Food and Agriculture Organization of the United Nations

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AgWA Partnership for agricultural water for Africa

Emerging practices from Agricultural Water Management in Africa and the Near East

Thematic Workshop

Theme 3

The 3-Pronged Approach

Conjunctive use of ground and harvested water, modern irrigation, solar energy for irrigation

Motasem Abukhalaf, Project Officer, FAO-Jordan

Bari, 29 August 2017

Theme 3:

The 3-Pronged Approach

PRESENTATION OUTLINE

BACKGROUND/ PILOT AREA

WATER HARVESTING

METHODOLOGY/ PARTNERS

GROUNDWATER

FIELD MEASUREMENTS/ SYSTEM DESIGN

SOLAR COMPONENT

DESIGN OF IRRIGATION SYSTEM

TECHNOLOGY

Theme 3:

The 3-Pronged Approach

BACKGROUND/ PILOT AREA


GCP/JOR/018/SWI
Reduce vulnerability in Jordan in the context of water scarcity and increasing food/energy demand
DESK REVIEW
SELECTION OF A WATER HARVESTING SITE FOR THE APPLICATION OF THE THREE-PRONGED APPROACH

Selection of potential site

Desk review

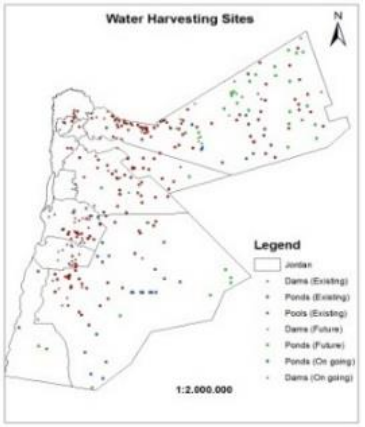
Appropriate project potential sites

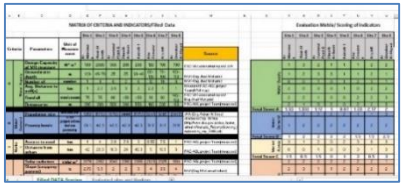
Matrix of criteria/parameter

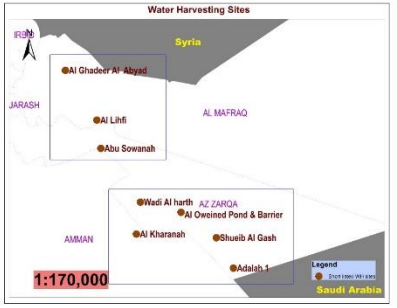
Investigating identified potential sites

Filling data gaps/analysis of the matrix criteria

Selection of the most suitable WH site







Theme 3:

The 3-Pronged Approach

BACKGROUND/ PILOT AREA

Al Ghadeer Al Abyad Dam سد الغدير الأبيض

Site selection

Theme 3:

The 3-Pronged Approach

PILOT AREA / PARTNERS

PILOT AREA

Conduct preparatory studies for the Pilot Area

General characteristics Hydrological features Biophysical features	Cropping Pattern

Implementation of Pilot Project

Design/ Implementation of Irrigation System (Solar Power)	Prepare a model (Conjunctive use of ground & surface water)

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The 3-Pronged Approach

METHODOLOGY/ PARTNERS

Conducted Studies/ Data Collection & Analysis

General Characteristics

- Satellite Images
- Land cover/Use maps
- Topographic maps

Hydrological Features

- Precipitation
- Evaporation
- Runoff volume
- Infiltration rate
- Groundwater data

Biophysical Features

- Soil analysis
- Water analysis
- Geology
- Relief
- Land suitability maps

Cropping-Pattern

- Verities & suitability

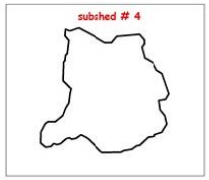
Meteorological Data

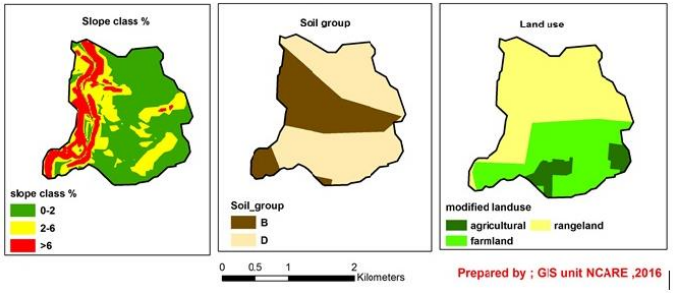
- Least monthly precipitation measurement
- Min/ Max temperatures
- Air relative humidity
- Wind speed
- Incoming solar radiation

