Rapid Intervention Program (RIP) to Improve Operational Management and Efficiencies in Irrigation Districts

Irrigation Show Technical Session
Austin, Texas

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Texas A&M AgriLife Extension

Gabriele Bonaiti
Extension Program Specialist
Guy Fipps
Professor and Extension Specialist

Irrigation Technology Program
Water District Program

Department of Biological and
Agricultural Engineering
College Station, Texas

Texas A&M AgriLife Extension

Rapid Intervention Program (RIP)

- Is based on ten-year experience at the Texas A&M Extension Service
- Is a structured and systematic approach for:
  - Analyzing the distribution network and on-farm irrigation of irrigation schemes
  - Developing recommendations on improved management strategies

Rapid Intervention Program (RIP)

Is designed as:

- A low-cost, user-friendly and versatile approach …
- … that takes advantage of the knowledge and experience of the scheme operators and managers

RIP Components Include

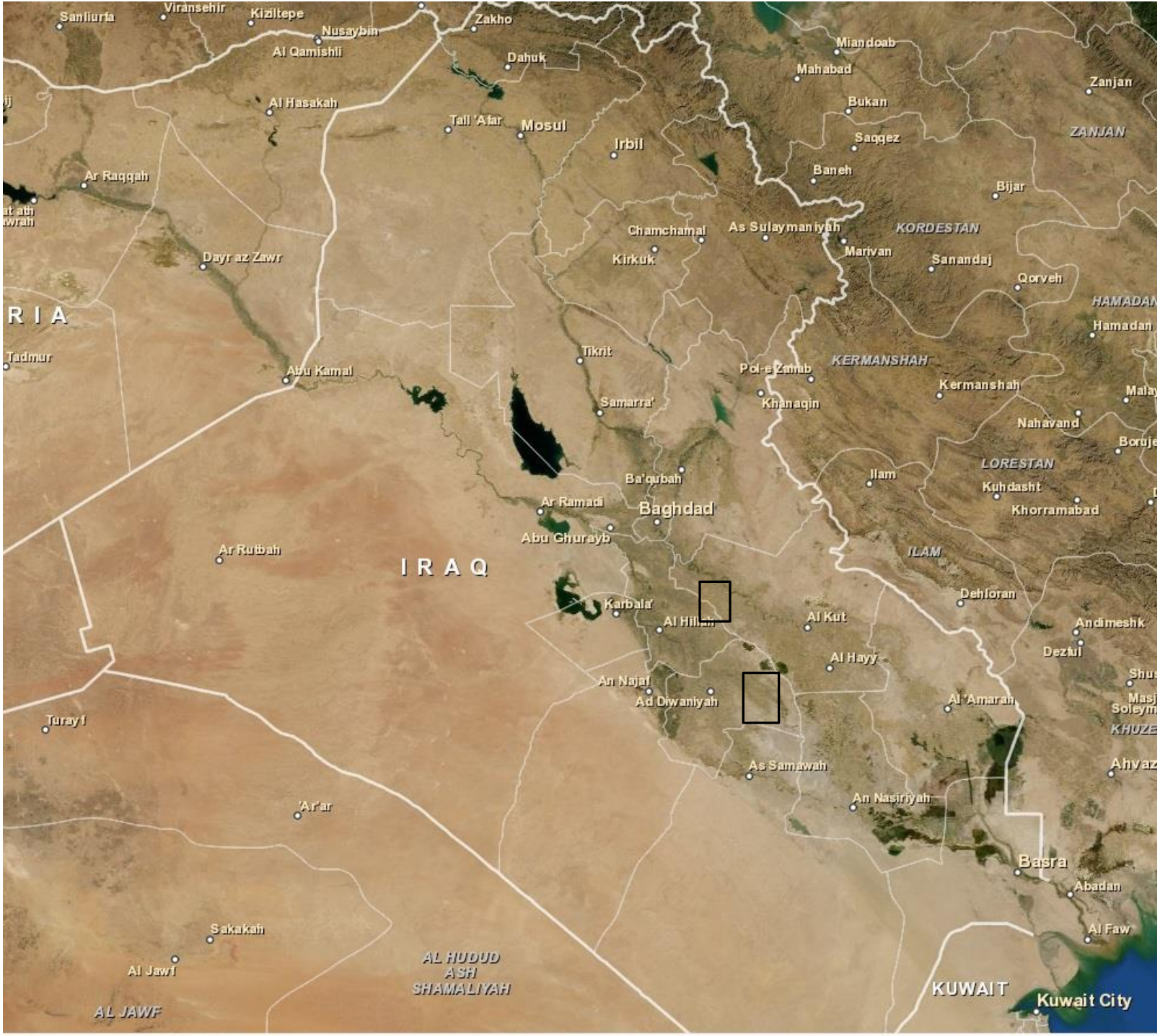
1. Inventory of basic data needed to estimate water supply, flows and on-farm irrigation needs
2. Hydraulic Head Survey and Analysis Tool
3. Distribution Network Condition Rating Tool
4. On-farm Survey and Analysis Tool and Water delivery Schedule Calculation Procedure
5. Spreadsheets and GIS map for data analysis
6. Training curriculums for persons implementing the RIP (flow measurement, spreadsheets, GIS)

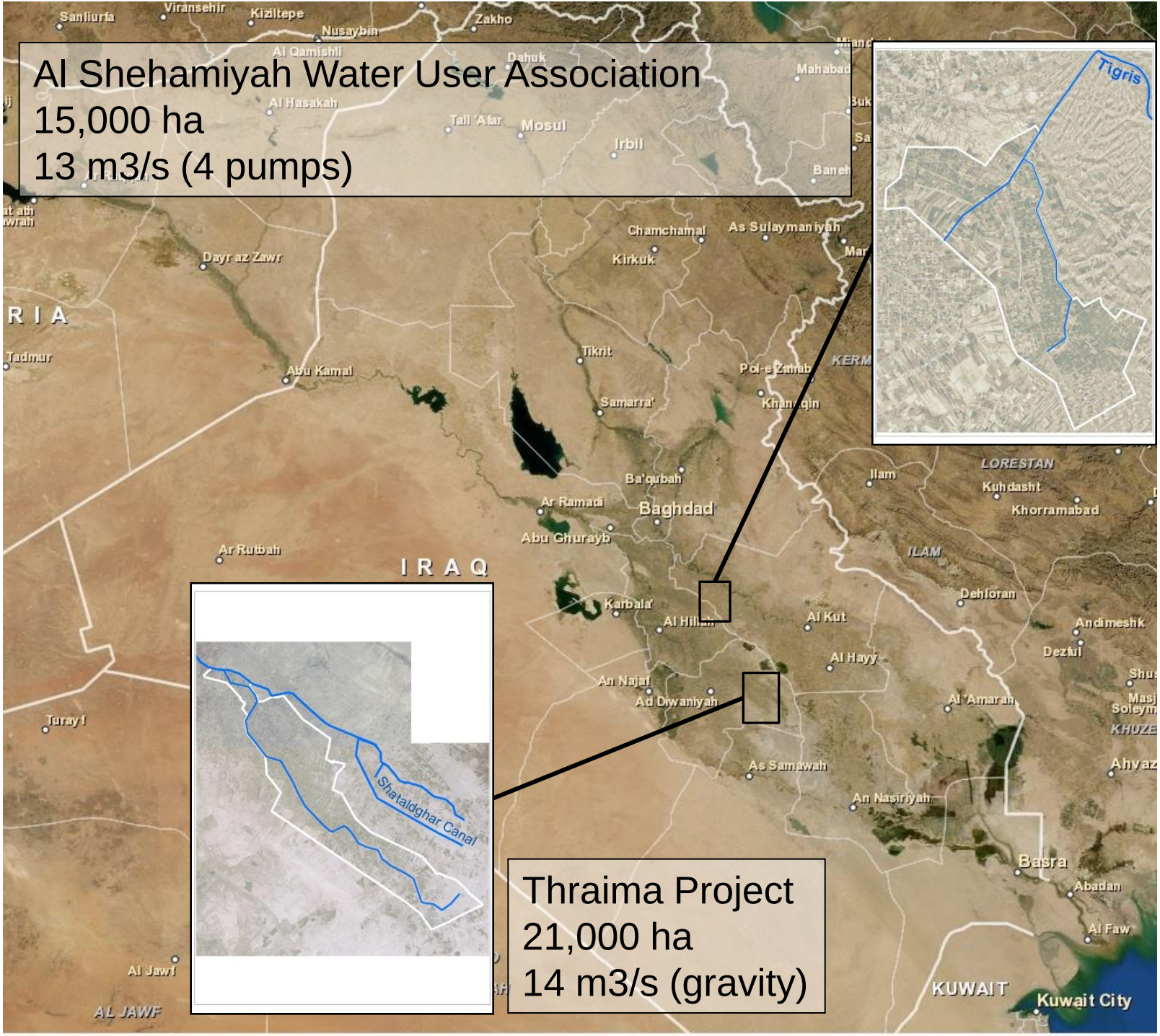
Case Studies

- Design of RIP procedure (Central and South Iraq, 2012)
  1. Al Shehamiyah Water User Association
  2. Thraima Project

- Prioritization of canals for lining (Texas, 2013):
  3. Gulf Coast Irrigation Division of the Lower Colorado River Authority (LCRA)

Al Shehamiyah Water User Association and Thraima Project, Iraq


Sanliurfa
Viransehir
Kiziltepe
Nusaybin
Al Qamishli
Zakho
Dahuk
Miandoab
Mahabad
Zanjan
Bukan
Saqqez
ZANJAN
Al Hasakah
Tall 'Afar
Mosul
Irbil
Ar Raqqah
Baneh
Bijar
Chamchamal
As Sulaymaniyah
KORDESTAN
Marivan
Sanandaj
Kirkuk
Dayr az Zawr
Qorveh
HAMADAN
Hamadan
Tadmur
Tikrit
Abu Kamal
Pol-e Zahab
KERMANSHAH
Kermanshah
Samarra'
Khanaqin
Nahavand
LORESTAN
Ilam
Kuhdasht
Ba'qubah
Ar Ramadi
Baghdad
Khorramabad
Abu Ghurayb
Ar Rutbah
ILAM
IRAQ
Dehloran
Karbala'
Al Hillah
Al Kut
Andimeshk
Dezful
Al Hayy
An Najaf
Ad Diwaniyah
Al 'Amarah
Turayf
As Samawah
Ahvaz
An Nasiriyah
'Ar'ar
Basra
Abadan
Sakakah
Al Faw
Al Jawf
AL HUDUD ASH SHAMALIYAH
KUWAIT
Kuwait City
AL JAWF


Al Shehamiyah Water User Association
15,000 ha
13 m3/s (4 pumps)
Tigris
Shataldghar Canal
Thraima Project
21,000 ha
14 m3/s (gravity)
Sanliurfa
Viransehir
Kiziltepe
Nusaybin
Zakho
Al Qamishli
Dahuk
Mahabad
Al Hasakah
Tall 'Afar
Mosul
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Ar Ramadi
Abu Ghurayb
Ar Rutbah
IRAQ
Karbala'
Al Hillah
Al Kut
Al Hayy
An Najaf
Ad Diwaniyah
Al 'Amarah
As Samawah
An Nasiriyah
Basra
Abadan
Al Faw
Turayf
Al Jawf
AL JAWF
KUWAIT
Kuwait City
Ilam
LORESTAN
Kuhdasht
Khorramabad
ILAM
Dehloran
Andimeshk
Dezful
KHUZE
Ahvaz

Pumping Station (Al Shehamiyah)

Inlet
(Thraima)

Control Structure


TOYOTA

End of Main Canal

Main Drain

Secondary canal

Water Course

Irrigated field (Border)

Survey and Rating Tools Procedure

- Obtain map of the distribution network and irrigated areas
- Working with the operators, complete and modify survey forms
- Encourage operators to conduct ground truth, and carry out measurements of actual flow rates for canals and at on-farm turnouts
- Enter data into spreadsheet
- Analyze data and create maps showing results (include data quality control, link spreadsheets to GIS, review of results with operators)
- Create reports (include tables of results, GIS maps with results)

RIP Manual

A manual was developed within the Iraqi project, to serve as both a training program and a reference guide to all the steps required in order to successfully apply the RIP

The manual also includes four Appendixes:

- Survey forms (English and Arabic)
- Training curriculums
- Case study results (Al Shehamiyah and Thraima Projects)

Head Survey

Purpose:

- Identification of canals and areas that currently have continuous or intermittent water supply problems
- Identification of the potential causes of these problems

Head Survey (cont.)

