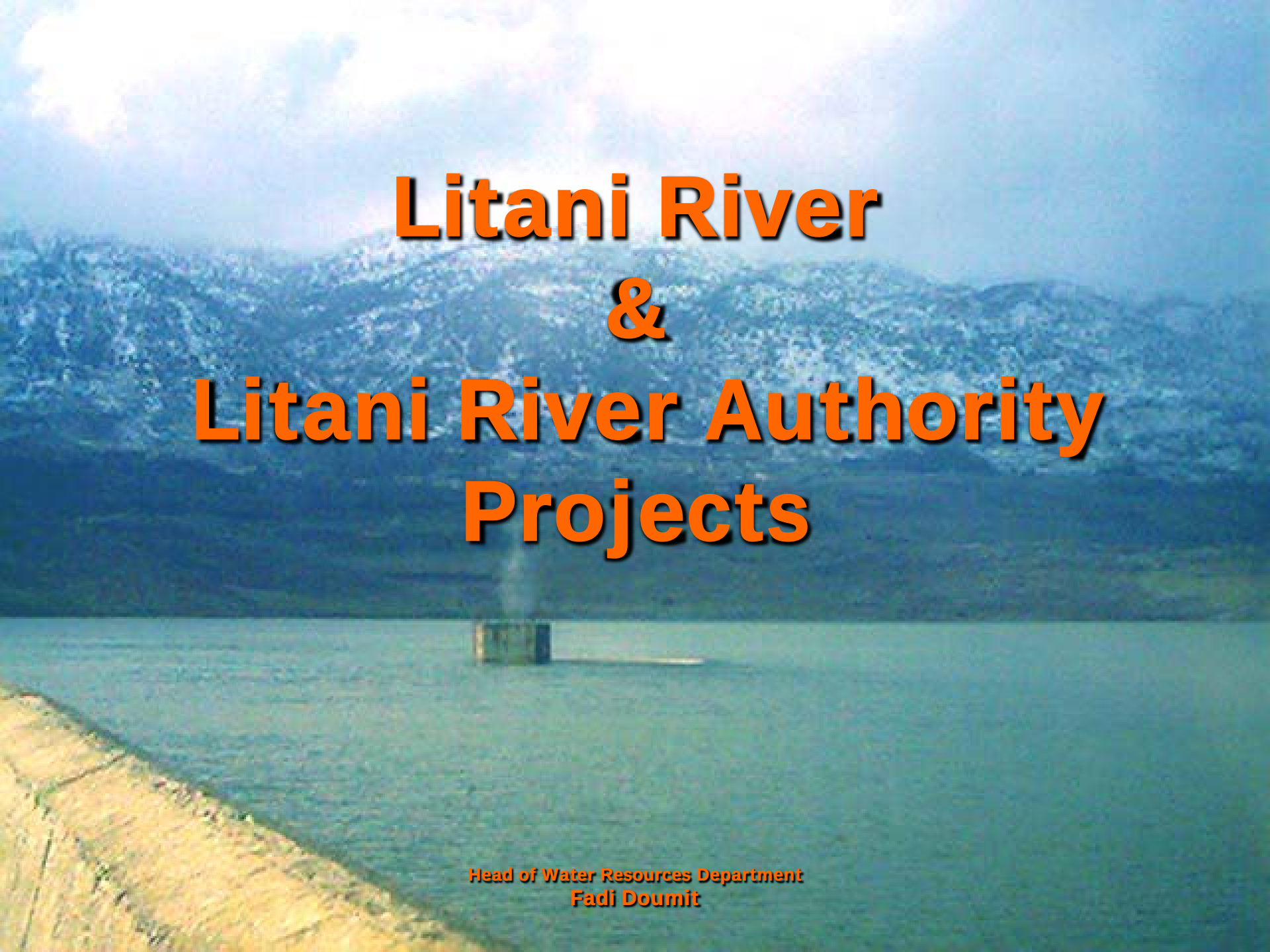


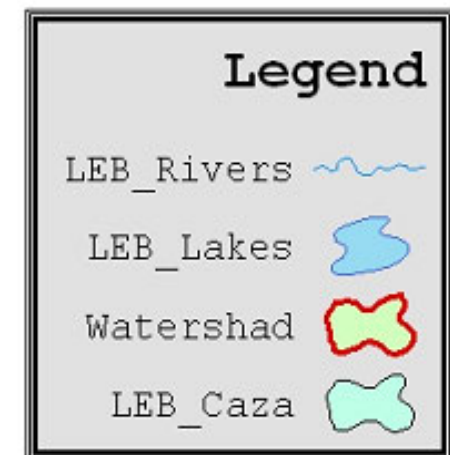
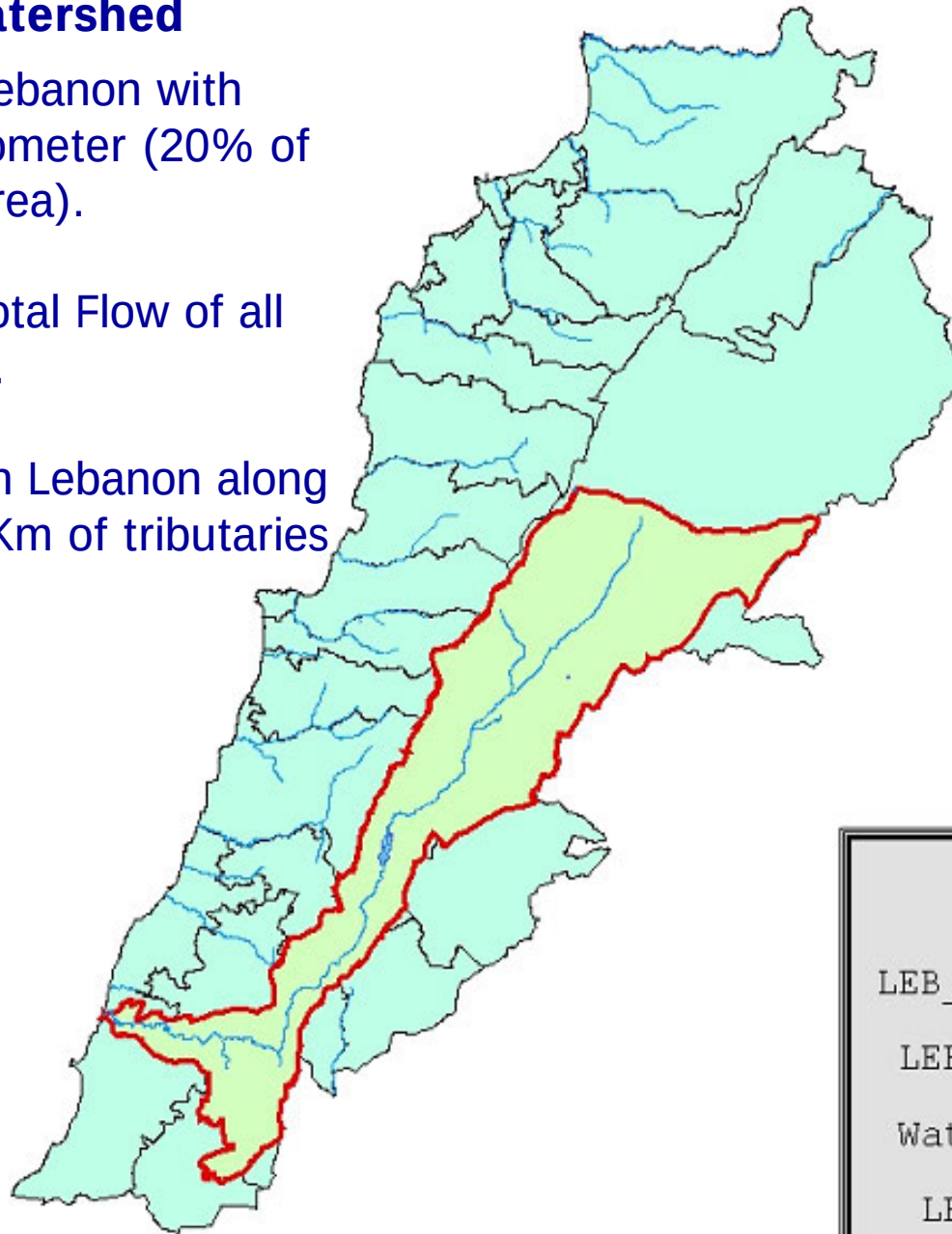


Litani River & Litani River Authority Projects

**Head of Water Resources Department
Fadi Doumit**

Litani River & Watershed

- The Largest in Lebanon with 2170 Square Kilometer (20% of Lebanon Total Area).
- 30% From the total Flow of all Lebanese Rivers.
- Totally running in Lebanon along 170 Km and 60 Km of tributaries



Litani River Authority

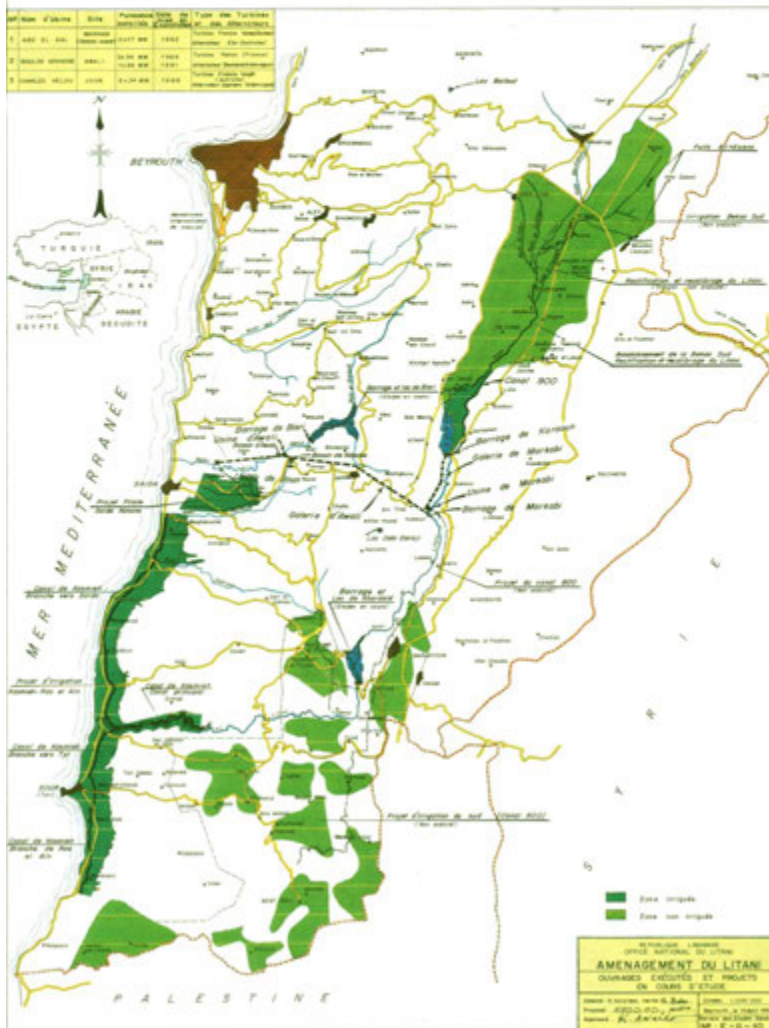
- Created by a Law dated on 14 August 1954 and rectified later on 30 December 1955:
 - Execute the Litani River Master Plan for irrigation, drainage and domestic water.
 - Execute the hydraulic electrical power generation and electrical networks between powerhouse and electrical distribution networks in all Lebanese regions.

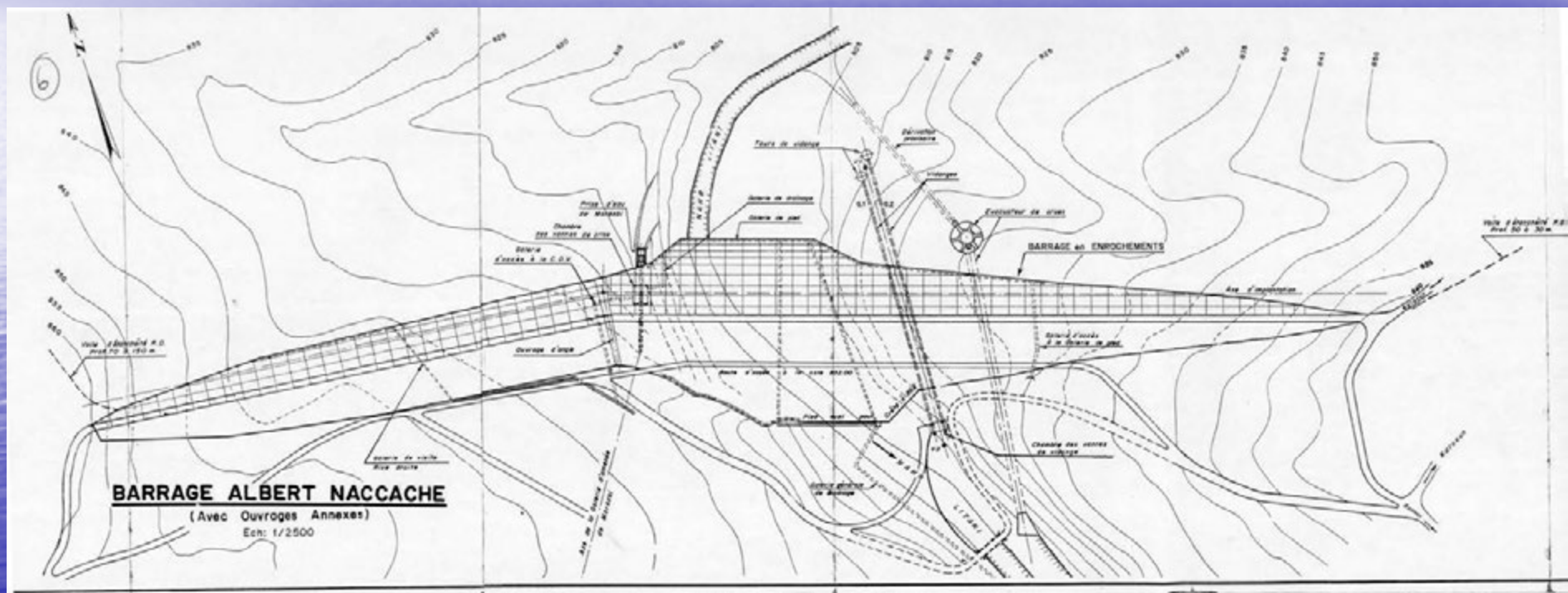
Litani River Authority

- By different decrees, the government of Lebanon adds the following tasks:
 - Hydraulic measurements on all Lebanese rivers.
 - Study and execution of different mountain lakes like Kawachra in Akkar Zone, Kfarhouna in Jezzine and Ballout in Matn region.
 - Technical land survey and studies of dams on Lebanon Rivers.
 - Bisri Dam Studies.
 - Choumarieh Dam
 - Khardale Dam
- Recently, new law 221 (water authorities Law) adds to its responsibilities all irrigation schemes in South Bekaa and South Lebanon Regions.
- A new Environmental department was created in 2006 to assess the water quality of Litani River & tributaries

Litani River Authority Projects

- Sited in and out Litani River Basin
- Three Hydro electrical Plants producing 7-10% of Electrical Energy produced in Lebanon
- Potable Water for Southern Lebanon Region representing 20% of Lebanese population
- Irrigation Schemes for South Bekaa and South Lebanon – Concerned Regions Represent 42% of Lebanese Area (264 Villages and Towns)
- Possibility for Tourist Projects





Karaoun Dam Characteristics

Designation	Value
Total Length	1090 meters
Height (From ground level)	62 meters
Altitude Water level surface	858 meters
Useful Volume of the Lake	220 MCM
Area	12.3 Km ²
width at Top	6 meters
width at Bottom	162 meters
Concrete mask area	50.000 m ²

Water Conveyance Structures Characteristics

	Markabi Tunnel	Awali Tunnel	Joun Tunnel
Length in meters	6400	17.070	6984
Diameter in meters	3.1	3.27	3.4
Useful cross section in square Meters	7.55	8.35	9.52
Flow Cubic Meters per Second	25	25	30
Slope (per Thousand)	2.2	-0.5 & + 2.2	3
Head loss friction in meters	9.7	35	

