
22928
R-41870
41871
F-25
May 19, 1966

MEMORANDUM

Mr. Bankus telephoned this morning to advise that he had contacted Mr. Carl Rohde to prepare plans and specifications in accordance with our instructions. He further advised that Mr. Rohde was slow and that we, the State Engineer, should, from time to time, jack up Mr. Rohde in order that these plans and specifications would be submitted on time. I told Mr. Bankus that Mr. Rohde was his agent and that if he was dissatisfied with the services that Mr. Rohde was providing, that he should obtain the services of another engineer; that it was not this offices intent or purpose to police Mr. Rohde or to take any action with Mr. Rohde to insure that the plans and specifications are submitted, as this is the responsibility of Mr. Bankus.

I reiterated again that work was to cease on the project and was not to be started again until plans and specifications had been submitted and approved and a permit issued. This was to be done immediately or it would be necessary to take steps to lower this reservoir to the permit capacity.

A. M. Potska
Engineer

AMP:jb

3311
5114
5705
7364
22928
R-41870
41871
F-25

May 19, 1966

Mr. Elmer Bankus
Brookings Water Company
Brookings, Oregon

Dear Mr. Bankus:

Mr. Carl Rohde just telephoned requesting that he be given ten days to prepare the complete plans and specifications for your Ferry Creek Dam. After some deliberation, I informed Mr. Rohde that plans and specifications covering this project were to be submitted to this office prior to June 1, 1966.

I can see no reason for rehashing the previous correspondence and verbal messages to justify this position since they are well known to you. I hope I made my position clear in our telephone conversation of Wednesday, May 18, 1966.

In the event plans and specifications are not submitted prior to this date, action will be taken to limit the capacity of your reservoir to that called for in the permits as specified and outlined in my letter of February 7, 1966.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
A. M. Petska
Engineer

AMP:jb

cc: Carl Rohde

3311
5114
5705
7364
22928
R-41870
41871
F-25
May 18, 1966

MEMORANDUM

Conversed this date by telephone with Elmer Bankus regarding the Ferry Creek Reservoir and his actions. Advised Elmer that Mr. Hall of this office had visited this project and found that he had or was essentially raising the structure approximately six feet, that he was modifying or was about to modify the spillway.

Mr. Bankus indicated he does not consider that he is raising the dam six feet and would not be increasing the height until he had closed the gap. I reminded Mr. Bankus of previous correspondence and conversations during which he avowed that he would not do any more construction on this project until plans and specifications had been submitted and approved, and a permit issued. Mr. Bankus, after much words, advised me that his hearing was not very good and there were certain words at certain frequencies that he could not hear nor could he comprehend.

I informed Mr. Bankus to obtain the services of a registered professional engineer to draw up and submit plans and specifications covering this structure at its ultimate height immediately.

A. M. Petska
Engineer

AMP:jb

Files

March 2, 1966

3311
5114
5705
7364

A. M. Petska
Engineer

Brookings Water Company Reservoir

Mr. Bankus was in the office this date regarding work done on the Brookings Water Company reservoir. He is presently engaged in extending the conduits in order that he may dress the front slopes to the required 3:1.

He further indicates that Mr. Rohde is supervising this work and will be reflected in the plans and specifications for the proposed completed structure. Mr. Bankus estimates this work will be completed and water will be impounded in the reservoir by March 15, 1966.

Stapled to this memorandum are two photographs which show the 1/2-inch steel pipe forms and reinforced steel just before pouring the encasing concrete. (See files R-41870 & 41871).

R-41870
41871

February 23, 1966

Elmer Bankus
Box 340
Brookings, Oregon

Dear Sir:

This will acknowledge your application for a permit to construct a reservoir and store 200 acre feet of water therein from Ferry Creek for municipal water supply and fees of $16 for which our receipt No. 8488 was handed to you. The application has been filed and numbered R-41870.

Also acknowledged is your application for a permit to appropriate 200 acre feet of water from Ferry Creek Reservoir for municipal water supply and fees of $15 for which our receipt No. 8489 was handed to you. The application has been filed and numbered 41871.

Further action on these applications will be withheld pending the submission of plans and specifications for the proposed structure and a map showing the intended boundaries of the area to be served as discussed on February 10, 1966, with you in our office.

Very truly yours,

CHRIS L. WHEELER
State Engineer

By
Larry W. Jebousek, Assistant

LWJ:bs

Form E-89 2M-60

OREGON STATE HIGHWAY DEPARTMENT

Materials Division

Laboratory Report

Project	Brookings Water Co. Dam	Prefix No.	State Eng'r.
Highway		County	
Contractor		Contract No.	F. A. Project No.
Submitted by	Gred Gustafson	Date reported	June 1,1961

REPORT ON SAMPLE OF SOIL

Source of material	Hole #4		
Sampled at			
To be used		Date received	May 18,1961
Sampled by	Carl Rohde	Quantity represented	
Laboratory No.	554121	Type of material	soil (Sack)
Data Sheet No.	None	Sample No.	2

TEST RESULTS

SOIL ANALYSIS:

LL	33	%
PI	10	%
FME		%
SL		%
R		%
Cf		%
LS		%
Classification—Group		
Sp. Gr. (Le Chatelier)	2.69	
Sand Equivalent		%
Natural Moisture		%

SIEVE ANALYSIS:

Ret. on	% Single Sieve
4	8.6
10	8.3
40	13.1
60	ϕ 5.6
200	15.5
pass	48.9

DENSITY DETERMINATION:

Dry Density, lbs./c. f.	% moisture
97.9	11.6
100.2	14.0
102.8	16.4
106.8	18.8
104.0	21.3

HYDROMETER ANALYSIS: Passing No. 10 / Total Sample

Particles larger than 2.0 mm.	%	16.9	%
Coarse sand, 2.0 to 0.42 mm.	15.8%	13.1	%
Fine sand, 0.42 to 0.074 mm.	25.4%	21.1	%
Silt, 0.074 to 0.005 mm.	32.8%	27.3	%
Clay, smaller than 0.005 mm.	26.0%	21.6	%
Colloids, smaller than 0.001 mm.	%		%

TRIAXIAL SHEAR TEST:

Sample	Remolded	xxxxxxxxx	
% Compaction			
% Moisture	21.3	23.6	26.0
Depth Ratio Z/R			
Pavement Thickness, Z			
Angle of Friction, ϕ °	8	5	3
Cohesion, C psi	8	4	2
R Value			

Remarks: Permeability, 20°C K=ft./day

Load P.S.F.	Voids ratio
1000	.762
8000	.609

RECOMMENDATIONS

Material as represented by this sample ..... S.C ..... suitable for use. Clayey sand

TEST REPORT DISTRIBUTION:

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G. W. Hoover

Engineer of Materials

State Printing 26736

Form E-69—15M—4-60

OREGON STATE HIGHWAY DEPARTMENT

Materials Division

Laboratory Report

Project	Brookings Water Co. Dam	Prefix No.	State Eng'r.
Highway		County	
Contractor		Contract No.	F. A. Project No.
Submitted by	Gred Gustafson	Date reported	June 1,1961

REPORT ON SAMPLE OF SOIL

Source of material	Hole #4		
Sampled at			
To be used		Date received	May 18,1961
Sampled by	Carl Rohde	Quantity represented	
Laboratory No.	554121	Type of material	soil (Sack)
Data Sheet No.	None	Sample No.	2

TEST RESULTS

SOIL ANALYSIS:			SIEVE ANALYSIS:		DENSITY DETERMINATION:		
LL	33	%		% Single	Dry Density, lbs./c. f.	% moisture	
PI	10	%	Ret. on	Sieve			
FME		%			97.9	11.6	
SL		%	4	8.6	100.2	14.0	
R		%	10	8.3	102.8	16.4	
Cf		%	40	13.1	106.8	18.8	
LS		%	60	∅ 5.6	104.0	21.3	
			200	15.5			
Classification—Group			pass	48.9	TRIAXIAL SHEAR TEST:		
					Sample	Remolded	xxxxxxxxxx
Sp. Gr. (Le Chatelier)	2.69				% Compaction		
Sand Equivalent		%			% Moisture	21.3 23.6 26.0	
Natural Moisture		%			Depth Ratio Z/R		
					Pavement Thickness, Z		

HYDROMETER ANALYSIS: Passing No. 10		Total Sample		Angle of Friction, ϕ °	8	5	3
Particles larger than 2.0 mm.	%	16.9	%	Cohesion, C psi	8	4	2
Coarse sand, 2.0 to 0.42 mm.	15.8%	13.1	%	R Value			
Fine sand, 0.42 to 0.074 mm.	25.4%	21.1	%	Remarks:			Permeability,
Silt, 0.074 to 0.005 mm.	32.8%	27.3	%	Load P.S.F.	Voids ratio		20°C K=ft./day
Clay, smaller than 0.005 mm.	26.0%	21.6	%	1000	.762		2.67x10⁻⁴
Colloids, smaller than 0.001 mm.	%		%	8000	.609		1.06x10⁻⁴

RECOMMENDATIONS

Material as represented by this sample ..... suitable for use.

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H. W. Kern

Engineer of Materials

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OREGON STATE HIGHWAY DEPARTMENT

Materials Division

Laboratory Report

Project	Brookings Water Co. Dam	Prefix No.	State Eng'r.
Highway		County	
Contractor		Contract No.	F. A. Project No.
Submitted by	Fred Gustafson	Date reported	June 1,1961

REPORT ON SAMPLE OF SOIL

Source of material	Hole # 4		
Sampled at			
To be used		Date received	May 18,1961
Sampled by	Carl Rohde	Quantity represented	
Laboratory No.	554120	Type of material	soil (Tube)
Data Sheet No.	None	Sample No.	

TEST RESULTS

SOIL ANALYSIS:			SIEVE ANALYSIS:		DENSITY DETERMINATION:		
LL	31	%		% Single	Dry Density, lbs./c. f.		% moisture
PI	4	%	Ret. on	Sieve			
FME		%					
SL		%					
R		%					
Cf		%					
LS		%					
Classification—Group					TRIAXIAL SHEAR TEST:		
					Sample	Remolded	Undisturbed
Sp. Gr. (Le Chatelier)					% Compaction		
Sand Equivalent		%			% Moisture		
Natural Moisture	22.4	%			Depth Ratio Z/R		
					Pavement Thickness, Z		

HYDROMETER ANALYSIS:	Passing No. 10	Total Sample
Particles larger than 2.0 mm.	%	%
Coarse sand, 2.0 to 0.42 mm.	%	%
Fine sand, 0.42 to 0.074 mm.	%	%
Silt, 0.074 to 0.005 mm.	%	%
Clay, smaller than 0.005 mm.	%	%
Colloids, smaller than 0.001 mm.	%	%

Angle of Friction, ϕ °

Cohesion, C psi

R Value

Remarks:

RECOMMENDATIONS

Material as represented by this sample ..... suitable for use.

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Engineer of Materials

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OREGON STATE HIGHWAY DEPARTMENT

Materials Division

Laboratory Report

Project	Brookings Water Co. Dam	Prefix No.	State Eng'r.
Highway		County	
Contractor		Contract No.	F. A. Project No.
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Source of material	Hole # 4		
Sampled at			
To be used		Date received	May 18,1961
Sampled by	Carl Rohde	Quantity represented	
Laboratory No.	554120	Type of material	soil (Tube)
Data Sheet No.	None	Sample No.	

TEST RESULTS

SOIL ANALYSIS:			SIEVE ANALYSIS:		DENSITY DETERMINATION:		
LL	31	%		% Single	Dry Density, lbs./c. f.	% moisture	
PI	4	%	Ret. on	Sieve			
FME		%					
SL		%					
R		%					
Cf		%					
LS		%					
Classification—Group					TRIAXIAL SHEAR TEST:		
					Sample	Remolded	Undisturbed
Sp. Gr. (Le Chatelier)					% Compaction		
Sand Equivalent		%			% Moisture		
Natural Moisture	22.4	%			Depth Ratio Z/R		
					Pavement Thickness, Z		

HYDROMETER ANALYSIS: Passing No. 10		Total Sample	
Particles larger than 2.0 mm.	%	%	Angle of Friction, ϕ °
Coarse sand, 2.0 to 0.42 mm.	%	%	Cohesion, C psi
Fine sand, 0.42 to 0.074 mm.	%	%	R Value
Silt, 0.074 to 0.005 mm.	%	%	Remarks:
Clay, smaller than 0.005 mm.	%	%	
Colloids, smaller than 0.001 mm.	%	%	

RECOMMENDATIONS

Material as represented by this sample ..... suitable for use.

TEST REPORT DISTRIBUTION:

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G. W. Harvey

Engineer of Materials

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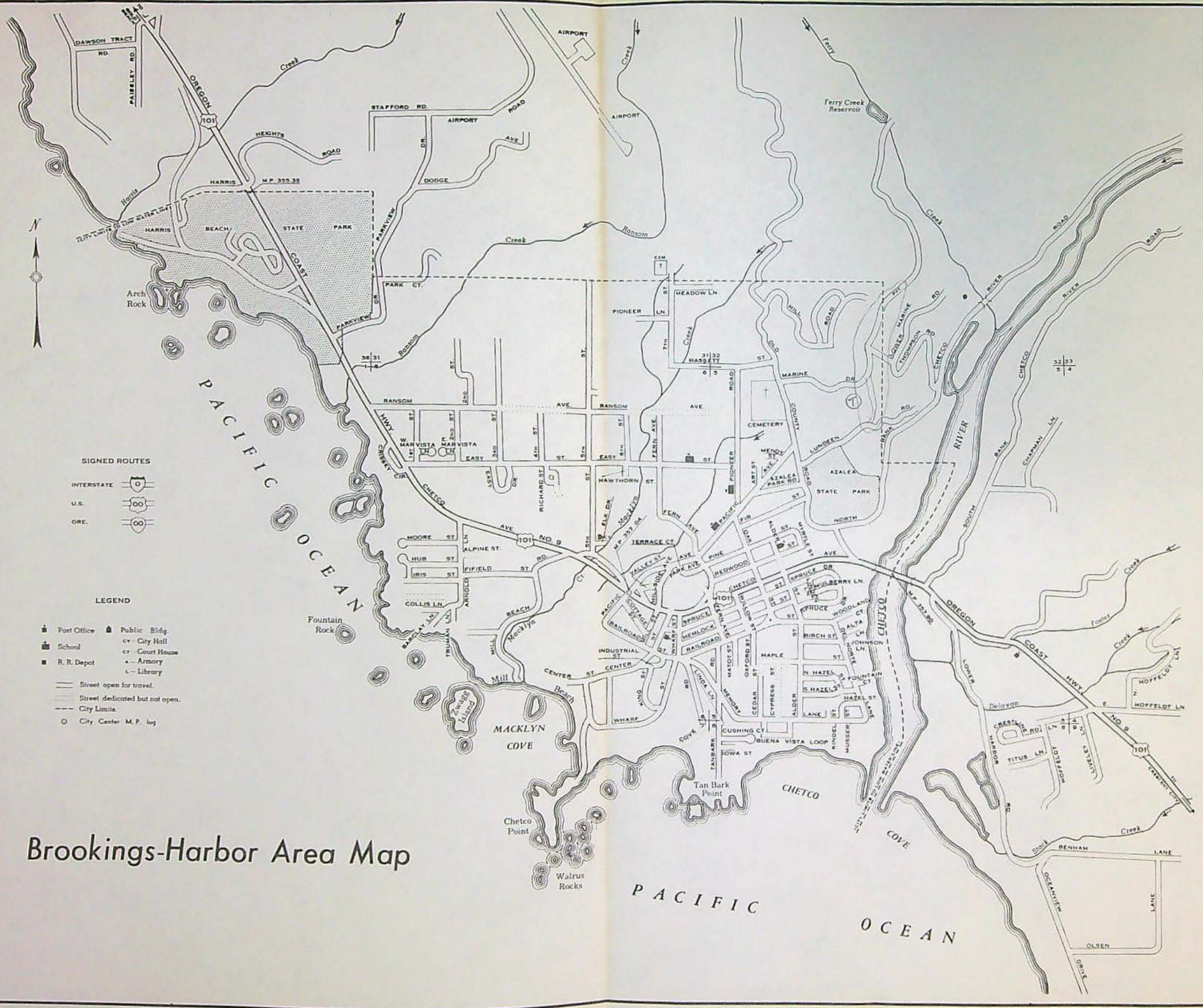

