

**REPORT TO DESERT LAND BOARD
ON CENTRAL OREGON PROJECT:
WITH SPECIAL REFERENCE TO
SEEPAGE LOSSES AND CANAL
CAPACITIES**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649327317

Report to Desert Land Board on Central Oregon Project: With Special reference to seepage losses and canal capacities by John Dubuis

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

JOHN DUBUIS

**REPORT TO DESERT LAND BOARD
ON CENTRAL OREGON PROJECT:
WITH SPECIAL REFERENCE TO
SEEPAGE LOSSES
AND CANAL CAPACITIES**

REPORT TO
DESERT LAND BOARD
ON
CENTRAL OREGON PROJECT

WITH SPECIAL REFERENCE TO
SEEPAGE LOSSES AND
CANAL CAPACITIES

By JOHN DUBUIS
Field Inspector
December 1, 1914



SALEM, OREGON:
STATE PRINTING DEPARTMENT
1915

TCR24
07.45
1912

TO VIEW
CALIFORNIA



PILOT BUTTE CANAL NEAR REDMOND

CONTENTS

	PAGE
Synopsis	5
Introduction	8
Scope of investigations	8
Personnel	8
Description of Project:	
Location	9
Water supply	9
Climatic and agricultural conditions	9
Irrigation plan	10
Water Supply:	
Source	11
Water requirements at Bend	12
Water requirements below Bend	12
Water requirements above Bend	14
Safe Capacities:	
Definition	15
Central Oregon Canal	15-16
Laterals of Central Oregon Canal	17
North Canal	17
Pilot Butte Canal	18
Laterals of the Pilot Butte Canal	18
Determination of the Value of "N"	19
Summary of Results	20
Transmission Losses:	
Nature of Problem	21
Location and Description of Gages	21
Discharge Measurements by Current Meter	22
Weirs	23
Method of Procedure	23
Units Used in Expressing Transmission Losses	23
Computations	25
North Canal	25
Pilot Butte Canal:	
Main Canal	27
Lateral Systems	30
Lateral E	30
Lateral F ¹	31
Lateral B	31
Lateral A ²¹	31
Lateral C ¹	32
Lateral J	32
Summary	33
Central Oregon Canal:	
Main Canal	34
Lateral Systems	36
Lateral A	36
Lateral D	37
Lateral H	38
Lateral I	38
Lateral P	39
Summary	39
Farmer's Ditches	40
Evaporation	40

CONTENTS—Continued.

	PAGE
Transmission Losses—Continued.	
Summary of Losses	41
Pilot Butte System	41
Central Oregon System	42
Seepage Conditions on Entire Systems	42
Comparison of Results with Other Data	44
Remedies for Losses	45
Weather Conditions	46
Crop Report and Census:	
Report	47
Percentage of Cleared Land Not in Cultivation	47
Duty of Water	49
Adequacy of System:	
General	57
Pilot Butte Canal	57
Central Oregon Canal	58
Cost of Repairing Deficiencies in Capacities:	
General	59
Central Oregon Canal	59
Pilot Butte Canal	60
Operation and Maintenance:	
General	61
Maintenance	61
Operation	62

ILLUSTRATIONS

	PAGE
Pilot Butte Canal near Redmond—FRONTISPIECE	
North Canal	25
North Canal	26
Pilot Butte Canal, Mile Post 6.88	28
Lateral A, Central Oregon Canal	36
Lateral D, Central Oregon Canal	37
Lateral A ¹⁰ , Central Oregon Canal	45

DRAWINGS

	PAGE
Fig. 1. Condition of North Canal, 1914	10
" 2. Daily Flow of Deschutes River near Bend, Oregon	13
" 3. Gage Types	22
" 4. Central Oregon Irrigation Project	24
" 5. Distribution of Water Diverted at Intake	43
" 6. Water Diverted at Canal Intakes	52
" 7. Capacities of Central Oregon and Pilot Butte Canals.....	58

SYNOPSIS

The following report contains data relative to the physical condition of the Central Oregon Irrigation Company's Project, together with certain conclusions therefrom. These conclusions in brief synopsis are herewith presented.

1. The total water lost in transmission through the canals from point of diversion at the river to place of use on the farmers' land, including losses in farmers' ditches, ranges from 67% to 75% of the total amount diverted from the river.

2. The losses in main canals and laterals from river diversion to point of delivery by the Company at or within one-half mile of the farmers' land, range from 45% to 57% of that diverted. Losses in main canals alone amount to from 25% to 40% of the water diverted from the river.

3. These heavy losses seem to be due to the porous, seamy nature of the lava rock which underlies the greater part of the segregation, to the relatively shallow soil, and to the character of construction of the canals. Caves, underground channels, and sink holes have been noted in places where this rock is exposed.

Canals have been built wider and more shallow than proper, in order to avoid rock excavation. Where natural depressions were used the water has been allowed to spread over large areas. Since the loss of water is to a certain degree directly proportional to the wetted area, some of the excess loss is the natural result of this excess area.

4. The soil itself is relatively tight. Recorded losses sometimes run as low as 0.3 cubic foot per square foot of wetted area per 24 hours. Where the seamy rock is encountered however, the losses will run up to 3.0 cubic feet per 24 hours, and in the case of the North Canal the remarkable figure of 45.0 cubic feet per square foot of wetted area was obtained.

