NGEST Effluent Recovery Scheme – tekopohjavettä jätevedestä

6.10.2010 / Suvi Niini

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NGEST Effluent Recovery Scheme

- Part of a larger Northern Gaza Emergency Sewage Treatment Project (NGEST) with several donors

- Comprises the risk management facilities of the NGEST Project, funded by the World Bank

- Consultancy Services for Detail Design, Tender Documents, and Construction Supervision of Effluent Recovery & Irrigation Scheme

- Contracted with Center for Engineering and Planning (CEP) and FCG Finnish Consulting Group in June 2009

- Client is Palestinian Water Authority

- Contract value 685,230 USD (~500,000 EUR), FCG share 300,720 USD (~220,000 EUR)

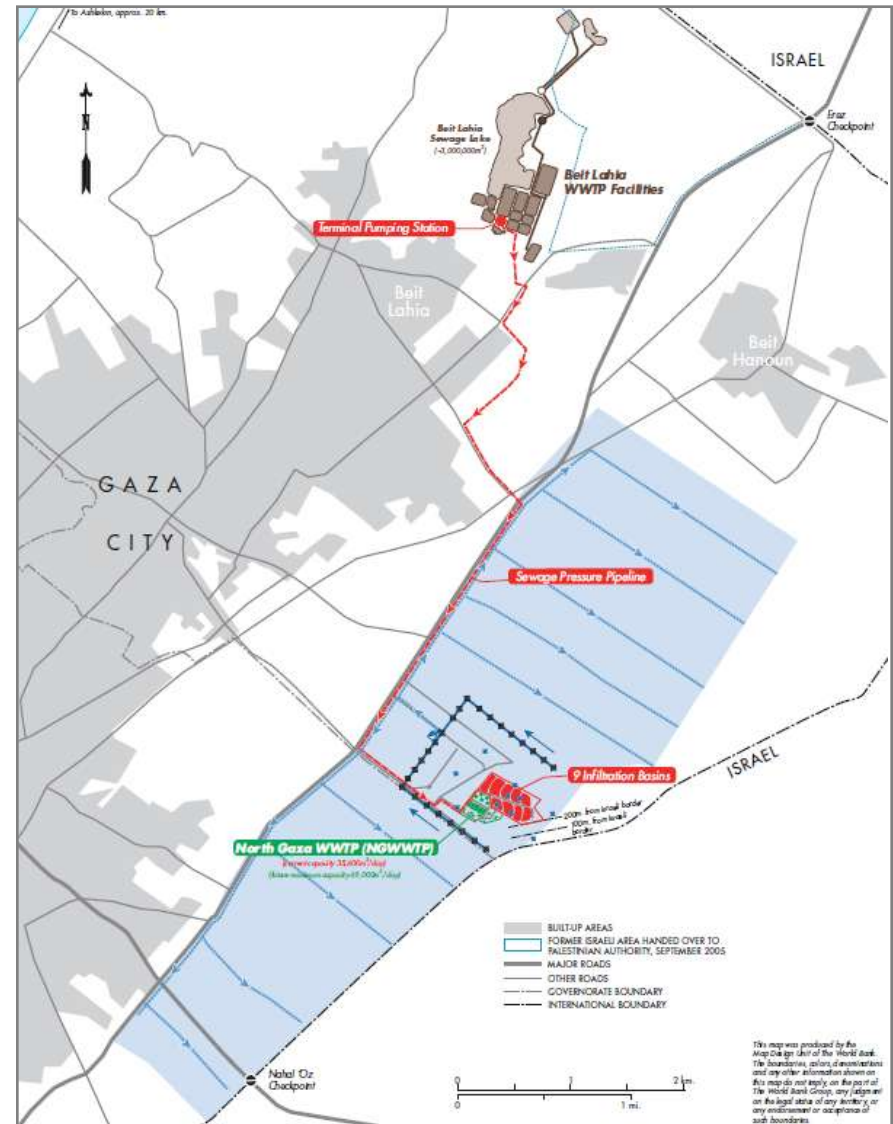**FCG.** Finnish Consulting Group

NGEST Project

- Immediate measures to prevent environmental disaster in Beit Lahia:
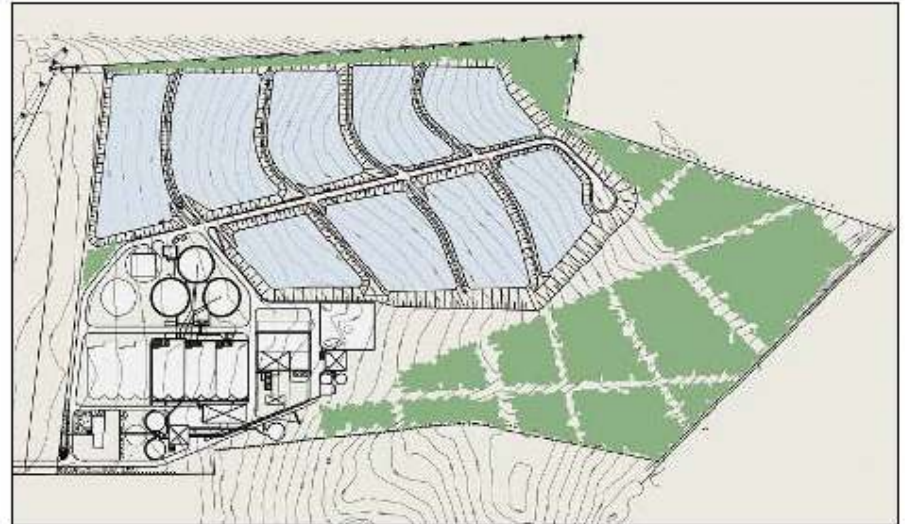
    - Terminal pumping station in Beit Lahia

    - Pressure pipeline
    - Nine infiltration basins at the new site
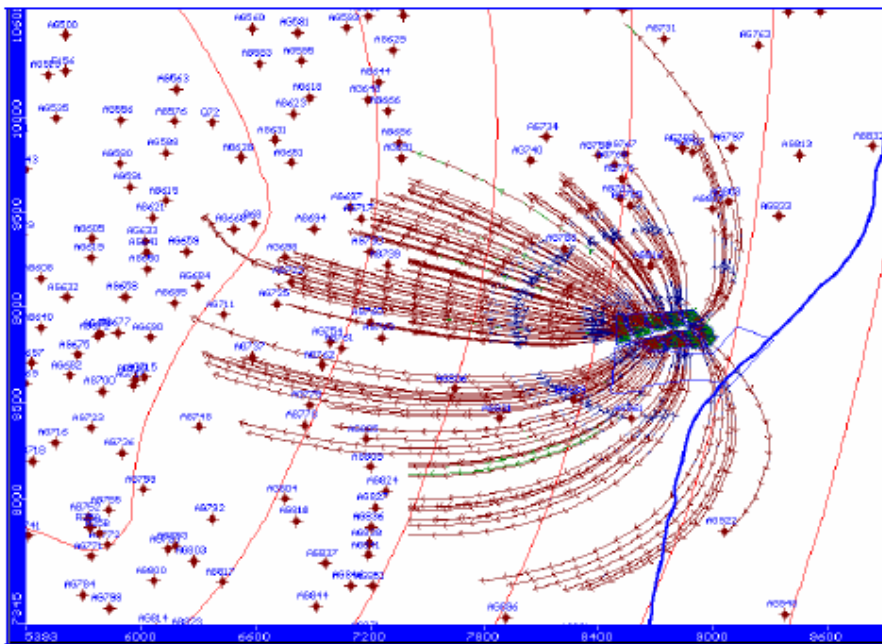
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NGEST Project

- Beit Lahia WWTP to be replaced by a new North Gaza WWTP in 2015
- Infiltration basins already built and functioning at the site of the NGWWTP
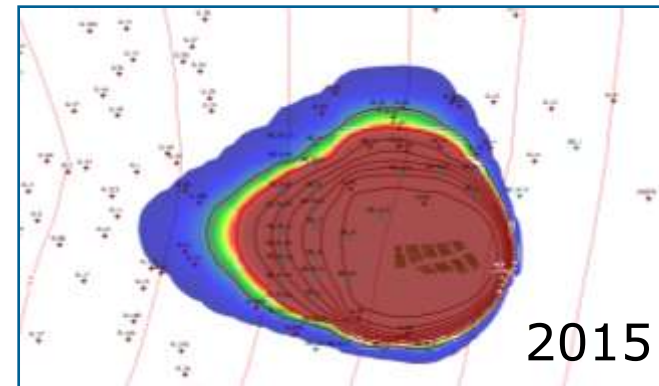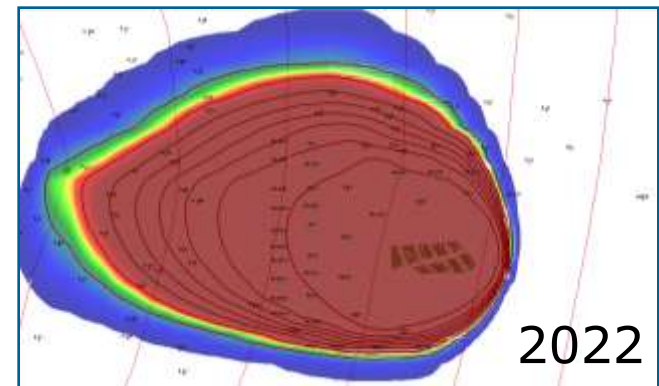
NGEST Project

- Groundwater model was built by SWECO and EMCC in 2004 to study environmental impacts