Brookings-Harbor Area Map
N
SIGNED ROUTES
INTERSTATE
U.S.
ORE.
LEGEND
Post Office
School
R. R. Depot
Public Bldg.
CH – City Hall
CT – Court House
A – Armory
L – Library
Street open for travel.
Street dedicated but not open.
City Limits.
City Center M.P. log
PACIFIC OCEAN
Arch Rock
Fountain Rock
Zwingle Island
MACKLYN COVE
Chetco Point
Walrus Rocks
Tan Bark Point
CHETCO COVE
HARRIS BEACH STATE PARK
DAWSON TRACT RD.
PAISLEY RD.
OREGON
101
STAFFORD RD.
AIRPORT
HEIGHTS ROAD
DODGE
PARKVIEW DR.
COAST
HARRIS
M.P. 335.38
PARK CT.
RANSOM AVE.
W. MARVISTA
E. MARVISTA
EASY
RICHARD ST.
HWY
CHETCO AVE.
NO. 9
MOORE ST.
HUB ST.
IRIS ST.
ALPINE ST.
FIFIELD ST.
COLLIS LN.
ARNOLD
BARCLAY LN.
TRUMAN LN.
BEACH
Mill
Macklyn
CENTER ST.
INDUSTRIAL ST.
WHARF
KING ST.
MEADOW LN.
PIONEER LN.
HASSETT ST.
CEMETERY
MARINE DR.
COUNTY ROAD
PIONEER
HAWTHORN ST.
TERRACE CT.
FERN AVE.
PACIFIC
AZALEA PARK RD.
AZALEA STATE PARK
NORTH
FIR
ALDER ST.
MYRTLE ST.
PINE
REDWOOD
SPRUCE DR.
VALLEY ST.
PARK AVE.
CHETCO
SPRUCE
HEMLOCK
RAILROAD
MAPLE
BIRCH ST.
WOODLAND DR.
ALTA CT.
JOHNSON LN.
CYPRESS ST.
CEDAR
OXFORD ST.
MATOT ST.
LINDA LN.
MEMORY
N. HAZEL
S. HAZEL
FOUNTAIN CT.
HAZEL ST.
LANE
CUSHING CT.
BUENA VISTA LOOP
SOWA ST.
TANBARK
KINDEL
MUSSER
Ferry Creek Reservoir
Ferry Creek
Ransom Creek
Harris Creek
Chetco River
LOWER MARINE RD.
THOMPSON RD.
MILL ROAD
LUNDEEN PARK RD.
CHAPMAN LN.
BANK
SOUTH
RIVER
OREGON COAST HWY
Foster Creek
Delyon
HOFFELDT LN.
CRESTVIEW RD.
HARBOR RD.
TITUS LN.
HOFFELDT
LINDLEY LN.
CHETCO AVE.
Stout Creek
BENHAM LANE
OCEANVIEW LANE
OLSEN
GRISE
PACIFIC OCEAN

CH2M HILL
engineers
planners
economists
scientists

10 June 1976

C9710.A0

City of Brookings
P.O. Box C
Brookings, Oregon 97415

Attention: Mr. Al R. Hooten
City Manager

Gentlemen:

Subject: Engineering Report of the
Water Distribution System

Transmitted herewith is our report reviewing the present condition of the Brookings municipal water system and presenting a Distribution System Improvement Plan in accordance with your authorization of 17 November 1975.

This report proposes major improvements to the distribution system, and when implemented the City will be able to provide adequate and reliable water service within all sectors of the service area through 1996. Figure III-4 outlines the distribution system improvements as a guide to construction. The improvements recommended upgrade the system to meet growth in demand, to supply larger fire flows to critical areas, and are in conformance with the present standards of the Oregon Health Division as we interpret them.

The financial requirements to provide the needed facilities are discussed in Chapter V. The present rate structure is not adequate to support the growth in system demand, upgrade the system to meet the minimum requirements, and keep pace with rapidly rising costs for equipment, supplies, and labor to operate and administer the water department. Guidelines for rate increases and fees are considered in Chapter V. Our recommendations concluding this study are contained in Chapter VII.

We wish to express our sincere appreciation for the opportunity to assist you with the planning of Brooking's municipal water system, and to convey our special thanks for the cooperation and assistance of the City Staff and Council members.

Sincerely,

Charles R. Meek

Charles R. Meek
Project Manager

kf

ENGINEERING REPORT
OF THE
WATER DISTRIBUTION SYSTEM

CITY OF BROOKINGS
OREGON

Prepared By

CH2M HILL, INC.
1600 S.W. Western Boulevard
Corvallis, Oregon 97330

Date: June 1976

Project No. C9710.A0

ENGINEERING REPORT OF THE WATER DISTRIBUTION SYSTEM

LIST OF TABLES

LIST OF FIGURES (PLATES)

Chapter I
INTRODUCTION

GENERAL

Prior to 1973, the water supply and distribution system serving the City of Brookings was owned and operated by Elmer Bankus, whose ownership and operation of the system dated back to the early beginnings of the City. During the growth years, much of the water system had become deficient, and in 1973, when the plans for the City's acquisition of the privately owned facilities were being developed, it was generally recognized that major improvements to the water supply and distribution system would be needed. Therefore, in addition to the financial aid for the purchase of the water system, the City also borrowed additional funds through the U.S. Department of Agriculture, Farmers Home Administration, for the construction of some major expansions.

The construction of the major improvements was started in 1975 with the work proceeding under four separate phases. A 1.5 million gallon per day (mgd) water treatment facility and intake improvement is scheduled for completion in the fall of 1976, and a 1.5 million gallon welded steel reservoir was placed into service in the fall of 1975. Additional major improvements are either under construction or construction is about to commence, including almost two miles of 14-inch asbestos cement transmission pipe between the new water treatment plant and the 1.5 mg steel reservoir; approximately 3/4-mile of 10-inch raw water pipeline; and another major section of 12-inch and 16-inch asbestos cement pipeline which interconnects the new 1.5 mg steel reservoir with the existing distribution network.

With the completion of the major improvements to the water supply facilities and the addition of the distribution storage, much of the water systems deficiencies will be corrected; however, the distribution network is overextended in the upper elevations and the system consists of undersize and aged pipe which contribute to the inadequate pressures and low flow capabilities for meeting normal consumptive needs and fire fighting requirements.

PREVIOUS STUDIES

Since the incorporation of the City of Brookings in 1951, three major engineering studies have been made on the potable water system in behalf of the City. The reports are as follows:

> R. H. Erichsen and Associates, Coos Bay, Oregon, Engineering Report -- Water Supply Study -- City of Brookings, Oregon, November 1961.
>
> Cornell, Howland, Hayes and Merryfield, Corvallis, Oregon, An Engineering Report to the Brookings City Council on a New Municipal Water System, August 1964.
>
> B. A. Martin, Preliminary Engineering Study, City of Brookings, Oregon, Municipal Water System, June 1966.

The 1961 report was prepared during the early years of the City's actions to acquire the privately owned water system from Elmer Backus. The report summarized the evaluation made on the existing system and proposed improvements to the water supply, distribution, and storage facilities to

bring the system up to acceptable standards, and it compared this alternative with the City's option of constructing an entirely new water system. The report recommended that the City negotiate with the owner for the purchase of the existing system.

The subsequent engineering reports in 1964 and 1966 presented preliminary plans and estimated costs related to the City's alternatives of constructing a new municipal water system or purchasing and improving the existing system. The existing water system was purchased by the City in 1973, culminating several years of negotiation.

CURRENT SITUATION

With the acquisition of the water system, and seeing that the construction projects which will bring about the improvements to the water supply facilities and distribution storage are nearing completion, the City recognized that a second program to correct the deficiencies to the distribution system was needed. To initiate this program, the City authorized CH2M HILL to conduct the current study. The study is to:

- Review the available records and other data and determine the per capita water usage.
- Based upon the present and anticipated land use in the service area, estimate the water requirements.
- Prepare a base map and show the existing water distribution system and the proposed additional pipelines needed to satisfy the present conditions and the future growth.

- Review the water distribution system with representatives of ISO of Oregon and determine the recommended fire flows and the affect of proposed system improvements upon the City's fire protection rating.

- Prepare a recommended improvement plan for the distribution system and, based upon this plan, prepare preliminary cost estimates for the proposed improvements.

- Prepare a detailed plan for financing the proposed improvements through federal financing and/or a bonding program.

INFORMATION SOURCES

The following documents, reports, and references were reviewed and used in the preparation of this study.

(1) H.G.E., Inc., A Comprehensive Plan for Sanitary Sewer and Storm Drainage Development, Coos Bay, Oregon, May 1974.

(2) Oregon Center of Population Research and Census, Population Estimate: Oregon Counties and Incorporated Cities, Portland State University, Portland, Oregon, 1971 to 1975.

(3) Bureau of Governmental Research and Service, Planning for Brookings, University of Oregon, Eugene, Oregon, April 1970.

(4) H.G.E., Inc., Lincoln County, A Comprehensive Water, Sewerage and Solid Waste Management Plan, Coos Bay, Oregon, January 1974.

(5) Edmundson, Kochendoerfer, Kennedy and Daniel, Mann Johnson, and Mendenhall, Master Water Plan - Eugene-Springfield Urbanizing Area, Eugene, Oregon, January 1971.

(6) Harland, Gressford, Erichsen, Douglas County Water and Sewerage Comprehensive Plan, Coos Bay, Oregon, May 1970.

(7) Insurance Services Office, Grading Schedule for Municipal Fire Protection, New York, 1974.

(8) The American City, Municipal Index, Pittsfield, Mass., 1975.

REPORT ORGANIZATION

Tables and figures in this report are numbered consecutively within each chapter, and they generally appear in the text of the report on the page or pages following the first reference. A complete list of tables and figures is contained in the Table of Contents. Reference numbers following text reference to publications are keyed to the Information Sources listed in the preceeding paragraphs.

Chapter II
WATER REQUIREMENTS

GENERAL

The amount of water used by a water system to meet the needs of its customers is related primarily to the population served and the industrial water usage. The water consumption per capita is generally the basis used for determining the consumptive water requirements, and in this chapter the historical water usage has been considered and the future water requirements estimated, assuming a per capita consumption applied to the projected future population in the service area. Industrial water requirements cannot be forecasted without the specific information regarding an existing or new industry's plans; and, since this information is usally confidential or influenced by social or economic happenings, the necessary data is not available or insufficient for making estimates of water use. For this reason, a significant increase in industrial water demand must be examined as a special condition, and this report has not attempted to anticipate a change in industrial water demands.

The forecasting of population changes involves the making of assumptions which are also clouded by uncertainties and therefore the longer the planning period, the more difficult it is to determine the precise character of the water needs.

POPULATION

The estimate of future population was developed by the analysis of the historical growth trends and the forecasts made in the 1974 Comprehensive Sewer and Storm Drainage

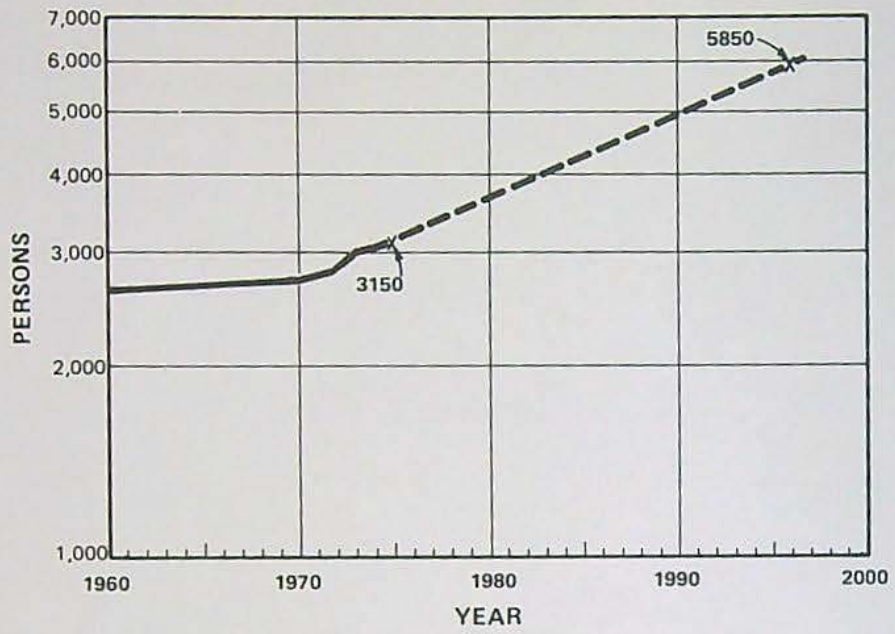
Plan (1). Figure II-1 shows the population trends since 1960 and makes projections of the population to 1996, 20 years in the future. As shown, the population change for the 10-year period between the national census counts of 1960 and 1970 does not show a significant growth trend, nor does the population estimates by the Oregon Center for Population Research and Census (2) for the years subsequent to the 1970 Census show a clear picture of the anticipated rate of growth. The annual growth rate for the five-year period between 1970 and 1975 has been around 2 to 3 percent. The Comprehensive Sewer and Storm Drainage Plan (1) also estimated future populations based upon several growth rates and concluded from the review that the population within the City of Brookings would reach 5,790 in 1995, a 3 percent annual increase in population. This same rate was used to establish the water requirements for the 20-year planning period to 1996. Table II-1 summarizes the population projections for the City of Brookings.

TABLE II-1
SUMMARY OF PROJECTED POPULATIONS

Year	Projected Population
1976	3,240
1981	3,760
1986	4,350
1991	5,050
1996	5,850

LAND USE AND INDUSTRIAL DEVELOPMENT

The preliminary comprehensive plan (3) which was completed in 1970 studied the population distribution and present land use patterns; and from this information and other pertinent planning data the writers prepared a land use plan and



——— POPULATION BASED ON 1960 AND 1970 U.S. CENSUS AND OREGON CENTER FOR POPULATION RESEARCH AND CENSUS, 1971-1975

– – – PROJECTED POPULATION BASED UPON 3% ANNUAL INCREASE

PAST AND PROJECTED POPULATION

FIGURE
II-1

CH2M HILL

C9710.A0

recommended that it be used as a guide for the orderly growth of the Brookings planning area. The document noted that growth would occur in all directions from the city center with faster development on the outer edges of the present city. It was also anticipated that the area north of Highway US 101 would grow faster than the areas south of the highway due to the availability of developable space. The retail commercial area of Brookings is expected to remain central to the downtown area, as well as along the highway in the northwesterly direction. The tourist commercial area will develop more to the south side of the highway in the west portion of the City, where tourist facilities are presently the predominate land use.