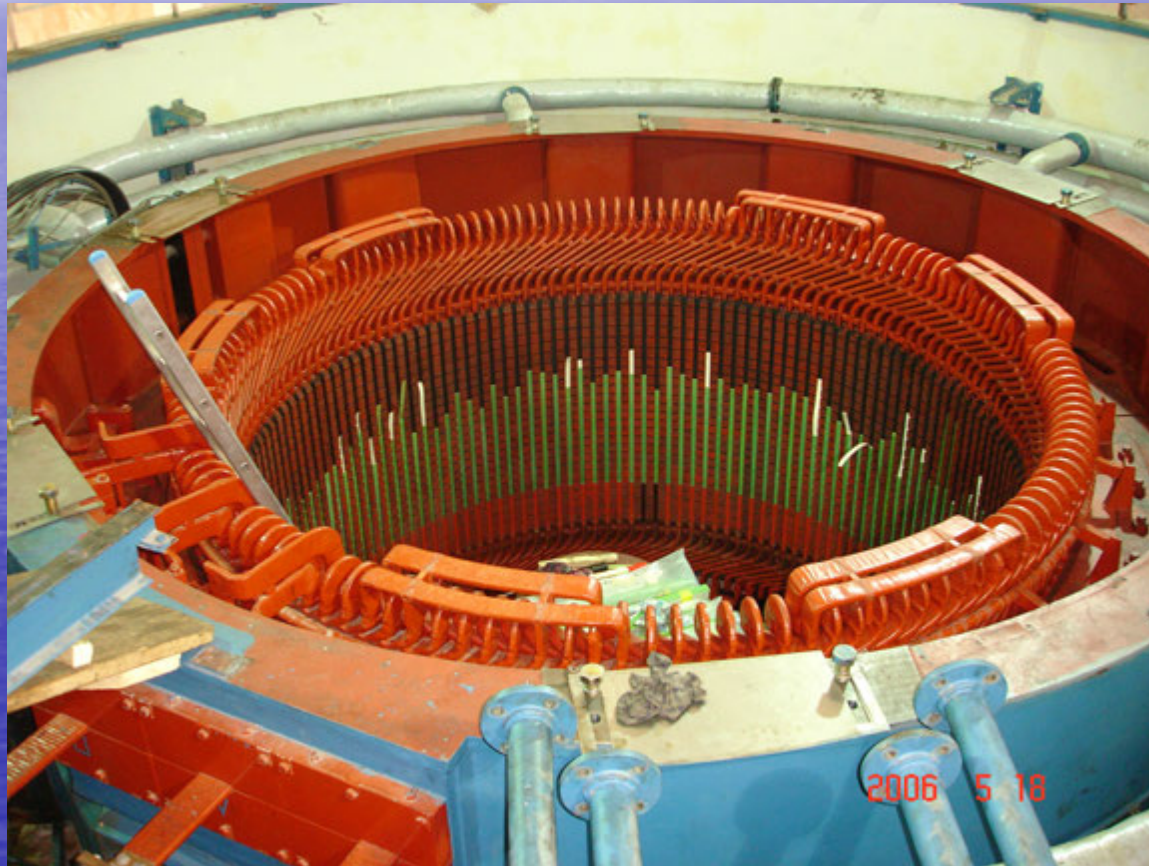
Electrical Plants Power

- **Markabi** (2 X 21250 KVA) 2X17 MW - Waterfall (chute) 199 m
- **Awali** (3 X 45625 KVA) 3X36 MW: Waterfall 400 m
- **Joun** (2 X 30000 KVA) 2X24 MW: Waterfall 196 m

Roue turbine Pelton-AWALI



Stator ALTERNATEUR - AWALI

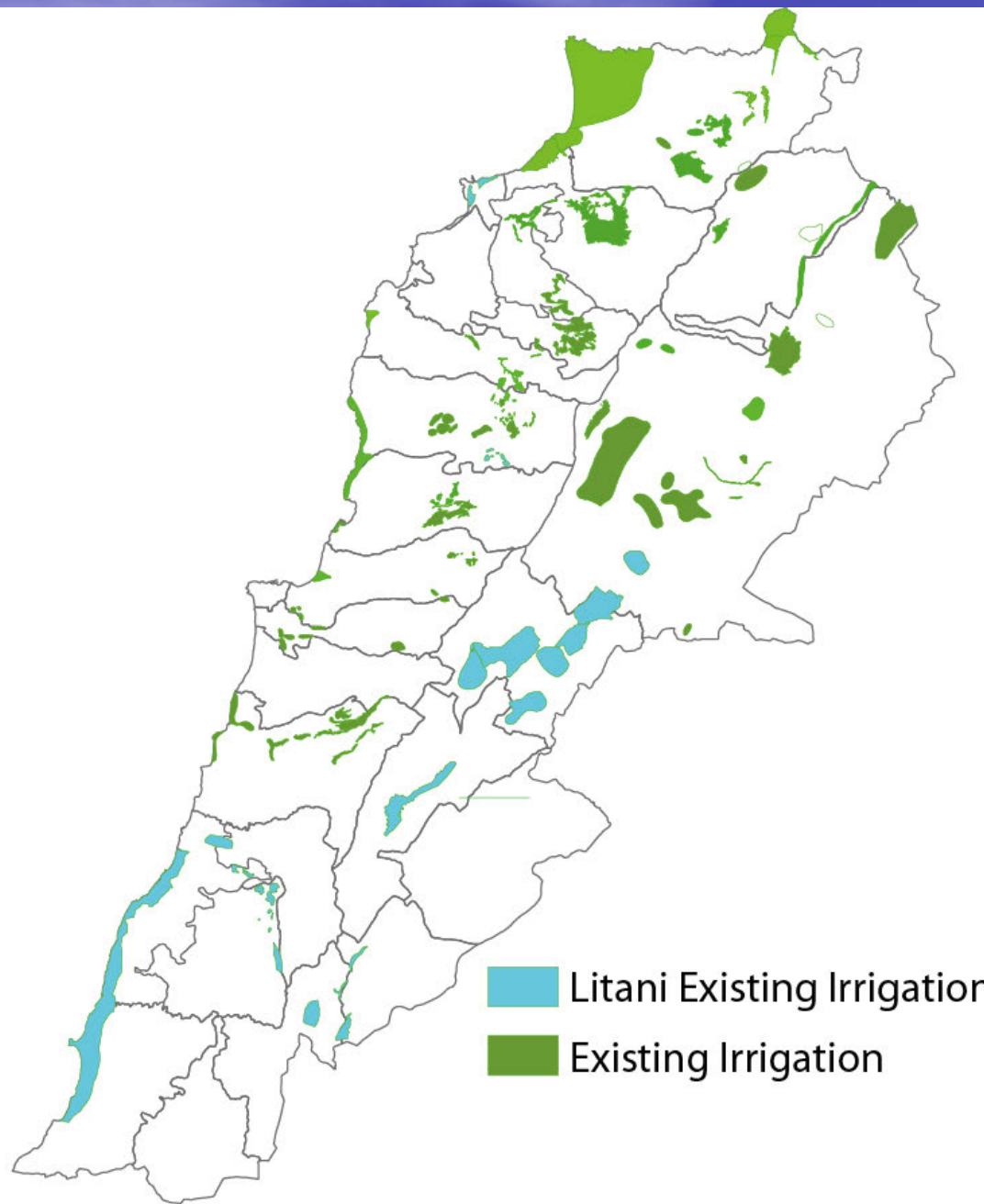


Rotor – Alternateur - AWALI

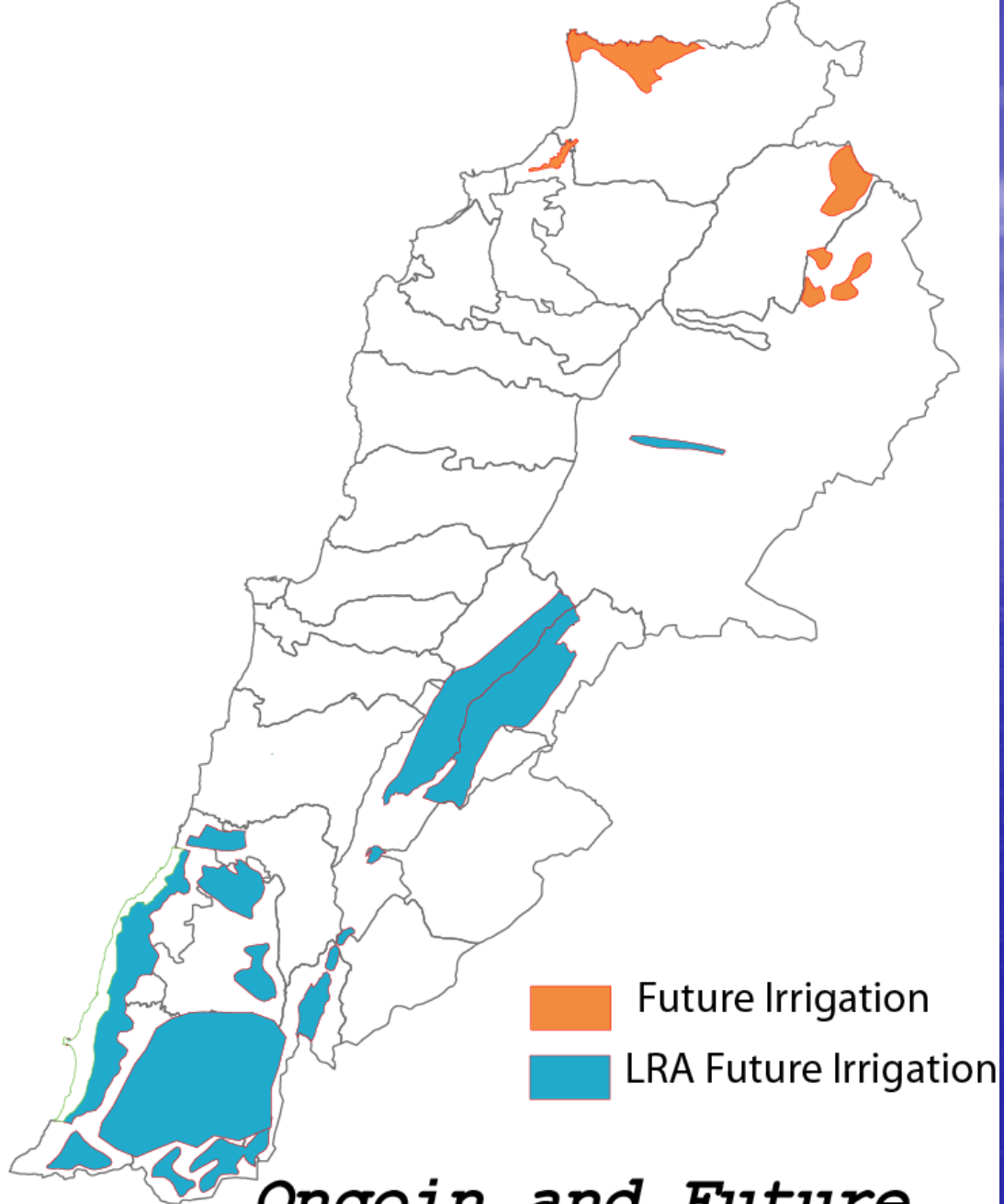


Irrigation Schemes (Lebanon Vs LRA)

AREA IN Ha			
	Irrigated	Ongoing & Proposed	Total
Total Lebanon Schemes	60,900	82,000	142,900
LRA Schemes	16,530	60,330	76,860
LRA IN % OF LEBANON	27.14	73.75	53.79



Existing Irrigations schemes



*Ongoin and Future
Irrigation Schemes*

Litani River Authority Irrigation Schemes

Region	Project	Area in Ha			
		Irrigated	Ongoing	Proposed	Total
South Bekaa	South Bekaa	2000	6700	14800	23500
	South Qaraoun Dam		980		980
	Small and medium Schemes	8090			8090
	Total	10090	7680	14800	32570
South Lebanon	South Lebanon		15000	20000	35000
	Qasmieh	4000		2000	6000
	Pilot Sector	350	850		1200
	Small and medium Schemes	2090			2090
	Total	6440	15850	22000	44290
Total		16530	23530	36800	76860

Irrigation Schemes

- **Canal 900**
- **Conveyor 800**
- **Canal 600**
- **Quasmieh & Ras el Ein Project**

CONVEYOR 800 PROJECT

Employer/ Developer: CDR

Owner (future): Litani River Authority

Design & Supervision: JV Lahmeyer-DAR-Gauff

Contractor: JV MAK Kharafi-Veziroglu-Guris

Subcontractor for U/G works: Stanilov, Bulgaria

Funding agencies: Arab & Kuwait Funds & Govt. of Lebanon

Value: 330 milion USD divided into Fixed part (200 mil USD) & Optional part (130 mil USD)

Commencement date: 02 May 2012

Completion date:	CS-1	07 Jan 2015		
	CS-2	26 Nov 2015 (Fixed)	&	14 Oct
2016 (Opt)	CS-3	25 Nov 2016		

Tunnels & adits (8 nos): 9.6 km (dia 3.2m); longest Yohmor = 6 km
Shafts (4 nos): 180m (dia 2.6-8m) & 3 vent. shafts (380m)

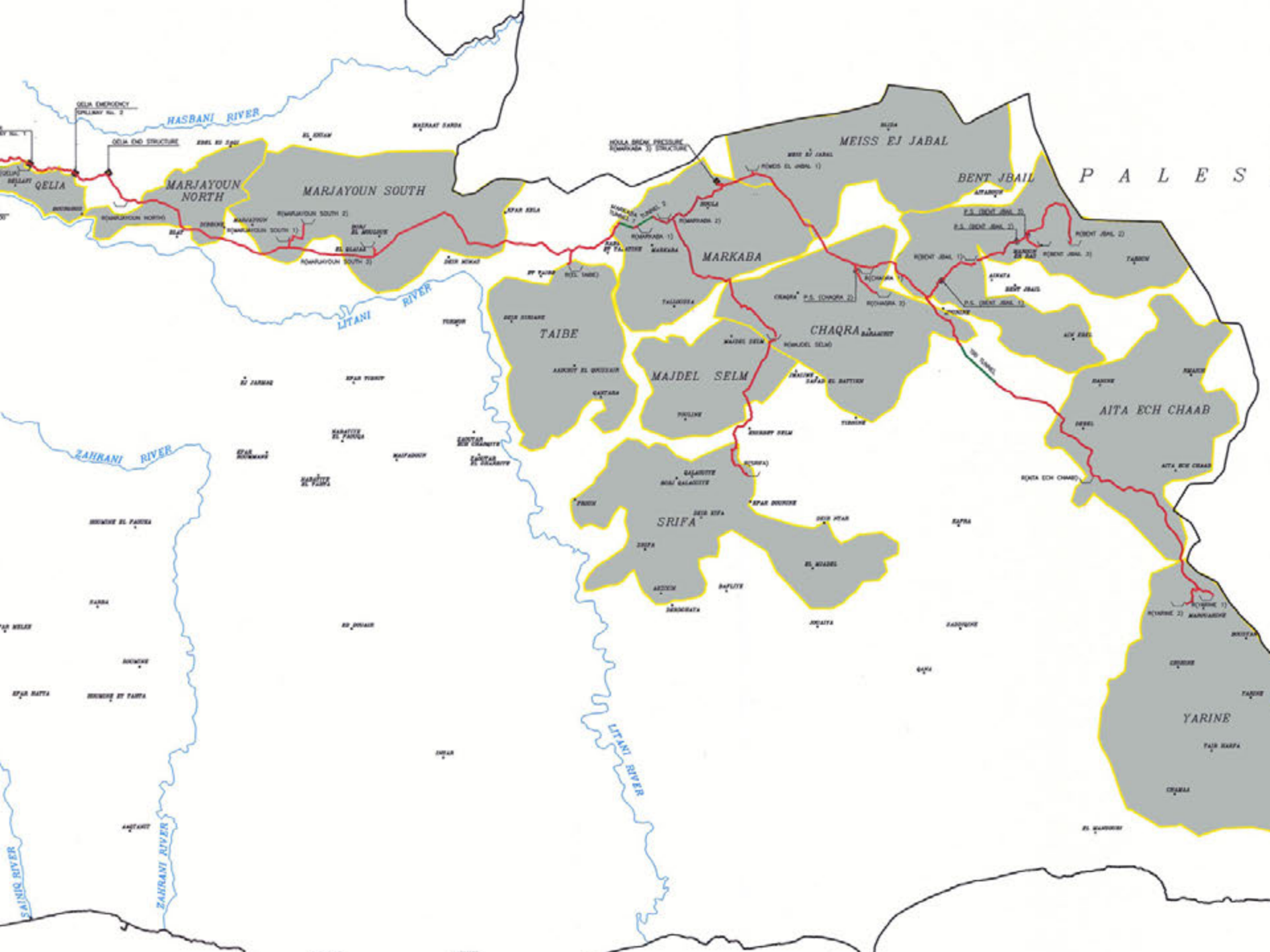
Qelia Canal: 7,4km (Dept 0.7-1.6m, width 6.90m), including 3 siphons & 4 structures (Intake, Offtake, Int.regulator, & End structure with Algae Removal Plant)