5. It is believed that in canals dug entirely in earth without encountering rock or gravel, the loss will be about 0.6 cubic foot per square foot of wetted area in 24 hours.

6. Evaporation loss in comparison with seepage and leakage loss is so small as to be negligible.

7. The greatest losses are in the main canals and the places of their occurrence are thus easily accessible. From this and other data at hand it is probable that losses in canals and laterals can be reduced to 40% of the total water diverted from the river without resorting to expensive methods of lining.

8. The duty of water of 1.8 acre feet per acre in 90 days may be sufficient after the project is well settled and all lands are under cultivation, although the settlers have been using more than this amount. (The proper duty for this or any project is not that which gives the greatest crop yield per unit of water used, but must take into consideration the cost of the land and water, value of crops, cost of labor, and other investment costs, and should be that which shows the greatest net profit in money to the farmer. A proper distinction should be made between the "economic use of water" and the "economic duty of water," as they are not synonymous terms.)

9. The present capacity of the main canals is insufficient to water all the lands sold and patented and listed for patent, if losses are not brought below 40%.

10. The condition of wooden structures on the project is unsatisfactory. Many cannot be expected to stand five years longer, and some have already passed the stage of economic usefulness. The estimated cost of replacing these wooden structures is \$130,000. This includes weirs, headgates and flumes.

11. Insufficiency of maintenance and assumptions of design which were not fulfilled in construction, are responsible to a large extent for the poor conditions on this project.

12. The proper cost of maintenance and operation should be in excess of \$45,000 and should provide a proper sinking fund to replace the temporary wooden structures.

13. The value of water made available by lessened seepage losses estimated by the Department of Agriculture in Bulletin No. 126, is \$3,000 per second foot saved. On the basis of sold lands on the project, amounting to 45,500 irrigable acres, the loss to the community represented by the present seepage loss as against the allowable loss provided for in contract is about \$800,000. Should the losses be reduced to 40% a saving to the community of \$500,000 would result. The cost of reducing losses even to 30% should be far less than \$800,000.

14. It is believed that a large part of the transmission losses can be eliminated if proper maintenance be done as estimated in item 12 above.

15. Seepage losses must be greatly reduced, or the canals must be enlarged if all the lands now under the canal system are to be watered. In view of the water supply situation the former expedient is the most advisable and to accomplish this it is recommended that the maintenance and operation department be greatly increased and a systematic effort made to reduce the excess wetted area of canals, to discover and cement leaks in canals, and drops, to work out effective designs of structure and systematically replace the worn-out structures with better ones, to the end that the system be more efficiently operated, that the maintenance and operation costs be decreased, and that there be a positive assurance that there will be an adequacy of capacity to supply all lands now under the canal system.

16. It has been stated in the past that engineers as a rule make an allowance of 20% of the total irrigable lands in a project for lands which will never be irrigated, such as lands taken up by roads, buildings, beds of streams, high land, waste lands, rights of way and even towns.

Attention is called to the fact that in the recent reports on irrigation projects in the Northwest including projects intermingled with and adjacent to this project, no mention is made of any such allowance, although the matter of water supply and irrigation requirements have been most carefully considered by men of national reputation.

In view of recent investigations of this subject and in view of the methods adopted by modern engineering practice which eliminates this allowance from serious consideration, it is not to be considered on this project for the following reasons:

a. High lands, waste lands, town areas, stream bed areas and some rights of way have already been eliminated from the irrigable area considered under the project.

b. No practicable rule to make any such allowance in the actual distribution of water has ever been suggested.

c. The poor condition of irrigation system and uncertainty regarding duty of water render such allowance unsafe.

d. The following legal question presents itself: Has not the settler the right to demand all the water his contract calls for regardless of the amount of land he has in cultivation? Has any irrigation company the right to sell water rights for, say, 20,000 acres of land and provide water for only 16,000 acres on the theory that 4,000 acres will not be in cultivation?

17. Popular opinion is that after an irrigation project is constructed the difficult work is over. Experience has proven that after the construction of an irrigation project is completed the real problems develop, the correct solution of which determine the success or failure of the venture.

18. It is recommended that prior to the active construction of any irrigation project by public or private funds, the following points should be given most careful and thorough investigation, even though the cry for immediate action and relief be urgent:

1. Water Supply. Sufficiency of water supply is absolutely essential.
2. Agricultural conditions, climate, character of crops, character of soil and subsoil upon which an estimate of duty of water to be based.
3. Market conditions, value of lands, value of crops, cost of living, etc., transportation facilities.
4. A financial arrangement which will be the most advantageous to the farmer and yet be sufficient to reimburse the expense of constructing and handling the project:
5. Design of the proposed works, which should take into consideration the following:
 - a. The character of soil and subsoil conditions with reference to the elimination of losses and to providing an ample supply of water for lands.
 - b. Minimum cost for maintenance and operation, taking into account interest on construction cost, depreciation of structures, ease and economy in the distribution and measurement of water.
 - c. The development of the project in small units whereby the lateral system may be extended as dictated by sales. (Lands in any unit, however, should not be opened for sale until all the land in that unit is provided with an ample lateral system. Thus construction can be kept just ahead of sales so that interest charges are low.)