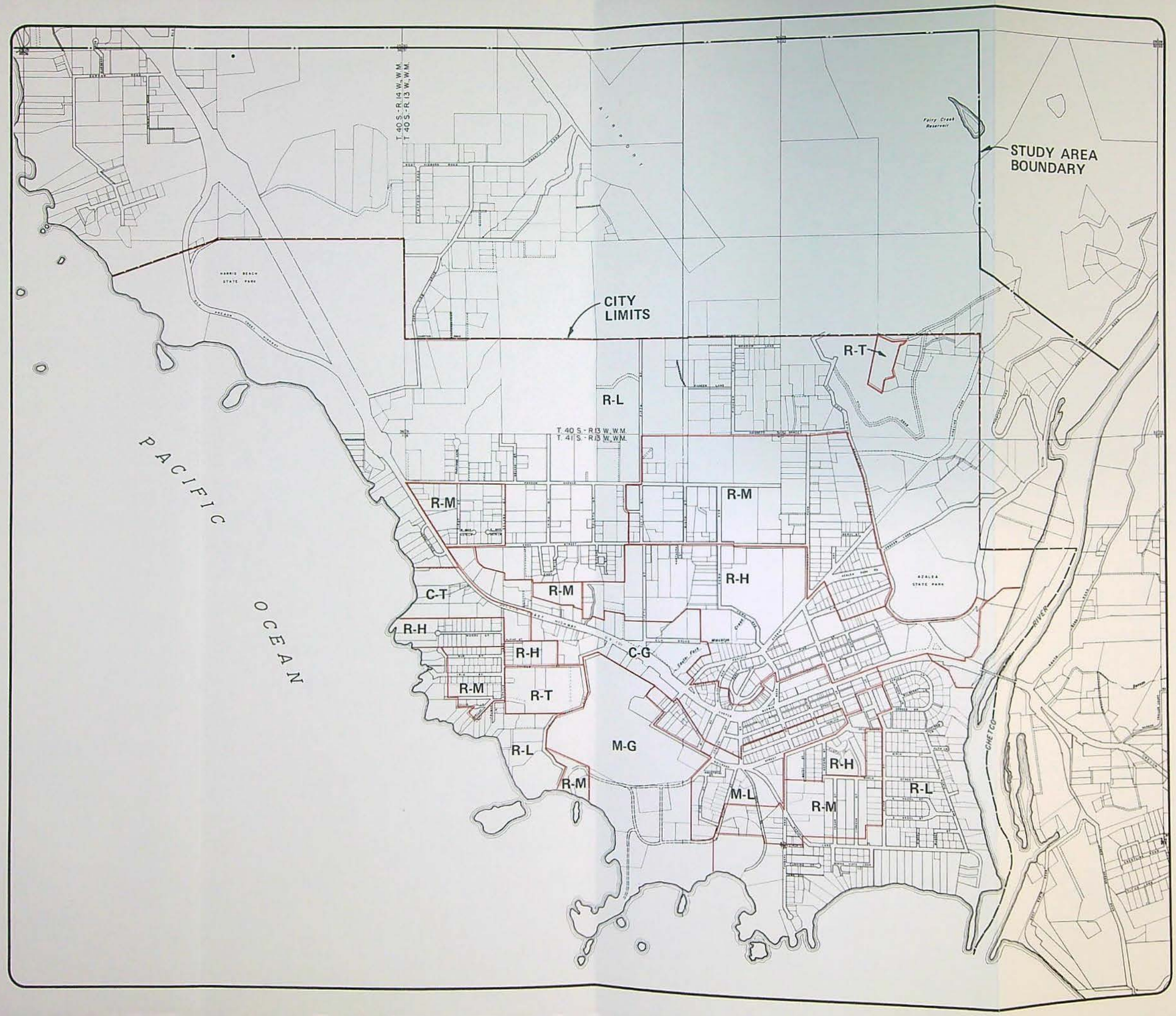
The industrial development within the planning area will be limited. The two areas which presently exist for general industry use are the Brookings Plywood area and the properties to the south and the lands used for industry along the old highway just north of its intersection with the new US 101. Of these areas, the only portions which have space available for industry expansion is the land south of the Brookings Plywood plant. Remaining lands which are suitable for commercial and service industry are in an area east of the plywood plant and south of the downtown region. The land use plan and the study area are shown on Figure II-2.

WATER DEMAND

General.

In this section, the past water demand characteristics are summarized and this data in conjunction with the projected land use and population provides the major elements for the determination of the future water demands.

Terms used in this section and the subsequent discussions in this report are defined as follows:



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SCALE IN FEET

LEGEND

R-L	RESIDENTIAL LOW DENSITY
R-M	RESIDENTIAL MEDIUM DENSITY
R-H	RESIDENTIAL HIGH DENSITY
R-T	RESIDENTIAL TRAILER
C-T	COMMERCIAL TOURIST
C-G	COMMERCIAL GENERAL
M-L	INDUSTRIAL LIMITED
M-G	INDUSTRIAL GENERAL

STUDY AREA AND LAND USE

FIGURE

II-2

CH2M HILL

C9710.A0

Annual To System. The total amount of treated water pumped into the distribution system in a year.

Average Annual. The total water delivered to the system in a year divided by the number of days in a year.

Maximum Month. The amount of water delivered to the system during the month of largest usage divided by the number of days in the month.

Maximum 5-Day. The average daily amount of water delivered to the system during the maximum 5 consecutive days of use during the year.

Maximum Day. The maximum amount of water delivered to the system in any single 24-hour period.

Maximum Hour. The maximum amount of water delivered to the system during a single hour, expressed as an average daily rate. Peak hour is often used and is synonymous with maximum hour.

Per Capita Demand.

The unit demands are the system demands averaged among the population within the service area. The water delivered to the distribution system divided by the service area population gives the per capita unit demand. These total system demands include the domestic, irrigation, leakage, fire protection, flushing, and any unaccounted for water within the system.

The Brookings water system does not have the historical information regarding the amount of water delivered to the system because the water source meters have been inoperative or unattended. Without this information, typical data from

other systems was evaluated for use. The ranges and average per capita demands for the Lincoln County water systems, as shown in the 1974 Lincoln County Comprehensive Water Plan (4), were examined and are shown in Table II-2. Several other documents were reviewed, including a report by the U.S. Department of Health, Education and Welfare which reported that 182 gpcd average annual per capita demand was representative of the unit demand for the typical Pacific Northwest city. Another report (5) covering the Comprehensive Water Plan for the Eugene-Springfield area showed a range of 117 to 193 gpcd for the average annual per capita demand for these southern Willamette Valley water systems; and a similar comprehensive plan report (6) for Douglas County communities found about the same level of unit demands of 186 gpcd. These unit demands are summarized in Table II-2.

TABLE II-2
UNIT WATER DEMANDS

	Per Capita Demand, gpcd		
	Average Annual	Maximum Day	Maximum Hour
Willamette Valley			
Residential Only	117-193	330-540	490-810
Includes Industry & Commercial	165	460	690
Douglas County	186	500	950
Lincoln County	127-167	317-437	445-612
Newport	167	417	584
Proposed Design Criteria	165	410	575

Based upon the evaluation of the available statistics and the characteristics of the Brookings system, it was concluded that unit demands of the Newport system were reasonable assumptions for use in projecting the water requirements for Brookings. Newport, a coastal city with a population of 5,800, has many of the same characteristics as Brookings that influence the water use, including moderate climate and high annual rainfall, tourism and commercial and recreational fisheries are basic to the economy, and large industrial water demands are not significant. The proposed design criteria for unit demands are shown in Table II-1.

In the analysis of the unit water demands, it was noted that attempts had been made in many of the previous studies to predict the change and trends in the per capita water usage. In the past, particularly in growing communities with abundant and relatively low cost water, a rising trend due to the increased use of automatic appliances, extensive gardening and landscaping, and generally favorable economic conditions has been noted in the per capita use of water. A similar rising trend cannot be clearly established for the Brookings system, nor is there sufficient experience to predict a reduction due to a conservation consciousness; therefore, in this study no change in the unit demand is forecast for the 20-year planning period.

Present and Projected Water Demand.

After considering the past water use, existing demand characteristics, growth trends, and the service area boundaries as discussed in the preceding paragraphs, the future system demands were calculated as shown in Table II-3.

The ratios of short-term to average-annual and maximum-day demands, as shown in Table II-4, were used where appropriate in the projections. This information was obtained from the

TABLE II-3

PRESENT AND PROJECTED SYSTEM DEMANDS

Projected Service Area Population	Average Annual (gpcd)	Annual To System (mg)	Maximum Day (gpcd)	Maximum Day (mgd)	Maximum Hour (gpcd)	Maximum Hour (mgd)
1976-3570 (1)	165	215.0	410	1.464	575	2.053
1981-3760	165	226.4	410	1.542	575	2.162
1986-4350	165	262.0	410	1.784	575	2.501
1991-5050	165	304.1	410	2.070	575	2.904
1996-5850	165	352.3	410	2.398	575	3.364

(1) In 1975, 330 persons were estimated outside city limits and served by water system. In subsequent 5-year periods it is assumed that all persons served are inside city limits.

gpcd = gallons per capita per day
mg = million gallons
mgd = million gallons per day

unit water demands as discussed in a preceding section and shown in Table II-2. The ratios are representative of the Newport water system and typical of most Oregon coastal communities.

TABLE II-4
DEMAND CHARACTERISTIC RATIOS

Ratio to Average-Annual	
Maximum Month	1.9
Maximum 5-Day	2.2
Maximum Day	2.5
Maximum Hour	3.5
Ratio to Maximum-Day	
Maximum 5-Day	0.9
Maximum Hour	1.4

FIRE FLOWS

The water distribution and storage facilities in conjunction with the supply system must be of sufficient capacity to furnish water for fighting fires in addition to maintaining adequate flow for the domestic, commercial, and industrial demands. Therefore, reasonable estimates of the system's fire protection needs must be determined. Such needs are generally stated as a series of fire flow requirements in gallons per minute for various locations throughout the service area, and a time duration for each flow, depending upon its magnitude. The greater the fire flow, the duration of flow is longer. The required fire flow at a given location is the rate estimated as necessary to contain a major fire to the building within a block or other building group complex.

To determine the fire flows, standardized formulas are applied which consider a structures construction, its floor area and heighth, occupancy and the exposure to the nearby buildings. In Oregon, the fire flow requirements for most municipalities are determined during periodic field surveys by the Insurance Services Office of Oregon. These surveys are used to determine the adequacy of a water system to meet the established fire flows. These gradings, which also consider other fire protection criteria within a municipality, are used to establish the fire insurance premiums of the area.

The grading of the Brookings' water system was last conducted in February 1975. The summary of the grading as related to the water system is found in the Appendix. This attached grading and the recent personal discussions with the Insurance Services Office is the basis for the recommended fire flows shown in Table II-5.

TABLE II-5
RECOMMENDED FIRE FLOWS

Location/Land Use	Quantity gpm	Duration hours	Volume mg
Commercial General	2500	2	0.30
Commercial Tourist	2000	2	0.24
Industrial General	3500	3	0.63
Industrial Limited	3500	3	0.63
Institutions			
High School	3000	3	0.54
Elementary School	3500	3	0.63
Residential			
High Density	1000	2	0.12
Medium Density	750	2	0.09
Low Density	500	2	0.06
Rural	500	2	0.06

Chapter III
DISTRIBUTION AND STORAGE SYSTEM

PRESENT SYSTEM

The City of Brookings' water distribution and storage system consists of the newly constructed 1.5 million gallon steel reservoir located in the hills near the northeast city limits, and distribution pipelines which were mostly installed during the era of the Bankus ownership. Major arterial pipelines from the reservoir to existing major pipelines and into the population center are now being planned or have recently been constructed by the City.

The present distribution system has many inadequacies, including the following:

1. Low service pressures, particularly in the western section of the service area, and in the upper elevations at the northern city limits.

2. Pipeline sizes are not large enough to provide the recommended fire flows throughout the City.

3. Pump stations for the upper levels are inadequate for supplying fire flows to the areas they serve, nor do they have reliability to provide uninterrupted service.

4. The physical condition of some pipelines is deteriorating or the pipe was substandard when installed and replacement or extensive repairs and maintenance is necessary.

5. Fire hydrants are sparsely spaced, improperly valved, or connected to undersize pipe.

6. Distribution system includes many deadend runs, and mains are not cross connected to give good circulation.

The distribution system is composed of mostly small diameter pipe in a variety of types including asbestos cement, plastic, steel, cast iron, and copper. These small diameter pipelines and the questionable condition of the mixed types are the major cause of the inadequacies in the system. Further verification of the system's inadequacies is noted by reference to the most recent survey by the Insurance Services Office of Oregon. In their letter of June 13, 1975, the system deficiencies were summarized. A copy of the letter is included in the Appendix of this report.

SERVICE LEVELS

General.

Distribution and storage systems must be separated into service levels to maintain adequate pressures at high elevations and prevent excessive pressures at lower elevations.

The system's maximum static pressures should not exceed 100 psi. Pressures above 100 psi tend to cause consumer plumbing problems. Unavoidable system surges, like those caused by fire hydrants being quickly closed, can cause the system pressures to greatly exceed static values. The maximum pressure desired will set the lower elevation boundaries of a service level at a specific vertical distance below the storage reservoir's maximum water surface elevation. Since 100 psi is the pressure exerted at the base of the column of water 231 feet high, the lowest consumer at a given service

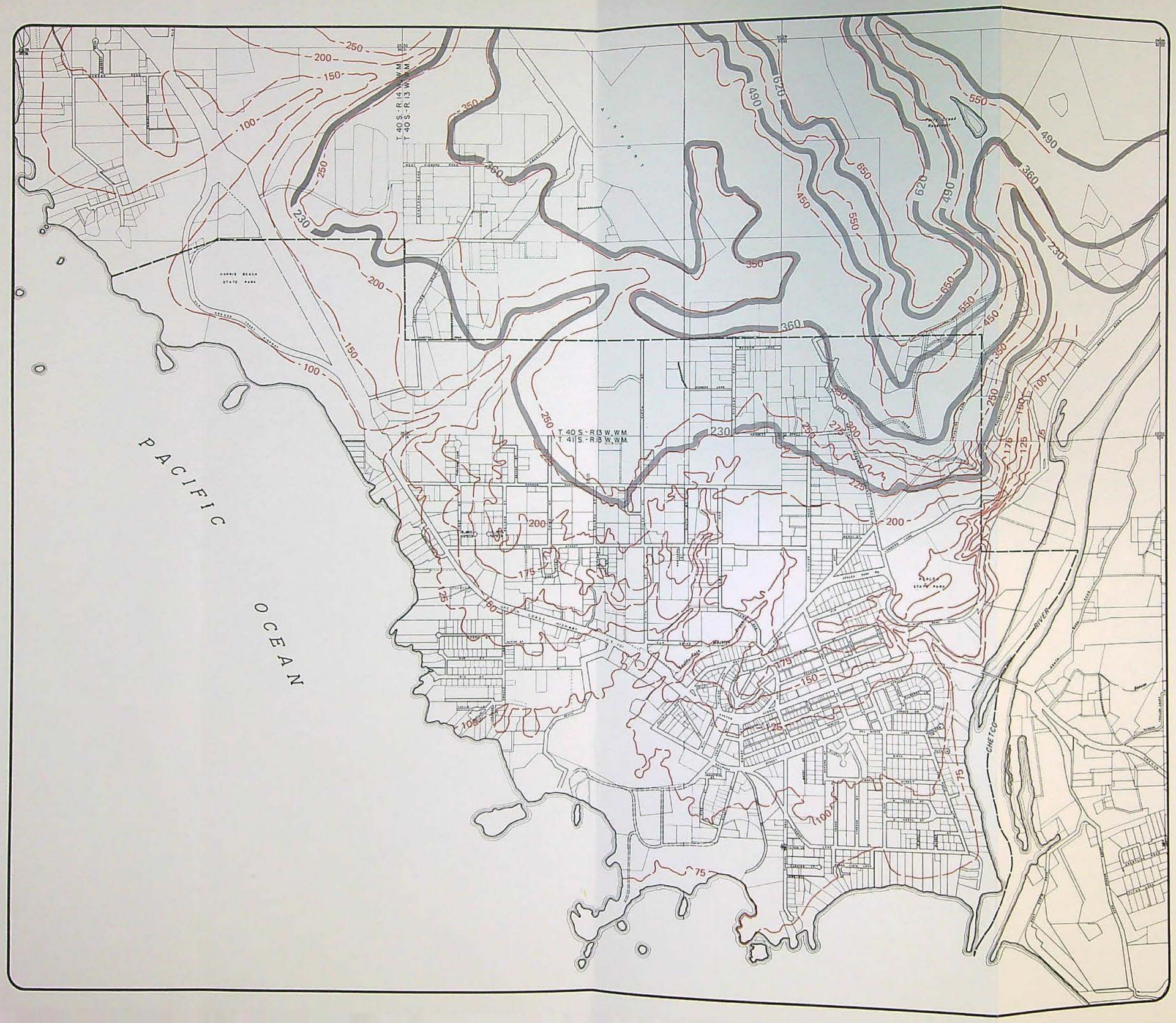
level should not be more than 231 feet of elevation below the overflow weir of the storage reservoir.