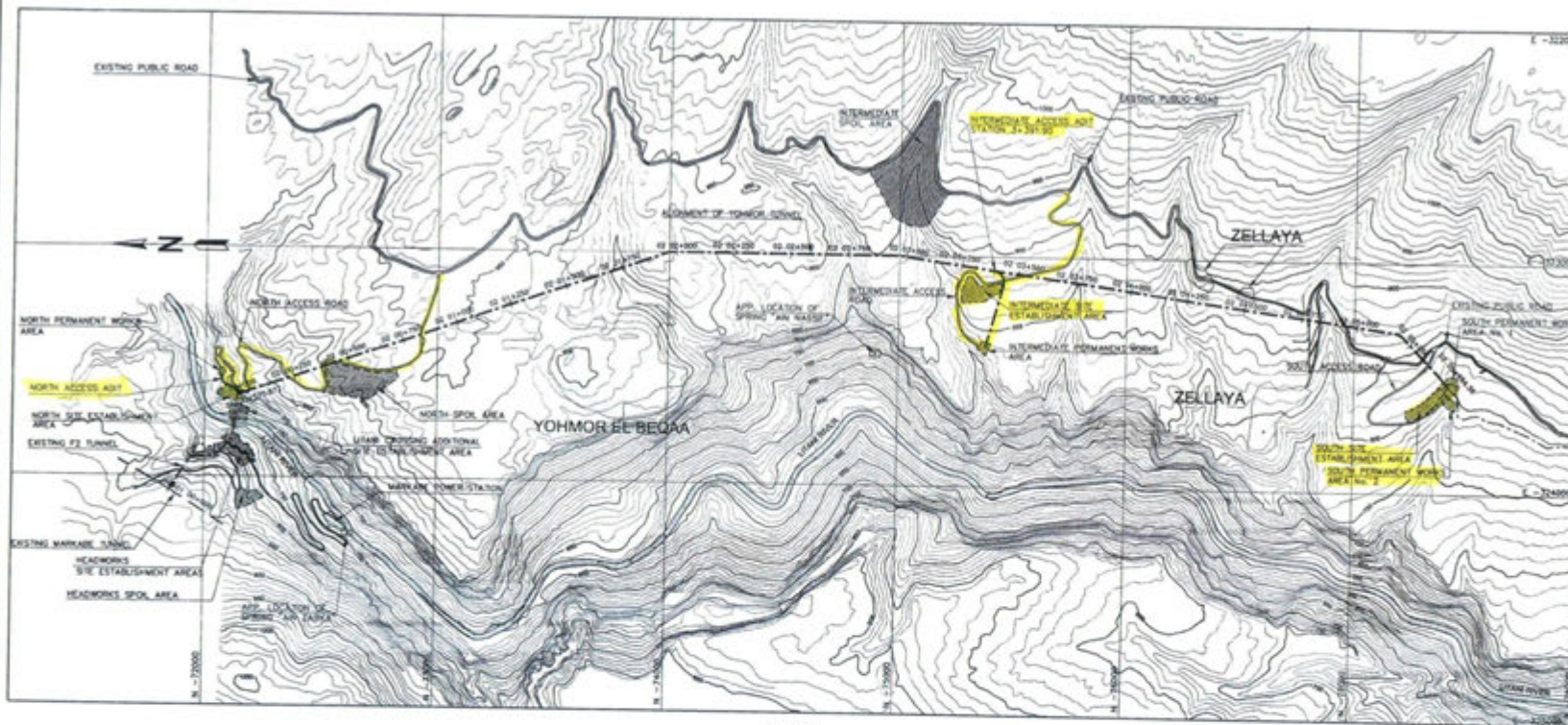
Pipelines (Dia from 300-2000mm), GRP, DI or Steel:

- Main conveyor 62.4km (twin pipes)
- Main. sec. conveyor 20.3km (twin pipes)
- Secondary conveyor 30.3km

12 Concrete & 8 embankment reservoirs of total capacity 160,000m³ for irrigation 13,000 ha of land and water supply for 70 villages with 7,500l/s through 4 pump stations

Mini HPP, initially designed for 1 MW, but now enhanced to 5 MW





LAYOUT

NOTES:

- 1- DIMENSIONS ARE IN METRES UNLESS OTHERWISE INDICATED
- 2- ELEVATIONS ARE IN METRES ABOVE AVERAGE SEA LEVEL (M. S.A.L.)
- 3- COORDINATES ARE IN METRES RELATIVE TO STEREOGRAPHIC PROJECTION GRID
- 4- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DROS NOS. 11-01 102 AND 11-01 103
- 5- CONVEYOR ALIGNMENT STATION NUMBERING INCLUDES THE CONVEYOR SYSTEM SECTION NUMBER FOLLOWED BY THE CHAINAGE (E.G. 02 05+484.260 MEANS SECTION 02, CHAINAGE DISTANCE 5,484.260 METRES)

LEGEND:

- APPROXIMATE EXTENT OF URBAN AREAS

TENDER DRAWING

REPUBLIC OF LEBANON
MINISTRY OF WATER AND ELECTRICITY
LITANI RIVER AUTHORITY

PROJECT: LITANI RIVER AUTHORITY
CONVEYOR 800

CONTRACT NO. 1420

DESIGNED BY: 800
CHECKED BY: 800
APPROVED BY: 800

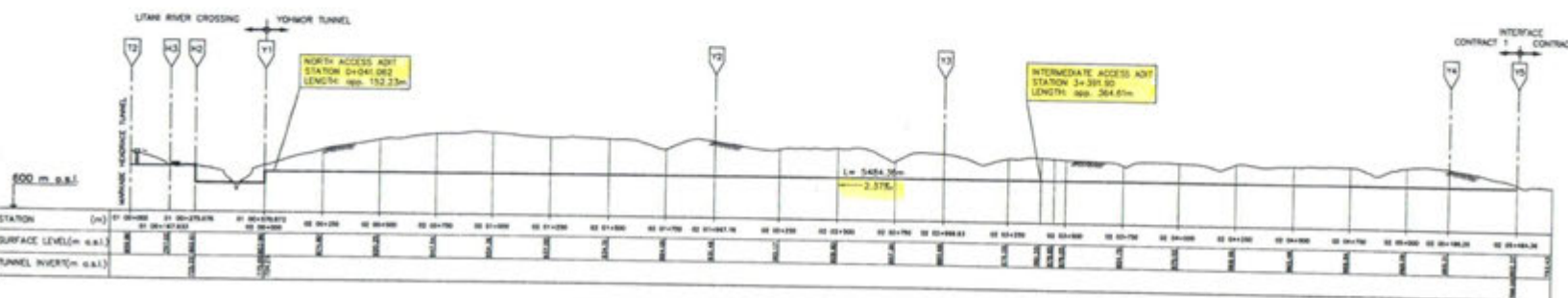
DATE: 28-01-2020

CONTRACT 1
HEADWORKS, LITANI CROSSING
AND YOHMOR TUNNELS

GENERAL LAYOUT AND PROFILE

SCALE: 1:10000

11-01 105



LONGITUDINAL PROFILE ALONG ALIGNMENT



**Existing F2 Tunnel –
actually the access to
Markaba Power
Tunnel;**

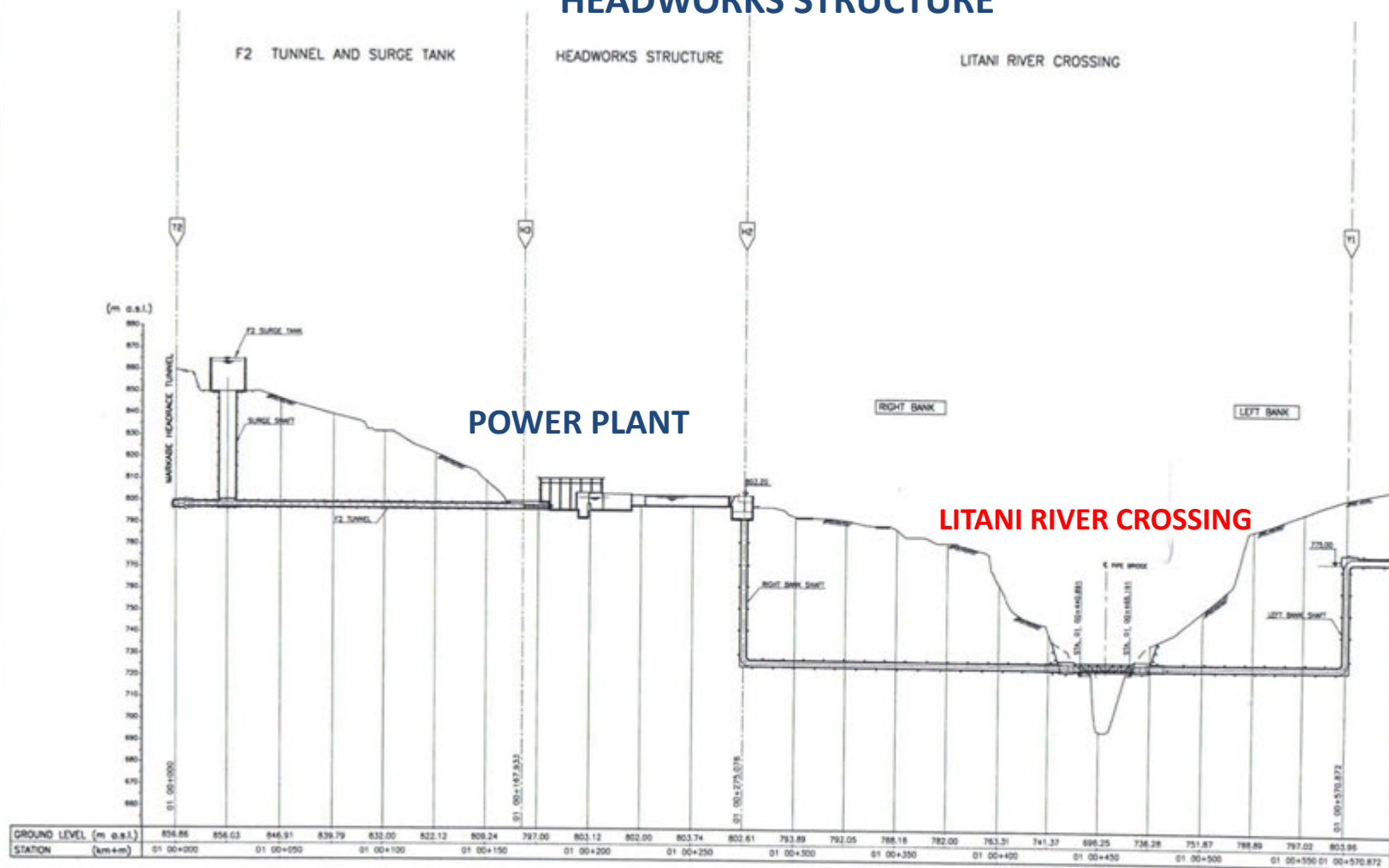
**Need to be
refurbished/
concrete lined**



HEADWORKS STRUCTURE

NOTES:

- 1- DIMENSIONS ARE IN METRES UNLESS OTHERWISE INDICATED
- 2- ELEVATIONS ARE IN METRES ABOVE AVERAGE SEA LEVEL (m a.s.l.)
- 3- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DMS NOS IT-01 105.11-02 101.11-03 101 AND IT-07 101
- 4- CONVEYOR ALIGNMENT STATION NUMBERING INCLUDES THE CONVEYOR SYSTEM SECTION NUMBER FOLLOWED BY THE CHANAGE (E.G. 09 05+323.200 MEANS SECTION 09, CHANAGE DISTANCE 5,323.200 METRES)



LONGITUDINAL PROFILE ALONG HEADWORKS STRUCTURE AND LITANI RIVER CROSSING

TENDER DRAWING

REPUBLIC OF LEBANON
MINISTRY OF DEVELOPMENT AND RECONSTRUCTION
LITANI RIVER AUTHORITY

WORKS FOR THE DEVELOPMENT OF SOUTH LEBANON
PROJECT FOR RIVER SUPPLY SYSTEM
CONVEYOR 800

CONTRACT NO. 2428

C800
CONVEYOR 800
DESIGNED BY: B. HADJILAKIS
CHECKED BY: HADJILAKIS
APPROVED BY: HADJILAKIS

DATE: 20-06-2005
DATE: 20-06-2005

CONTRACT 1
HEADWORKS, LITANI CROSSING
AND TUNNEL
LONGITUDINAL PROFILE

SCALE: 1:1000
DATE: 27.05.08

1T-01 106

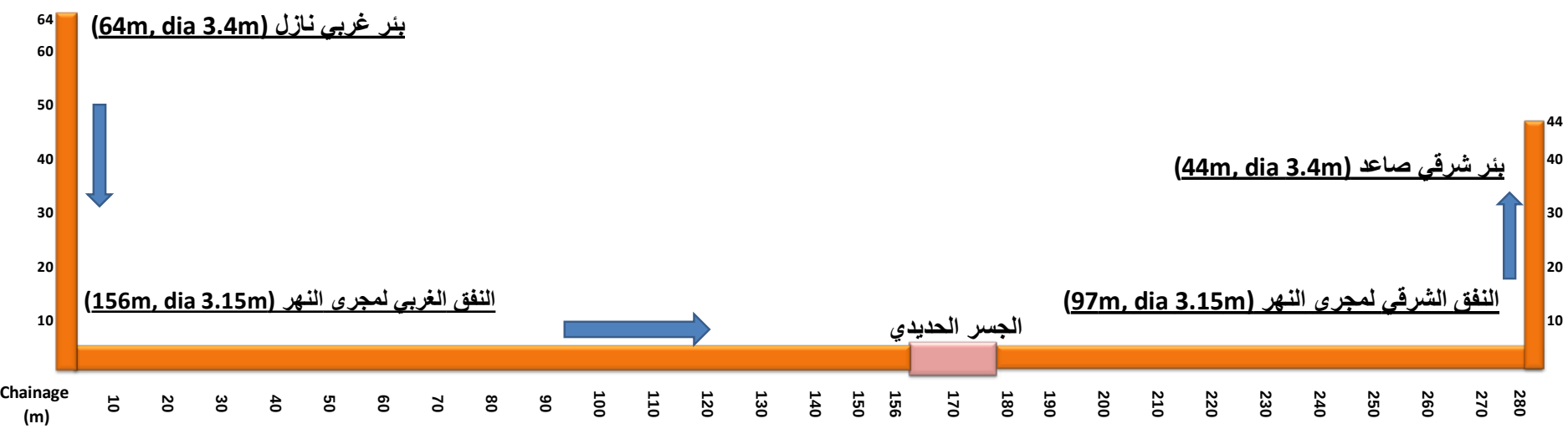
A large circular concrete structure under construction, viewed from the interior looking up towards a bright blue sky. A crane arm is visible extending from the center towards the top edge of the structure.