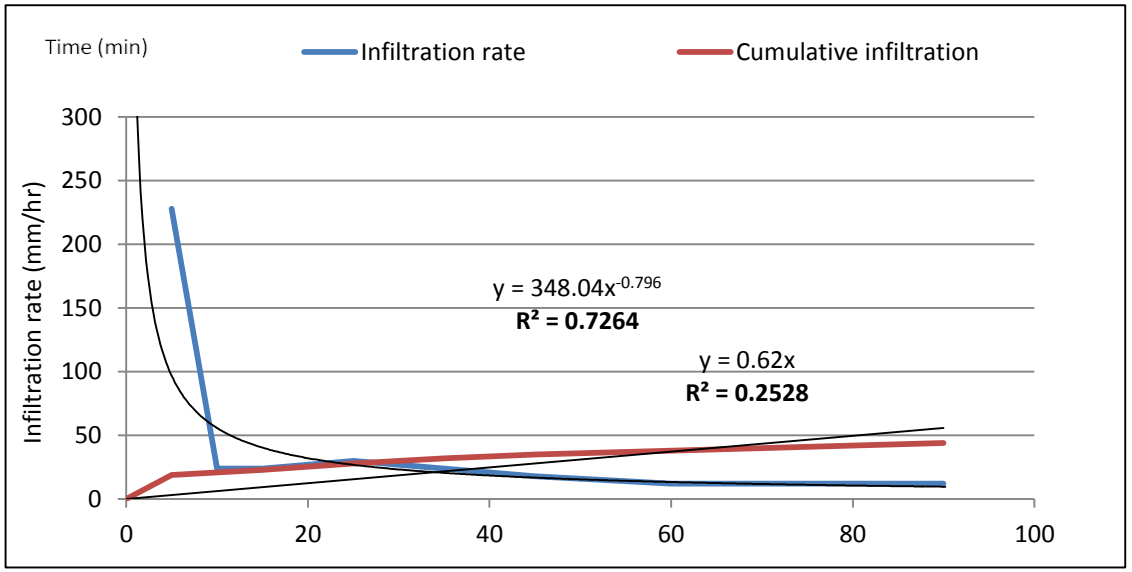
Theme 3:

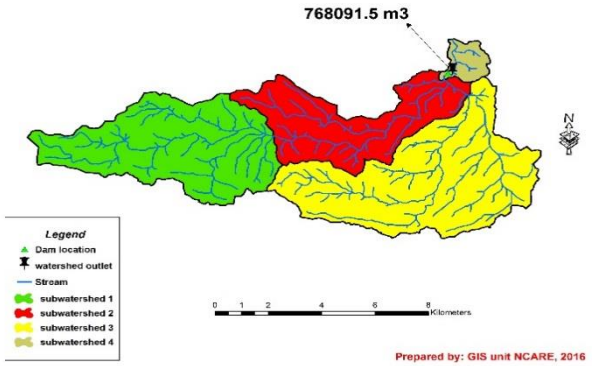
The 3-Pronged Approach

METHODOLOGY









Profile number	Bulk density	Basic infiltration rate (mm/hour)
PG1	1.46	12
PG2	1.31	16
PG3	1.29	26
PG4	1.30	28
PG5	1.26	30
PG6	1.25	18
PG7	1.32	16
PG8	1.31	8
PG9	1.32	14
PG10	1.32	16
PG11	1.22	16
PG12	1.28	20
PG13	1.21	24
PG14	1.23	16
PG15	1.29	12
PG16	1.25	14
PG17	1.30	12
PG18	1.30	12
PG19	1.31	16
PG20	1.24	18

Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION

Dam Maintenance/ Sediment Removal

Current capacity
of 250 000 m^3

↓

Design Capacity
of 700 000 m^3

Last Maintenance
in 1983

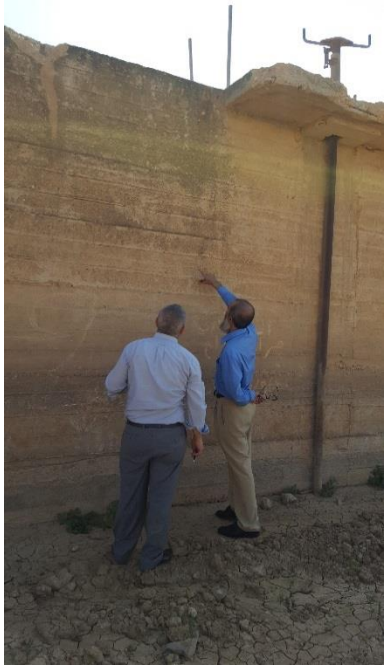
Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION