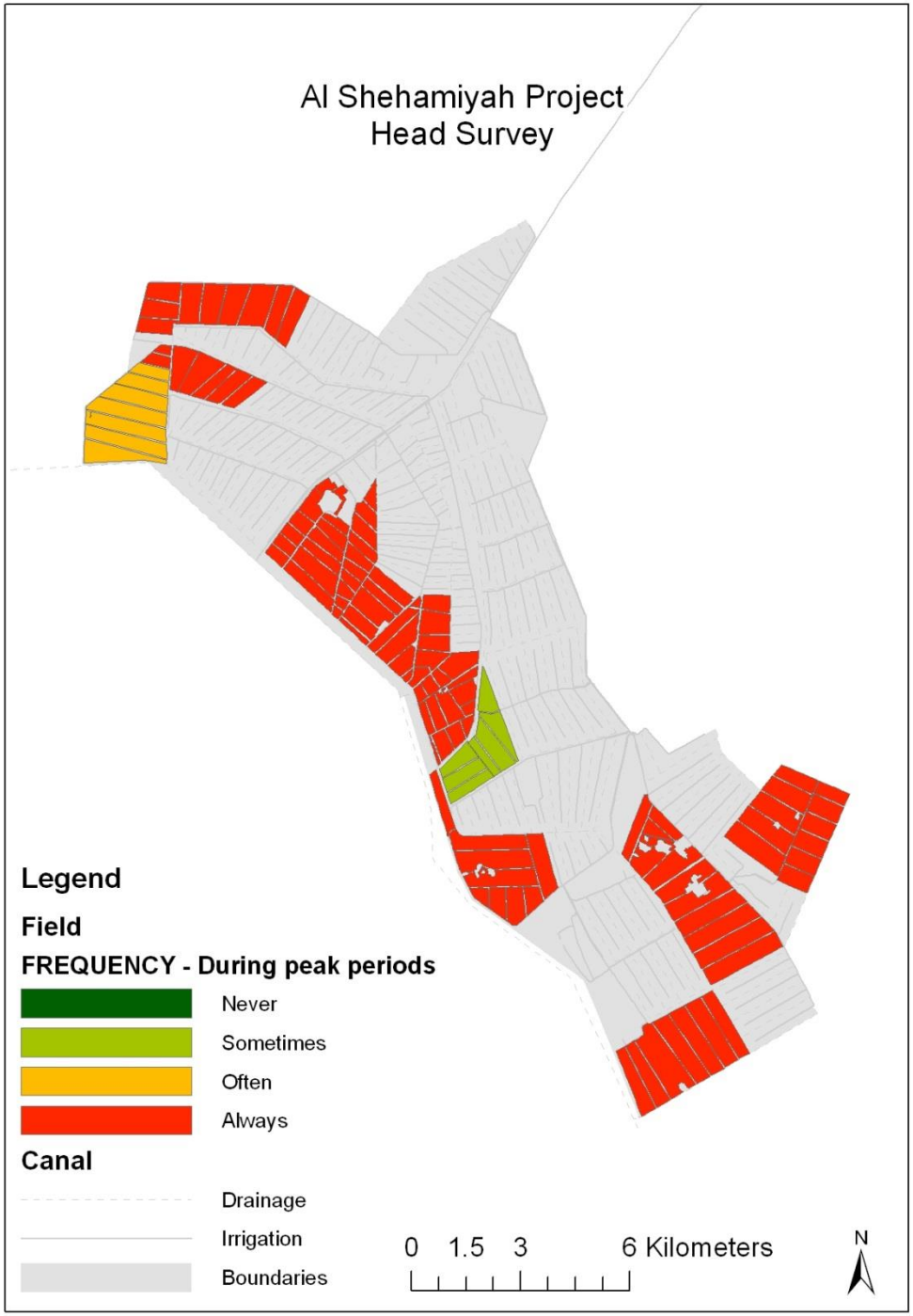
Two components:

1. Head Survey
   - Canals
   - Affected areas
2. Drainage survey
   - Areas with drainage problems

Head Survey

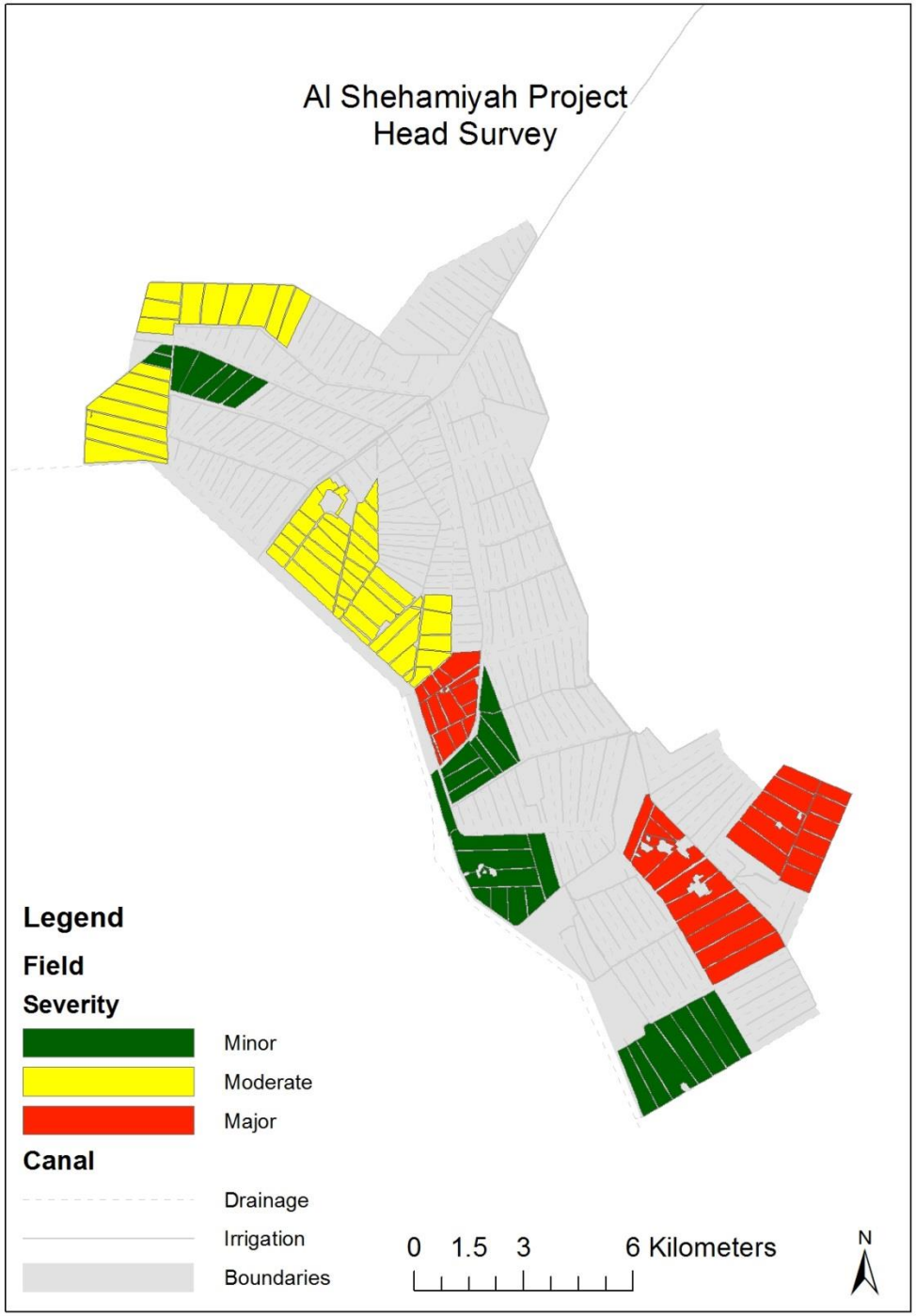
(Al Shehamiyah)

Frequency of head problem during peak period



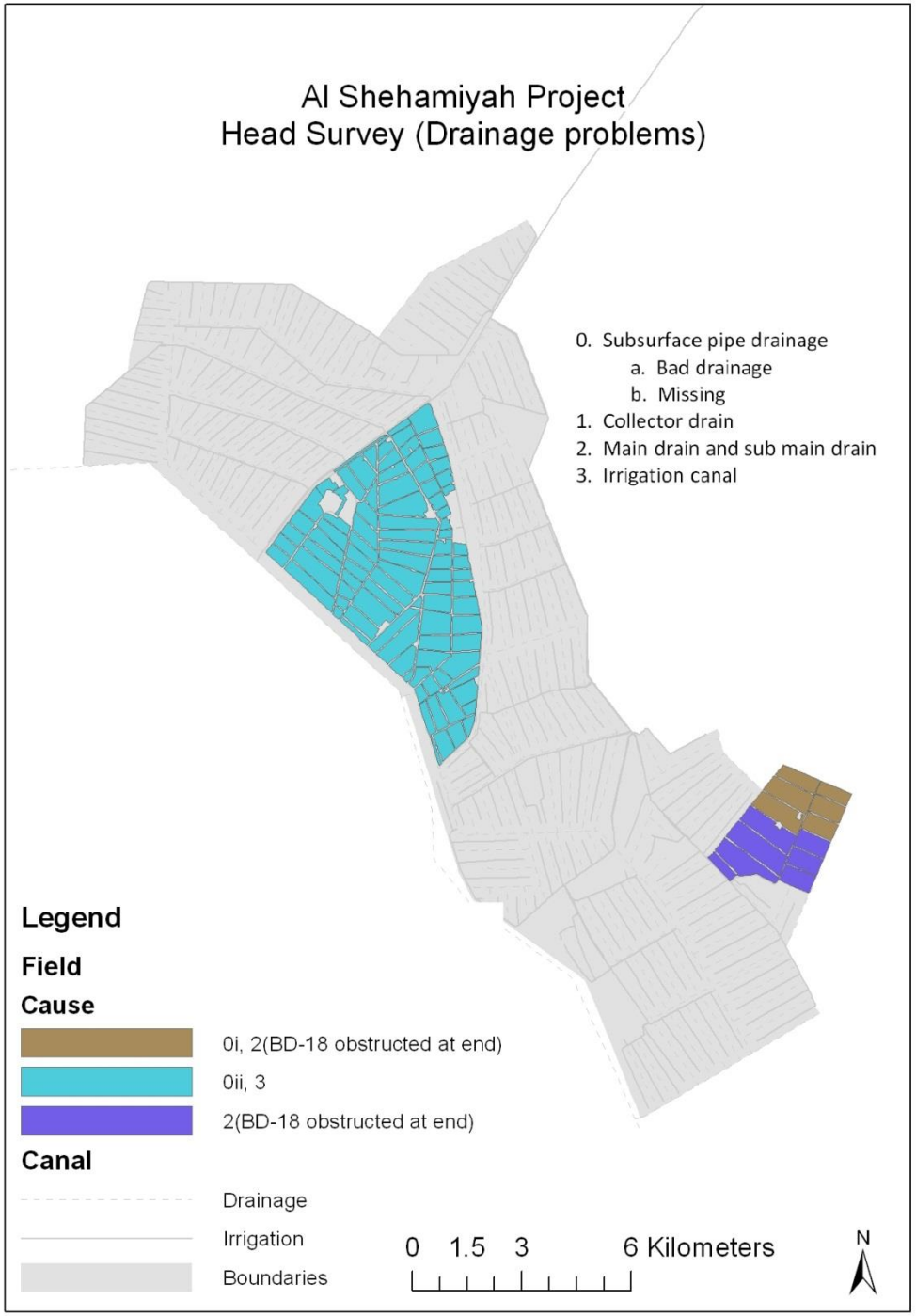
Head Survey
(Al Shehamiyah)