Pressures less than 25 psi at the consumer's connection will not allow water-using appliances or equipment to function properly; the common flush-valve toilet found in most commercial establishments is a good example. To maintain a pressure of 25 psi at the customer's connection (equivalent to a column of water 58 feet high), the upper elevation boundary should be located at least 100 feet below the storage reservoir's overflow weir. This would exert a maximum static pressure of 43 psi at the upper service level boundary. The 42-foot difference between the 100-foot minimum recommended elevation necessary and the 58 feet of head needed at the service connection is required to satisfy distribution system hydraulic requirements.

Under normal operating conditions, the water level in a reservoir may fluctuate 10 to 15 feet during the high demand season. At minimal reservoir levels, this will leave 27 to 32 feet of the 42-foot head available to force water through the pipelines to consumers near the service level's upper elevation boundary. For example, a 10-inch diameter pipe 2 miles in length would require about 30 feet of head differential to convey 600 to 700 gpm. The available capacity depends on the age and condition of the pipe. The same pipe would convey 425 to 475 gpm if the head differential were only 15 feet. Large pipelines must be used in the distribution system if the services are located less than 100 feet below the reservoir.

Recommended Service Levels.

Based upon these considerations, the study area requires five service levels as shown in Figure III-1 and Figure III-2. Figure III-1 shows the boundaries of the proposed service area together with the general mapping



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SCALE IN FEET

SERVICE LEVEL ELEVATION LIMITS

BASE LEVEL UP TO 230 FEET

2nd LEVEL 230 TO 360 FEET

3rd LEVEL 360 TO 490 FEET

4th LEVEL 490 TO 620 FEET

5th LEVEL 620 TO 750 FEET

SERVICE LEVELS

FIGURE

III-1

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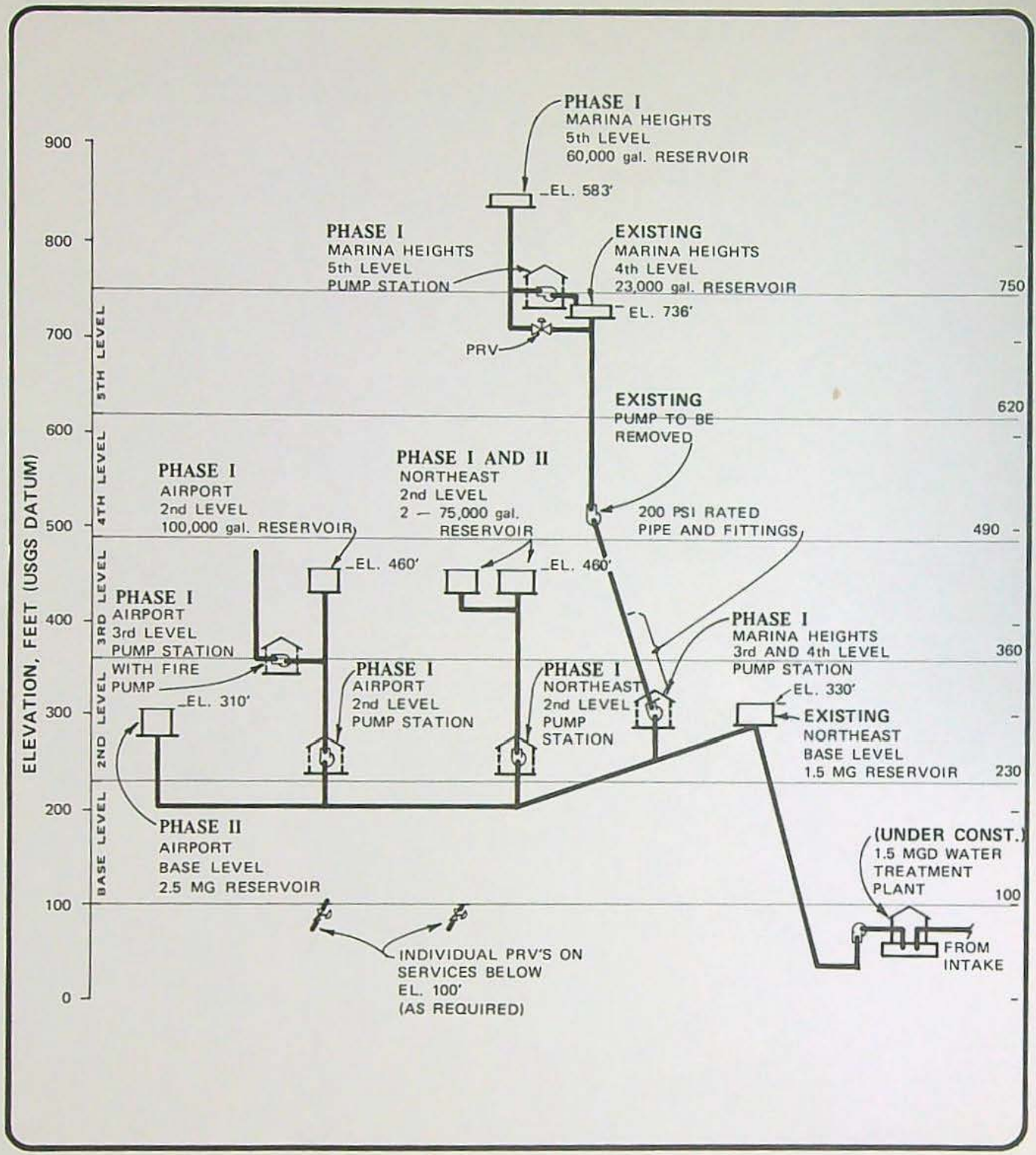
and topography information of the study area. A schematic hydraulic profile of the proposed water system and the relationship of the existing and proposed major facilities within the five service areas is shown in Figure III-2. Generally, these service levels will serve customers within the following elevation limits:

Base level	up to 230 feet
2nd level	230 to 360 feet
3rd level	360 to 490 feet
4th level	490 to 620 feet
5th level	620 to 750 feet

The water pressures at some services in the Base Level, under static conditions with a full reservoir, will exceed the recommended 100 psi maximum. The excessive pressure at these few properties while not desirable is not sufficiently high to justify the creation of another service level. If necessary, individual pressure reducing valves may be installed at these services.

The upper service levels are located north of the present city limits in two regions, separated by Ransom Creek--the slopes southwest and west of the airport east of Highway US 101; and the northeast hills, generally northwest of the existing 1.5 mg reservoir, west of the Chetco River. The residences in the upper elevations in the airport region are served by a small booster pump located on Park View Drive. Many existing residences have individual wells and have choosen not to connect to the City of Brookings' system. This existing upper level system is inadequate because of low pressures in the higher elevations and insufficient flows for fire protection. Two service levels are needed in this region.



HYDRAULIC PROFILE EXISTING AND PROPOSED WATER SYSTEM

FIGURE

III-2

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The residences in the upper levels in the northeast region are either served by the existing base level or the Marina Heights subdivision water system. The residences above the 230-foot elevation, which are now connected to the existing base level system, have low water pressures. The service levels in the Marina Heights subdivision coincide with the recommended service levels and the service pressures are satisfactory. This region will require four service levels. The 2nd level to serve the present and future customers north of the city limits and the 3nd, 4th and 5th levels to serve Marina Heights. At the present time, there are no services within the Marina Heights 3rd level.

STORAGE AND DISTRIBUTION SYSTEM

General.

The population and the growth anticipated in the Brookings study area was discussed in Chapter II. Based upon this discussion, the number of persons to be served in the proposed service levels has been estimated and are summarized in Table III-1. The storage and distribution facilities recommended are designed to meet the demands within these service areas.

TABLE III-1
PERSONS SERVED WITHIN SERVICE LEVELS

	1976	1996
Base Level	3370	4990
Airport 2nd Level	130	210
Airport 3rd Level	40	60
Northeast 2nd Level	10	320
Marina Heights 4th Level	20	190
Marina Heights 5th Level	--	80

Storage Reservoir Design Criteria.

The following three requirements should normally be considered in the sizing of storage reservoirs.

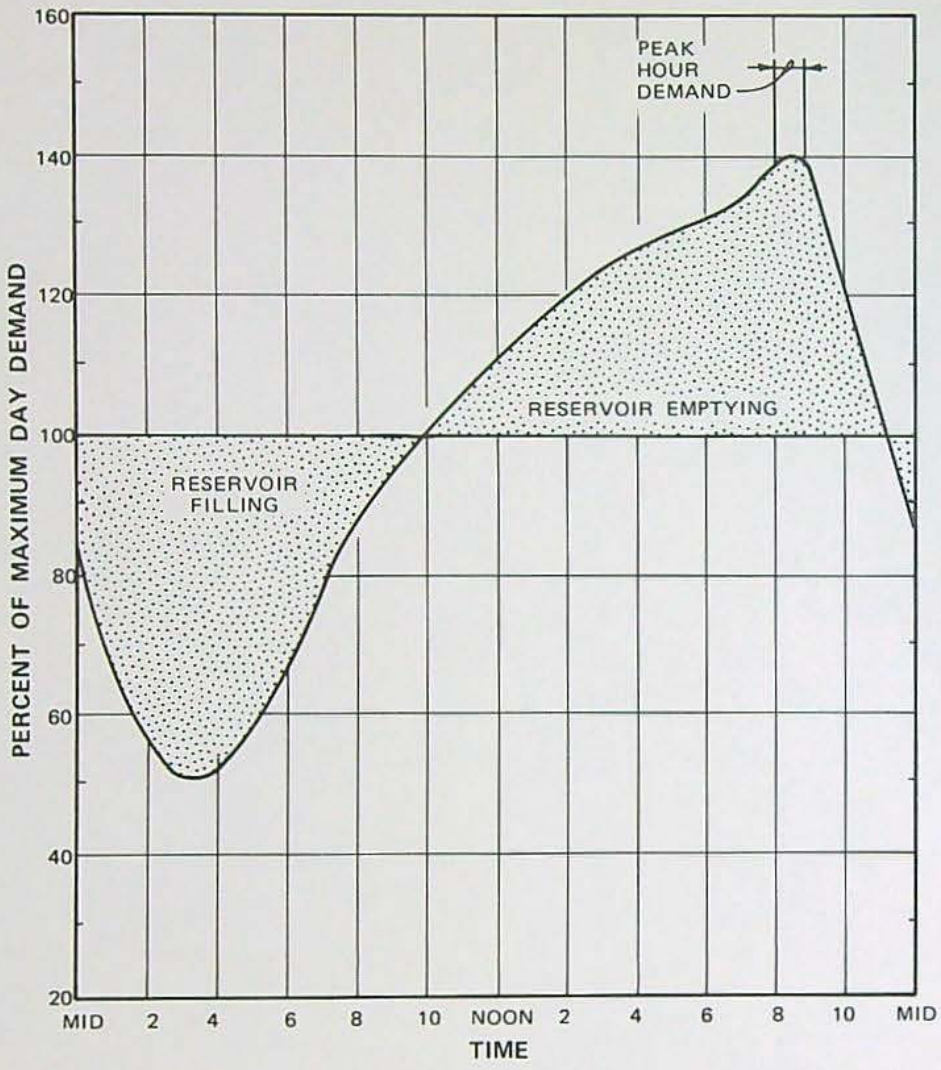
1. Equalizing storage should be equal to approximately 20 to 25 percent of the maximum daily demand for that portion of the service level(s) to be served by the reservoir.

2. Fire storage should be equal to the volume of water required to provide the maximum recommended fire flows in the reservoir service area for the required duration.

3. Reserve storage should be sufficient to supply the systems needs during the disruption of the supply capabilities because of an electrical outage, hazardous water quality, equipment breakdown, or broken water lines, and the volume required must be analyzed based upon the system's facilities.

The equalizing storage is used to provide for the hourly variation of demand in excess of the supply rate, usually the maximum day rate. The maximum hour demand is 140 percent of the maximum day demand, and the typical hourly variation during a 24-hour period is shown on Figure III-3. This data was used as a guide for determining the required equalizing storage.

The reserve storage is based upon the Insurance Services Office criteria for the grading of municipal water systems (7) for fire protection. This criteria evaluates the ability of the system to maintain the maximum daily consumption rate plus the basic fire flow at the required duration with one and two of the main supply pumps out of service. To have no



HOURLY VARIATION OF SYSTEM DEMAND

FIGURE
III-3

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deficiency in the grading, the remaining system capacity in conjunction with storage must be able to provide the basic fire flow for the specified duration at any time during a period of 5 days with consumption at the maximum daily rate.

Recommended Storage Reservoirs.

The new reservoirs shown on Figure III-4 were sized based upon the ISO criteria. However, because of the relatively high storage capacities needed with the "2 pumps-off" criteria, it is proposed that the future requirements to meet the 1996 demands be based upon the "1 pump-off" criteria. The calculation for the "1 pump-off" criteria in 1996 includes approximately 2.87 million gallons for reserve storage. This exceeds the maximum-day usage which is often used as a criteria for estimating reserve storage requirements. In addition, rather than construct more storage to meet the "2 pumps-off" criteria, additional pumping capacity can be provided in lieu of the far more costly reserve storage.

The proposed reservoirs in the upper service levels are based upon a criteria that the reserve storage is maintained in the base level, and in the Marina Heights subdivision the developer's plans for reservoir size were used without change. As proposed, the equalizing storage, as well as the reserve storage for the Marina Heights 5th level, is to be maintained in the base level system; and in the Marina Heights 4th level the fire protection storage is maintained in the Marina Heights 5th level storage reservoir. The storage requirements and sizing criteria for service levels above base level and for the base level are shown in Tables III-3 and III-2, respectively.

The location for future reservoirs should consider the following criteria: 1) the site should be as close to the service area as possible to minimize the transmission pipeline cost; 2) the site should be on reasonably flat ground to keep

N

0 800 1600

SCALE IN FEET

LEGEND

- PIPELINE AND SIZE OF PIPE IN INCHES
- RESERVOIR
- PUMP STATION
- FIRE HYDRANTS
- PHASE I PRIORITY I
- PHASE I PRIORITY II
- PHASE II

SERVICE LEVEL ELEVATION LIMITS

BASE LEVEL UP TO 230 FEET
2nd LEVEL 230 TO 360 FEET
3rd LEVEL 360 TO 490 FEET
4th LEVEL 490 TO 620 FEET
5th LEVEL 620 TO 750 FEET

EXISTING SYSTEM AND PROPOSED IMPROVEMENTS

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FIGURE

III-4

TABLE III-2

STORAGE REQUIREMENTS FOR BASE LEVEL

	1976	1996
Estimated persons served	3570	5850
Maximum day demand, mgd	1.464	2.398
Maximum fire flow and duration, gpm-hrs	3500-3	3500-3
Equalizing storage at 1/4MDD, mg	0.366	0.600
Fire protection storage, mg	0.630	0.630
Storage draft with 1 pump-off, for 5MDD, mg	0	2.870
Storage draft with 2 pumps-off, for 5MDD, mg	2.100	6.470
Required storage based on 1 pump-off ISO criteria, mg	0.996	4.100
Required storage based on 2 pumps-off ISO criteria, mg	3.096	7.700
Existing base level storage capacity, mg	1.55	1.55
Additional storage capacity required for 1 pump-off ISO criteria, mg	none	2.55*
Additional storage capacity required for 2 pumps-off ISO criteria, mg	1.5	6.15
Recommended additional storage, mg	none	2.5*

*The recommended additional storage to meet the 1996 conditions is based upon "1 pump-off" criteria. Additional supply pumps may be provided in lieu of the storage required for the "2 pumps-off" criteria.