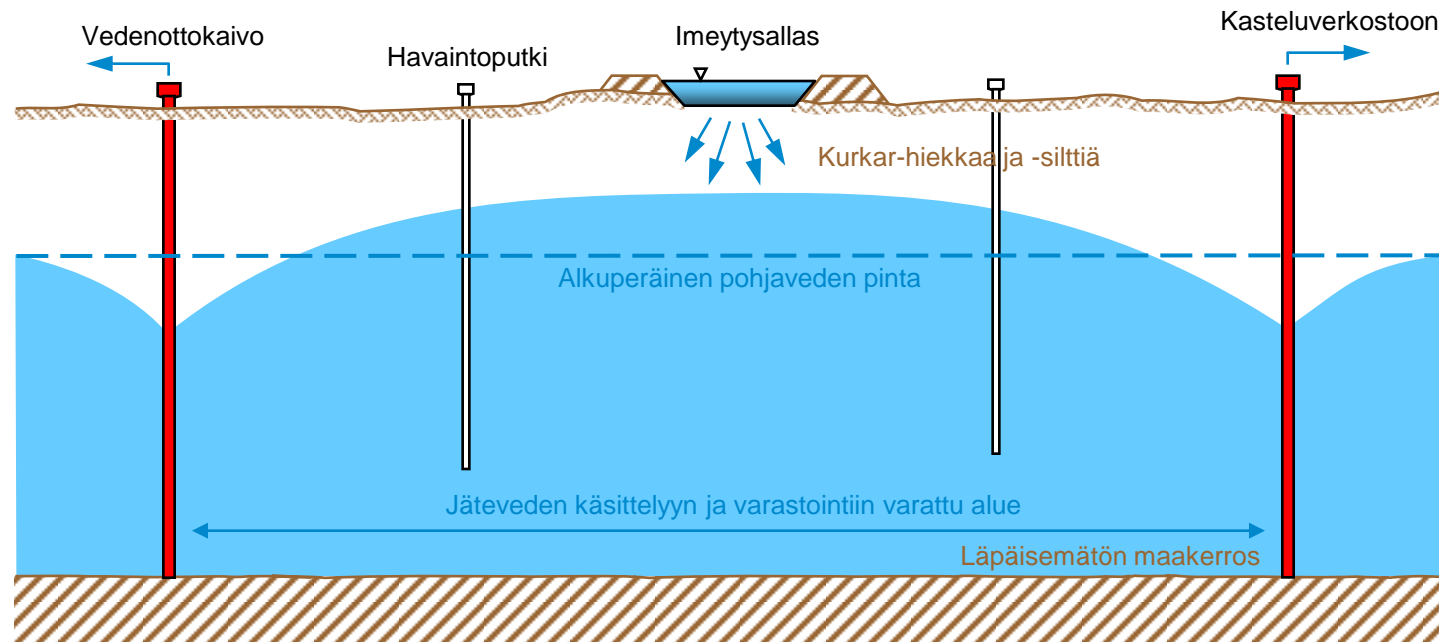Flow paths in 20 years

2015

2022

Contaminant plume without mitigation

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Principle of Effluent Recovery

- Aquifer infiltration and pumping back to agriculture

Recharge-Recovery Scheme

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NGEST Effluent Recovery Scheme

- Recovery wells around the infiltration basins

- Rehabilitation of the adjacent existing agricultural wells which will be included in the irrigation system

- Water storage tanks and booster pumping station

- Irrigation trunk lines

- Water quality and operational programme
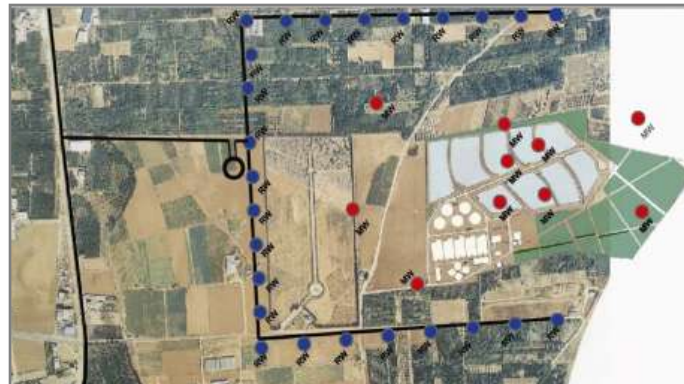
Tentative location of the scheme

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FCG/CEP Services

- Conceptual planning of recovery scheme by groundwater modeling
- Detail design of the recovery wells and irrigation scheme
- Complete set of bidding documents following World Bank procurement standards
- Support in Tender Procedure
- Construction supervision services

→ Project Start-up took place in November 2009
→ Design phase 1 year, then Supervision Phase 2,5 years

