

**Ministry of Higher Education
and Scientific Research
University of Diyala
College of Engineering**



EVALUATION OF MAIN AND SECONDARY CHANNEL SYSTEM OF AL-KHALIS IRRIGATION PROJECT

**A Thesis Submitted to Council of College of Engineering, University
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ عَلَيْهِ
تَوَكَّلْتُ وَإِلَيْهِ أُنِيبُ ﴿٨٨﴾

صَدَقَ اللَّهُ الْعَظِيمُ

سورة هود



To My Parents

*For their Love, endless support
and encouragement*



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Abstract

The irrigation project of Al-khalis is one of the most important projects for the Diyala lower basin, which is one of the most productive agricultural areas in the Iraq, divided into two geographical areas, the upper and lower of Al-khalis.

This study conducts on upper part of Al-khalis project, occupied an area of (72850ha.)which included measure seepage losses for Al-khalis Main Canal between the kilometer (5.600) and (9.200) and Secondary Canal (9L), check the water conveyance efficiency, measure and specify the water quality variables of the project by comparing with their standard limitations and calculate a Canadian Water Quality Index (CWQI).

Seepage losses for Al-khalis Main Canal and Secondary Canal (9L), which unlined canal which considered in this study are measured by inflow-outflow method and the results were compared with the results of two empirical equations (Moritz and Molesworth-Yennidunia), by using the reaches on canals. The results of seepage losses in main canal are variable spatially and temporally in five segments (S_1 , S_2 , S_3 , S_4 , S_5), Temporally, observed that seepage losses in December less than the rest

of the months found to vary between (0.055 l/s per m²) to (0.177 l/s per m²), spatially S₁ and S₄ recorded the highest seepage losses from the rest of the sections (0.265 l/s per m², 0.239 l/s per m²) respectively, for Secondary Canal (9L) results show that the seepage is varied spatially and temporally in three reach (R₁, R₂, R₃). Temporally, observed that seepage losses in December higher than rest of months found to vary between (0.0131 l/s/m²) to (0.059 l/s/m²), spatially R₂ was recorded high seepage losses from other reach it varied between (0.053 l/s/m² to 0.059 l/s/m²). The results of water conveyance efficiency for Al-khalis main canal and secondary canal (9L) were (66%, 66.4%) respectively. When compared with the design values, were less than them.

For chemical evaluation, eight sites were selected, where all test results were stratified to the specifications. The results of Canadian water quality Index for both Al-khalis Main Canal and Secondary Canal (9L) were (94.75%), to be described as excellent.

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List of Symbols

Symbol	Definition	Units
B	Trace Elements Boron	mg/l
Ca ⁺²	Calcium Ion	mg/l
Cl ⁻	Chloride Ion	mg/l
CO ₃ ⁻²	Carbonate	mg/l
EC	Electrical Conductivity	mmhos/cm or µmhos/cm or dS/m or µS/cm
Fe	Iron	mg/l
HCO ₃ ⁻	Bicarbonate	mg/l
K ⁺	Potassium Ion	mg/l
Mg ⁺²	Magnesium Ion	mg/l
Na ⁺	Sodium Ion	mg/l
No ₃ ⁻	Nitrates	mg/l
P	Phosphor	mg/l
p ^H	PH-Values	-
SO ₄ ⁻²	Sulfate	mg/l
TDS	Total Dissolved Solid	mg/l
TH	Total Hardness	mg/l
TSS	Total Suspended Solid	mg/l

CHAPTER ONE

INTRODUCTION

1.1 Seepage in Irrigation Canals

During the passage of water from the main canal to the outlet at the head of the water course, water may be lost either by evaporation from the surface or by seepage through the peripheries of the channels. These losses are sometimes very high, of the order of 25 to 50% of water diverted into the main canal (Koradiya et al., 2011). At present, the development of new sources of water has become difficult, so it is necessary to pay attention to reducing the losses of the irrigation canals. Seepage in irrigated agriculture has been defined as the movement of water in or out of earthen irrigation canals through pores in the bed and bank material. There are many factors that affect seepage from canals (Worstell 1976): texture of the soil in the canal bed and banks, water temperature changes, siltation conditions, bank storage changes, soil chemicals, water velocity, microbiological activity, irrigation of adjacent fields, and watertable fluctuations.

The upper of Al-khalis project play an import role in supplying agricultural product for Diyala government. This project need to be supplied by water from Diyala river with an average discharge rate of 64.59 m³/s. Due to the shortage in water supply, this project need to be evaluate for seepage losses for both main canal and secondary canal (9L).

1.2 Objectives

Evaluate the seepage losses for the Main and Secondary Canal (9L) in upper Al-khalis irrigation project in addition to the evaluate of its water quality .

1.3 Methodology

1. Estimating the water losses and evaluate the conveyance efficiency for Alkahlis main canal from (5.600km) to (9.200km) and one secondary canal (9L).
2. Calculating a Canadian Water Quality Index (CWQI) after a chemical analysis for the water of Alkahlis main canal and secondary canal (9L) to know the appropriateness of the canals water for the irrigation uses.
3. Observing problems and excesses faced the operation of the project.
4. Measuring and specify the water quality variables of the project.