TABLE III-3

STORAGE REQUIREMENTS FOR SERVICE AREAS ABOVE BASE LEVEL

	Reservoir Site or Identify	Estimated Persons Served	Maximum Day Demand mgd	Maximum Fire Flow/Time gpm-hrs	Equalizing Storage gal	Reserve Storage gal	Fire Protection Storage gal	Total Required Storage gal	Recommended Storage Capacity gal
1976	Airport 2nd Level	170	0.070	500-2	18,000	18,000	60,000	96,000	100,000
	Northeast 2nd Level	10	0.004	500-2	1,000	1,000	60,000	62,000	75,000
	Marina Heights 4th Level	20	0.008	500-2	2,000	2,000	60,000	64,000	20,000
	Marina Heights 5th Level	–	–	–	–	–	–	–	60,000
1996	Airport 2nd level	270	0.111	500-2	28,000	28,000	60,000	116,000	100,000
	Northeast 2nd Level	320	0.131	750-2	33,000	33,000	90,000	156,000	150,000
	Marina Heights 4th Level	190	0.078	500-2	20,000	20,000 (2)	60,000 (2)	116,000	20,000
	Marian Heights 5th Level	80	0.033	500-2	8,000 (1)	8,000 (1)	60,000	78,000	60,000

(1) Equalizing and reserve storage maintained in Base Level Reservoir.

(2) Reserve storage maintained in Base Level Reservoir and Fire Protection Storage maintained in Marina Heights 5th Level Reservoir.

excavation costs down; 3) the reservoir and the pump station serving the reservoir should be located at opposite ends of the service level in order to minimize system pressure losses during peak demands; and 4) the site should allow the reservoir to blend into the environment with an aesthetically pleasing appearance.

At each reservoir there should be water-level sensing equipment which will control the operation of the pump station and transmit the reservoir level to a central supervisory control center for observation and recording.

Pump Station Design Criteria.

The capacity of pump stations which serve levels with distribution storage reservoirs must be adequate to provide the maximum day demand to all areas served by the pump station; and the capacities of smaller pump stations which serve areas without a distribution storage reservoir, the pumps must be sufficient to furnish the maximum hour demand. Pump stations in a given service level must pump sufficient water to serve all levels above their particular level, in addition to serving their own level. Except for small service areas, the pump stations should have at least two pumps and the total capacity of the pumps should be generally 20 to 50 percent in excess of the calculated capacity of the pump station. This allows a pump to be out of service for maintenance repairs without causing a deficiency in supply capability. To have the emergency reliability, one pump in each major pump station should be equipped with an auxiliary driver such as a gasoline or gas engine to supplement the standard electric motor. This will allow some supply capability to the high service levels in the event of a general electric power outage.

When possible, pump stations should be located at storage reservoirs serving the next lower service level in order to

keep land costs at a minimum and to maintain stable suction pressures. Conversely, the pump stations and reservoirs serving the same level should not be located in close proximity since larger pipelines will then be required in the remainder of the service level.

Each pump station should be controlled by the water level in the reservoir to which it pumps, with the pumped water metered at the pump station. It is usually desirable as the system grows to transmit the reservoir water level and the metered flow data to a central location for supervisory control.

Recommended Pump Stations.

The recommended pump stations and their location are shown on Figure III-2 and Figure III-4. These pump stations serve the upper service levels as described in an earlier section. The Airport 2nd level pump station replaces the existing pumps on Park View Drive which are inadequate and poorly constructed for the intended purpose. A second pump station is needed in the airport area to serve the small number of customers anticipated above elevation 360 feet. A storage reservoir has not been proposed for this service level because of the small number of customers; and, therefore, the pump operates continuously to supply the consumptive demands. A 500 gpm fire pump with an auxiliary driver is proposed for providing fire protection and also as a standby unit in the event of a power outage.

A new pump station is proposed for the Northeast 2nd level. The services in this area are presently being served from the base level and consequently because of their elevation the service pressures are too low. A storage reservoir is proposed for this level and therefore, the pumps are sized to meet the consumptive demand, and fire flow is obtained from the storage reservoir.

It is proposed that two new pump stations replace the existing pumps for the Marina Heights service levels. The present pumps are inadequate and are poorly constructed and cannot be depended upon to provide the uninterrupted service expected from a municipal water system. A new Marina Heights 4th level pump station would be located at the site of the existing 1.5 million gallon reservoir and would lift water approximately 435 feet to the Marina Heights existing 23,000 gallon reservoir. This pumping head will cause high pressures near the pump station; however, there are no services anticipated because of the steepness, and, if needed, individual pressure reducing valves could be used. The existing pipes are to be used to serve the 2nd level services through the Northeast 2nd level pump station.

A second Marina Heights pump station is proposed at the 23,000 gallon existing reservoir. This proposal follows the plan of the developer and the pumps supply the proposed 60,000 gallon reservoir and the 5th service level.

The pump station requirements for each service level are summarized in Table III-4. The pump capacities and the number of pumps in each pump station generally follow the design criteria of the preceding paragraphs.

Distribution System Design Criteria.

The capacity of a distribution system depends on the location and size of all components including pipelines, storage reservoirs, and supply facilities. A given length and diameter of pipe has a capacity, depending upon the pressure available to push the water through the pipeline. Generally, the locations close to pump stations and reservoirs have ample amounts of water available at more than adequate pressures. Locations more distant from reservoirs and pump stations have

TABLE III-4

PUMP STATION REQUIREMENTS BY SERVICE LEVEL

	Pump Station	Estimated Persons Served	Maximum Day Demand gpm	Maximum Hour Demand gpm	Recommended Pump Capacity and Approximate Horsepower
1976	Airport 2nd Level	130	37	52	2 @ 80 gpm-7½ hp
	Airport 3rd Level	40	11	15	1 @ 25 gpm-2 hp & 500 gpm-50 hp fire pump/w. aux. drivers
	Northeast 2nd Level	10	3	4	2 @ 5 gpm-½ hp
	Marina Heights 4th Level	20	6	8	2 @ 15 gpm-1½ hp
	Marina Heights 5th Level	–	–	–	2 @ 40 gpm-5 hp
1996	Airport 2nd Level	210	60	84	Add 1 @ 125 gpm-10 hp
	Airport 3nd Level	60	17	24	Add 1 @ 40 gpm- 5 hp
	Northeast 2nd Level	320	91	127	Add 2 @ 150 gpm-15 hp
	Marina Heights 4th Level	190	54	76	Add 2 @ 150 gpm-25 hp
	Marina Heights 5th Level	80	23	23	Add 1 @ 40 gpm- 5 hp

less flow available at lower pressures, thus pipeline diameters vary considerably, depending upon the anticipated flows and the distance from storage reservoirs.

A water distribution system should be capable of supplying the necessary quantity of water to any given location under the varying service conditions. Three separate service conditions should be considered for all portions of each service level distribution system:

1. The distribution system should be capable of supplying the maximum-hour demand to the entire service area while maintaining the minimum pressure at the upper elevations of the service level. Reservoir levels are assumed to be 10 feet below overflow during the maximum-hour demand.

2. The distribution system must be capable of conveying the required fire flows to a given location at the same time the distribution system is supplying a flow equal to the maximum-daily demand to the entire service area. Minimum allowable pressure at the site of the assumed fire flow is 20 psi. Reservoir levels are assumed to be 10 feet below overflow for this condition. Each service level should be investigated for the fire flows at different locations, one fire at a time.

3. The supply facilities for the distribution system must be capable of refilling the reservoirs during low demand periods. Pipelines between pump stations and storage reservoirs must be adequately sized to avoid excessive pressures in the lower elevations

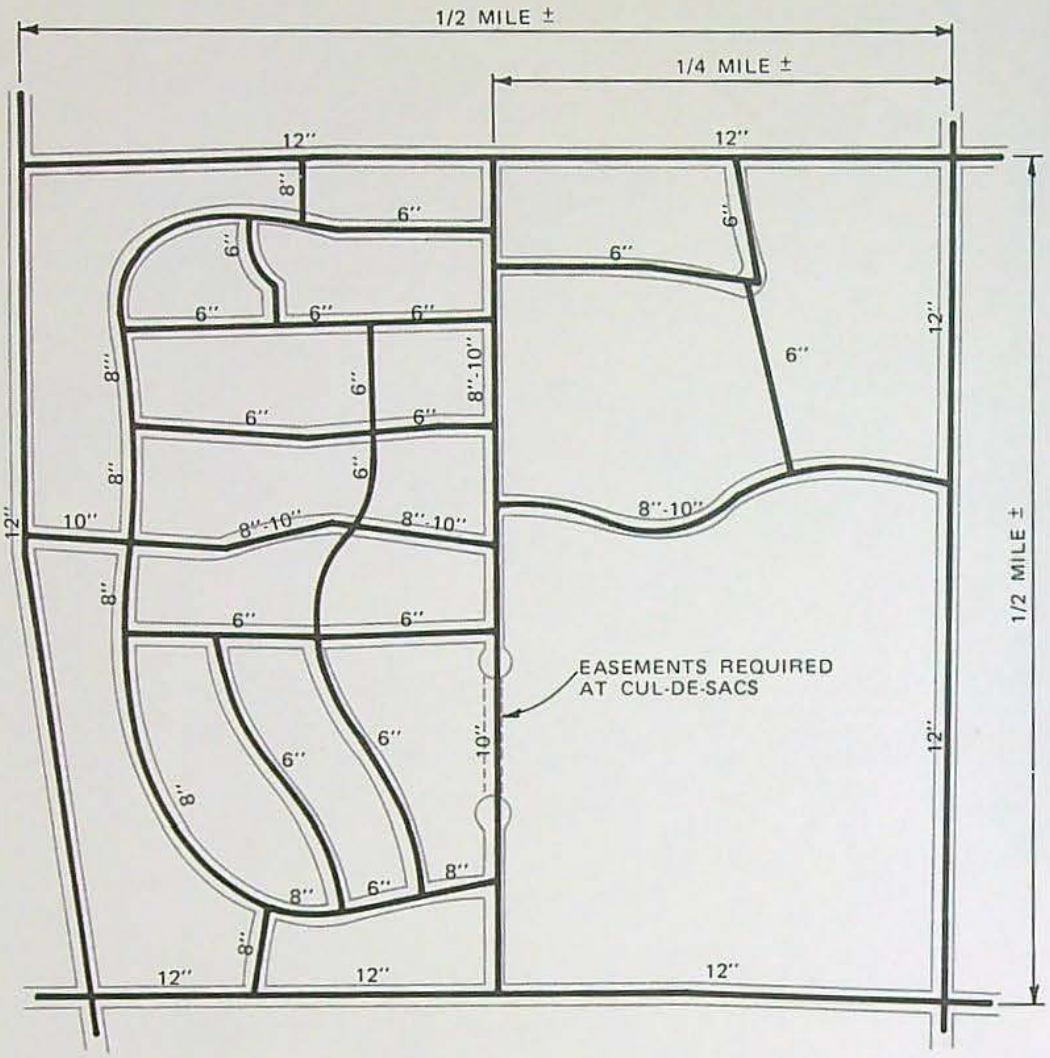
of the service level while the pumps are operating. Pump station discharge pressures should not exceed an absolute maximum of 120 psi, and the pumps should be controlled to minimize surges when starting and stopping.

Figure III-5 is a typical distribution grid which illustrates the recommended sizes for local water distribution pipelines. This example should be followed to determine the best approximation of the piping grid in planning street layouts. Pipelines in all new subdivisions should be laid out as near as possible to the typical distribution to insure adequate capacity. Where subdivisions use short deadend streets, the waterline serving the deadend street should be extended to an existing pipeline. Where a specific pipeline size is proposed for construction on a particular street, the intent is to provide sufficient pipeline capacity to satisfy a demand for water. Pipeline sizes and routes indicated may be changed if the demand for water supply can be satisfied without sacrificing adequate system pressures.

Although each deviation from the recommendations should be individually analyzed, the following equivalent pipe relationships generally will provide approximately equal carrying capacities:

One 16-inch pipe = two 12-inch pipes
= four 10-inch pipes
= six 8-inch pipes

One 12-inch pipe = two 10-inch pipes
= three 8-inch pipes
= six 6-inch pipes



TYPICAL DISTRIBUTION GRID

FIGURE

III-5

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One 10-inch pipe	= two 8-inch pipes
	= four 6-inch pipes
One 8-inch pipe	= two 6-inch pipes
	= six 4-inch pipes
One 6-inch pipe	= three 4-inch pipes

These ratios are based on approximately equal headloss characteristics. Small pipelines constructed in parallel can be effective for supplying a particular location with a specific amount of water. However, this may not be the most economical use of funds. The installed cost of the several small pipelines necessary to equal the carrying capacity of the single large pipeline will usually exceed the cost of the larger pipeline. If the small pipelines are integrated into the distribution system of the service level rather than used merely to convey water to a specific area, the higher construction cost may be justified. For system reliability, it is preferable to have parallel smaller pipelines, assuming that they are not too small, rather than a single, large pipeline.

Valves should generally be spaced no further than 600 feet apart in a looped distribution system. Each pipeline intersection should have two or three valves, corresponding to a tee or cross connection, to minimize the areas out of service during a pipeline failure, repairs, or extensions. Fire hydrants should be spaced to meet the criteria recommended by the Insurance Services Office survey report. Their letter of 13 June 1975 (Appendix) recommended that the high valve districts have a hydrant for each 125,000 square feet and for residential districts one hydrant for each 160,000 square feet. This corresponds to a spacing of fire hydrants at about 350-400 feet in the high valve districts and 450-500 feet in the residential districts.

Pipeline materials should be standardized to reduce maintenance problems and repair part inventories. Corrosion-resistant materials should conform to the American Water Works Association standards.

Recommended Distribution System Improvements.

The distribution system pipe network was analyzed by an electronic computer to determine the adequacy of the existing system and to provide the guidance for sizing pipelines to overcome the present deficiencies and to meet future demands. The network analysis were performed by using mathematical models of the system and the computations made on the in-house DEC-10 computer. Preliminary runs were made on the existing system to check the validity of the initial assumptions made in the distribution of consumptive demands throughout the network. After verification of the computer model, the system was analyzed following the criteria discussed earlier, i.e., supplying the maximum hour demand, furnishing a required fire flow plus the maximum day demand under several assumed fire flow conditions, and refilling the storage reservoirs during a period of low demand.

The recommended pipeline improvements shown on Figure III-4 were determined through these computer analysis.

Chapter IV
CONSTRUCTION SEQUENCE AND COST ESTIMATES

CONSTRUCTION SEQUENCE

General.

To correct the existing deficiences and to meet future requirements, we have proposed improvements which will allow the City to provide adequate and reliable water service within the study area through the year 1996. A construction schedule of the proposed improvements is shown in Table IV-1.