Severity of head problem



Head Survey
(Al Shehamiyah)

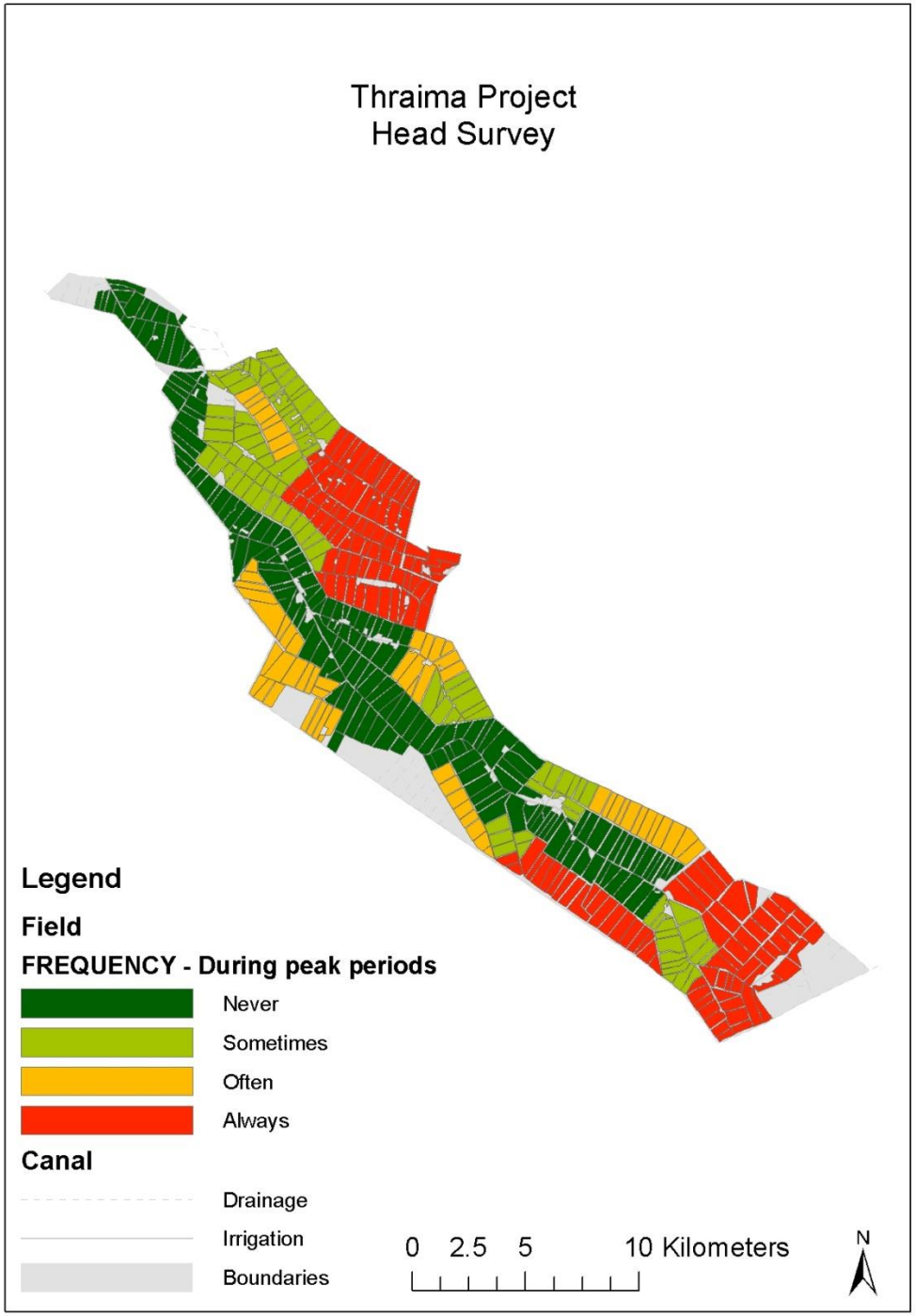
Cause of drainage problem



Head Survey

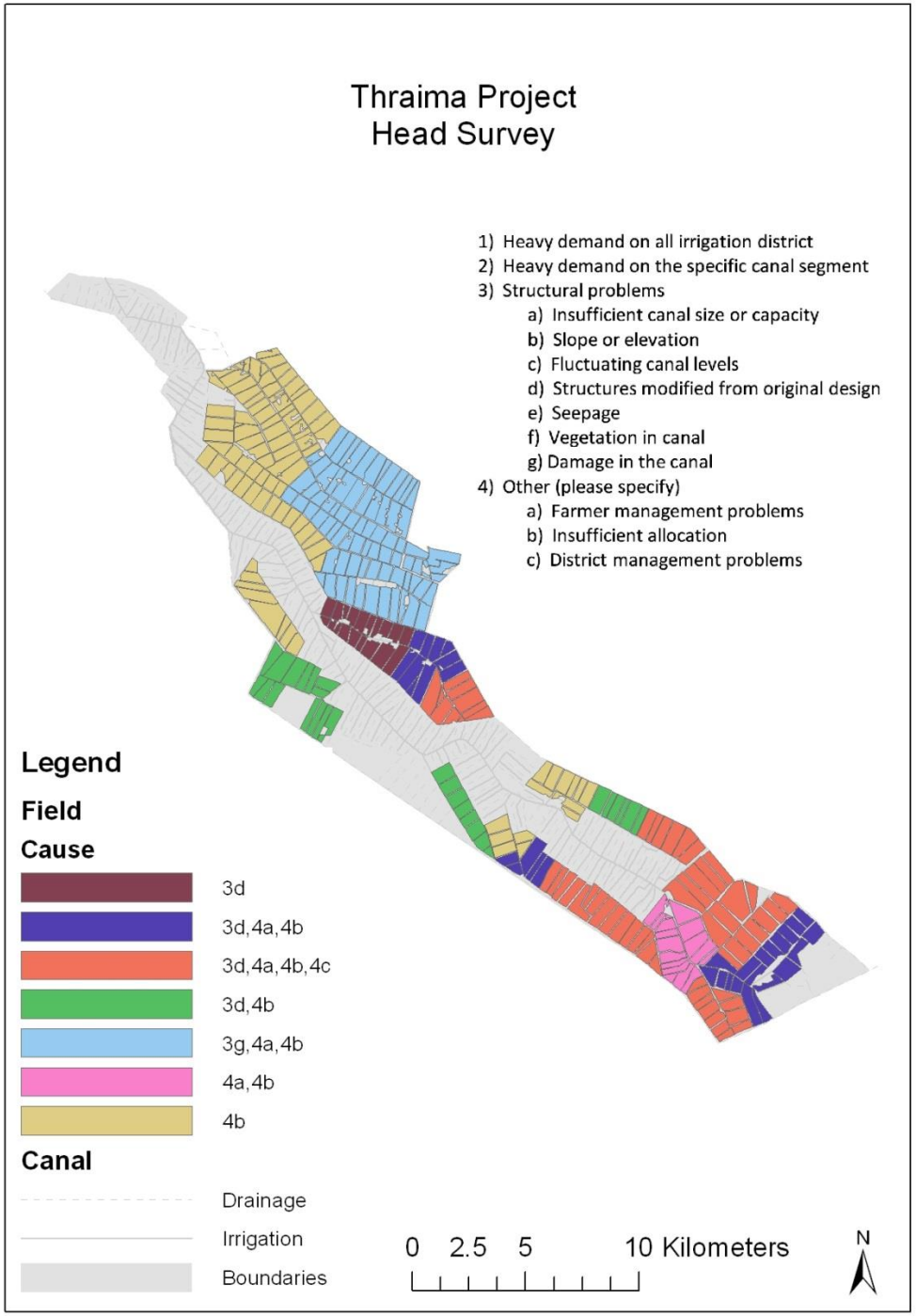
(Thraima)

Severity of head problem



Head Survey
(Thraima)

Cause of head problem



Canal/Gate Evaluation

Purpose:

- Assess general condition of the irrigation distribution network through a visual rating system to identify segments which need rehabilitation

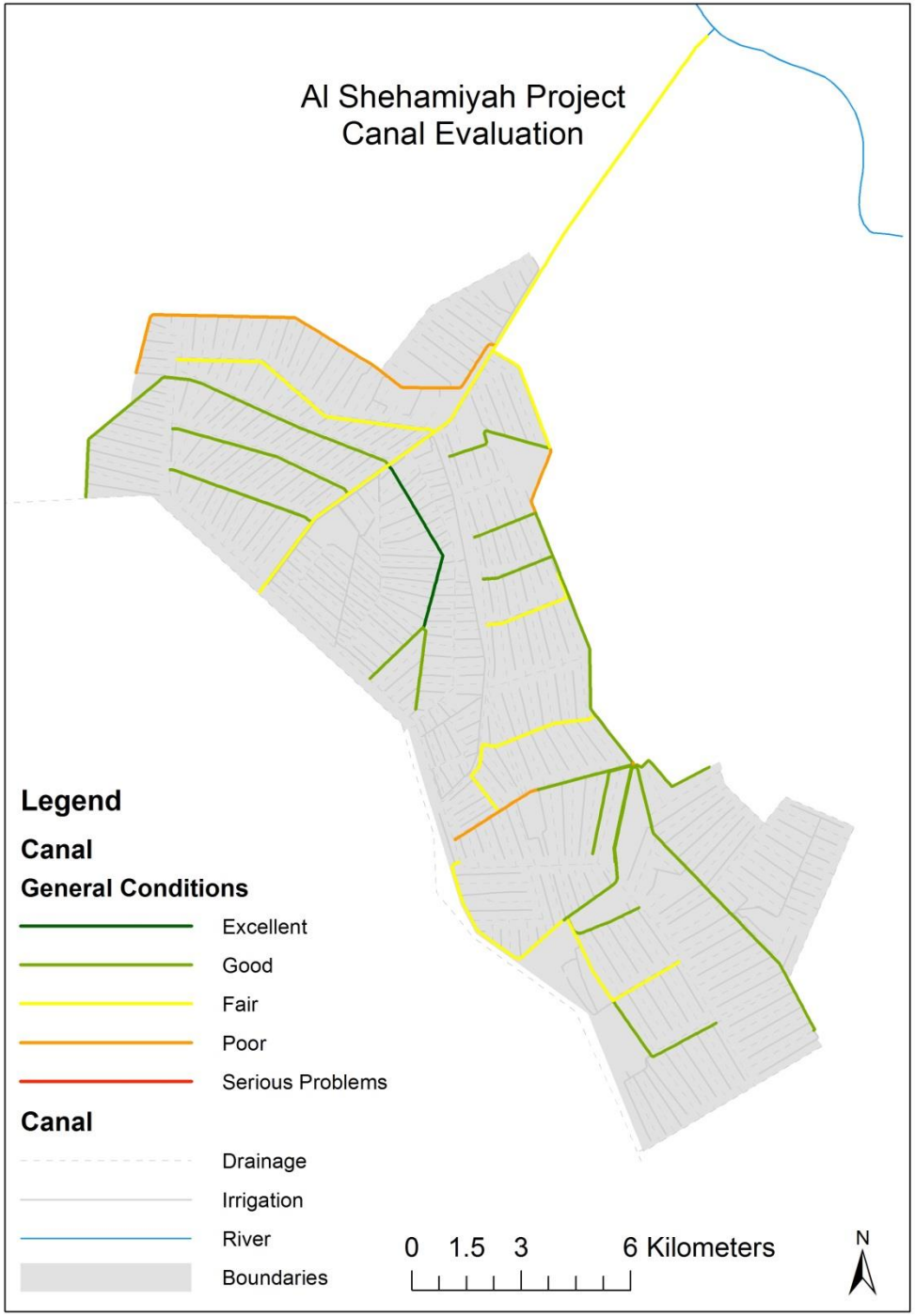
General description: Segment ID*, Current Canal Operating Depth, Freeboard*, Year of installation*, Use frequency*, How often does the district perform cleaning*, Vandalism*