**Slope
protection &
excavation
for
foundation of
Headworks
structure**

C800 RIVER CROSSING LONGITUDINAL PROFILE







EXECUTED TILL DEC 31 2015

Litani River Authority

Execute the Litani River Master Plan

- Execute the hydro-electrical power generation and electrical networks and its connection to the electrical distribution networks

By different decrees, the government of Lebanon adds the following tasks:

- **Hydraulic measurements on all Lebanese rivers**
- Irrigation schemes studies
- Provider of potable water for south of Lebanon
- Responsible of irrigation schemes in southern Bekaa and south Lebanon
- Study and supervision of Dams

A new Environmental department was created in 2006 to assess the water quality of Litani River & tributaries

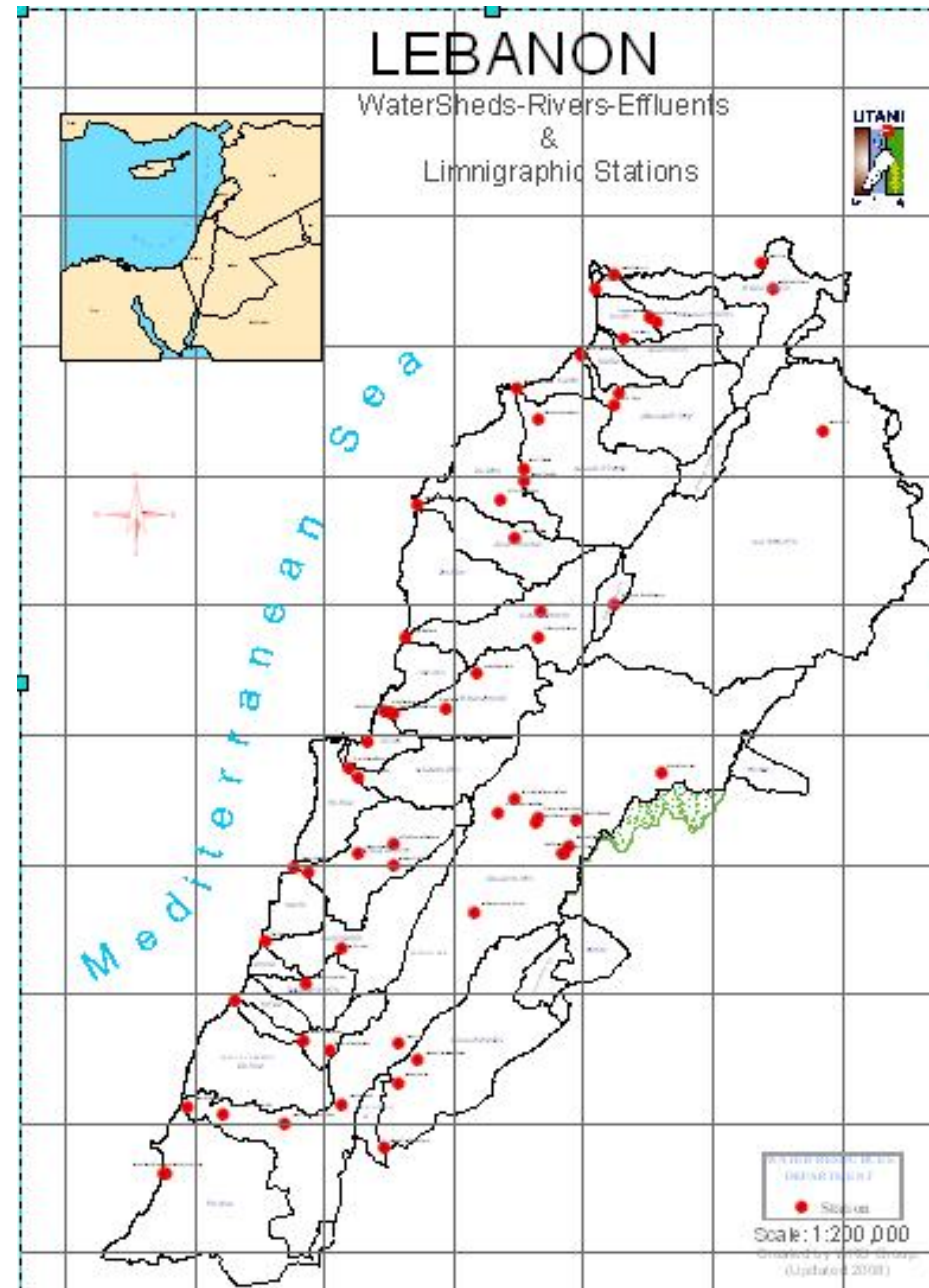
Water Monitoring

Surface gauging stations on most of Lebanese rivers and tributaries

In addition we have 13 monitoring wells in upper litani basin measuring under ground water level and 6 weather stations

Water Quality monitoring (World Bank Project).

Improving Water Quality using ultrasound (Dutch Project)



Riverbed

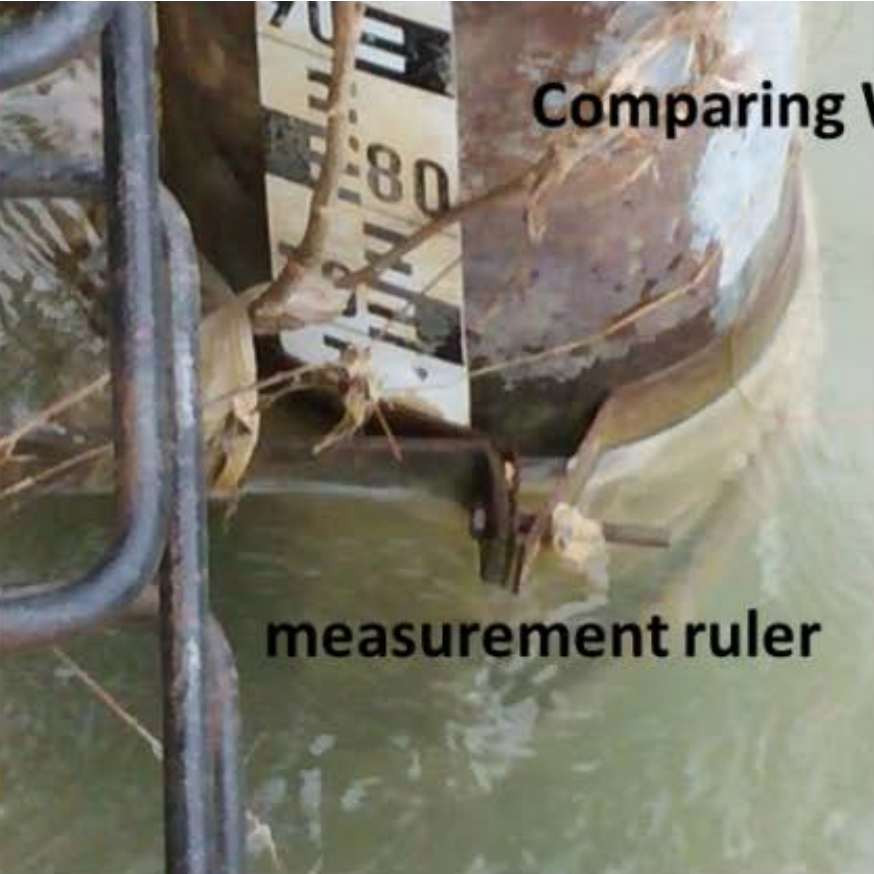


Gauge Station



Comparing Water levels

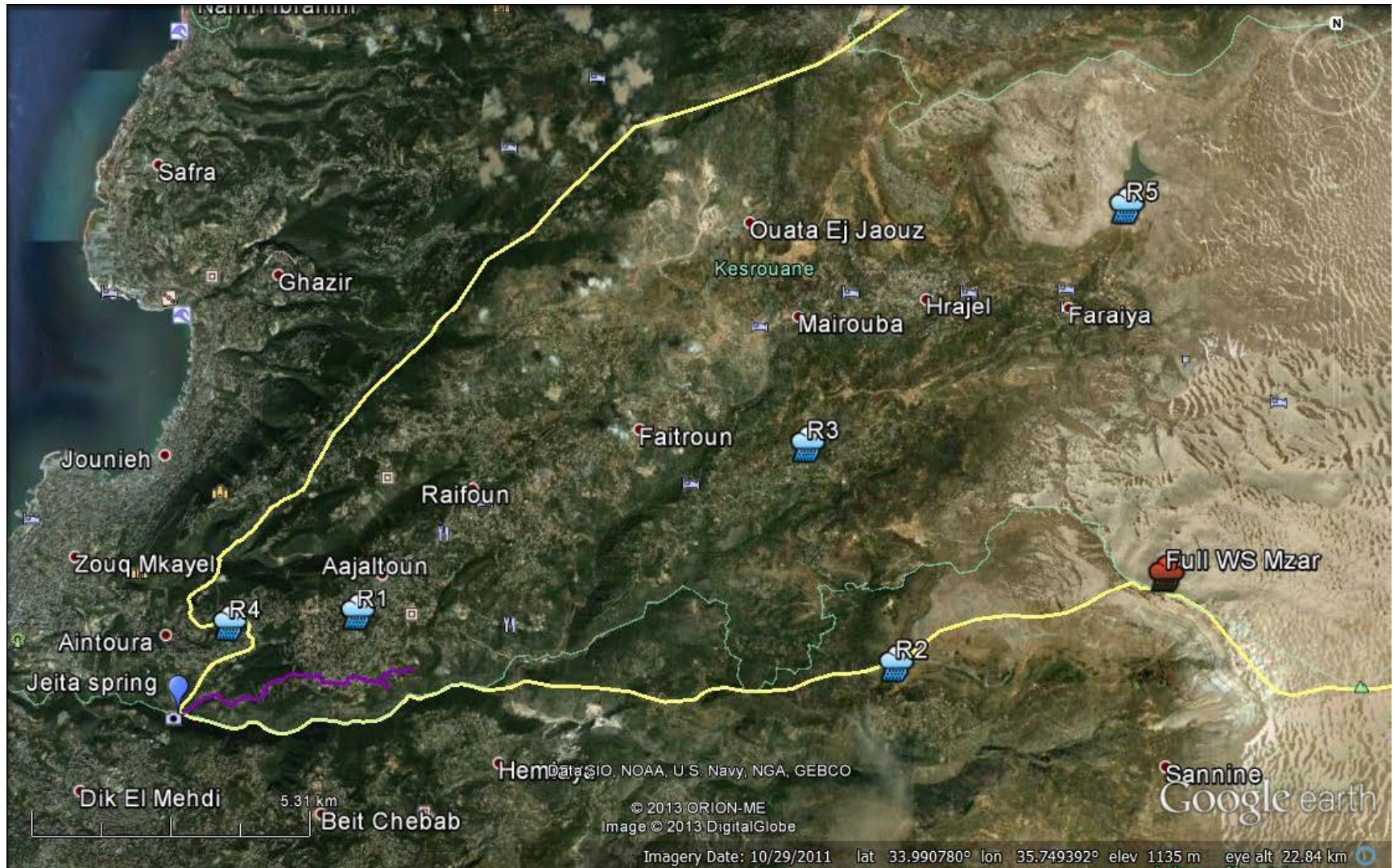
measurement ruler



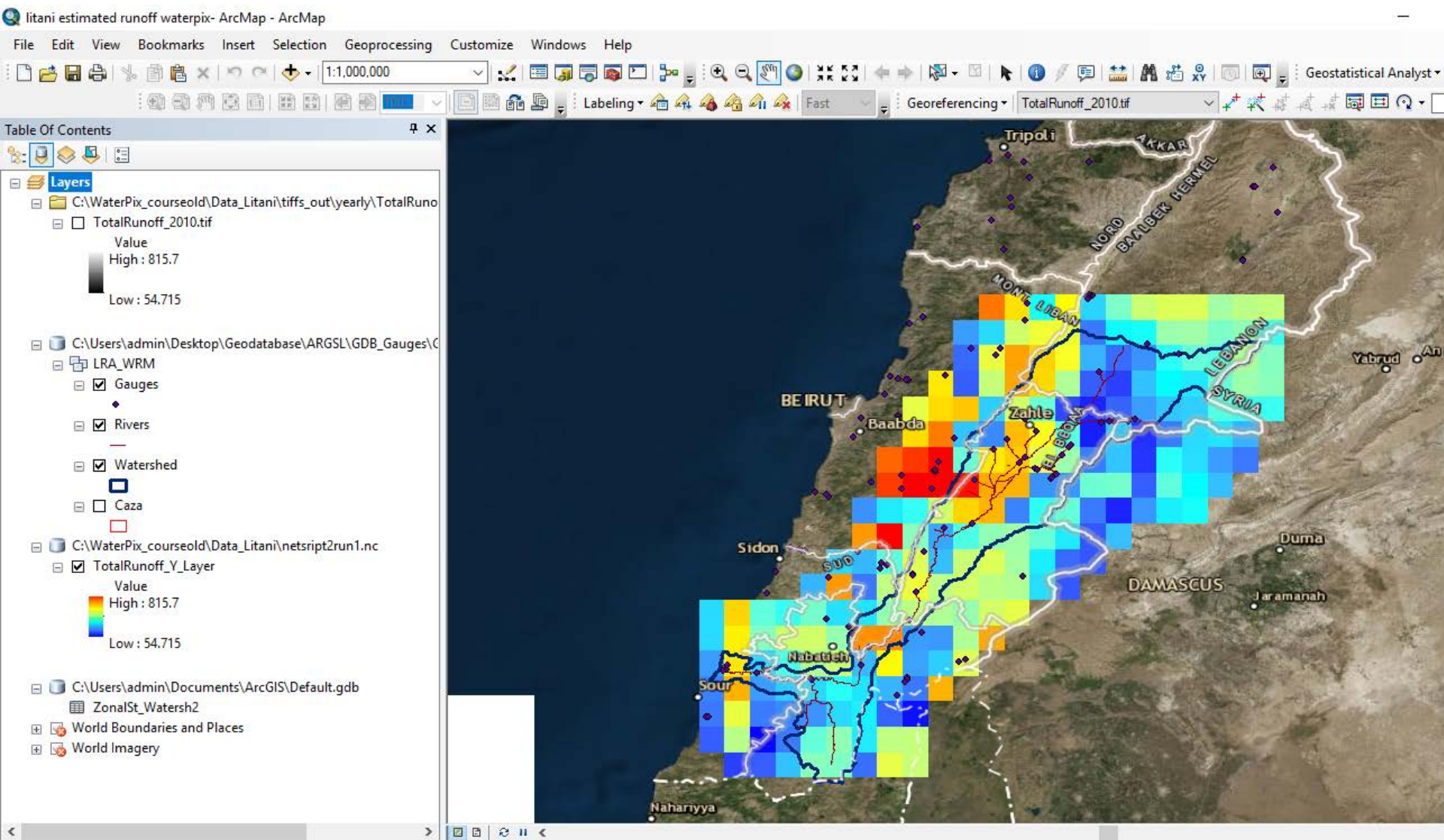
Water level sensor



September 2014 – 6 weather stations delivered from BGR to LRA installed in Nahr el Kalb basin



■ Waterpix GIS runoff model (IHE project)



Geodatabase

Lebanon Water Project (LWP) funded by USAID have made an assessment for all water monitoring station, a Geodatabase have been created containing all station information.



Litani River Authority Wetland Water Treatment (LRBMS Project – USAID)

Wetland as Possible Solution
for Surface Water Treatment in
Lebanon-Results of Water Quality
Monitoring of Kherbet Kanafar
Constructed Wetland“



- Key factors
 - Population Growth
 - Infrastructure
 - Urbanization
 - Economic Growth
 - Climate Change

NEW TECHNIQUE FOR TREATMENT

In Lebanon

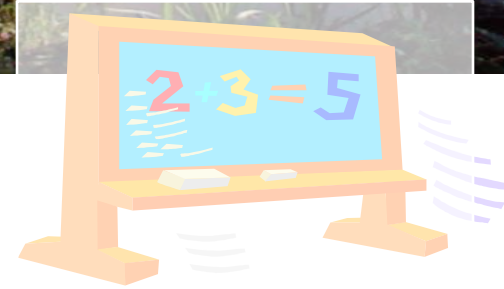
- ➡ Wetland is an area of seasonally or permanently water logged land, whether for fresh or saline, flowing or static water.