Three construction priorities have been developed for the improvements recommended through the year 1996. Phase I - Priority 1 - includes those improvements that are urgently needed to meet existing system requirements and should be constructed within the next few years. Phase I - Priority 2 - are improvements that are less important but are required to upgrade the system to meet the fire flow requirements throughout the system and the construction should be initiated within the foreseeable future. Phase II are those improvements needed to strengthen the distribution system and to provide the needed capacity when the presently sparsely settled areas become more populated. The need for these improvements is dependent upon the rate of growth within the specific areas and the construction of the facilities may not occur for more than 10 years.

The separate projects to be undertaken within these priority schedules are presented in Table IV-1. They are listed in an order which can be considered as an indication of their relative priority.

TABLE IV-1

PROPOSED SYSTEM IMPROVEMENT AND CONSTRUCTION PRIORITY

	System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
I-1-1	Reservoir, Airport 2nd level	100,000 gal.	$ 55,000		
I-1-2	Reservoir, Northeast 2nd level	75,000 gal.	45,000		
I-1-3	Pump Station, Airport 2nd level	2 pumps @ 80 gpm	13,000		
I-1-4	Pump Station, Airport 3rd level	1 pump @ 25, 1 pump @ 500 gpm	24,000		
I-1-5	Pump Station, Northeast 2nd level	2 pumps @ 5 gpm	15,000		
I-1-6	Pump Station, Marina Heights 4th level	2 pumps @ 15 gpm	29,000		
I-1-7	Pump Station, Marina Heights 5th level	2 pumps @ 40 gpm	10,000		
I-1-8	Pipeline, Pacific Ave.; Oak St. to Hwy. 101	12" - 2150'	56,000		
I-1-9	Pipeline, Hwy. 101; Pacific Ave. to Easy St.	12" - 4050'	106,000		
I-1-10	Pipeline, Hwy. 101; Pacific to Fern Ave.	8" - 1550'	25,000		
I-1-11	Pipeline, Pioneer Rd. ext.; Hassett St. to Ransom Ave.	6" - 700'	10,000		

TABLE IV-1 - Continued

System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
I-1-12 Pipeline, Ransom Ave; County Rd. to Second St.	10" - 5210'	$114,000		
I-1-13 Pipeline, Ransom Ave; Paradise Ln. to Hwy. 101	10" - 700'	15,000		
I-1-14 Pipeline, Fern Ave; Ransom Ave. to Easy St.	8" - 800'	13,000		
I-1-15 Pipeline, Fourth St; Ransom Ave. South	6" - 230'	3,000		
I-1-16 Pipeline, Third St; Ransom Ave. South	8" - 320'	5,000		
I-1-17 Pipeline, Easement; Airport Res to Dodge Ave.	6" - 1250'	18,000		
I-1-18 Pipeline, Dodge Ave; South from Airport Res. Pipeline	6" - 800	11,000		
I-1-19 Pipeline, County Rd; N.E. Res. to Nr. Hassett St.	8" - 1700'	28,000		
I-1-20 Pipeline, Meadow Ln. ext; County Rd. to End	8" - 480'	8,000		
I-1-21 Pipeline, Hill Rd; County Rd. to Existing Pipe	8" - 1150'	19,000		
I-1-22 Pipeline, Easement; Pipeline Rd. to Hill Rd.	8" - 400	7,000		
TOTAL, PHASE I - PRIORITY 1		$629,000		

TABLE IV -1 - Continued

	System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
I-2-1	Pipeline, Stafford Rd; W. Hiebard Rd. to Park View	6" - 1430'		$ 20,000	
I-2-2	Pipeline, Moore St; Arnold Ln. to End	6" - 900'		13,000	
I-2-3	Pipeline, Easement; Moore St. to Collis Ln.	6" - 940'		13,000	
I-2-4	Pipeline, Parallel to Collis Ln; Arnold Ln. to End	6" - 820'		12,000	
I-2-5	Pipeline, Arnold Ln-Mill Beach Rd-Center St.	8" - 5360'		87,000	
I-2-6	Pipeline, Easement; Center St. to Wharf St.	8" - 740'		12,000	
I-2-7	Pipeline, Wharf St; King St. South then West	8" - 960'		16,000	
I-2-8	Pipeline, King St; West of Wharf St.	6" - 270'		4,000	
I-2-9	Pipeline, Easement; Wharf St. to Cove Rd.	8" - 670'		11,000	
I-2-10	Pipeline, Railroad St; Pacific Ave. to Mill St.	6" - 750'		11,000	
I-2-11	Pipeline, Railroad St; Mill St. to Cove St.	8" - 620'		10,000	

TABLE IV-1 - Continued

	System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
I-2-12	Pipeline, Mill St; Hwy 101 to Railroad St.	8" - 600'		$ 10,000	
I-2-13	Pipeline, Wharf St; Hwy 101 to Spruce St.	6" - 300'		4,000	
I-2-14	Pipeline, Cove Rd; Railroad St. to Tanbark Rd.	8" - 1400'		23,000	
I-2-15	Pipeline, Railroad St; Fern Ave. to Tanbark Rd.	6" - 120'		2,000	
I-2-16	Pipeline, Tanbark Rd; Railroad St. to End	6" - 2250'		32,000	
I-2-17	Pipeline, Linda Ln and Memory Ln; Tanbark to Cedar	6" - 700'		10,000	
I-2-18	Pipeline, Del Norte Ln; Oak to Woodland Ln.	8" - 1020'		17,000	
I-2-19	Pipeline, Del Norte Ln; Woodland Ln. to Memory Ln.	8" - 1680'		27,000	
I-2-20	Pipeline, Hazel St; Hazel St. to Del Norte Ln.	6" - 300'		4,000	
I-2-21	Pipeline, Alder St; Hemlock to Spruce Dr.	4" - 150'		2,000	
I-2-22	Pipeline, Spruce St; Oak to Alder St.	6" - 430'		6,000	

TABLE IV-1 - Continued

System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
I-2-23 Pipeline, Redwood St; Fern to Myrtle St.	8" - 1560'		$ 25,000	
I-2-24 Pipeline, Myrtle St. ext; Redwood to Hwy. 101	8" - 220'		4,000	
I-2-25 Pipeline, Hwy. 101; Myrtle Ext. to North Bank Rd.	8" - 600'		10,000	
I-2-26 Pipeline, North Bank Rd; Pacific to Hwy. 101	12" - 2150'		56,000	
I-2-27 Pipeline, Alder St; Redwood to Hwy. 101	8" - 250'		4,000	
I-2-28 Pipeline, Between Fern and Oak; Redwood to Hwy. 101	8" - 250'		4,000	
I-2-29 Pipeline, Fir St; to North Bank Rd.	8" - 580'		9,000	
I-2-30 Pipeline, Marina Heights PS to Marina Heights Loop	6" - 780'		11,000	
I-2-31 Pipeline, Marina Heights Loop; Pacific View to Eastwood	6" - 2190'		31,000	
I-2-32 Pipeline, Eastwood Ln; Marina Heights to Pacific View	6" - 1550'		22,000	
I-2-33 Pipeline, Marina Heights Res. to New Marina Heights Res.	6" - 3350'		47,000	
TOTAL, PHASE I - PRIORITY 2			$569,000	

TABLE IV-1 - Continued

	System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
II-1	Reservoir, Airport Base Level	2.5 mg			$415,000
II-2	Reservoir, Northeast 2nd Level	75,000 gal.			45,000
II-3	Additional Pump, Airport 2nd Level PS	1 pump @ 125 gpm			2,000
II-4	Additional Pump, Airport 3rd Level PS	1 pump @ 40 gpm			2,000
II-5	Additional Pumps, Northeast 2nd Level PS	2 pumps @ 150 gpm			5,000
II-6	Additional Pumps, Marina Heights 4th Level PS	2 pumps @ 150 gpm			10,000
II-7	Additional Pump, Marina Heights 5th Level PS	1 pump @ 40 gpm			2,000
II-8	Pipeline, Airport Base Level Res. to Hwy. 101	12" - 3010'			79,000
II-9	Pipeline, Hwy. 101; Res. Pipe to Easy St.	12" - 5480'			143,000
II-10	Pipeline, Hwy. 101; Crossing at City Limit	8" - 40'			2,000
II-11	Pipeline, Hwy. 101; Crossing at Hanson St.	12" - 40'			3,000

TABLE IV-1 - Continued

	System Improvement	Facility Capacity or Pipeline Size and Length	Phase I Priority 1 Cost	Phase I Priority 2 Cost	Phase II Cost
II-12	Pipeline, Hwy. 101; Res. Pipe to Dawson Rd.	12" - 2250'			$ 59,000
II-13	Pipeline, Dawson Rd; Hwy. 101 to End	8" - 1270'			21,000
II-14	Pipeline, Dawson Rd; South to End	8" - 2270'			37,000
II-15	Pipeline, Easement; Hwy. 101 to Dawson Rd.	8" - 1270'			21,000
	TOTAL, PHASE II				$846,000
	TOTALS		$629,000	$569,000	$846,000

Phase I - Priority 1.

In this priority schedule, the construction of the 12-inch pipeline along Pacific Avenue to Chetco Avenue and then north on Highway US 101 to Ransome Avenue; and, a 10-inch pipeline with its connecting laterals along Ransome Avenue and north to Hassett Street are of major importance for obtaining an adequate waer system. The Pacific Avenue pipeline is needed to provide a major arterial tie between the main commercial area and the reservoir, and the pipeline section along Highway US 101 is necessary as a major pipeline to provide fire flows to the commercial and high value properties along this street. The Ransome Avenue pipeline is necessary to provide capacity for maintaining the minimum pressures in the northern section of the service area during periods of high demand. Also, the reservoirs and pump stations for the 2nd and 3rd levels in the Airport region and the 2nd level in the Northeast area are high priority system improvements. The customers in these service levels currently experience low flows and pressures and the new pressure zones are necessary to provide the adequate and reliable service conditions. There are minor pipeline change-overs and new constructions to isolate the proposed service areas. The Marina Heights 4th and 5th level pump stations are Phase I, Priority 1 improvements. The existing Marina Heights pump station is obsolete and is incapable of providing reliable uninterrupted service. The Phase I, Priority 1 improvement program is proposed to upgrade the existing facilities to meet the minimum standards for community water systems.

Phase I, Priority 2.

In this priority schedule, additional pipelines throughout the service area should be constructed to provide better

reliability. These pipelines strengthen the distribution system which presently has deficiencies because of the considerable footage of small diameter pipe and nonlooped or deadend pipeline extensions.

Phase II.

Phase II projects are primarily improvements for the construction of additional pipelines to adequately serve areas where future growth is likely to occur. In conjunction with these pipelines, the growth within some areas will require the addition of pumps within the existing pump stations and an additional reservoir will be needed in the Northeast 2nd level system. A major distribution storage reservoir will be required for the anticipated growth to 1996. We have proposed that a base level 2.5 million gallon storage reservoir be constructed north of the City, a short distance east of Highway US 101. This siting of the proposed 2.5 mg storage reservoir provides capacity for the growth north along Highway US 101, and of equal importance, the reservoir helps to maintain the system pressures during the periods of high demands or during an emergency.

The order in which the separate projects are listed in Table IV-1 is the suggested order of priority within the grouping; however, many of the pipeline projects are equal in importance. All projects should be reviewed as the time for their construction nears in order to verify the predicted development trends and to assure proper service to the development which actually occurs.

COST ESTIMATES

Basis for Estimate.

The cost estimates shown in Table IV-1 are based upon current material and construction costs within the State of

Oregon and adjusted for the conditions at Brookings. The Engineering News Record Construction Cost Indexes may be used as the basis for escalating these costs to the time of proposed construction. The estimated costs assume that the work will be undertaken by a private contracting company. The project cost of each of the improvements includes an allowance for contingencies, administrative and engineering costs.

In the determination of estimated costs of installed pipe it was assumed that all water lines would be constructed of asbestos cement pipe, and the unit costs used for pipeline construction are shown in Table IV-2.

Reservoir costs are based on current construction costs for steel reservoirs. Reservoir protective coatings are assumed to be a high-quality vinyl paint system with a useful life of 15 years or more. Prices include the cost of site work, foundations, piping, controls, and miscellaneous appurtenances. An allowance for contingencies, administrative and engineering costs is included.

Pump stations are to be constructed initially with the number of pumps installed as recommended in Table III-4; however, the building and basic piping is normally constructed initially for ultimate capacity. Pumps, motors, and corresponding electrical switchgear are included in the phase development as are control valves for individual pumps. Estimated prices include buildings, piping, pumps as indicated, control telemetering, accessories and allowances for contingencies, administrative and engineering costs.

Future Cost Estimates

The cost estimates for this study are based on an Engineering News Record Construction Cost Index of 2220. Construction costs have increased steadily over the past 15 years. Prior to 1967, the costs increased at approximately 5.5 percent per year; however, the trend changed abruptly in January 1968, and during the last few years there has been an approximate 10 percent per year increase. The forecast for the next year is for an increase in construction costs of 6 to 10 percent.

TABLE IV--2

ESTIMATED COST OF INSTALLED PIPE
ASBESTOS-CEMENT

Pipe Size	Unit	AC Pipe	Hydrants Valves & Fittings	Laying	Trench Excavation & Backfill	Surface Restoration	Construction Cost	Project Allowance	Project Cost
6"	L.F.	$ 2.50	$2.90	$2.40	$3.10	$0.40	$11.30	$2.85	$14.15
8"	L.F.	3.70	3.25	2.60	3.10	0.40	13.05	3.25	16.30
10"	L.F.	5.40	4.60	3.20	3.10	1.20	17.50	4.40	21.90
12"	L.F.	7.50	5.30	3.80	3.10	1.20	20.90	5.25	26.15
14"	L.F.	9.10	5.85	4.40	3.10	1.20	23.65	5.90	29.55
16"	L.F.	11.20	7.70	5.00	3.10	1.20	28.20	7.05	35.25

Assumed Pipe Installation Conditions

1. All pipe to be Class 150 asbestos-cement pipe.
2. Fire hydrants spaced at approximately 400 feet and valves spaced at approximately 400 feet for 6-inch through 12-inch, and 800 feet for 14-inch and larger.
3. All pipe to have 3 feet of cover.
4. Restoration of gravel surfacing required for 70 percent of pipelines.
5. Pavement removal and replacement required for 10 percent of 8-inch and smaller and 30 percent of 10-inch and larger pipelines.
6. Project allowance at 25 percent of construction cost includes construction contingencies, engineering services, legal fees and administration.

The above unit prices are based on an Engineering News Record Construction Cost Index of 2321.

CHAPTER V
FINANCIAL CONSIDERATIONS

The improvements program outlined in the preceding chapters will require substantial sums of money to implement. Most of the funds for the major capital improvements must be derived from the sale of general obligation or revenue bonds or warrants, with possibly some help from a Federal grant or low interest loans. Some contributions will be obtained from new customers requesting service connections and main extensions, or from builders planning the construction of several homes. The needed financing to repay the debts incurred by major construction programs and to operate and maintain the system must come from the sale of water, connection changes, property taxes, or other sources.

The financial aspects of the water system operation and a method for accomplishing the improvement projects are reviewed in the following paragraphs. Estimates of future revenue, operating and maintenance expense, debt service requirements, and a brief description of their projections are developed. A tentative financial schedule containing a pro forma flow of funds is provided for the study period. The figures are estimates and based upon certain assumptions, and therefore, subject to the uncertainties common to making predictions in the future. They have been prepared using historical data on City's operating experiences, and incorporating knowledge gained from similar systems operating in a like manner.

Chapter IV contains the detailed tabulations of anticipated water system improvements needed over the next 20 years. The following Table V-1 is an abbreviated summary of major program costs.