Field rating (concrete, earthen, gates): General conditions*, Vertical and Horizontal Cracks (Hairline, Pencil-size, Large), Noticeable amounts of maintenance & repair*, Buckles and Erosion behind concrete lining, Vegetation*, Concrete erosion, Evidence of seepage*, Major damages*

Canal Evaluation

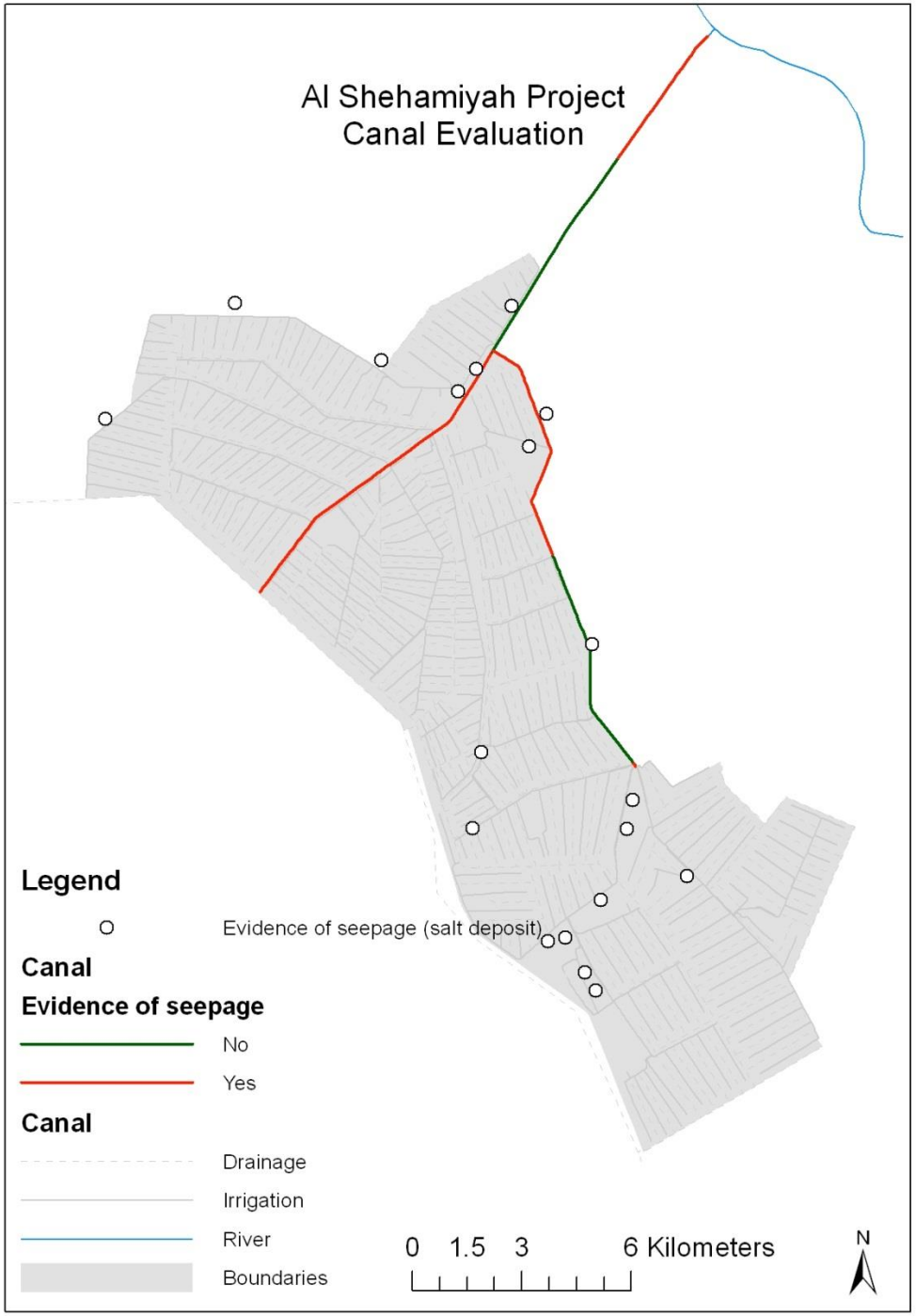
(Al Shehamiyah)

General conditions (concrete canal)



Canal Evaluation
(Al Shehamiyah)

Evidence of seepage

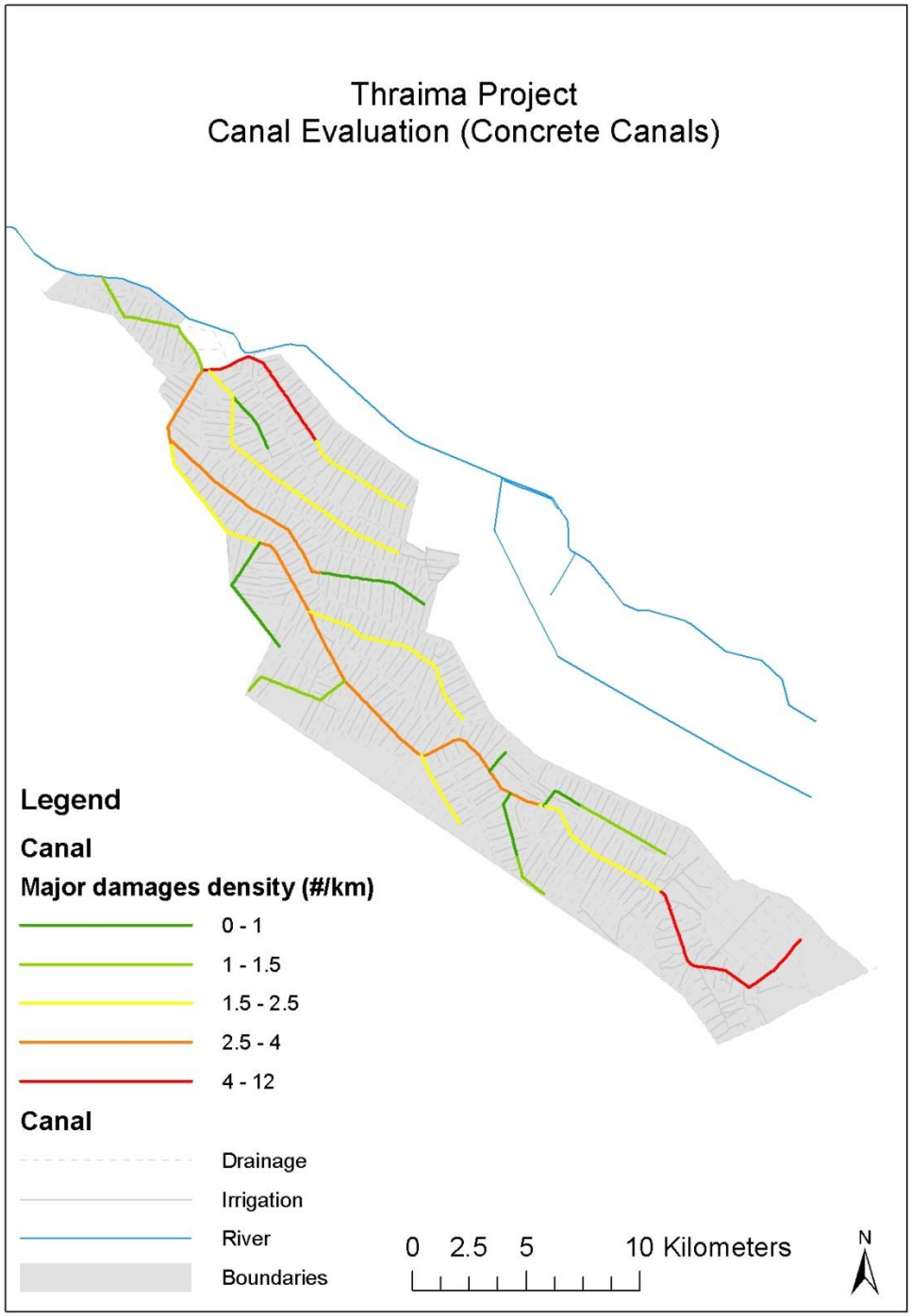


Canal Evaluation

(Thraima)

Major damages, #/km

(concrete canal)



Damage on canal liner

On-Farm Survey

Purpose:

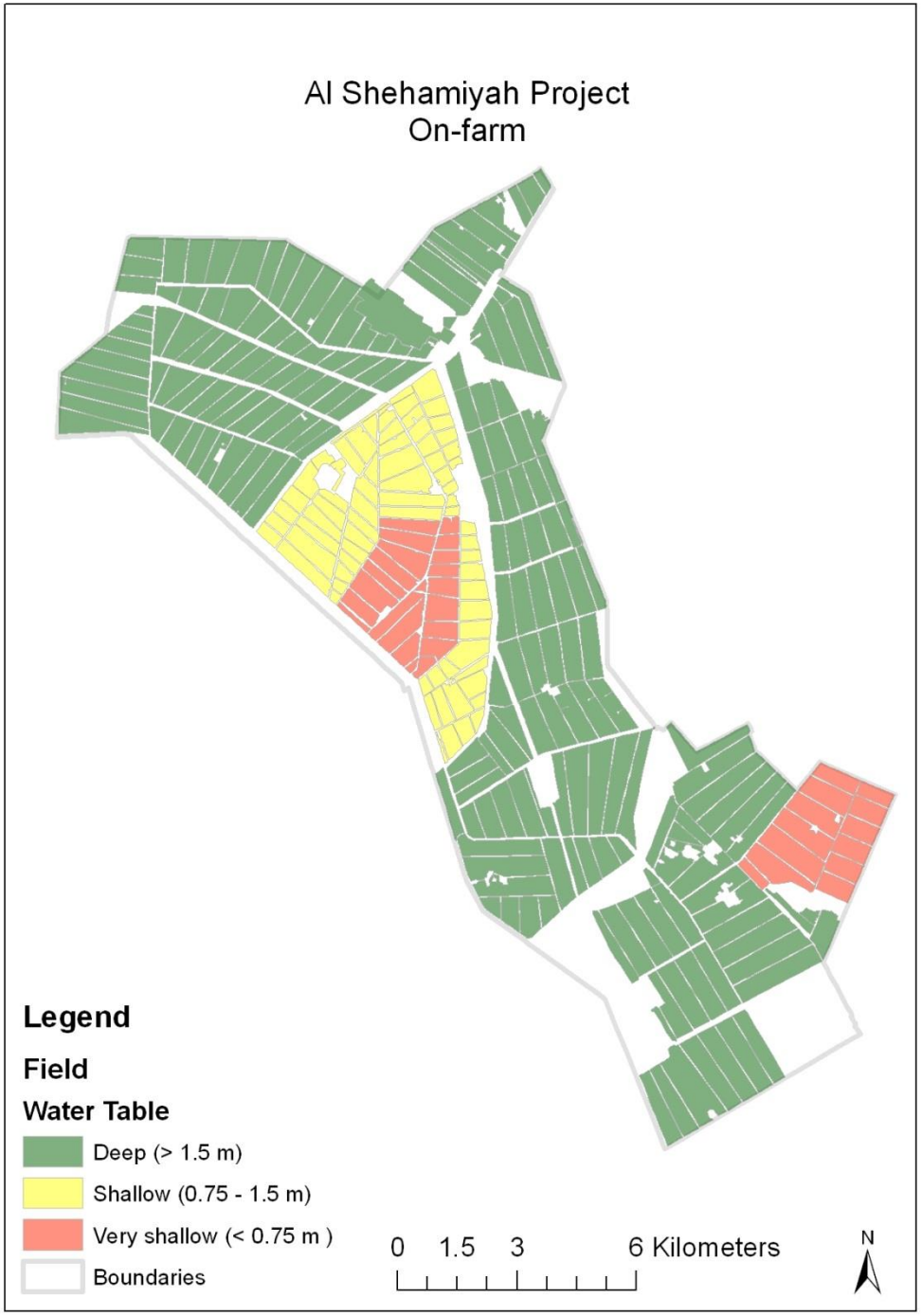
- Information needed to determine if the current flow at the farm turn-out is sufficient to allow for efficient on-farm irrigation
- For a representative field in each command area during peak irrigation