Dam Maintenance/ Sediment Removal

- Evaluation of current situation
- Conduction of full survey
- Measurements

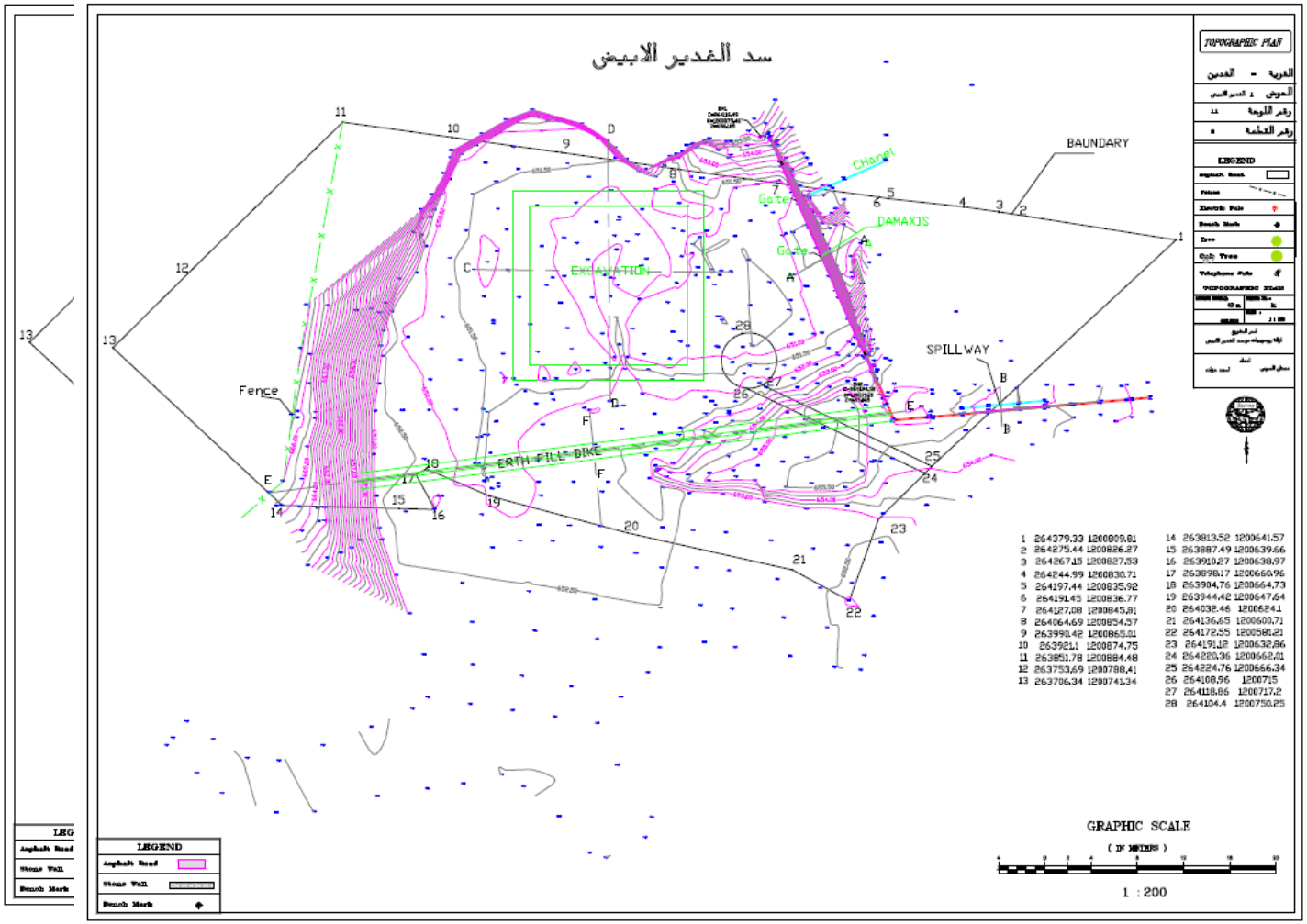


Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION

Dam Maintenance/ Sediment Removal



Preparation of Maintenance Plan/ Sediment Removal

Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION/WATER HARVESTING

Dam Maintenance/ Sediment Removal

Preparation of BoQ

Preparation of complete Tender Document

ITEM	Unit	Quantity
Excavations in cubic meters (m^3): Removal of sediments and accumulated muds in Al-Ghadeer Al-Abyad dam.	m^3	35 000
Construction of protection wall (in m^2): - The price include the supply and construction of bricks. This wall is composed of cement bricks with (20 cm thickness) in high specifications. - Mortaring for the bricks during construction in order to prevent the leakage of water. - Bricks will be watered daily twice, for a period of three days.	m^2	24
Works of an earth berm to protect the site from floods: 1. Construction of an earth berm (350 m length, 4 m height, top width 2 m, 10 m bottom width), with estimated quantity of 6 000 m^3. 2. Berm will be constructed based on the provided technical specification or/ 3. The berm would be removed before the initial receipt of the works from works	-	-