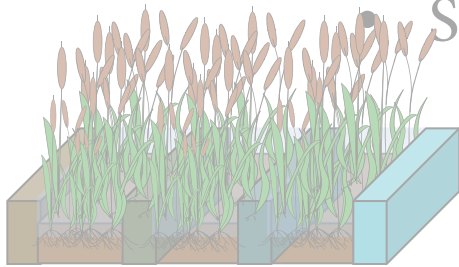
Khirbet Kanafar Wetland

DESIGN GOALS

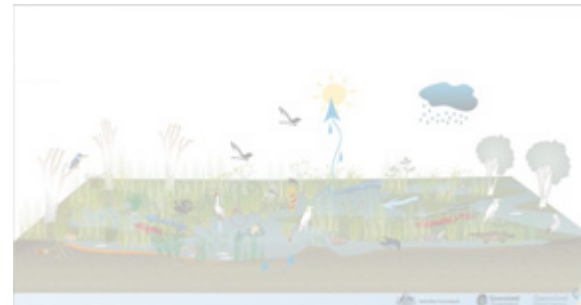
- Simple/Easy to operate



- Significant water quality impact



- Floodplain habitat

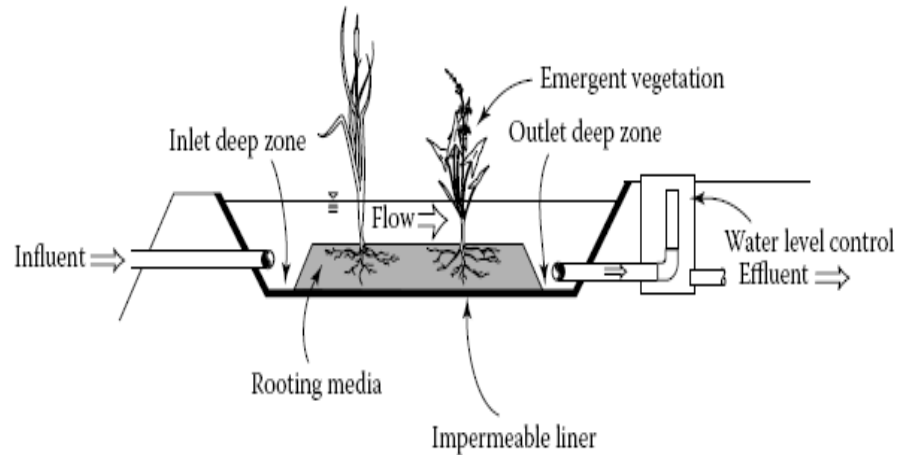


- Environmental Education





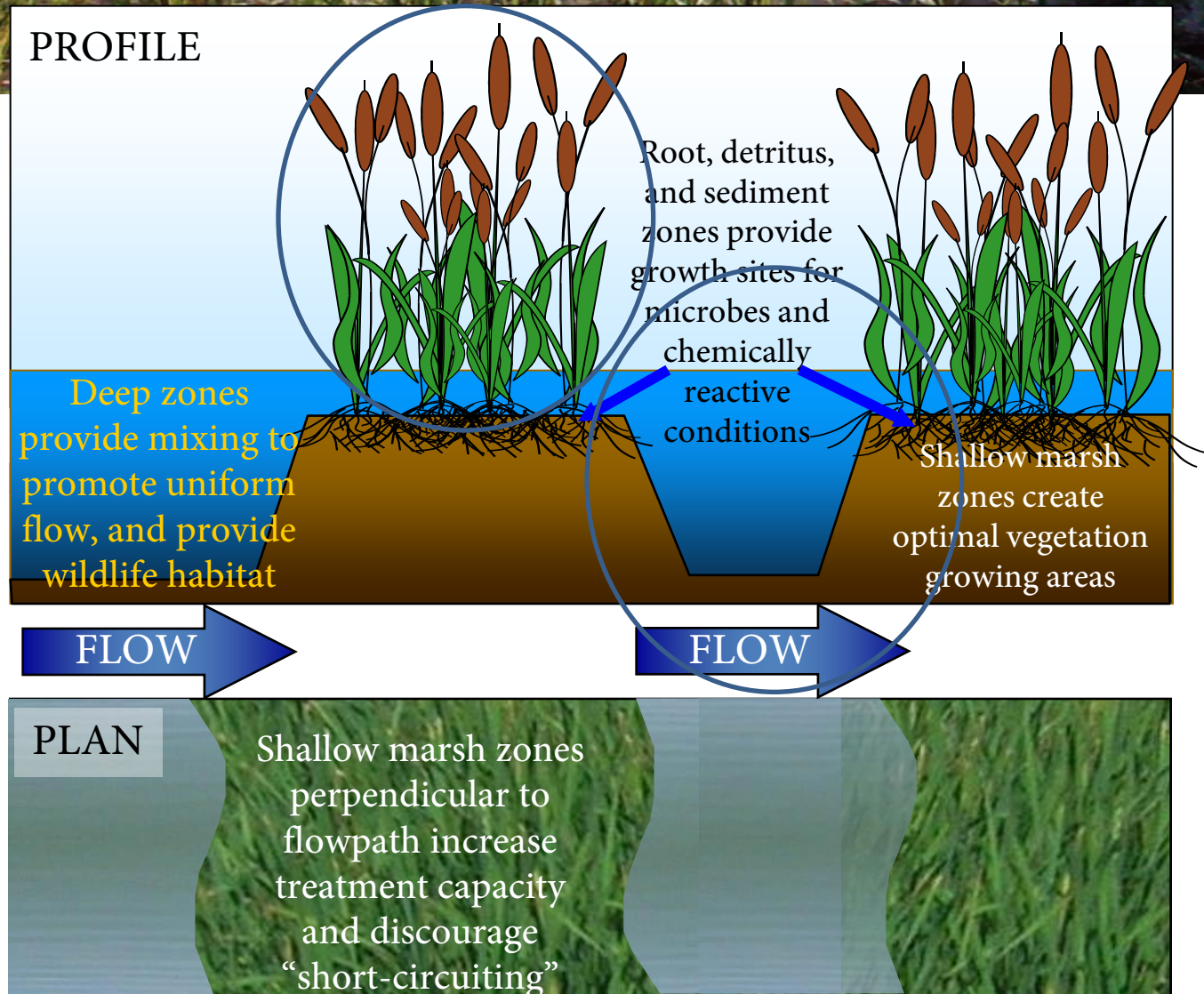
Figure 4: Joub Janine W



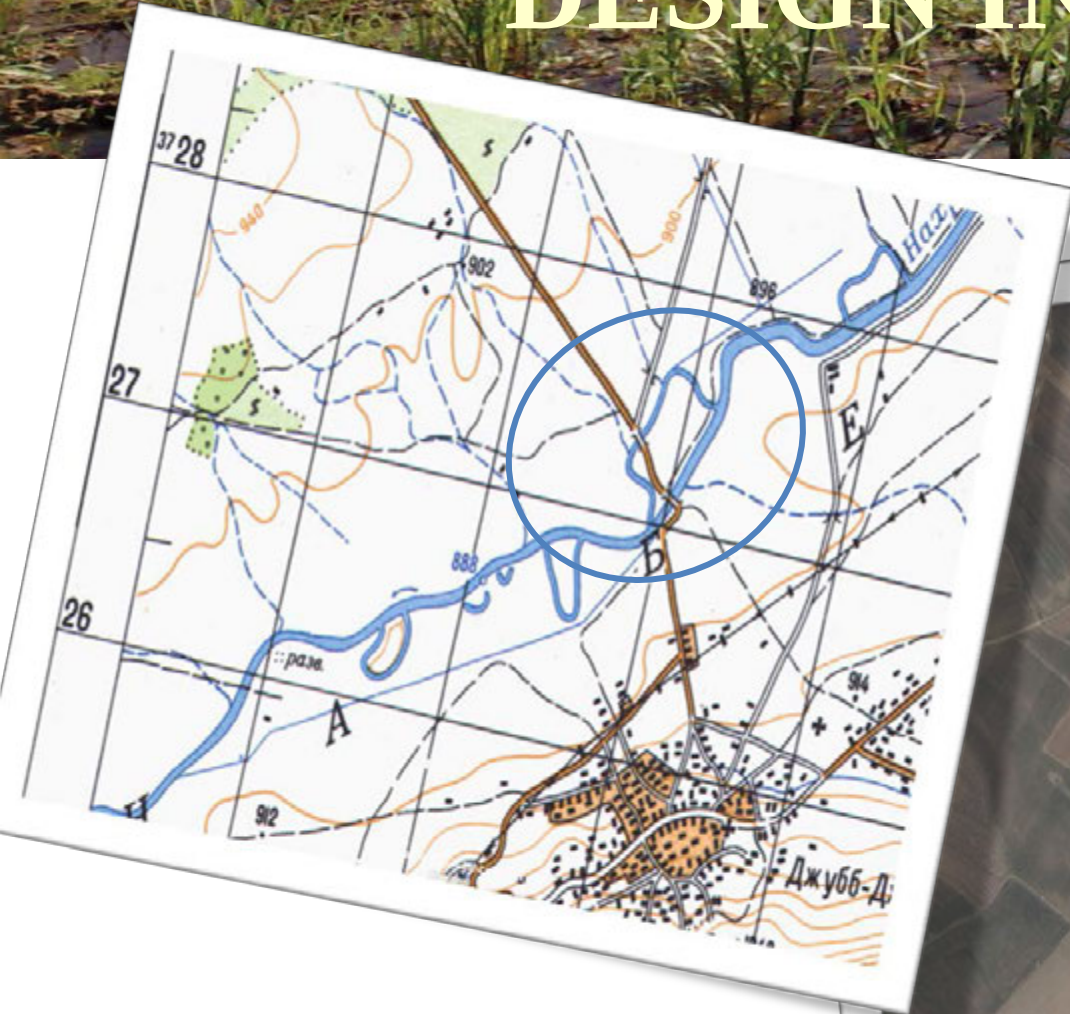
Basic elements of a FWS wetland.

Mechanism of biofiltration

WETLAND PROFILE



DESIGN INSPIRATION



LAYOUT AND



Ioub Janine Wetland Park (viewed by SPOT, google earth)

CONSTRUCTED WETLAND VEGETATION

- *Sparganium Erecrtum* (shallow pond)
- *Phragmites Australis* (shallow pond)



SAMPLING CAMPAIGN



Sample collection



Input
source



EC400 ExStik Conductivity/TDS/Salinity Meter.



Output
source

LABORATORY ANALYSIS

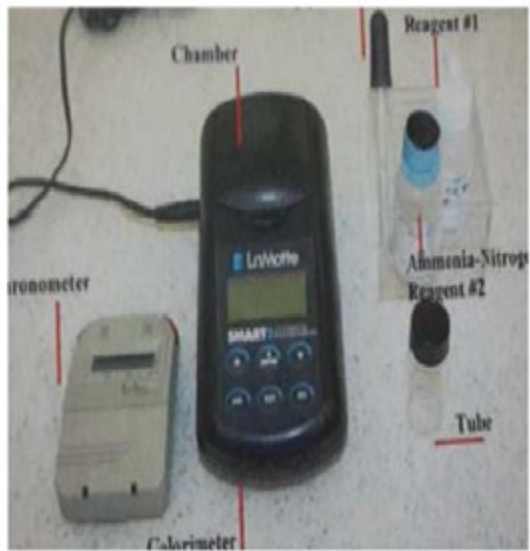


Sample filtration using a 0.2µm filter



Ion Chromatography Technique at EDST

LABORATORY ANALYSIS



LAMOTTE
colorimeter



MILWAUKEE SM600 DO

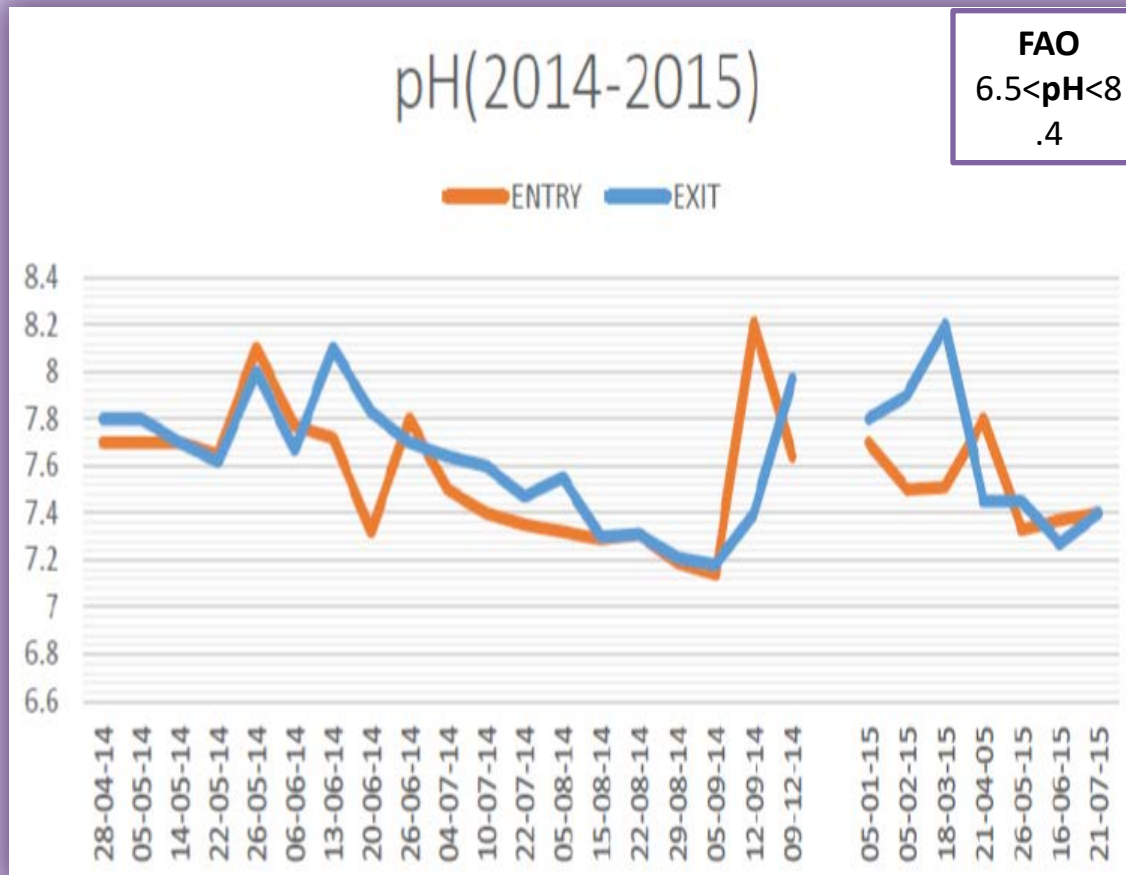


VELP BOD system



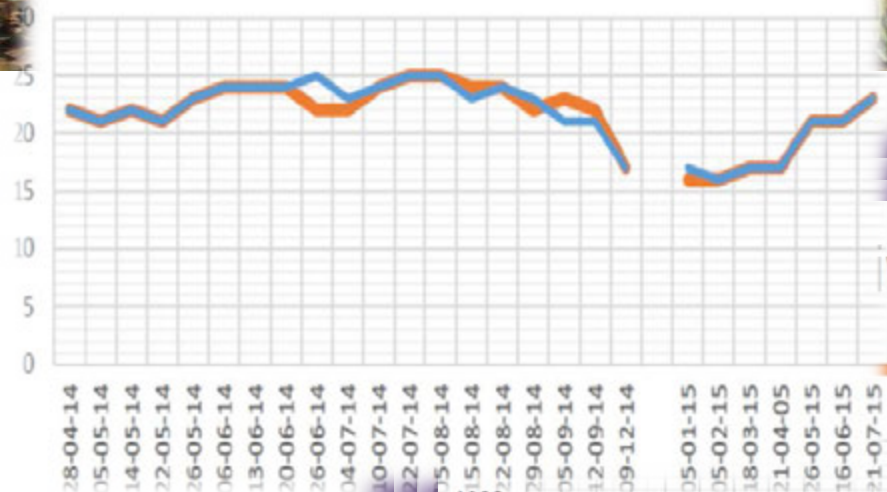
JENWAY 370 pH
meter

RESULTS AND DISCUSSION



Temperature(2014-2015)