General Description: Presence of gravel, Soil type*, Top soil depth, Hard pan/impermeable layer limiting roots growth, Water table depth*, Irrigation method*, Irrigation efficiency in surface irrigation*, Crop composition in peak month*

Current Irrigation Practices: Flow rate (maximum actual flow)*, Time to irrigate a typical border*, Time lost to move water*, Time assigned to each scheduling unit*, Irrigations interval*, Number of Water courses/scheduling units, farms/water course, borders/farm irrigated at the same time*, Number of inlets to irrigate one border*

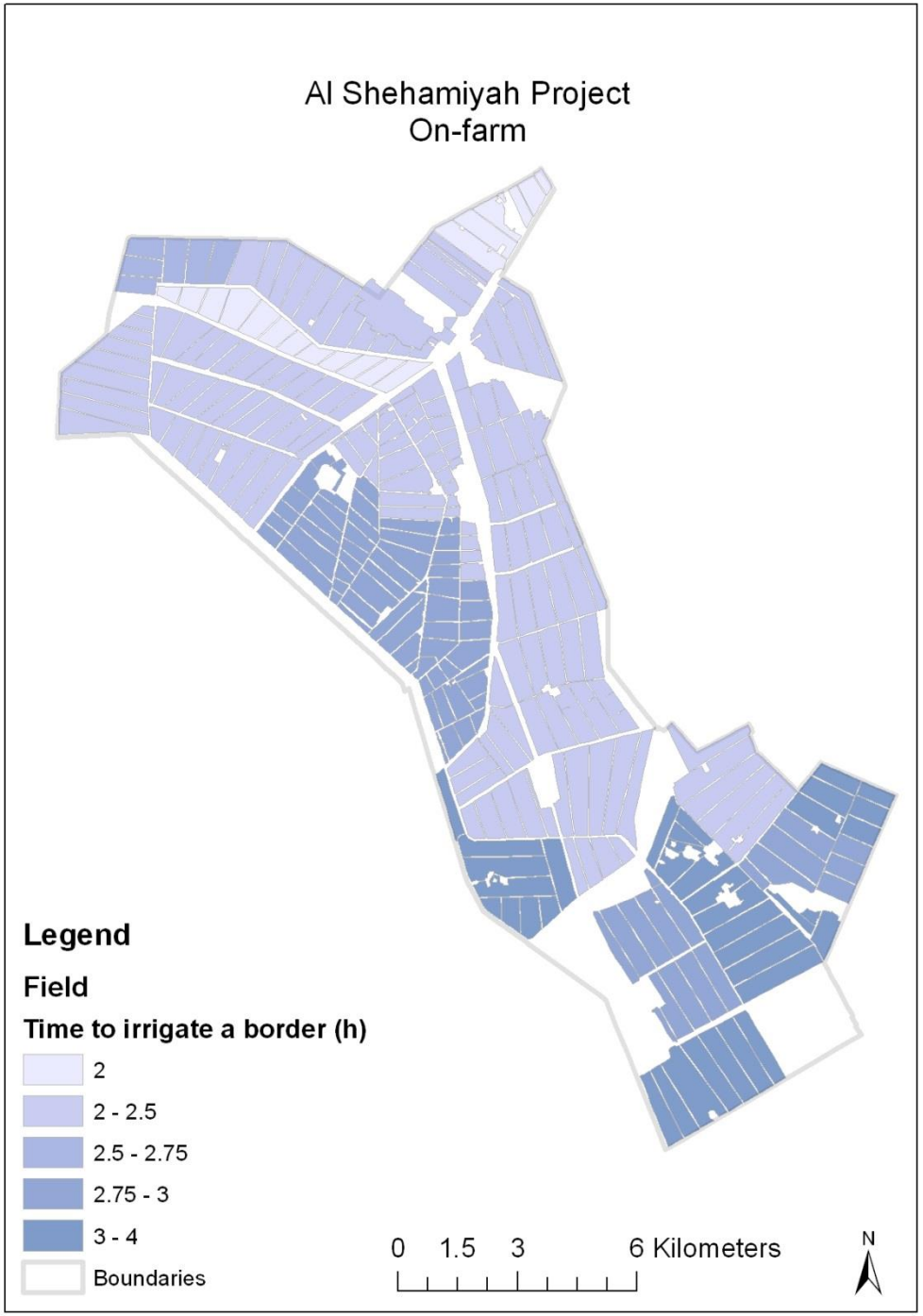
On-Farm Survey
(Al Shehamiyah)

Water Table depth



On-Farm Survey
(Al Shehamiyah)

Time to irrigate a border



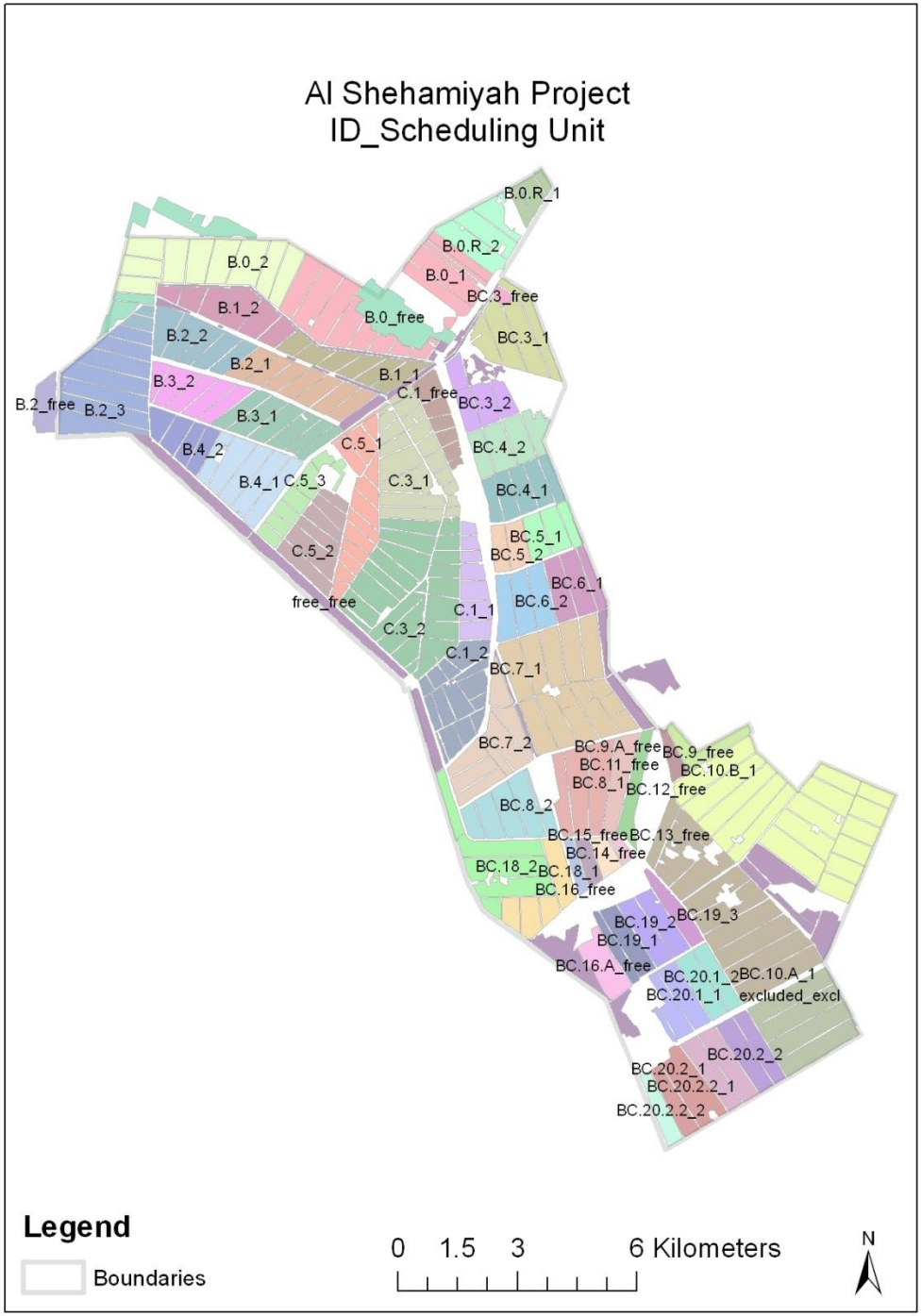
Water Delivery Scheduling Calculation Procedure

Steps:

1. Organize collected data (including distribution network levels and command areas) for peak irrigation month and define a representative field for each scheduling unit (SU)
2. For each SU calculate: crop water requirement, net irrigation depth, interval between irrigations, irrigation stream per border and time of application, border irrigated at the same time and total stream per SU, net and gross crop irrigation requirement
3. Compare calculations to available data and identify structural problems

On-Farm Survey
(Al Shehamiyah)

Scheduling Units (SU)



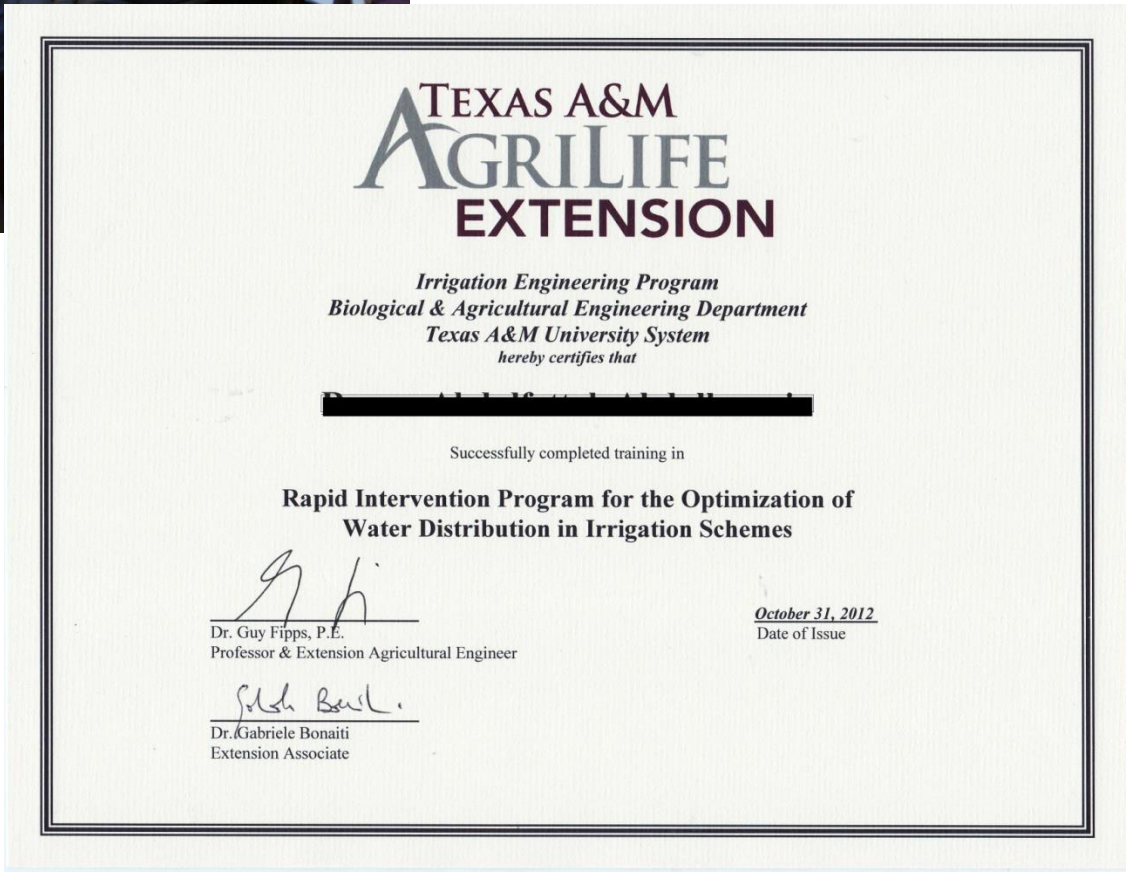
Water Delivery Scheduling Calculation Procedure (cont.)