منظمة الأغذية والزراعة للأمم المتحدة

عطاء صيانة/ إزالة ترسبات سد الغدير الابيض

محافظة المفرق

الشروط العامه والخاصه

و المواصفات والمخططات وجداول الكميات

منظمة الأغذية والزراعة للأمم المتحدة

مشروع الحدّ من مخاطر الضعف في الأردن ضمن سياق الأمن المائي وارتفاع الطلب على الأغذية والطاقة

كانون الاول 2016

Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION/GROUNDWATER

Mapping of Wells

Station Id	**AD1105**
Station Name	TAWEELA

Well depths	**334 m**
Static Water Level	**107 m**
Pump water level	**252 m**
Average Flow Rate	**18-15 m^3/hr**

Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION/ SYSTEM DESIGN

- Site overseeing with different components
- Conducting needed measurements (dam area, surrounding plots, wells, etc.)
- Meeting with Farmers and local community representatives
- Data verification with the local authorities
- Collection of Cadastral and Altimetric Maps
- Surveying and assessing lacking data for a final layout
- Data verification/ Complementary measurements
- Final Layout of convey and distribution system with management rules

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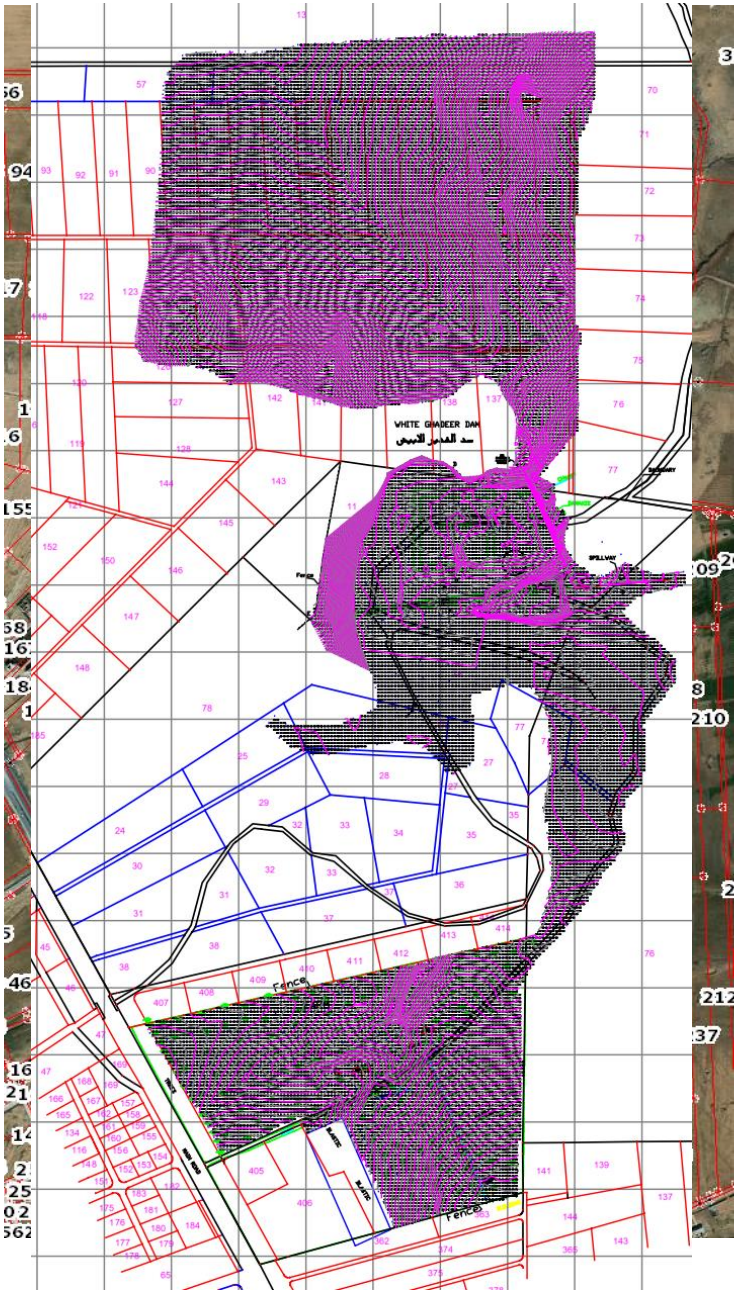
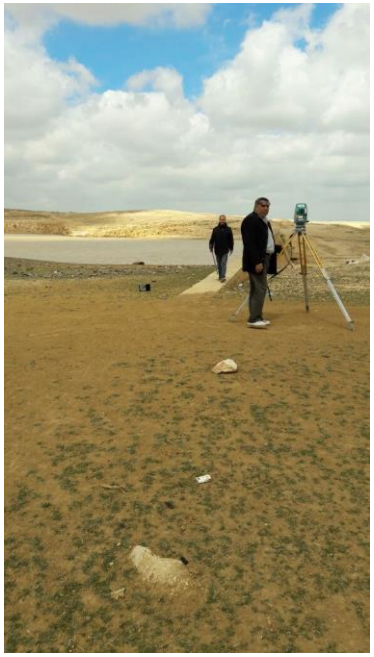