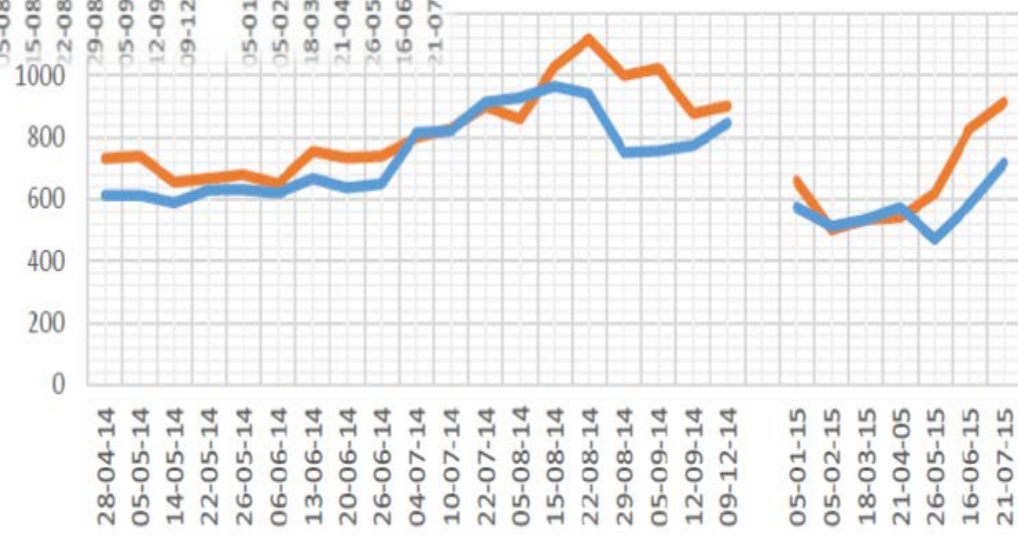
ENTRY EXIT



DISCUSSION

Activity(2014-2015)

ENTRY EXIT

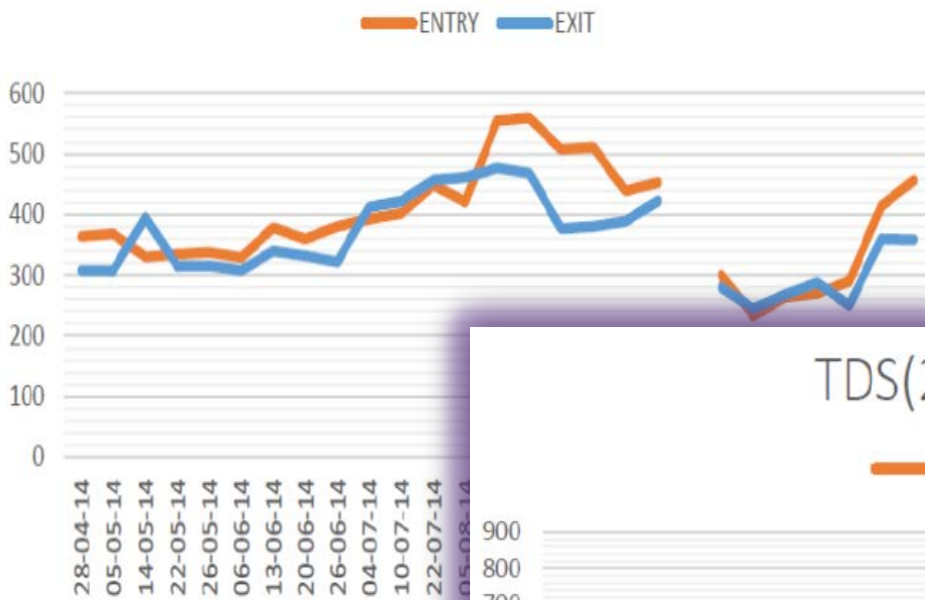


FAO

700<EC<3000
μS/cm

RESULTS AND DISCUSSION

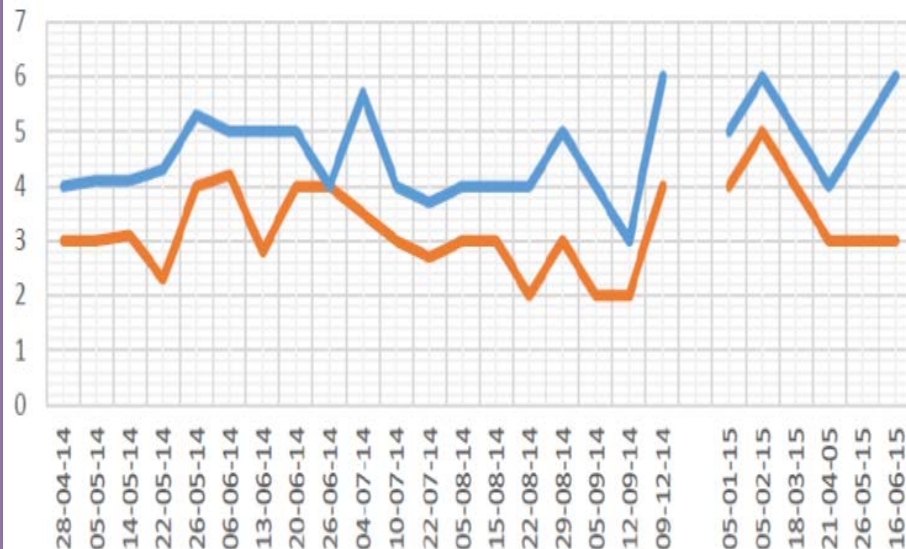
Salinity(2014-2015)



RESULTS AND DISCUSSION

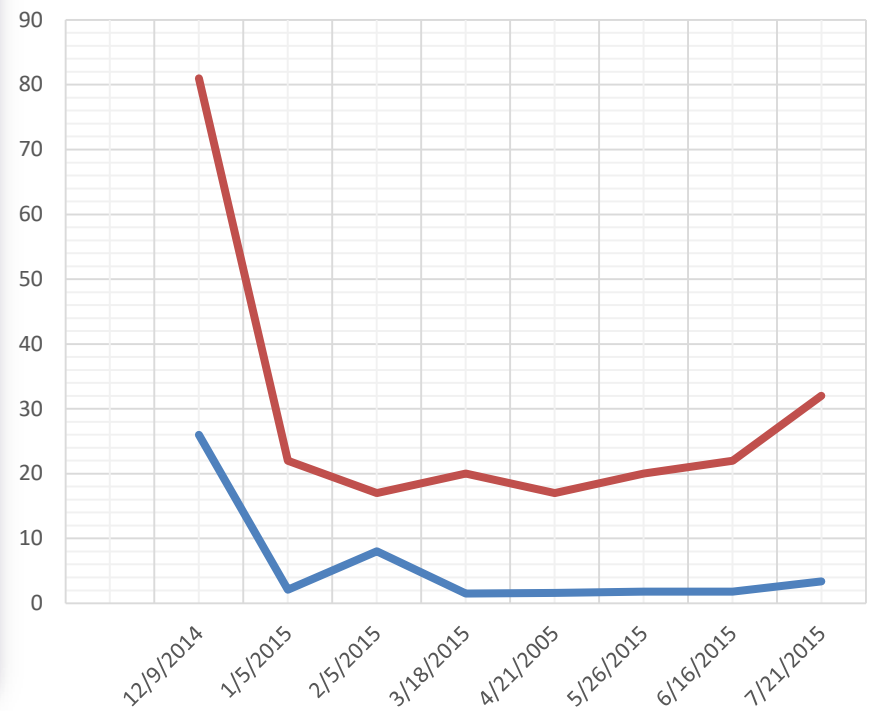
DO(2014-2015)

ENTRY EXIT



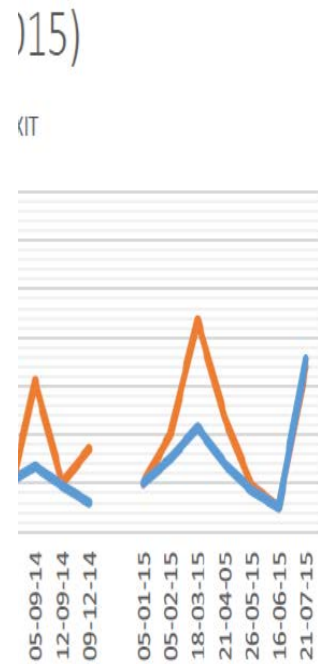
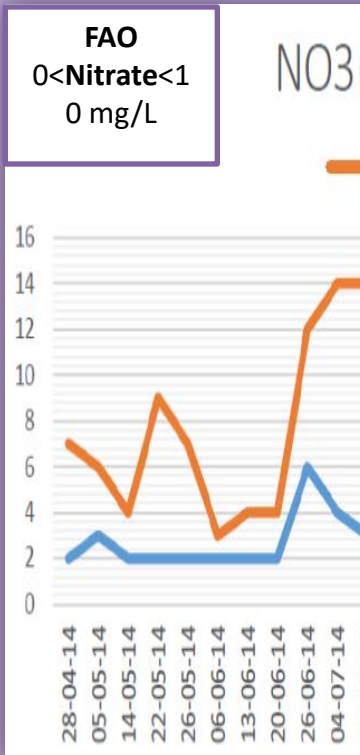
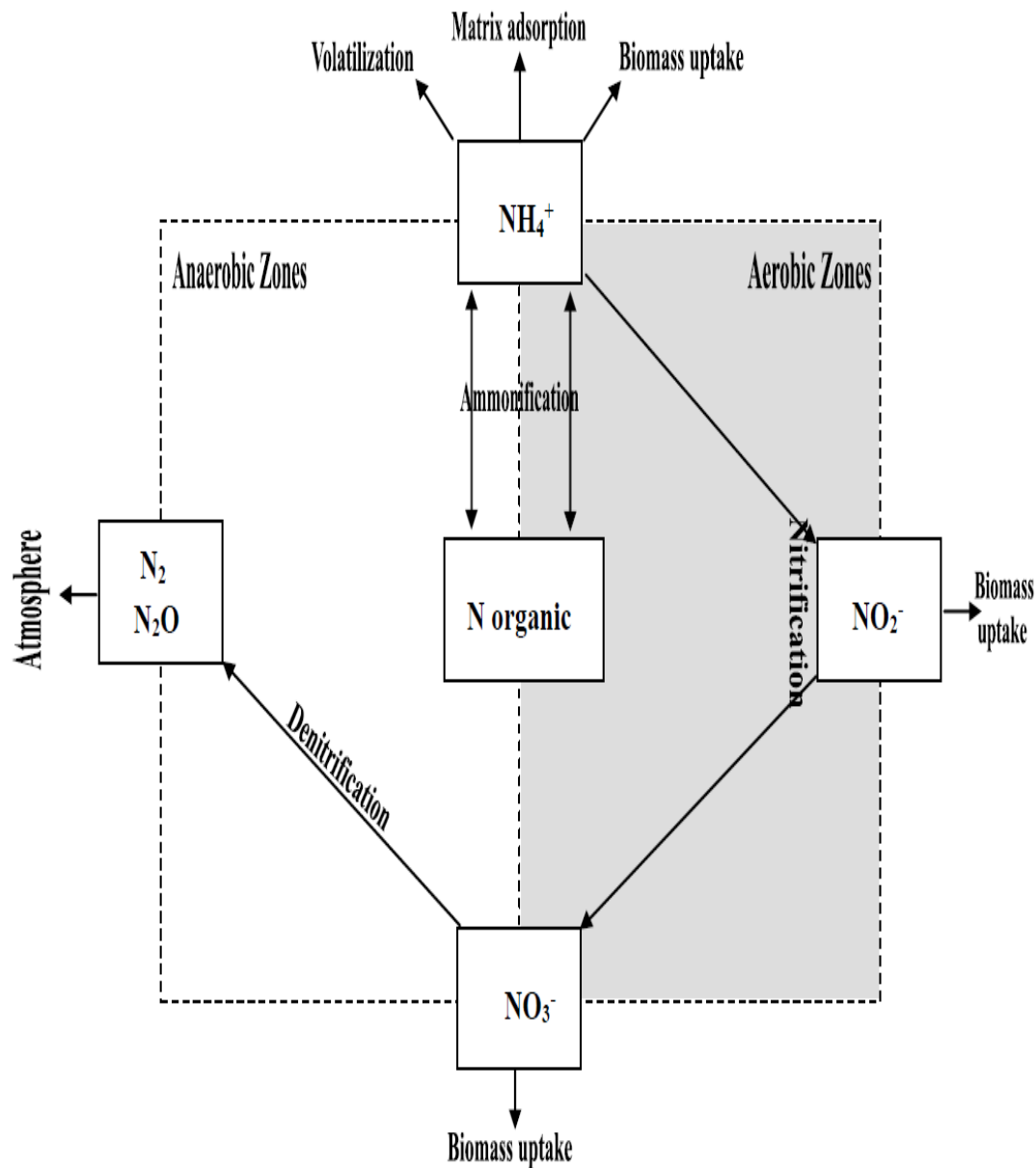
BOD(2014-2015)

ENTRY EXIT



RESU

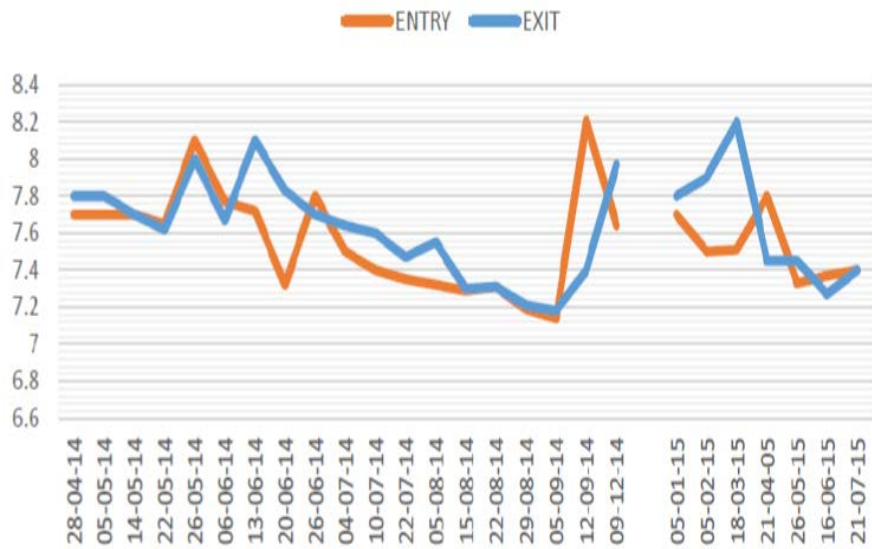
ION



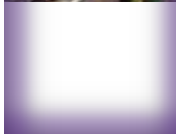
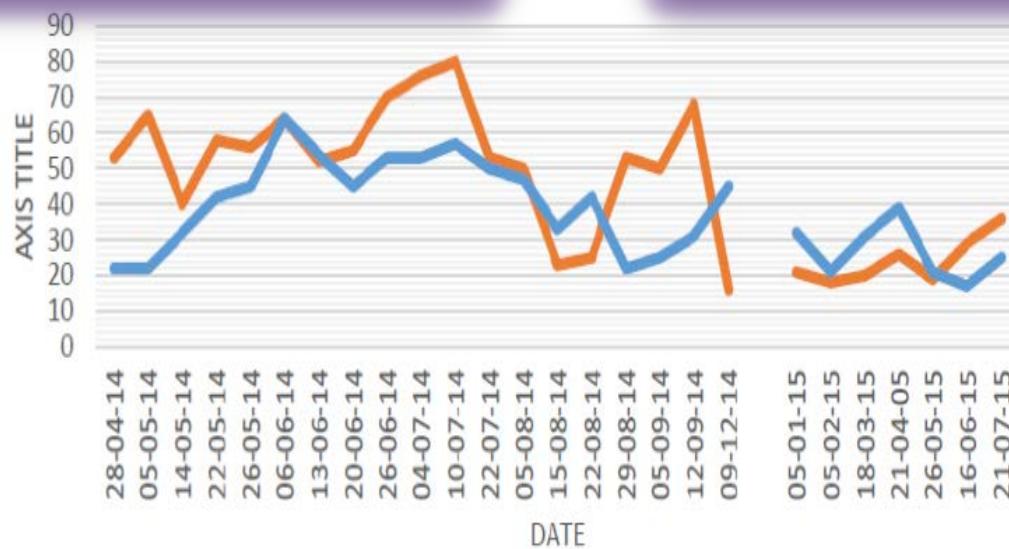
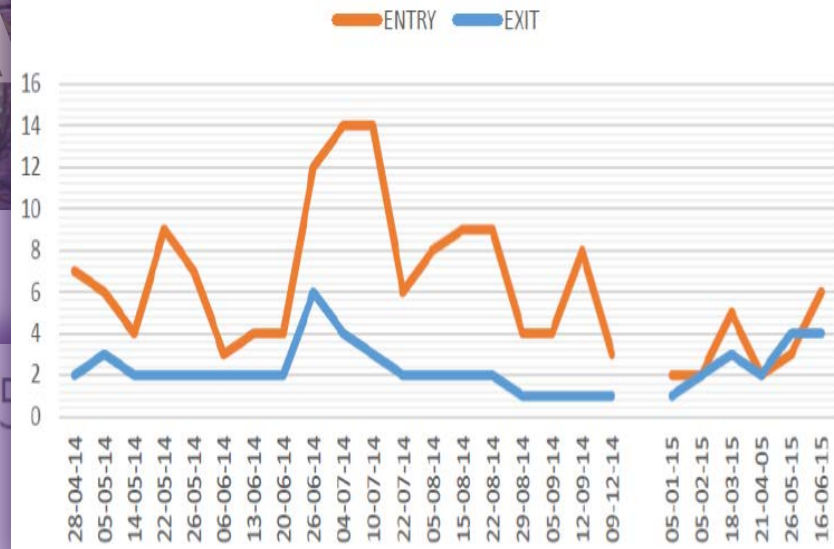
RESULTS AND DISCUSSION



pH(2014-2015)