Purpose:

- Provides recommendations for
  - Optimal flow at the farm turnout
  - Frequency and volume of irrigation at peak demand
  - Number of fields that can be irrigated at the same time
  - Maximum flow in each canal segment
- Not completed (flow measurements not available)

Al Shehamiyah

Thraima



TEXAS A&M AGRILIFE EXTENSION

Irrigation Engineering Program
Biological & Agricultural Engineering Department
Texas A&M University System
hereby certifies that

[redacted]

Successfully completed training in

Rapid Intervention Program for the Optimization of Water Distribution in Irrigation Schemes

Dr. Guy Fipps, P.E.
Professor & Extension Agricultural Engineer

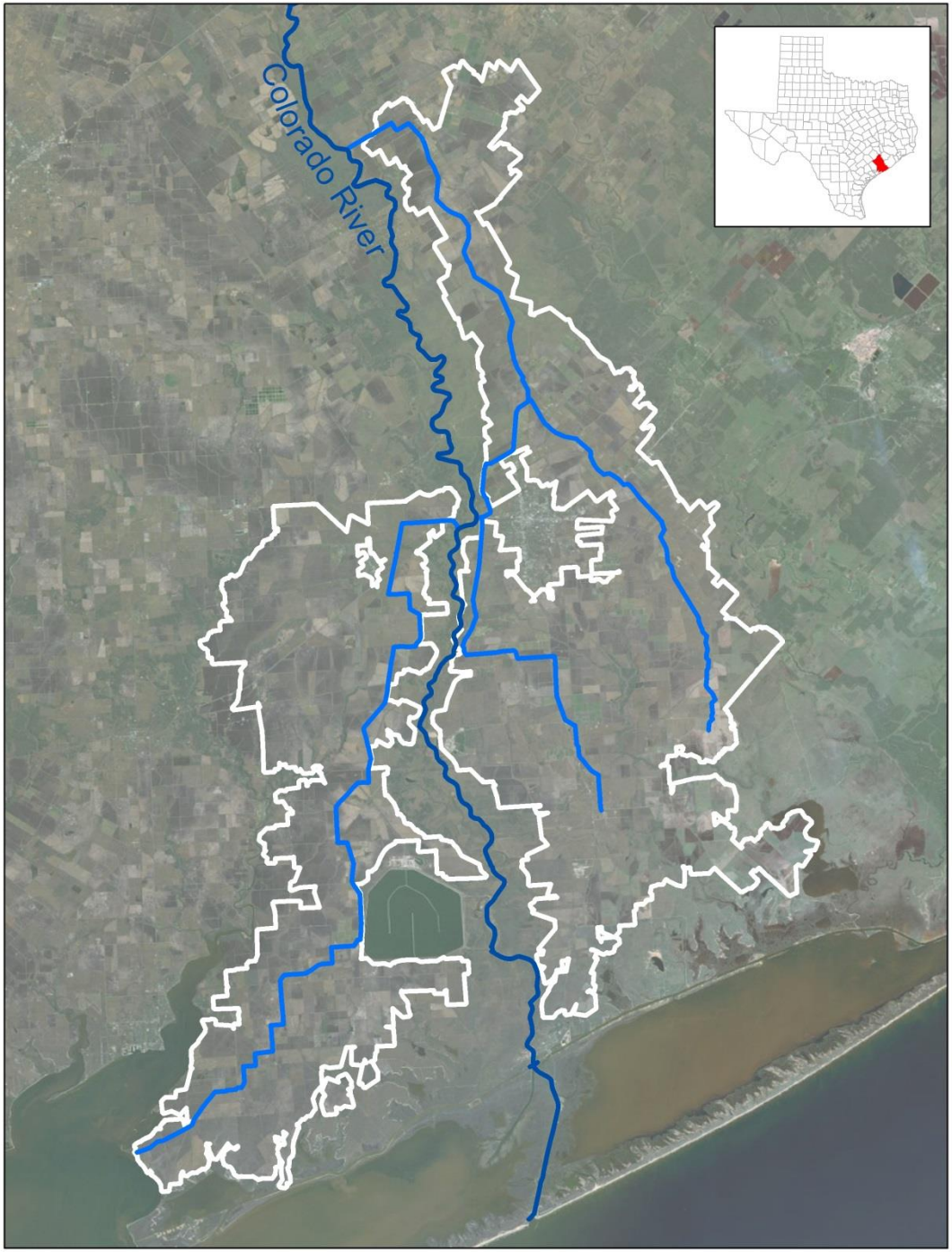
October 31, 2012
Date of Issue

Dr. Gabriele Bonaiti
Extension Associate

Baghdad Water Technical Meeting and certificates

27 June 2012

Gulf Coast Irrigation Division of the Lower Colorado River Authority (LCRA), Texas


Colorado River

Objectives

Develop and apply a methodology for prioritizing the lining of irrigation water delivery canals

Elements:

- In cooperation with LCRA staff apply the RIP and modify it as needed (emphasis on identification and quantification of seepage)
- Evaluate the methodology by conducting field reconnaissance and more detailed study of selected canal segments
- Update and verify the revised methodology
- Demonstrate the revised methodology by applying it to a portion of one irrigation divisions

Steps

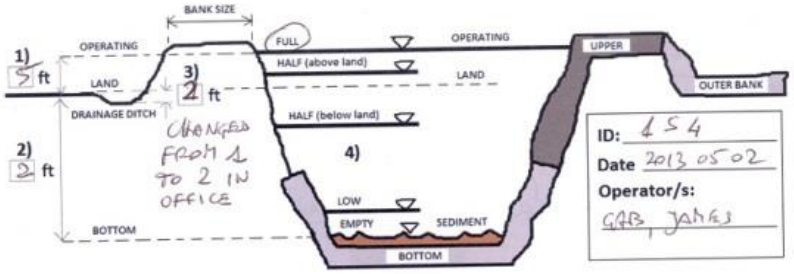
1. Surveys
   - General Survey (information on general maintenance, operation, and suspected seepage issues)
   - Head Survey and Seepage Surveys
   - Field Seepage Survey to verify collected data
2. GIS soil analysis

Steps (cont.)

3. Seriousness of expected seepage losses: a 3-point ranking scale based on
   A. Canal use frequency
   B. Severity and cause of seepage
   C. Visual indicators of seepage
   D. Soil maps analysis

Example of survey form (Field Seepage Survey)

FIELD RATING FORM (EARTHEN CANAL) – With water coordinator



1) Operating Water Level (write on picture)	
2) Bottom Canal Level (write on picture)	
3) Drainage ditch depth (write on picture)	
4) Current Water Level (choose on picture)	

5) Bank Size	
0	Wide (driveway ≈ 12 ft ≈ 4 steps)
1	Narrow (<driveway ≈ 6 ft ≈ 2 steps)
2	Very narrow (walk ≈ 3 ft ≈ 1 step)

6) Sediment		
0	Low or none	N/A FULL
1	Medium (some inches)	
2	High (>= 1 foot)	

Bank Slope	7) Bottom	8) Upper/Out	
0 Good	N/A FULL	✓	N/A
1 Moderate			
2 Poor			

Bank Erosion	9) Bottom	10) Upper/Out	
0 Good	N/A FULL	✓	N/A
1 Moderate			
2 Poor			

Animal Holes	11) Bottom	12) Upper/Out	
0 None	N/A FULL	✓	N/A
1 Some			
2 Strong			
A Crawfish	OPTIONAL		
B Alligator	OPTIONAL		
C Gopher	OPTIONAL		
D Varmint	OPTIONAL		
E Armadillo	OPTIONAL		
F Nutria	OPTIONAL		

Weeds/ Extra grass	13) Bottom	14) Upper	15) Outer
0 None	N/A FULL	✓	✓
1 Some			
2 Strong			
A Cane	OPTIONAL		
B Arundo	OPTIONAL		
C Arundo ver	OPTIONAL		
D Typha	OPTIONAL		
E Cahaba Lily	OPTIONAL		
F Cow itch	OPTIONAL		
G Poison Ive	OPTIONAL		
H Juncos	OPTIONAL		✓
J Flat sage	OPTIONAL		

Trees	16) Bot	17) Upp	18) Out
0 None	✓	✓	✓
1 Some			
2 Strong			
A Tallow	OPTIONAL		
B Willow	OPTIONAL		
C Bay bush	OPTIONAL		
D Huckleberry	OPTIONAL		

19) Gates/Lateral conditions	
0	Good (no leak)
1	Moderate (possible leak)
2	Poor (evident leak)

N/A

20) Seepage	
0	None
1	Some (moist soil/little standing water)
2	Strong (standing/running water)

N/A

21) General conditions (seepage control)	
0	Excellent
1	Good
2	Fair
3	Poor
4	Serious Problems

4_Canal Evaluation Field Forms_draft4

5/7/2013

FIELD RATING FORM (EARTHEN CANAL) – With water coordinator

Guess causes of seepage
- Major:
- Minor:

Other notes

- 19) JAMES OPINION
- LEFT SIDE NOT LOOKED ; JAMES THINK TREES ROOTS ARE THE PROBLEM (MANY TREES)
- ALSO RATED SIDE (RIGHT) USED TO HAVE A LOT OF TREES

Identify on map

S = seepage point; D = drainage pipe crossing; P = other pipe crossing (ex. gas, oil);
C = check gate; L = lateral gate; ...