METHODOLOGY IN ACTION/ SYSTEM DESIGN



Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION/ SYSTEM DESIGN

Reliable Amount

200 000 **m³** - with 70,000 more after maintenance

Average need= 5000 **m³** /ha

Currently Area 2

Surface Water = 0

The well= max 150 000 m³

Theme 3:

The 3-Pronged Approach

METHODOLOGY IN ACTION/ SOLAR ENERGY

Area 1 = 17 ha

Two Pumps

Solar Panels

Area 2 = 15.7 ha

METHODOLOGY IN ACTION/ SYSTEM DESIGN

Normal Year	Dry Year
Area 1 = 100 000 **m³**	Area 1 = 100 000 **m³**
Dam= 200 000 **m³**	**Dam=** 150 000 **m³**
remaining needed volume will be taken from the existing well	
Area 2 = 100 000 **m³**	**Area 2 =** 50 000 **m³**

METHODOLOGY IN ACTION/ SYSTEM DESIGN

Conjuntive use (Surface water and Ground water) will be used to irriagte the area 2

75 000 m³ as buffer in case of extesion or water stress

Dry Year

Area 1 = 100 000 **m³**

Dam= 150 000 **m³**

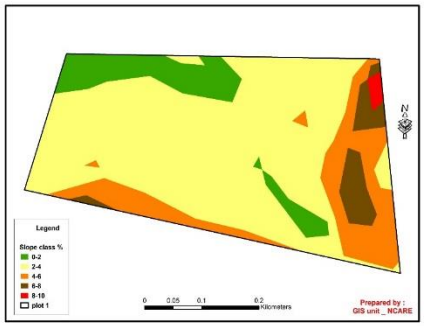
Area 2 = 50 000 **m³**

Well

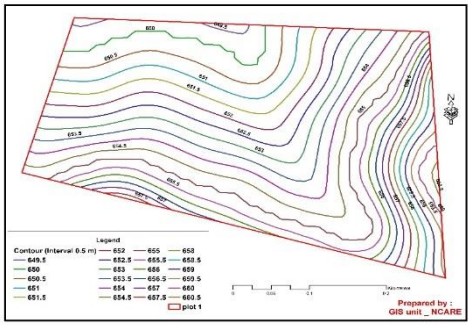
Theme 3:

The 3-Pronged Approach

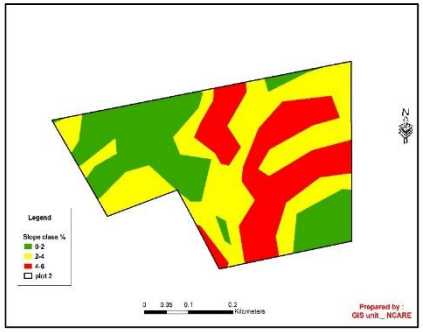
METHODOLOGY IN ACTION/ SYSTEM DESIGN

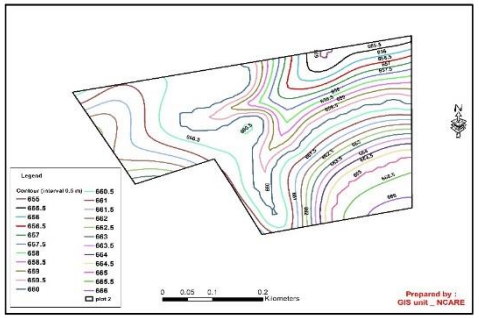


Slope Map



Contour Map

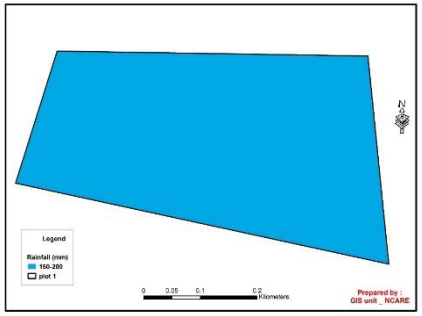




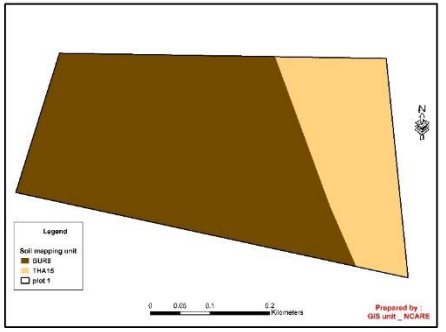
Theme 3:

The 3-Pronged Approach

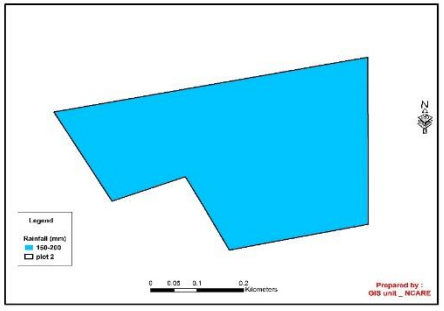
METHODOLOGY IN ACTION/ SYSTEM DESIGN

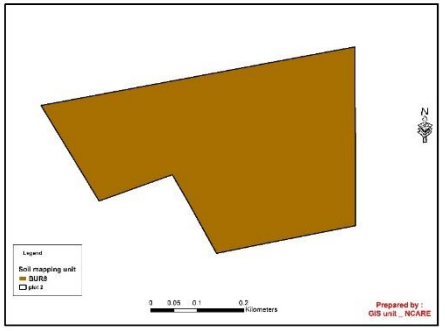


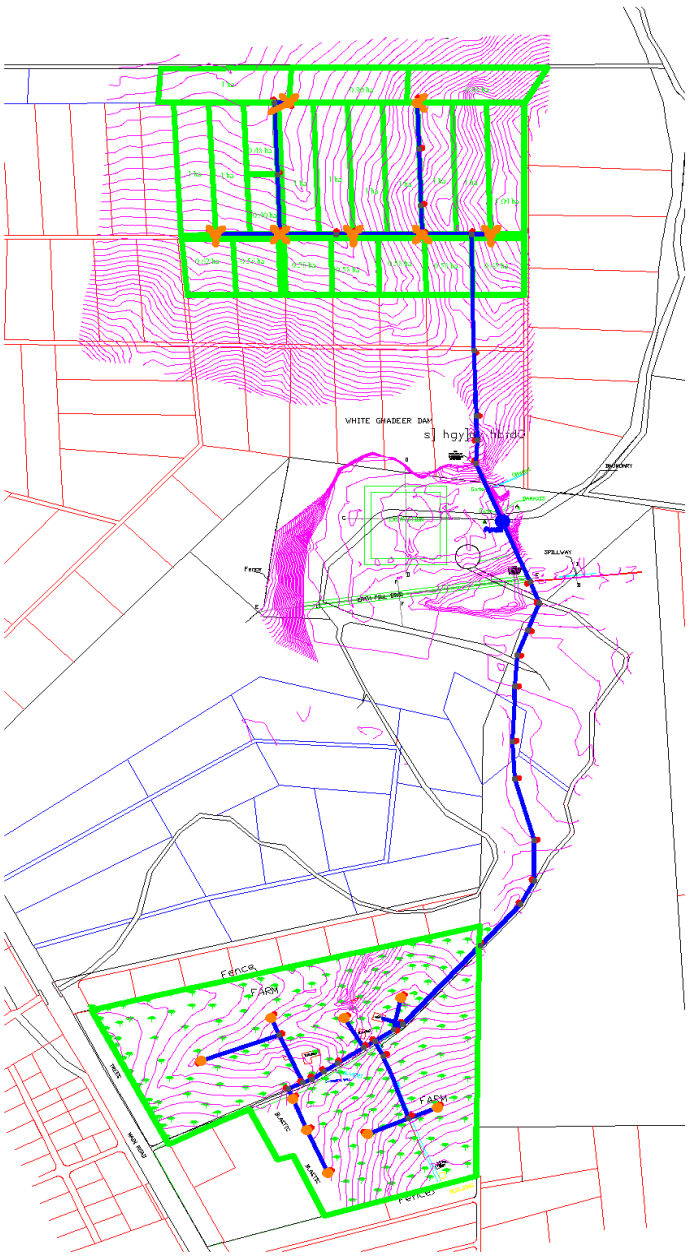
Rainfall Map



Soil Map







DESIGN OF IRRIGATION SYSTEM

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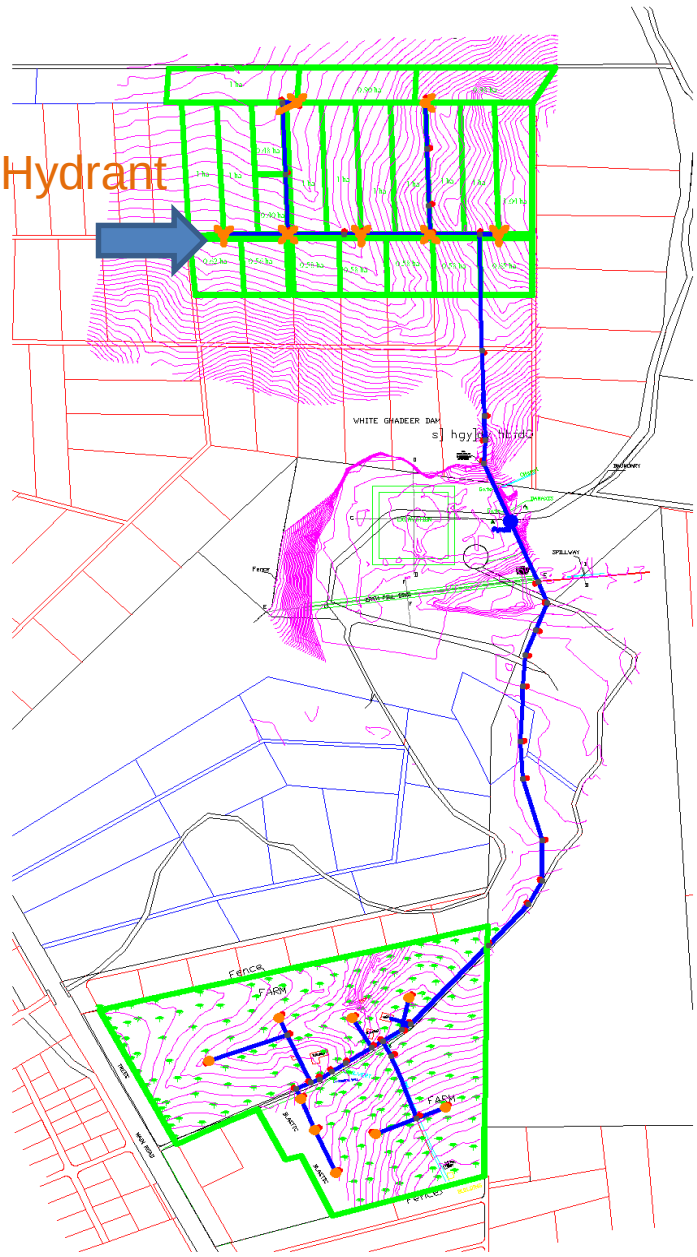
Area 1 = 17 ha **(21 Plots)**

Two Pumps (one for each area)
Pressure Head = 36 m
Discharge= 35 l/s

Area 2 = 15.7 ha



DESIGN OF IRRIGATION SYSTEM

Area 1 = 17 ha **(21 Plots)**

A pressurized irrigation system is designed

One hydrant provide 5 l/s
(irrigate around 2.5 ha)
Minimum pressure head = 20 m

(if we put 2.5 l/s per hydrant, on peak you need to irrigate overnight which does not suit solar pumping)

Water duty 1 l/sec/ha (suitable to most crops)