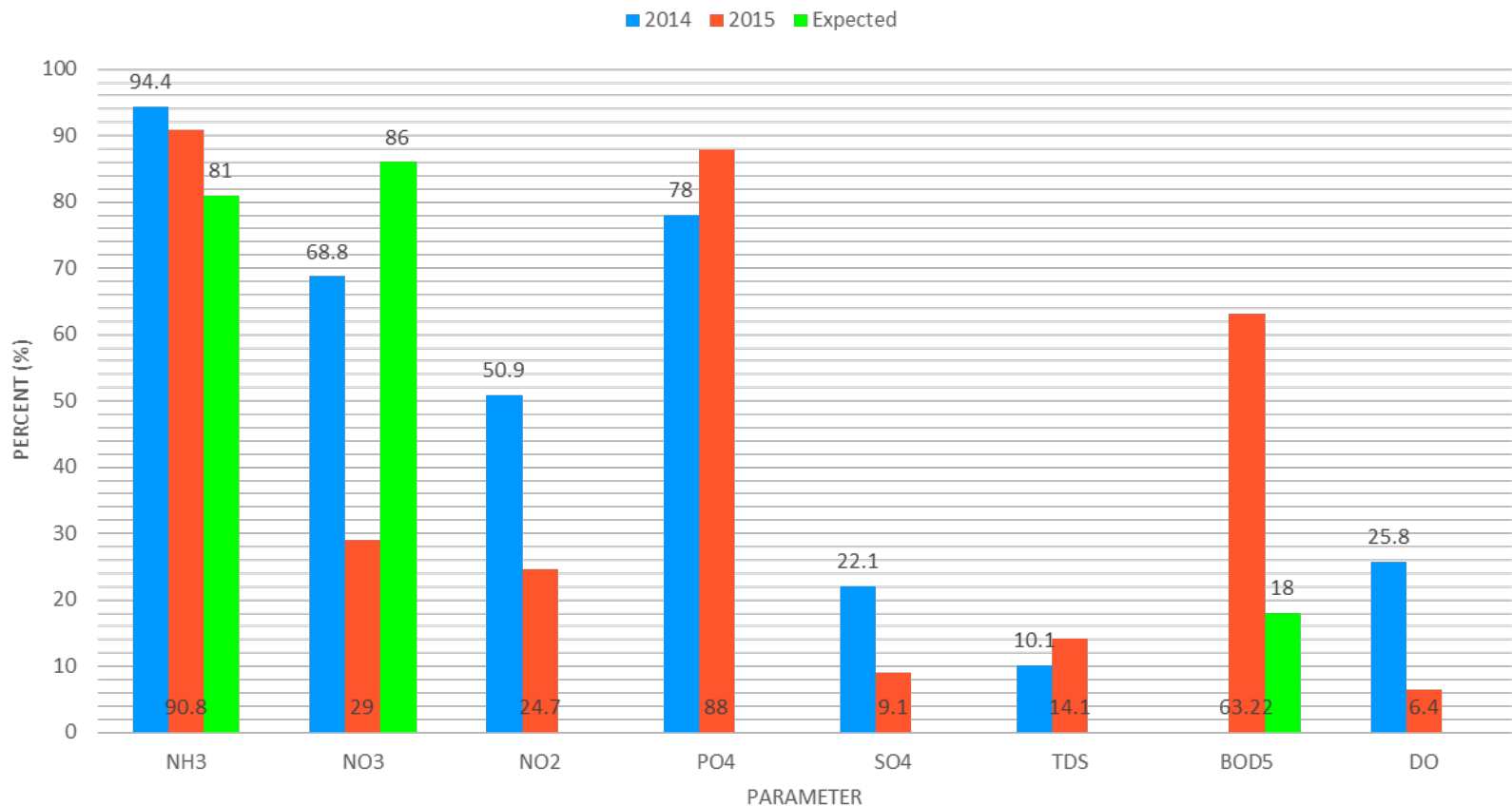
NO3(2014-2015)



14-2015

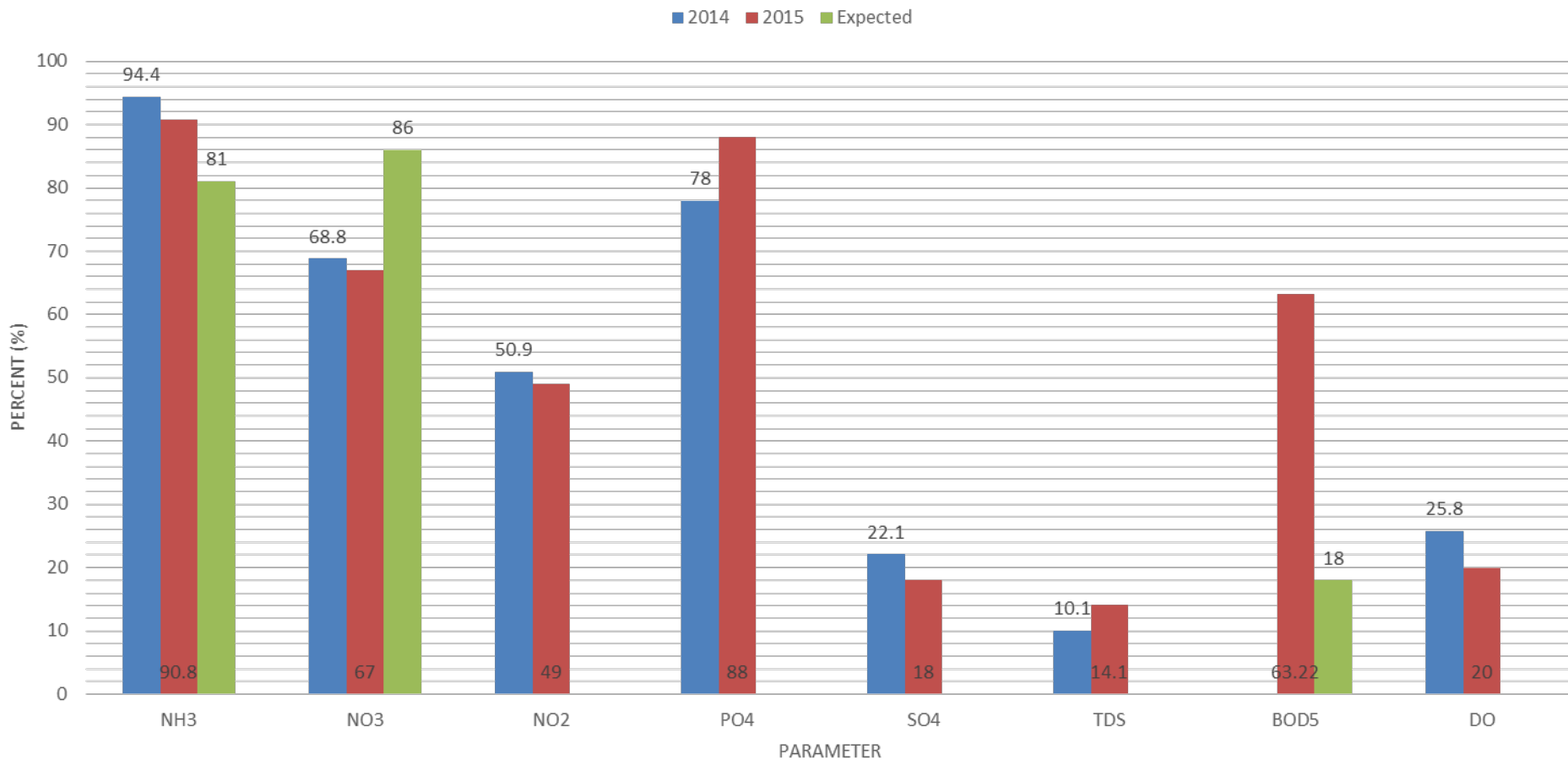
RESULT COMPARRISON

Expectation vs Reality



RESULT COMPARRISON

Expectation vs Reality





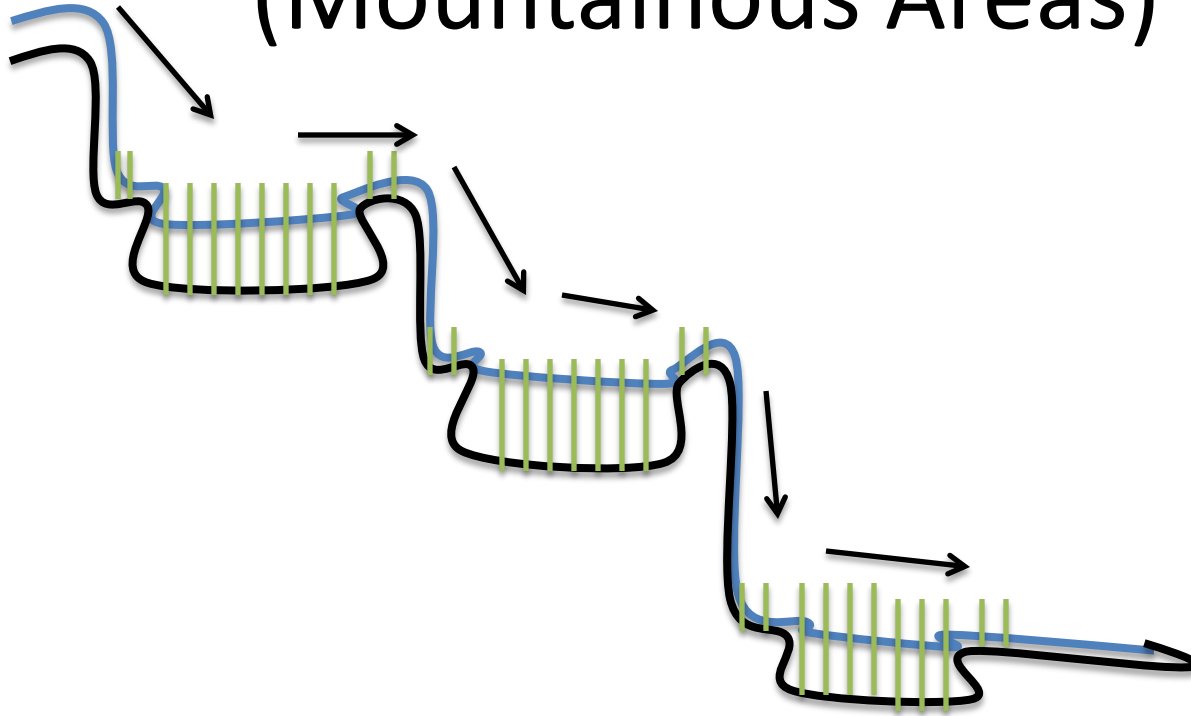
CONCLOUSION

- TDS,EC, and SAL levels increased due to: Evapotranspiration and low dilution
- Due to a wider root zone by the emerging flora→ [DO] increased.
- Phosphate level were decreased into the recommended ranges after exceeding it by **7x**
- Major removal efficiency rate towards certain ions:
 - Ammonia→76.2 %**
 - Phosphate→50%**
 - Nitrate→42.9%**

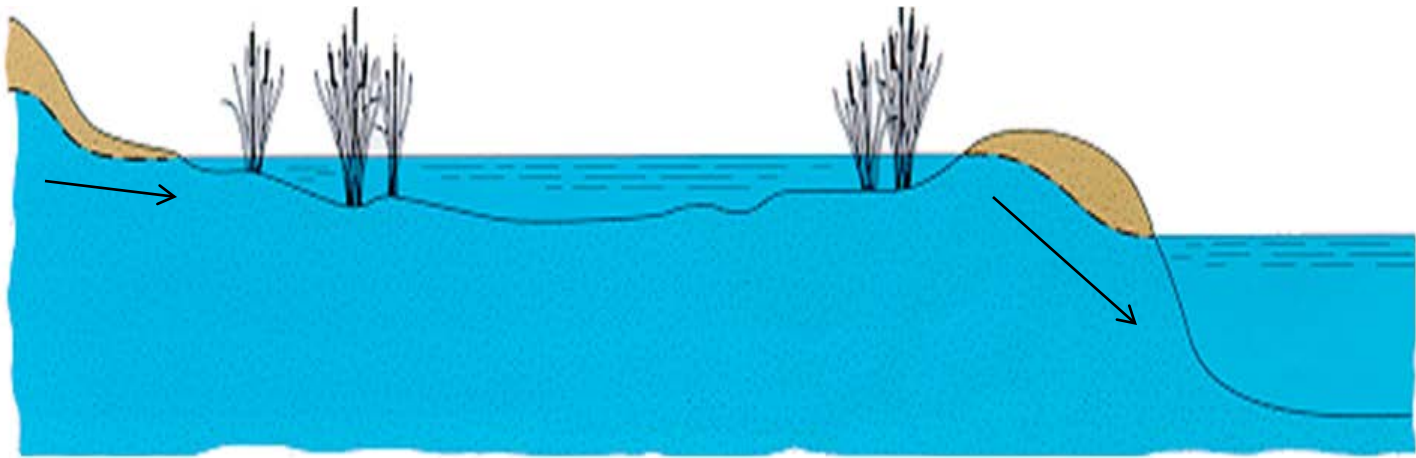
ADVANTAGES VS DISADVANTAGES

Advantages	Limitations
Less expensive to build than other treatment options.	Large area requirement
Simple construction, operation and maintenance.	Wetland treatment may be economical relative to be other options only where land available and affordable
Fit harmoniously in the landscape	Design criteria have to be developed for different types of wastewater and climates
Ensure elemental cycling, such as the Nitrogen cycle.	Mosquitos
Reduction of eutrophication in high nutrient polluted waters.	