TABLE V-1

SUMMARY OF PROPOSED CONSTRUCTION COSTS

Improvement Program	Approximate Year Initiated	Total Program Cost
Phase I, Priority 1	1976-1977	$629,000
Phase I, Priority 2	1981-1982	$569,000
Phase II	1991-1992	$846,000

MAIN EXTENSION POLICY

It is recommended that Brookings apply a nonrefunding assessment policy for all water main extensions within the City. The policy provides that all properties fronting a new main, and which are not presently served by an adequate size water pipe will be assessed on a front-foot basis the cost of a 6-inch main complete with valves, fittings, and necessary appurtenances. If the line size required is larger than 6 inch, the assessment is still on the basis of a 6-inch line and the City pays the difference; if the line size needed is smaller than 6 inch, the assessment is also based on the cost of a 6-inch line. Generally, lines smaller than 6 inch will be installed only in cul-de-sacs. The customers taking service from these lines are receiving the benefits of the larger lines serving the dead-end main and thus should help pay for that service. For each main extension it is proposed that some form of a special improvement district be established and the appropriate cost of the extension be assessed directly to the benefited properties.

It is further recommended that in cases where application is made to serve City water to a new development area that the developer pay for the installation of a water distribution system in accordance with City standards. In most cases, the City would require a deposit equal to the project's

cost, build the system, and bill or refund to the developer the difference between the true cost and the deposit. This cost is passed on directly to the home buyer as part of the cost of the home.

SERVICE CONNECTION FEE AND SYSTEM DEVELOPMENT CHARGE

The City of Brookings presently charges $200 for installing a new 5/8" x 3/4" residential service. This charge only covers the City's cost for labor and material and to install the service. It is recommended that the City also consider the assessment of an additional fee to assist in financing needed improvements to the supply, storage, and arterial distribution system. A system development charge of $25 per water use fixture per new service is recommended. A new residential home with kitchen, laundry, and 2 baths would have 9 fixture units and the system development charge would total $225. Motels and tourist facilities with more fixtures would pay substantially more because of the greater demand on the water system.

BONDED INDEBTEDNESS

The mechanics of financing municipal improvements by the sale of general obligation bonds are not overly complex. A cost estimate is used to determine the amount of the bond issue; an election is held; and, if approved by the voters, the bonds are offered for sale and the money for construction is obtained prior to the time the project is actually undertaken.

While there is no statutory limitation on the amount of general obligation bonds which a City can issue for utility construction, there is a practical limitation above which reasonable rates of interest can no longer be obtained from private investors. This generally amounts to approximately

10 percent of the true cash value of the City. The true cash value of Brookings for fiscal year 1975-76 was $38,854,809. General obligation bonds are usually retired by revenues from the operation of the utility, or property taxes, or both.

The total amount of outstanding municipal bonds, as of June 30, 1975, is $2,469.582.

FEDERAL ASSISTANCE FOR CONSTRUCTION

There are various Federal funding programs available to local government. The following list obtained from the Municipal Index (8) summarizes several which are appropriate to the funding of water systems; however, there remains a distinction between the authorization of the program and appropriation of funds. Legislation that creates new programs and projects or continues existing ones is known as authorization legislation. Actual money to run the program must come from passage of another measure called an appropriation bill. Also, Federal aid programs undergo constant changes and revisions, and there is considerable movement of officials administering the programs. The following summaries and new programs should be updated by discussion with the responsible Federal agencies, whenever the specific projects are being considered for construction.

Community Development

The Housing Community Development Act of 1974 (PL 93-383) initiates new program of assistance to urban and rural communities. A major feature of the bill is that it consolidates HUD's major categorical grant programs into a single block grant program of assistance. The act provides for formula grants to cities for broad-range, locally designed programs. It is popularly known as "community development block grants."

Objectives. To develop viable urban communities by providing decent housing and a suitable living environment and expnading economic opportunities, principally for persons of low and moderate income.

Highlights.

- Funds are distributed to cities on a formula basis with 80% of the money going to SMSA's.
- The formula is based on population, housing overcrowding, poverty, and a hold-harmless provision for cities which have used previously funded categorical grants.
- There is no local match required.
- Cities which are not entitled to funds under the formula base in the legislation may apply for funds under the discretionary funds program.
- Money may be used for almost any community development activity which is specified in the local plan for the use of the block grant funds. These include, but are not limited to, housing code enforcement, urban renewal, public housing, neighborhood development, economic, development, etc.

Economic Development

Funding for economic development projects which are designed to revitalize the local economy of cities which suffer from high enumployment is found in the Public Works and Development Act, as amended (PL 89-136).

Economic development funds are spent by the Economic Development Administration (EDA) within the Department of Commerce. EDA operates an extensive program of grants for public facilities as well as loans and loan guarantee programs for business locating or expanding production in an EDA project area.

Public works grants and loans may go to states, local subdivisions, Indian tribes, and private or public nonprofit organizations or associations representing a redevelopment area or a designated economic development center.

Objectives. To assist in the construction of public facilities necessary for the long-term economic growth of an area. The business loan and loan guarantee programs are designed to encourage private investment in an economic development area.

Highlights.

- This program has historically concentrated on economic development in cities in the predominately rural sections of the country. Grants are also awarded to some large urban areas.

- EDA funds may be used for water and sewer systems, access roads to industrial parks, port facilities, railroad sidings and spurs, public tourism facilities, vocational schools, flood control projects, site improvements for industrial parks, etc.

- Business loans and loan guarantees may be made for both fixed assets and working capital.

- EDA may also guarantee lease agreements.

- Money is also available for planning assistance as well as a new program for broad-range economic adjustment programs for cities suffering a precipitous economic crises.

- Special provisions are made for economic adjustment program in cities suffering from shifts in international trade or natural disasters.

General Revenue Sharing

General revenue sharing funds are administered by the Office of Revenue Sharing (ORS) within the Department of the Treasury under the authority of the State and Local Fiscal Assistance Act (PL 92-512). The funds are allocated on the basis of population and need.

The Congress is considering bills to extend the program. President Ford has recommended that the General Revenue Sharing program be continued through 1982, with annual increases in funding of $150 million-therefore reaching an annual rate of $7.2 billion in 1982.

Objectives. To provide financial assistance to all states, counties, and cities on a regular basis which provides for maximum flexibility at the local level on how the money will be directed to meet local needs.

Highlights.

- The general revenue sharing program is funded from a special trust fund within the Treasury. The money comes directly from individual income taxes.

- Local governments must establish a trust fund at the local level from which projects that are designed to meet local priorities may be funded.

- Local governments must certify that they meet various provisions against discrimination and other provisions in order to qualify for the revenue sharing money.

Parks and Recreation

The Federal government has many programs which are designed to promote outdoor recreation, wildlife conservation, and public parks usage and management. These programs are found in the Bureau of Outdoor Recreation in the Department of the Interior (DOI). The most important program for cities is administered by the Bureau of Outdoor Recreation.

The Bureau of Outdoor Recreation's Acquisition, Development and Planning grant program is authorized under the Land and Water Conservation Fund Act of 1965 (PL 88-578) as amended by (PL's 90-401; 91-485; 91-308; 92-347; and 93-81).

Objective. To provide financial assistance to states and their political subdivisions for the preparation of comprehensive state-wide outdoor recreation plans and acquisition and development of outdoor recreation areas and facilities for the general public, to meet current and future needs.

Highlights.

- Acquisition and development grants may be used for a wide range of outdoor recreation projects, such as picnic areas, inner city parks, campgrounds, tennis courts,

boat launches, bike trails, outdoor swimming pools, as well as support facilities such as roads, water supply, etc.

- Facilities must be open to the general public and not limited to special groups.

- Development of basic rather than elaborate facilities is favored.

- Money is not available for operation and maintenance of a facility.

- All money is coordinated by the state office which has been designated to administer the federal funds for this program.

Small Community Development Programs

Rural communities with populations of less than 10,000 will find funding assistance available to them to construct needed facilities and aid their economic development in a series of loan and grant programs. These programs are administered by the Farmers Home Administration (FmHA) within the Department of Agriculture (USDA). Authority for these programs comes from the Consolidated Farm and Rural Development Act (PL 92-419).

Objectives. To promote the development of small communities through loans and grants for basic facilities and economic development.

Highlights.

- Community Facility loans are available for the construction and financing of any type of community facility which is necessary for the public good in communities with populations under 10,000. Such facilities may include hospitals, clinics, community centers, libraries, recreational facilities, nursing homes, fire protection, etc. The interest rate on these loans is 5%.

- Water and Wastewater Disposal loans are also available to cities under 10,000 from FmHA. These loans may be used to build water supply facilities as well as wastewater disposal systems, including pipelines and sewage treatment facilities. These loans are available on a 5% interest basis.

- Water and Wastewater Disposal Grants are also administered by FmHA. They are available for the same uses as in the loan program, but are available on a more limited basis.

- Industrial development grants are available to communities of under 50,000. These grants may be used to help a public body construct, repair, or replace facilities in an industrial park which is designed to increase employment in the community.

- Business and Industrial Development Loans are available to business and industry which plan to locate or expand their operation in a rural area. These loans come in the form of loan guarantees and the interest rate is fixed by the particular lending institution.

TENTATIVE FINANCIAL SCHEDULES

Table V-2, Projected Cash Flow and Capital Statement, is a pro forma flow of funds for selected years during the 20-year planning period. Assumptions made concerning the future revenue and expenditures are noted at the bottom of the schedule. This financial schedule assumes a self-supporting water utility whereby needed revenues are obtained through water sales and from the May 1976 Farmers Home Administration $150,000 grant for the major pipeline construction along US Highway 101. Water sales revenues were set after determining anticipated operating expenditures and debt service requirements.

Under this tentative plan, Brookings will need to increase its water rate schedule in order to finance the proposed water system improvements. The present water rate structure generates about $150,000 per year. The proposed financial schedule under Plan A is based upon water rate increases of 75 percent in years 1976-77 and 10 percent in years 1991-92. In addition, it is proposed that the system development charge will create a fund of about $7,000, $39,000 and $97,000 for expenditures on planned system improvements in years 1976-77, 1981-82 and 1991-92, respectively.

TABLE V-2

PROJECTED CASH FLOW AND CAPITAL STATEMENT (For Selected Years)

	Current Budget 1975-76	Phase I – Priority 1 1976-77	Phase I – Priority 2 1981-82	Phase II 1991-92
CASH FLOW STATEMENT				
Operating Income				
Water Sales	$150,000	$270,000 (1) (4)	$313,000 (1)	$463,000 (1) (11)
Connection Fees	8,000	6,000 (3)	8,000 (3)	10,000 (3)
Interest and Other Income	5,000	5,000	5,000	5,000
Total Operating Income	–	281,000	326,000	478,000
Operating Expenditures				
Total Operating Expenditures	120,000	127,000 (2)	170,000 (2)	305,000 (2)
Funds Available for Debt Service	–	154,000	156,000	173,000
Debt Service				
Present Bond Payment, 1973 Series	69,000	69,000	69,000	69,000
New Bond Payment, 1976 Series	–	39,000	39,000	39,000
New Bond Payment, 1991 Series	–	–	–	26,000 (10)
Total Bond Payments	–	108,000	108,000	134,000
Balance for Capital Use	–	46,000	48,000	39,000
Debt Service Coverage Ratio	1.21	1.43	1.44	1.29
CAPITAL STATEMENT				
Capital Available From:				
Operations	–	$ 46,000	$48,000	$ 39,000
Bond Sales	–	450,000	–	300,000 (10)
Government Grants	–	150,000 (7)	–	
Contribution in Aid of Construction	–	24,000 (12)	244,000 (12)	79,000 (12)
New System Development Fund	–	7,000 (6)	39,000 (6)	97,000 (6)
Accumulated Surplus	–	–	252,000 (8)	360,000 (9)
Total Capital Funds Available	–	$ 677,000	$583,000	$ 875,000
Capital Expenditures				
Extension Pipelines and Services	–	$ 24,000	$244,000	$ 79,000
Transmission and Major Pipelines	–	414,000	325,000	286,000
Distribution Storage	–	100,000	–	460,000
Booster Pump Stations	–	91,000	–	21,000
Total Capital Funds Expended	–	$629,000	$ 569,000	$ 846,000
Surplus		$48,000	$14,000	$29,000

(1) Assumes 3 percent annual growth rate.
(2) Expenses increase at 6 percent per year.
(3) Connection fees at $200/D.U.
(4) Assumes water rate increase of 75 percent, effective 7/1/76.
(5) $450,000 Bond Issue at 7 percent for 25 years.
(6) New Development Fund at $25/Fixture and 9 Fixtures/D.U.
(7) FmHA Grant of May 1976 at $150,000
(8) Assumes average year end surpluses of $52,000
(9) Assumes average year end surpluses of $40,000.
(10) $300,000 Bond Issue at 7 percent for 25 years
(11) Assumes water rate increase of 10 percent, effective 7/1/91.
(12) Property owner's share of cost for pipeline extensions and new services.

CHAPTER VI
ADMINISTRATION

A sizable construction program has been recommended in this report. The City of Brookings can finance this program, but it will need the understanding and support of all people served and a good deal of hard work.

The City Council, through their concern and willingness to serve, will largely set the measure of success of this program. The policies adopted by the Council will determine the manner in which the Water Department is administered and will influence public sentiment toward the City. The Council must maintain equitable rules and regulations which will allow the Water Department to continue as an economic and efficient operation.

In this chapter various rules and regulations as well as numerous systems for maintaining records and mapping of the water system, and completing periodic reports for the administration of the Water Department are discussed. The carrying out of all of the items listed in the subsequent paragraphs would be a monumentous task and impossible for the present department personnel. It is recommended, however, that these items be reviewed in conjunction with existing and future needs and those records and reports that would be of specific value should be adopted.

RECORDS

A good system of records is an extremely useful tool in providing satisfactory service to customers of the city, in the planning of future improvements, and in normal maintenance practices; however, written reports and records are

time consuming, the time spent in organizing and keeping a good set of records must be balanced with other duties. As time permits, the records kept may include a system for recording all pertinent information in regard to location, size, type, materials, date of inspection, and maintenance of the following:

1. All major valves (gate and pressure-reducing)

2. Fire hydrants

3. Services

4. Meters

5. Leak repairs

6. Pipeline replacements

7. Installation of new lines

8. Pumps

In addition, materials inventories may be kept in sufficient detail to provide a current record of all materials on hand. Records of the use and maintenance of all equipment owned by the Water Department may also be kept current.

The meter is the "cash register" of a water system and when used should be kept in good repair and read. This is not only an obligation to the customer, but it will pay for itself in a very short time. Meters should be removed, cleaned, tested, and repaired in a systematic manner at intervals of five to ten years for small meters and one to four years for large meters. By keeping a good set of

record cards, a system can be established for doing this at the proper time. Meter repairs will rarely run over 25 to 30 percent of the cost of a new meter; and if properly repaired, will perform equally as well. Since the installation of a meter test facility is not economical for small water systems, it is recommended that arrangements be made to have the meters tested and repaired privately until such time as the city can afford to maintain its own meter shop.

REPORTS

Monthly Reports

A monthly report by the Water Department to the City Council at the close of the billing period for presentation at each regular Council meeting keeps the members informed. The following information may be included:

1. Number of active services by classifications and/or size.

2. Number of inactive services by classifications and/or size.

3. Number of turnons.

4. Number of turnoffs.

5. Number of applications for service.

6. Number of new service installations.

7. Total water produced

8. Total metered consumption.

9. Total water sales--dollars.

10. Unaccounted-for water--million gallons.

11. Maximum daily demand.

12. Power used.

13. Chlorine used.

14. Treatment cost.

15. Number of meters tested and repaired.

16. Number of leaks repaired.

17. Summary of other improvements made.

18. Brief statement of needed improvements.

19. Number of bacteriological tests made and the results.

20. Any other pertinent information that would be of value in later analyses.

The report can be on a standardized two-page form which can be duplicated for this use.