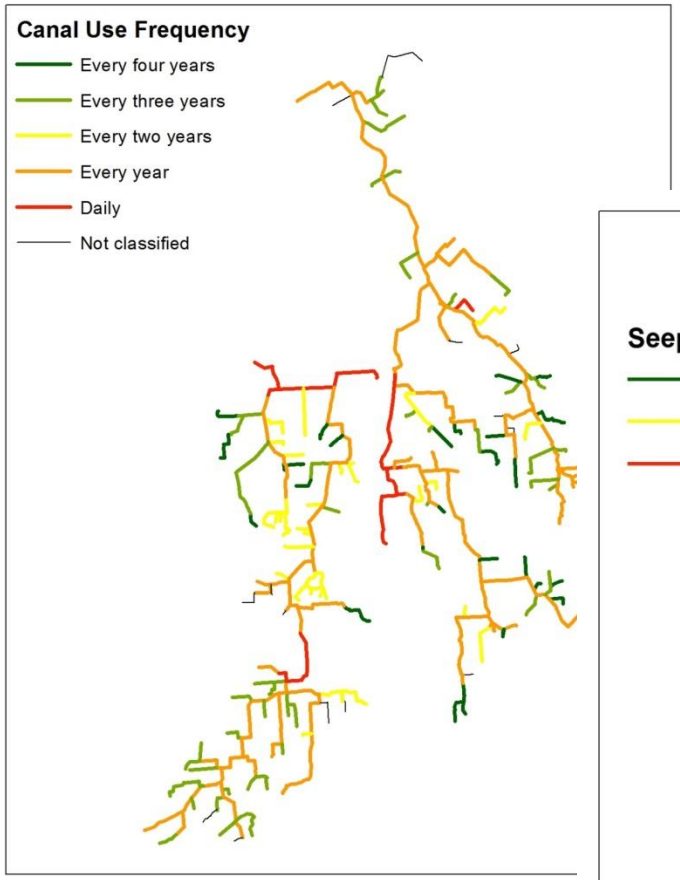
MAP

_Canal Evaluation Field Forms_draft4

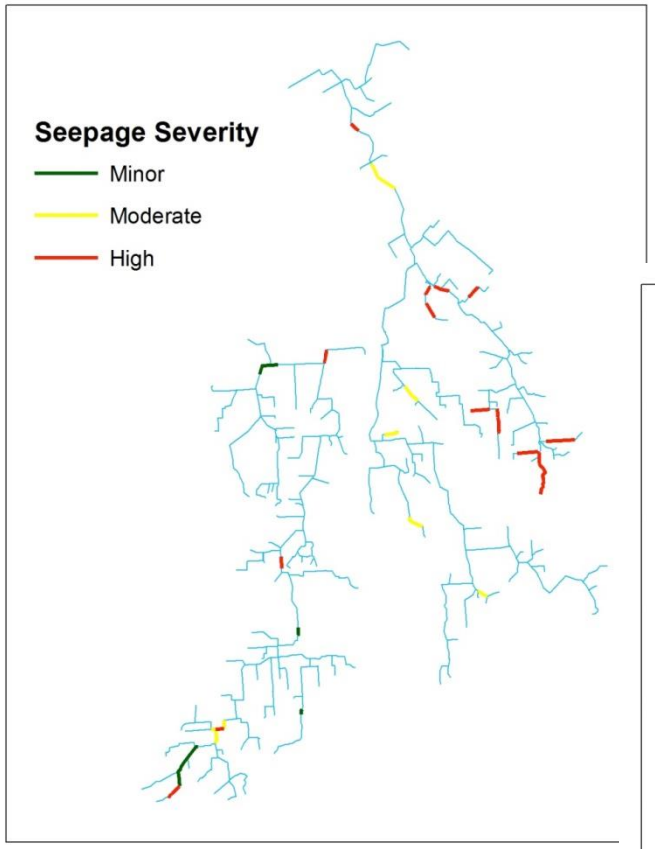
5/7/2013

Results

Steps to obtain Seriousness of expected seepage losses: a 3-point ranking scale

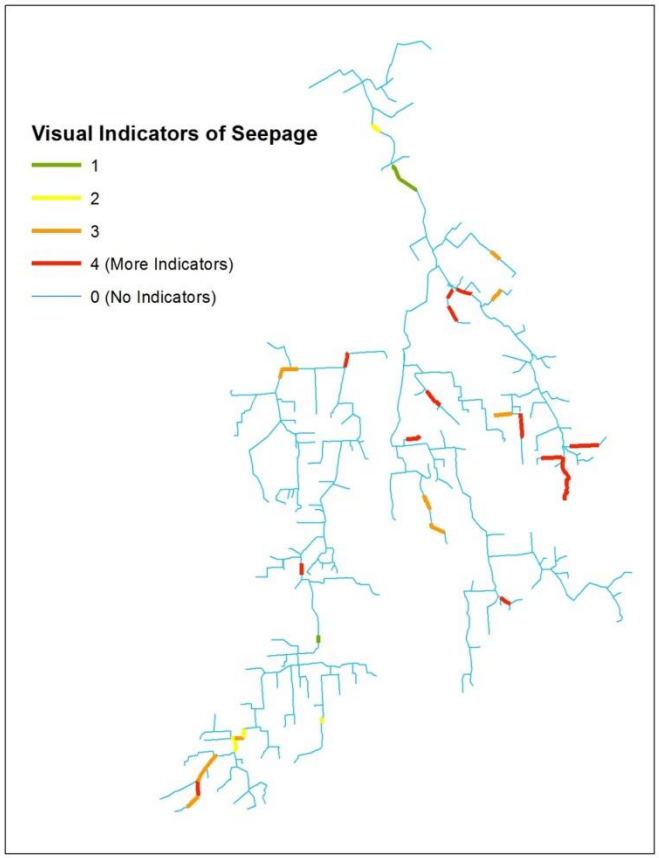


A) Canal use frequency

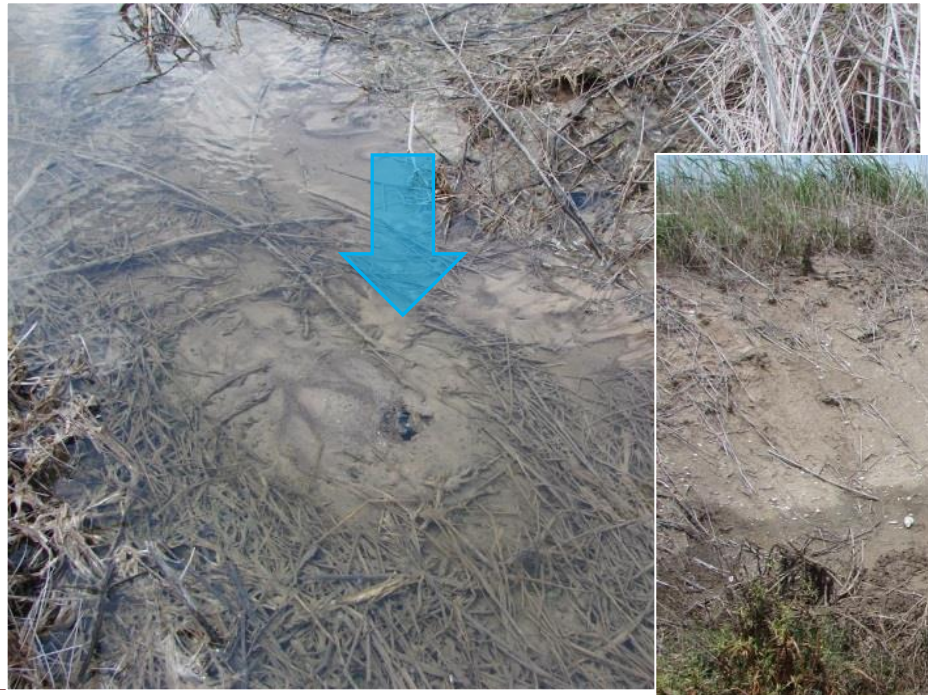


B) Severity and cause of seepage

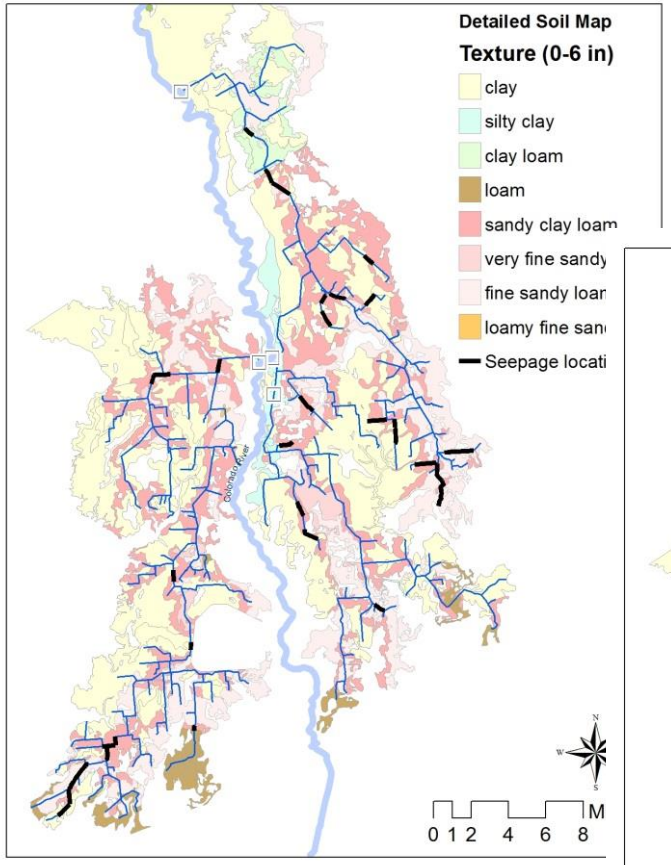
C) Visual indicators of seepage

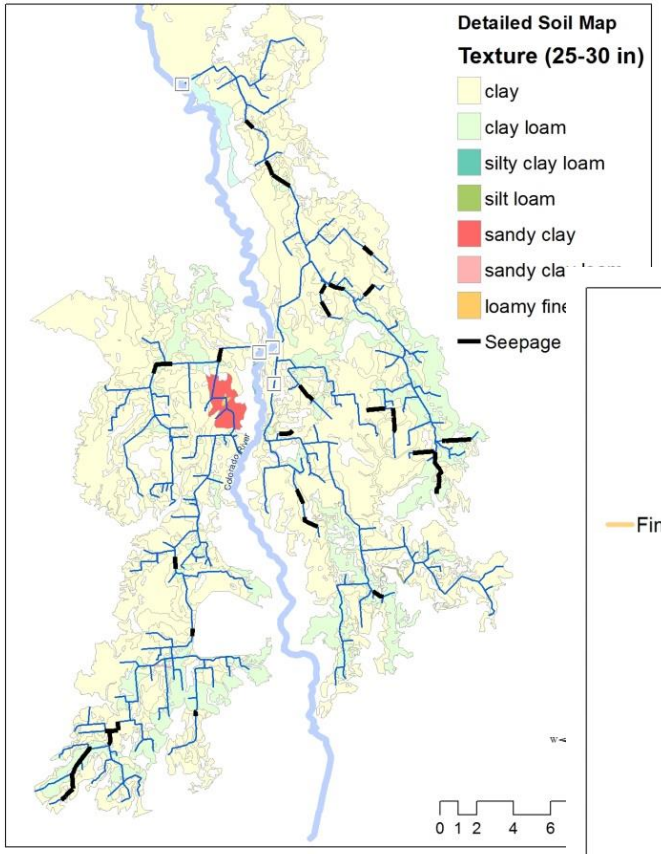


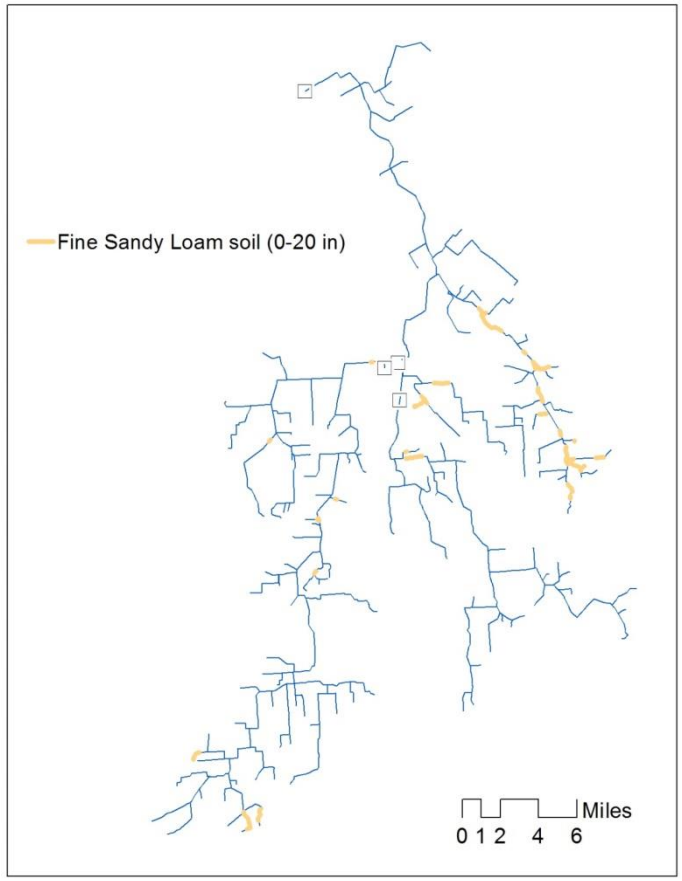
Examples of visual indicator of seepage



D) Soil maps analysis







Final map: Seriousness of expected seepage losses (a 3-point ranking scale)