Suitable for Lebanese relief (Mountainous Areas)



Suitable for Lebanese relief (Mountainous Areas)



ATIONS

However

- Neem (Azadirachta indica) is used to repel mosquitoes.
- Barriers should be built to prevent mosquitoes from entering the wetland.
- Mosquito fish (Gambusia affinis) are used to eat the larvae of the mosquito.
- The Syrian refugee camps are located in the wetland and especially in the area of the river.

face to repel

aries of the wetland

ths.

d





REFERENCES

- [1]: Robert B. Jackson et al (spring 2001), "**Water in a Changing World**," Ecological Society of America, ISSN No.9.
- [1]: Sogesid Mandated (November 2005), "**Local Water Supply, Sanitation and Sewage-Lebanon**," Euro-Mediterranean Information System On the Know How In the Water Sector with the Assistance of the European Union.
- [1]: Darine Geara et al (July 2010), "**State Of Art About Water Uses And Wastewater Management in Lebanon**," Lebanese Science Journal, Vol. 11, ISBN No.2.
- [2]: Ministry of environment (June 2011), "**State and Trends of Lebanese Environment**," MoE/UNDP/ECODIT.
- [3]: Elie Bou-Zeid et al (October 2002), "**Climate Change and Water Resources in Lebanon and the Middle East**," Journal of Water Resources Planning and Management.
- [4]: Robert Kadlec et al (June 1999), "**Free water surface wetlands for wastewater treatment- a technology assessment**," EPA/ETI.
- [5]: International Resources Group (April 2014), "**Litani River Basin Management Support Program**," USAID, ISBN No. I-00-04-00024-00.
- [5]: International Resources Group (February 2012), "**Litani River Basin Management Plan-Volume 1: Current Situation**" United States Agency for International Development (USAID).
- [6]: Luise Davis et al (1990), "**A Handbook of Constructed Wetlands**," USDA-Natural Resources Conservation Service/US Environmental Protection
- [7]: elżbieta lalke porczyk et al (MAY 2004), "**The Role of Bacteria Growing on the Root System of the Common Reed (Phragmites australis) in the Metabolism of Organic Compounds**", Polish Journal of Environmental Studies, Vol. 14, ISBN No.1, Page:57-64.



Cooperation with Foreign Projects

- Partnership
 - FASEP
 - WORLD BANK
 - DUTCH PROJECT
 - LWP
 - IHE



SECURISATION DES DONNEES POUR UNE CONNAISSANCE OPTIMISEE DE LA RESSOURCE EN EAU

PROJET PILOTE DE TELEMETRIE SUR LE BASSIN VERSANT DU NAHR DAMOUR

ORGANISATION GENERALE DE L'OPERATION

- **COMPOSANTE 1 :**

- Investigations préliminaires sur le bassin versant du DAMOUR
- Mise en application et transfert méthodologique en matière de sécurisation, contrôle et validation des données hydrologiques

- **COMPOSANTE 2 :**

- Conception, fabrication et implantation d'un dispositif « pilote » de télémesure des différentes ressources en eau du bassin versant;
- « Formation / Action » du personnel de l'ONL pour connaissance du matériel et exigences de maintenance

- **COMPOSANTE 3 :** Formation du personnel de l'ONL

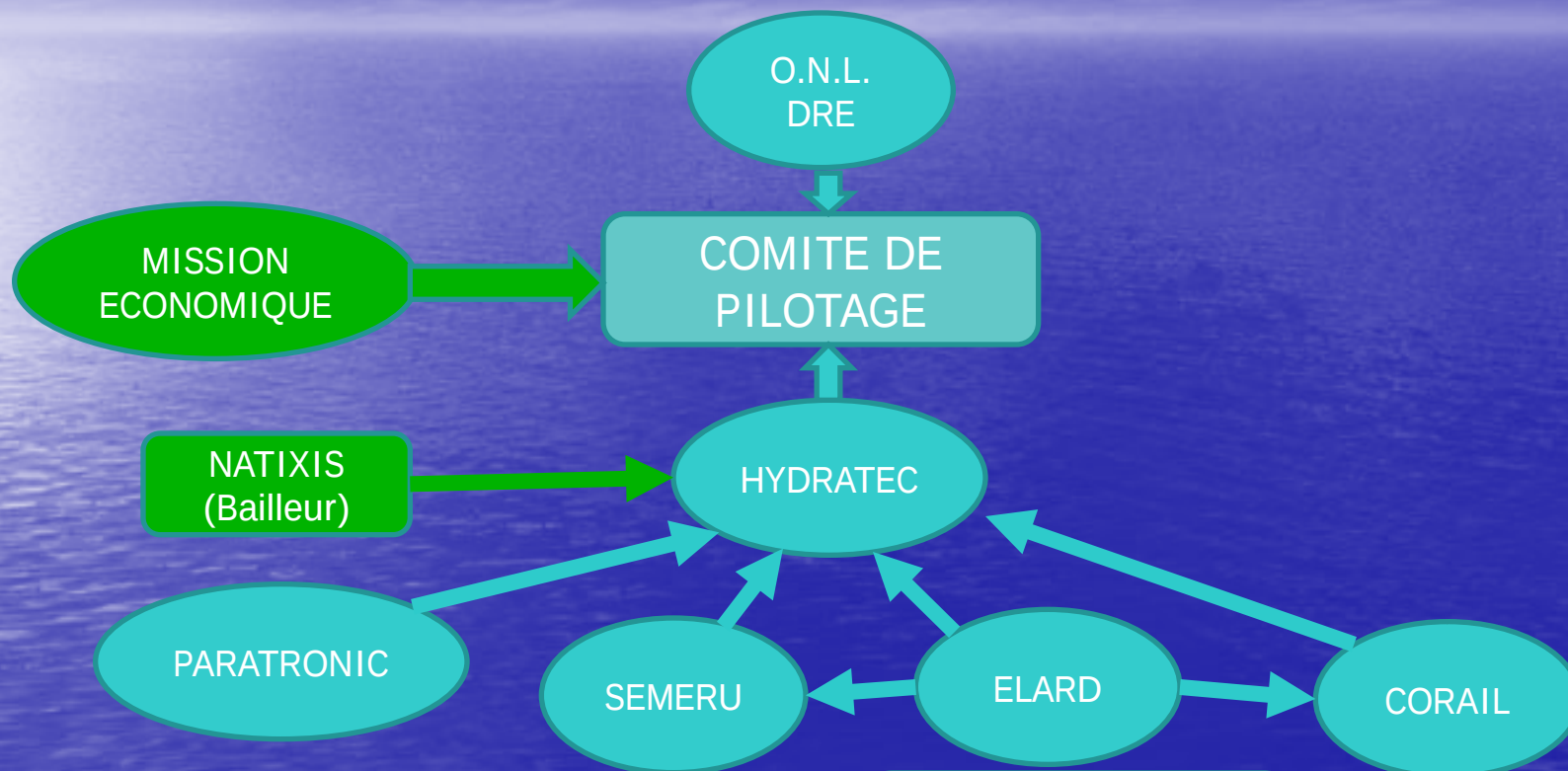
- à l'exploitation et la maintenance du dispositif ;
- à l'usage des procédures d'analyse et validation des séries hydrologiques disponibles
- aux techniques de jaugeage

- **COMPOSANTE 4 :**

- Modélisation organisationnelle, technique et financière des équipements, ressources humaines et financières nécessaires à l'acquisition, l'installation et l'exploitation d'un dispositif similaire étendu à l'échelle nationale



PROJET PILOTE DE TELEMETRIE PRESENTATION DES PARTICIPANTS



L'EQUIPE MOBILISEE :
Le Président
Jérôme WATTELET

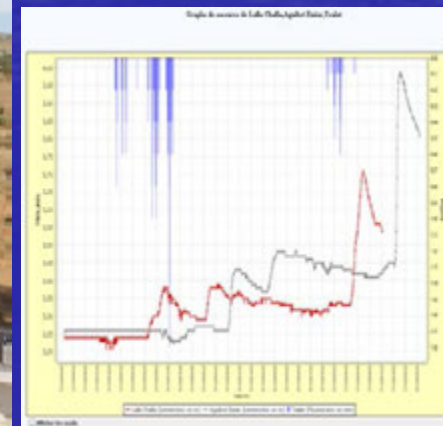
L'EQUIPE MOBILISEE :
Directeur :
Barthélémy FRONTERA
Chef d'équipe :
Thomas LECLERC
Responsable Opérationnel :
Christophe COPIN

L'EQUIPE MOBILISEE :
Dr. Farid Karam
Ing. Elias Ghazal
Topog. Nadim Hamoud

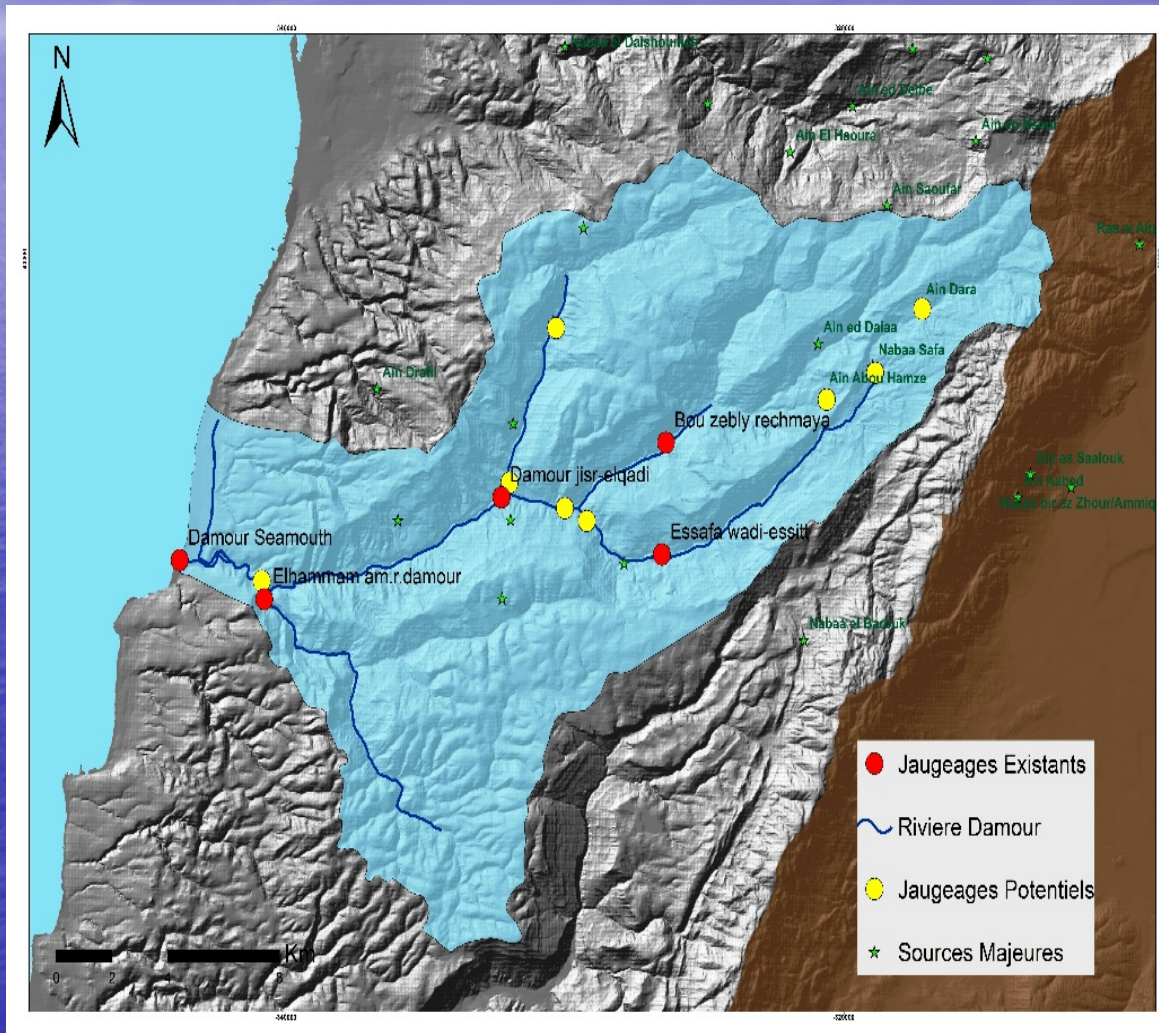
L'EQUIPE MOBILISEE :
Responsable de mission:
Alain TIDIER
Expert « formation » :
Véronique PASCAL

LE DISPOSITIF DE TELEMETRIE

PRESENTATION GENERALE DU DISPOSITIF



LE DISPOSITIF DE TELEMETRIE IMPLANTATION DES STATIONS



Algae Control Proposal



1. Treatment proposal

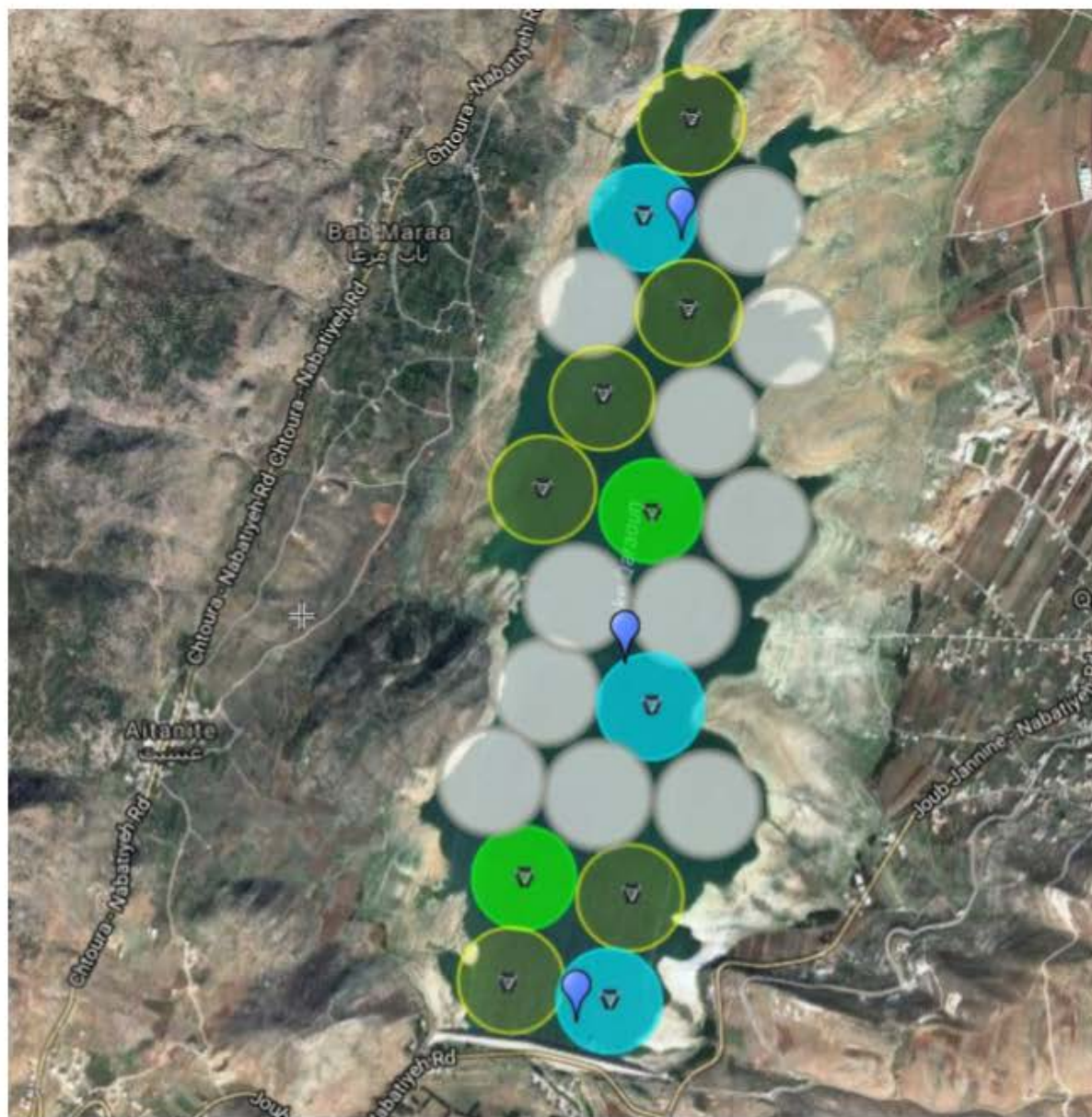
The algae control systems developed by LG Sonic offer an environmentally friendly solution to control algae by making use of ultrasound waves.

1.1. Proposed solution

The MPC-Buoy is a floating, solar-powered platform that combines continuous online water quality monitoring, web-based software, and ultrasonic technology to effectively control harmful algal blooms in large water surfaces, such as lakes and larger ponds. The MPC-Buoy eliminates up to 90% of the existing algae and prevents the growth of new algae when the entire water surface is covered.

One MPC-Buoy system can treat large surface areas up to 500-meter (1600 ft) diameter coverage. The MPC-Buoy is anchored in the centre of the lake, ensuring correct coverage of the ultrasound waves.







Thank You