Annual Report

The water department should prepare an annual report on the operation of the system which is basically a summary of the monthly reports. These should be kept as part of a permanent file together with copies of the past year's audit and the next year's budget for the city. It is not intended

that these reports be literary achievements, but a place in which useful information can be consolidated. There may be additional engineering studies of the water system in the future, and having factual historical data available in a form easily used will facilitate the work. The consolidation of information in such reports should result in overall savings to the city through more efficient operation and advance planning.

MAPS

As-Built Plans

As-built plans of the supply facilities, distribution system, storage reservoirs, pumping stations, and other key installations should be kept in duplicate with one copy filed in a safe location. In addition to helping improve the fire grading, the as-built plans can save many times their cost at the time modifications to the facilities are constructed.

Distribution System

The day-to-day operation and maintenance of the water system is facilitated by a complete set of maps of the distribution system. A single overall map of the system, at a scale of 1 inch = 400 feet, showing the line sizes, valve locations, hydrant locations, and an index to more detailed maps should be available. In addition, a detail map should be prepared at scales of 1 inch = 50 feet or 1 inch = 100 feet, to show the location of services, fittings, pipe materials, dates of installation, dimensions, etc. Separate valve, hydrant, and service records note the details of these installations.

Chapter VII
RECOMMENDATIONS

On the basis of this study, we recommend the following:

1. That the City of Brookings and all reviewing agencies adopt the plan for water distribution system improvements outlined in this report.

2. That this plan be periodically reviewed with particular attention to the needs and changing conditions of the study area.

3. That the City of Brookings initiate the actions necessary to implement the Phase I, Priority 1 phase of the water distribution system improvement plan.

4. That the City of Brookings apply the $150,000 Farmers Home Administration Grant to the Phase I, Priority improvements and that $450,000 in general obligation bonds to finance the remaining portion of the improvement program be approved by the voters of the City of Brookings.

5. That the City of Brookings adopt a Community Facility Development Fund policy whereby each new service is assessed a fee in proportion to the anticipated water use to pay for the needed facilities.

6. That the City of Brookings adopt a Water Rate Schedule that will finance the water system improvement program outlined in this report.

7. That the Public Works Department adopt as many of the administrative and procedural policies outlined in the study report as permitted by the manpower and budgetary limitations.

INSURANCE SERVICES OFFICE

OF OREGON

721 S.W. OAK STREET, PORTLAND, OREGON 97205
TELEPHONE (503) 226-2651

H. E. MARQUELING, MANAGER

June 13, 1975

To the Honorable Mayor and City Council
CITY OF BROOKINGS
Post Office Box "C"
Brookings OR 97415

Gentlemen:

As you may recall, the City's fire protection facilities were inspected during February in order to bring our records up to date. Our evaluation has been completed and revised fire insurance rating information is being mailed to the insurance companies and agents today.

Protection Class 7, a change from the previously authorized Class 8, has been authorized for the rating of dwellings throughout the City. The effective date of this change is May 15, 1975.

Protection Class 7(7b), a change from Class 8(8b), will be the basis when determining rates for properties other than dwellings. Rates for these properties will be released in the future since the buildings must be individually rated.

We are enclosing a general recapitulation sheet of the grading results and a copy of the fire flow test results which we believe will be of interest. A summary of the grading and improvement recommendations, based on the 1974 Grading Schedule for Municipal Fire Protection are also included as requested by Chief Frank.

Also enclosed is a water system map which was prepared following our inspection. Additional copies may be purchased if desired.

The City and its officials are to be complimented on the improvements which

continued--

CITY OF BROOKINGS

have been made in the fire defenses. We are available for consultation should there be questions relating to the grading or fire insurance rates in general.

In closing, I wish to thank all officials for the assistance extended to personnel from this Office.

Very truly yours,

INSURANCE SERVICES OFFICE

H. E. Marqueling
Manager

ny:
enclosures - as noted

cc with enclosures: Chief Merle Frank - Brookings Fire Department

Material referenced in the recommendations may be obtained from the following sources:

American Insurance Association

85 John Street
New York NY 10038

American Water Works Association

Publications Sales
6666 West Quincy Avenue
Denver CO 80235

Insurance Services Office

Municipal Survey Service
160 Water Street
New York NY 10038

National Fire Protection Association

Publications Service
470 Atlantic Avenue
Boston MA 02210

INSURANCE SERVICES OFFICE of Oregon
721 SW Oak Street
Portland, Oregon 97205

CITY OF BROOKINGS

Date Surveyed February 1975

GRADED WITH REFERENCE TO FIRE DEFENSES AND PHYSICAL CONDITIONS AS DETERMINED BY THE STANDARD GRADING SCHEDULE

	WATER SUPPLY	FIRE DEPART-MENT	FIRE SERVICE COMMUNICA-TIONS	FIRE SAFETY CONTROL	CLIMATIC CONDI-TIONS	DIVER-GENCE	TOTAL POINTS	CLASS
POINTS OF DEFICIENCY	1,513	982	294	464	45	33	3,331	7

The class is based on a total maximum of 5,000 points of deficiency as follows:

RELATIVE CLASS	POINTS OF DEFICIENCY
First,	1 - 500
Second,	501 - 1000
Third,	1001 - 1500
Fourth,	1501 - 2000
Fifth,	2001 - 2500
Sixth,	2501 - 3000
Seventh,	3001 - 3500
Eighth,	3501 - 4000

Ninth Class: 4001-4500 or receiving less than 4001 points but having no recognized water supply.

Tenth Class: More than 4500 points or without a recognized water supply and having a fire department grading over 1755 or with a water supply and no fire department or with no fire protection.

RELATIVE VALUES

	Points
Water Supply	1,950
Fire Department	1,950
Fire Service Communications	450
Fire Safety Control	650
TOTAL	5,000

Additional points of deficiency are applied under Climatic Conditions where these are in excess of the normal for the United States, and under Divergence where the gradings of Water Supply and Fire Department are greatly different.

RECOMMENDATIONS

The attached recommendations are offered to assist officials in planning improvements in the fire protection facilities. Since you have the final decision on any improvement program, we have listed several suggestions. We have not included every item for which a deficiency is charged but have attempted to cover the heaviest deficiency items.

We would like to emphasize that even a partial improvement in any of the items could provide a beneficial effect in the grading. It is possible to achieve a better protection class by partial improvement in many items or major improvement in a few important items.

If after reviewing these recommendations officials believe they can accomplish selected improvements, we can estimate the effect those improvements would have on the grading.

If work on these improvements is not started within one year, we reserve the right to review this information for conformity with standards in use at that time. These recommendations are made for fire insurance rating or grading considerations only and no representations or warranties of any kind are made or intended.

Public Protection Department
INSURANCE SERVICES OFFICE of Oregon

Brookings Recommendations
Based on 1975 Grading

WATER SUPPLY:

1. That, in addition to the present records and plans, the following be added as part of the records system. All plans and vital records should be kept up to date, in duplicate and safely filed to avoid a total loss in event of a catastrophe. MAINS: size, location, depth of bury, type of construction, date installed and fittings, leaks breaks and important repairs. SUPPLY WORKS: plans and details of each feature. GATE VALVE BOOK: detail of size, tied-in location, construction, inspection and condition including valves closed and direction of rotation. CONSUMPTION: production (master meters, etc.), sales and losses, number of services-metered and otherwise. HYDRANTS: size, type, construction, branch details, inspection and condition.

   The American Water Works Association's Manual 8, A Training Course In Water Distribution, is a good guide to use for a records system.

2. That additional pumps be installed or the reservoir capacity be increased so that with the two largest pumps in the system out of service, the recommended fire flow of 2,500 gpm will be available for 2 hours at a resi residual pressure of 20 psi during a five-day period of maximum domestic consumption.

3. That a duplicate supply main from the source to the distribution system be provided so that no single break can interrupt the water supply.

4. That arterial, lateral and girdiron mains be laid in proper locations and of adequate size to concentrate in any section of the City the fire flow recommended for that area. (See Fire Flow Test sheet for information.)

   That distribution mains which supply hydrants be 6-inch or larger, fully circulating and cróss-connected at frequent intervals.

5. That the distribution system be of sufficient capacity to furnish at least 500 gpm at a residual pressure of 20 psi in the residential areas.

6. That the system be gated so that no more than 500 feet of main in commercial areas nor more than 800 feet of main in other areas need be shut down for repairs.

7. That valves be checked for proper operation and carefully inspected at least annually; the more important valves should be inspected more frequently. Record of inspections and repairs should be kept.

8. That all valves in the underground distribution system be made accessible.

9. That additional hydrants be installed in those areas not properly protected as follows: (a) in high value districts, one hydrant for each 125,000 square feet; (b) in residential districts, one hydrant for each 160,000 square feet.

10. That all hydrants be kept in good mechanical condition. Hydrants should be thoroughly inspected at least twice annually, the necessary repairs made and records kept of the inspections.

11. That all hydrants installed in the future be those of the standard frost-proof type meeting the American Water Works Association's standards.

    Hydrants should be supplied by not less than a 6-inch lateral from the main.

    That a gate valve be installed on each lateral between the hydrant and the main.

FIRE DEPARTMENT:

1. That company officers be appointed.

2. That additional fire fighters be enrolled in the fire department in order to obtain a greater response at all times.

3. That the pumpers be tested annually from draft in accordance with the methods prescribed in the pamphlet, Fire Department Pumper Tests and Fire Stream Tables, published by the Municipal Survey Service of the Insurance Services Office.

4. That there be 2,400 feet of 2½-inch hose on hand for each pumper in service and 1,200 feet of 2½-inch hose for the reserve engine.

5. That written fire department rules and regulations be adopted, posted in the fire station and a copy given to each fireman. It is suggested that the American Insurance Association's Special Interest Bulletin No. 307, Fire Department Personnel-Rules and Regulations, be used as a guide.

6. That regular drills be held twice a month under charge of the chief or an experienced drillmaster. These should include engine, hose, ladder and salvage work. Fire methods and plan of attack on various buildings should

be discussed at monthly meetings or instead of drills in case of inclement weather.

That the department participate in the training programs conducted by the various State organizations.

7. That buildings, including private homes, be inspected at least annually by the firemen for the purpose of familiarization with structural conditions such as fire walls, vertical openings, standpipes, partitions, boiler and furnace rooms, etc.

9. That complete records on all fire department operations and activities be kept. Good reference material can be found in the American Insurance Association's Special Interest Bulletin No. 152, Fire Department Records, and the National Fire Protection Association's Pamphlet 4, Organization for Fire Services.

FIRE SERVICE COMMUNICATIONS:

1. That a modern municipal fire alarm system be installed in high value areas in accordance with the current edition of the National Fire Protection Association's Standard No. 73, Public Fire Service Communications, and eventually be extended to other built-up sections of the City.

2. That a voice recorder be installed on the fire phone circuit.

FIRE SAFETY CONTROL:

1. That the 1973 edition of the Uniform Fire Code be adopted and adequate provisions made for its strict enforcement.

May 1975

Public Protection Department
INSURANCE SERVICES OFFICE of Oregon

INSURANCE SERVICES OFFICE

OREGON
STATE OFFICE

SUMMARY OF GRADING

GRADING SCHEDULE FOR MUNICIPAL FIRE PROTECTION
(1974 Edition)

Date Graded: February 1975 City or District: City of Brookings

Total Deficiency: 3,331 Points. Graded by: A.Nisbet Engineering Representative

Protection Class 7

WATER SUPPLY

Item		Assigned Points
1.	Adequacy of Supply Works	155
2.	Reliability of Source Supply	101
3.	Reliability of Pumping Capacity	0
4.	Reliability of Power Supply	0
5.	Condition, Arrangement, Operation, and Reliability of System Components	67
6.	Adequacy of Mains	546
7.	Reliability of Mains	70
8.	Installation of Mains	74
9.	Arrangement of Distribution System	73
10.	Additional Factors and Conditions Relating to Supply and Distribution	15
11.	Distribution of Hydrants	235
12.	Hydrants - Size, Type and Installation	54
13.	Hydrants - Inspection and Condition	45
14.	Miscellaneous Factors and Conditions	78
	Total	1513

FIRE DEPARTMENT

1.	Pumpers	0
2.	Ladder Trucks	0
3.	Distribution of Companies and Type of Apparatus	0
4.	Pumper Capacity	16
5.	Design, Maintenance, and Condition of Apparatus	79
6.	Number of Officers	50
7.	Department Manning	182
8.	Engine and Ladder Company Unit Manning	134
9.	Master and Special Stream Devices	18
10.	Equipment for Pumpers and Ladder Trucks	14
11.	Hose	16
12.	Condition of Hose	10

Item		Assigned Points
13.	Training	218
14.	Response to Alarms	0
15.	Fire Operation	208
16.	Special Protection	0
17.	Miscellaneous Factors and Conditions	37
	Total	982

FIRE SERVICE COMMUNICATIONS

1.	Communication Center		18
2.	Communication Center Equipment and Current Supply		137
3.	Boxes		60
4.	Alarm Circuits and Alarm Facilities Including Current Supply at Fire Stations		29
5.	Material, Construction, Condition, and Protection of Circuits		16
6.	Radio		3
7.	Fire Department Telephone Service		24
8.	Fire Alarm Operators		5
9.	Conditions Adversely Affecting Use and Operation of Communication Facilities and the Handling of Alarms		2
10.	Credit for Boxes Installed in Residential Districts	(-)	0
	Total		294

FIRE SAFETY CONTROL

1.	Flammable or Compressed Gases	15
2.	Flammable or Combustible Liquids	93
3.	Special Hazards	109
4.	Miscellaneous Hazards	113
5.	Supplemental Fire Prevention Activities	32
6.	Building Laws	50
7.	Electricity	32
8.	Heating and Ventilating Installations	20
	Total	464

ADDITIONAL DEFICIENCIES

1.	Adverse Climatic Conditions	15
2.	Other Adverse Conditions or Occurrences	30
3.	Divergence Between Water Supply and Fire Department	33
	Total	78

SUMMARY OF DEFICIENCY POINTS

WATER SUPPLY	1513
FIRE DEPARTMENT	982
FIRE SERVICE COMMUNICATIONS	294
FIRE SAFETY CONTROL	464
ADDITIONAL DEFICIENCIES	78
Total Deficiency	3331

FIRE FLOW TESTS

Area Graded: Brookings County: Curry State: Oregon
Engineer: A. Nisbet & D. Locey (Public Protection Department) Date: 2-11-75
Pumps and tanks operating during high value flow tests: all

FVD tests: System consumption rate during tests 0.50 MGD; Time of day 9:00 to 11:00 a.m.

No.	LOCATION	PRESSURES-Lbs. Sq. In.			ORIFICE	DISCHARGE-G.P.M.				DISTRICT*
		Static	Resid.	Pitot		Observed	Rec.	20 lbs.	.. lbs.	
1	Mill & Chetco	100	18	3½	2 1/2	310	2,500	300		C
2	Pioneer & Pacific	91	48	12½	2 1/2	590	3,000	760		INS
3	Easy & Fern	83	25	7	2 1/2	360	3,500	400		INS
4	5th, north of Chetco	92	35	11	2 1/2	560	2,000	630		C
5	Arnold & Chetco	90	16	3½	2 1/2	310	2,500	300		C

*DISTRICTS.

C — Commercial
SC — Shopping Center
IND — Industrial
RES — Residential
INS — Institutional
** — Single Risk (use with one of above)

"Static" pressure indicates normal pressure in main at time of test.
"Residual" pressure indicates pressure in main during flow at hydrant.
"Pitot" pressure indicates measured velocity head of stream at hydrant outlet.
Column headed "Orifice," shows number and size of outlets opened.
"Observed" discharge shows flow computed from noted pressures.
"Recommended" discharge is the flow considered for fire insurance grading purposes.
"Discharge — 20 lbs.," is computed flow available for pumping engines.
"Discharge — ... lbs.," is computed flow available for direct hydrant streams.