Area 2 = 15.7 ha

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DESIGN OF IRRIGATION SYSTEM

Hydraulic Calculations & BoQ

P = (Q/(C*D^2 *935.3))^2
P= in Bars
Q= L\S
D= MM
C= Coefficient of Discharge

Velocity= gpm/(2.45*D^2)
Diameter =inches
Velocity =2652
Q= A* V
P = 0.01419 * V^2
P= Bars
V = M/S

Head Loss (Hf m)=F * Ku *(Q\C)^1.852 * D^-4.87
F=0.356
Ku=(1.21 * 10^10)
C= 150
Water H.P. =(gpm * head in feet) /3960

1 PSI = 2.31 feet

HEAD LOSS IN LATERALS & MANIFOLD

Flow g\min	Flow m3\hr	Flow L\S	I.D Dia. mm	Length m	riction Loss HF (m	Radius M	HF Accu. (mt)	Velocity m\s	Head Loss in PS	Hors
	0.05	0.013889	13	42	0.023050467	0.0065	0.023050467	0.1046914	0.033423178	
	4.2	1.166667	53.6	53	0.107483835	0.0268	**0.130534303**	0.517306	0.155851561	

HEAD LOSS IN MAIN LINE AND SUBMAIN

Flow g\min	Flow m3\hr	Flow L\S	Diameter mm	Length m	Friction Loss HF (mt.)	Radius (mt.)	Accu. Friction Loss HF (mt.)	Velocity m\s	Head Loss in PSI	Hors
	12.8	3.555556	76.6	190	1.497974718	0.0383	1.497974718	0.7719342	2.172063342	
	30.5	8.472222	93.6	200	2.966415911	0.0468	4.464390629	1.2319015	4.301303071	
	30.5	8.472222	93.6	60	0.889924773	0.0468	5.354315403			

Project Title : Al Ghadeer Al Abyadh

ITEM	DESCRIPTION	UNIT	QTY	U
1	H.D.P.E. PIPE 10 Bar - 315 mm K.S.A	LM	456	
2	H.D.P.E. PIPE 10 Bar -225 mm K.S.A.	LM	516	
3	H.D.P.E. PIPE 10 Bar -200 mm K.S.A.	LM	576	
4	H.D.P.E. PIPE 10 Bar -160 mm K.S.A.	LM	700	
5	H.D.P.E. PIPE 10 Bar -110 mm K.S.A.	LM	1100	
6	H.D.P.E. PIPE 10 Bar -90 mm K.S.A.	LM	2200	
7	H.D.P.E. PIPE 10 Bar -63 mm K.S.A.	LM	4800	
8	L.D.P.E. PIPE 4 Bar - 16 mm TH.1.3 K.S.A.	LM	375000	
9	Trench Cut and Fill	LM	1900	
10	P.E.Tee Equal 225 mm	Ea	1	
11	P.E.Tee Equal 200 mm	Ea	1	
12	P.E.Tee Equal 160mm	Ea	1	
13	P.E.Tee Equal 110mm	Ea	5	
14	P.E.Tee Equal 90 mm	Ea	12	
15	P.E.Tee Equal 63 mm	Ea	20	
16	P.E.Elbow 45 degree 315 mm	Ea	2	
17	P.E.Elbow 45 degree 225 mm	Ea	2	
18	P.E.Elbow 45 degree 200 mm	Ea	1	
19	P.E.Elbow 90 degree 200 mm	Ea	1	
20	P.E.Elbow Coupling 110mm	Ea	5	
21	P.E.Elbow 90 Degree 90 mm	Ea	8	
22	P.E.Reducer 315x225 mm	Ea	1	
23	P.E.Reducer 225x200 mm	Ea	2	
24	P.E.Reducer 225x160 mm	Ea	2	
25	P.E.Reducer 225x110 mm	Ea	1	
26	P.E.Reducer 200x160 mm	Ea	4	
27	P.E.Reducer 200x90 mm	Ea	1	
28	P.E.Reducer 160x110 mm	Ea	5	
29	P.E.Reducer 160 x 90mm	Ea	5	
30	P.E.Reducer 110x90 mm	Ea	4	
31	P.E.Reducer 90x63 mm	Ea	5	

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METHODOLOGY IN ACTION/ TECHNOLOGY

NORMAL HYDRANTS

Flow meter and Flow regulator

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TECHNOLOGY

ELECTRONIC WATER DELIVERY SYSTEM

1. **Other alternative of the Regualar Hydrants**
2. **More efficient**
3. **Represent a “model” to be replicated in other irrigated areas in Jordan**
4. **Each farmer will have his own electronic card**
5. **For the use these devices the role of WUA is important/ Training**

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شكراً لكم Thank You