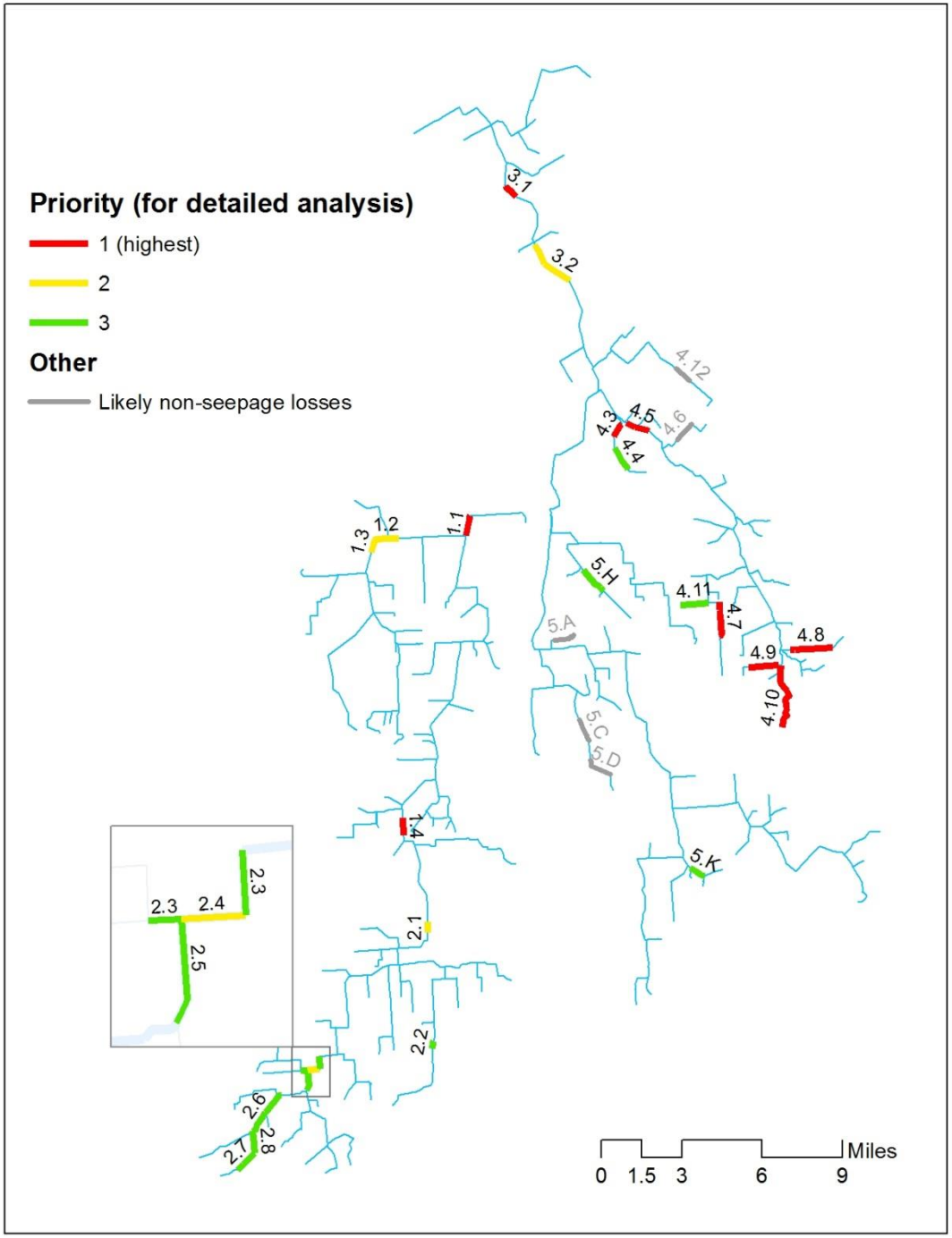
Rating based on highest priority for detailed analysis

1 = 9 segments (10 miles)

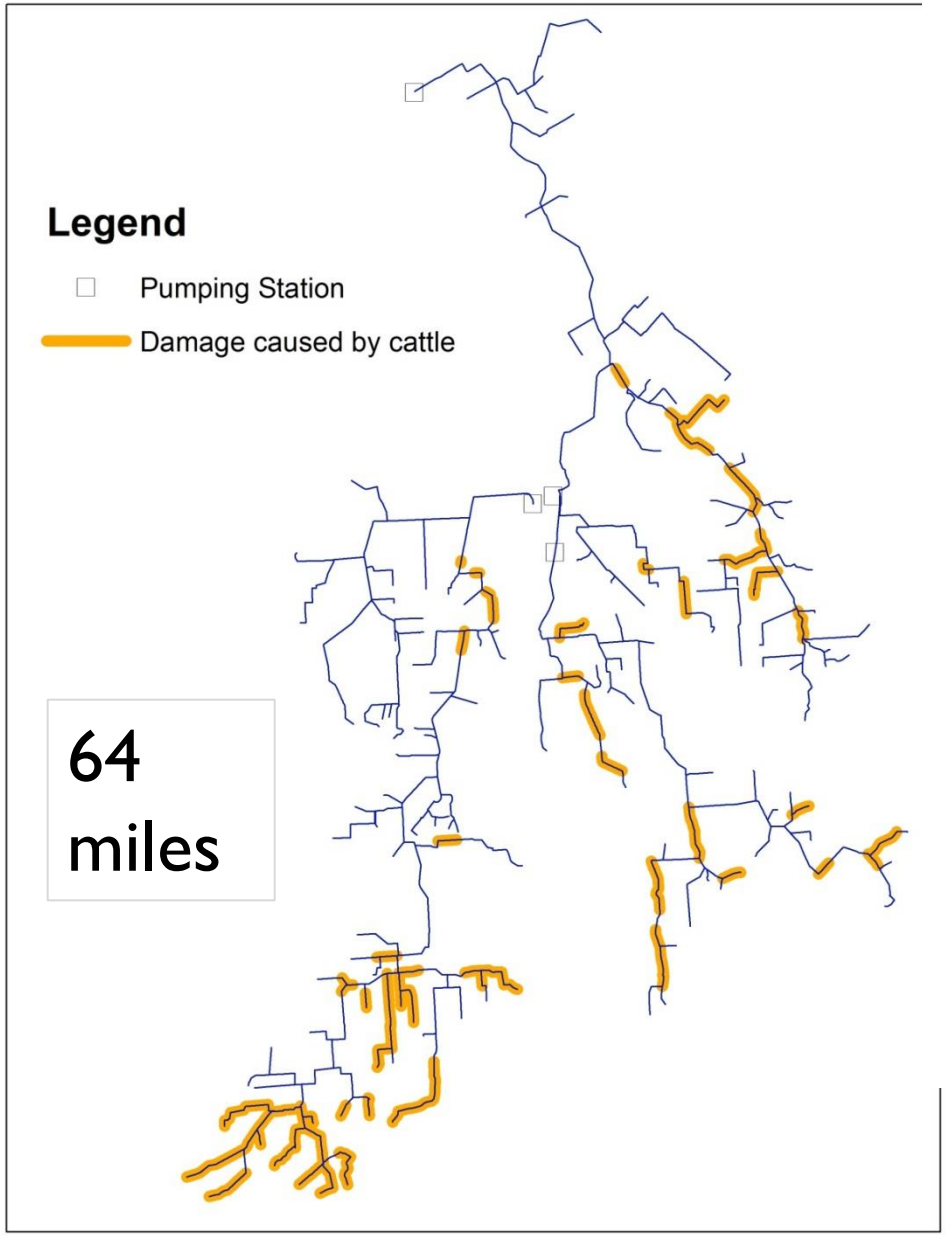
2 = 5 segments (4 miles)

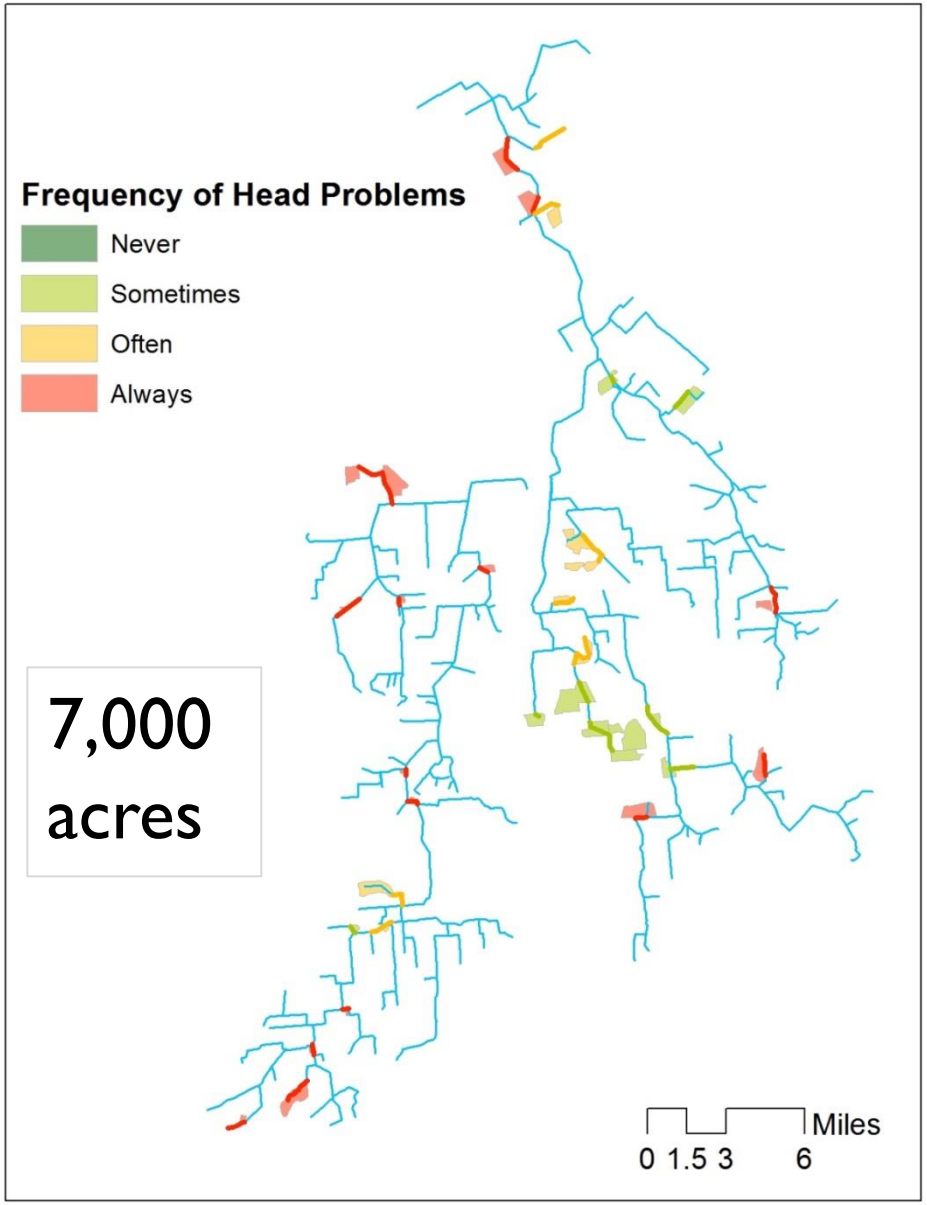
3 = 10 segments (9 miles)

Likely non-seepage losses = 5 segments (4 miles)



Non seepage problems





Conclusions

- RIP is an organized structure of data that can be further developed in more complex analysis (e.g. water delivery scheduling)
- Priorities to be addressed to improve water delivery efficiency are identified (in the Al Shehamiyah case studies several gates were replaced based on results)
- RIP is easily replicable using the same structure of data

Conclusions
(LCRA case study, Texas)

- We identified 27.4 miles of canals that are likely to have significant seepage losses and/or leaks. These canals were ranked by priority for further analysis
- We also identified non-seepage conditions and problems:
  - Head problems, resulting in insufficient flow (7,000 acres)
  - Cattle damage widespread in the South West and South East Sections
- Based on the observations we recommended some types of lining materials/systems (composite i.e. synthetic overlaid with a protective concrete layer, PVC blend reinforced with a polyester scrim, reinforced geomembrane)

For more information:

Irrigation Technology Program

Water District Program

http://idea.tamu.edu

Guy Fipps

http://gfipps.tamu.edu

g-fipps@tamu.edu

Gabriele Bonaiti

http://baen.tamu.edu/faculty/gabriele-bonaiti/

gbonaiti@ag.tamu.edu