Design Phase Workplan
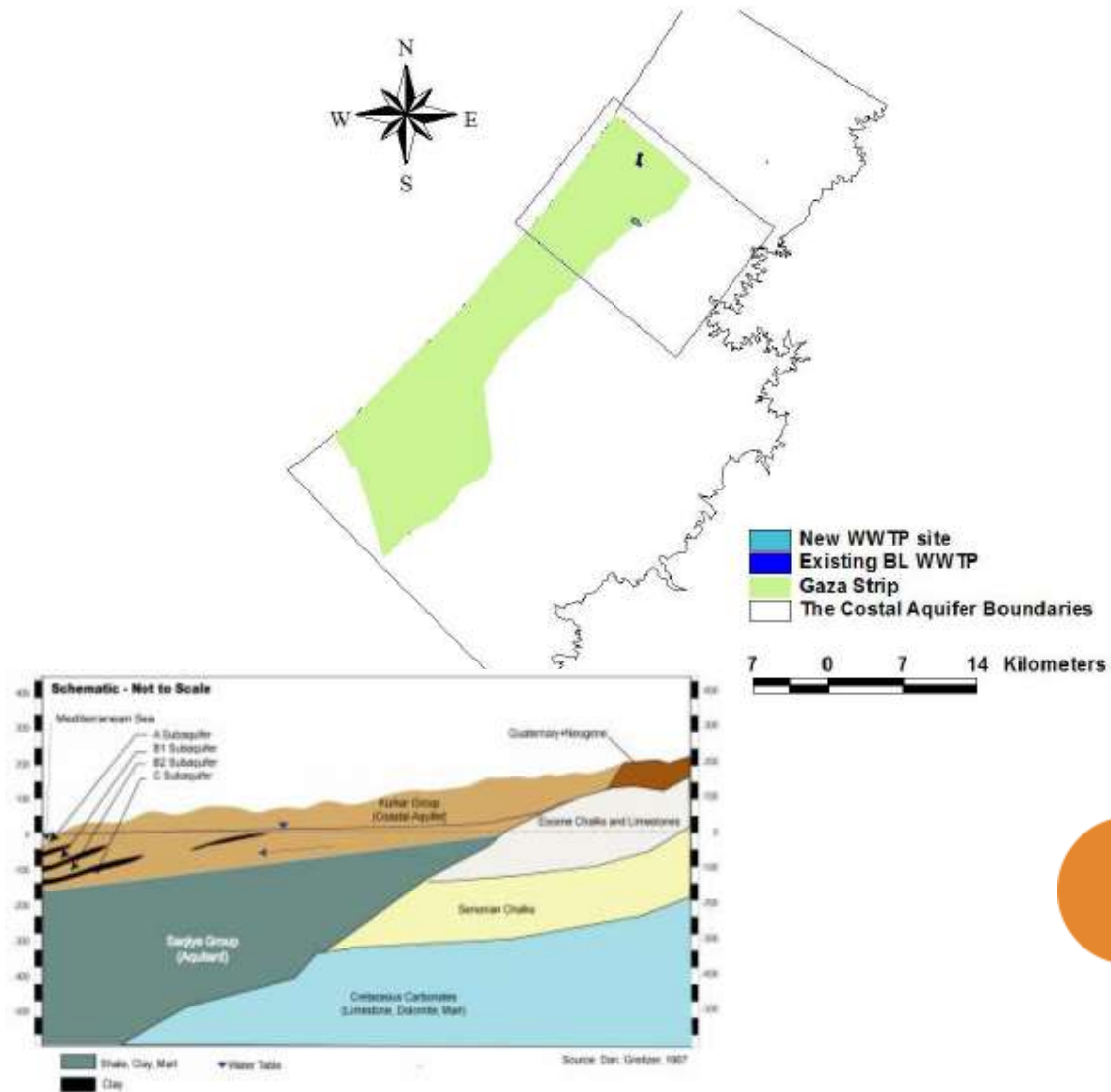
Project Organisation

• FCG team:

Timo Koski, Team Leader
Suvi Niini, PD /GW Modelling Expert
Esa Kallio, Hydrogeologist
Antti Auvinen, Hydraulic Engineer
Antti Ala-Kurikka, Electrical Engineer
Raine Rönnberg, Mechanical Engineer

PWA

CEP AND FCG OFFICES
LOGISTIC AND TECHNICAL SUPPORT

TIMO KOSKI
PROJECT MANAGER

LOCAL MANAGEMENT TEAM
Dr. Mohamed Ziara
Dr. Yunes Mogheir

Dr. Ahmed Abu Awad
Expatriate Reuse Expert

Mr. Roger Aopola
Hydrogeologist

Dr. Yunes Mogheir
Ass. Hydrogeologist

Dr. Khalil Tubail
Reuse Expert

Mr. Antti Ala-Kurikka Electrical and ICA Engineer

Dr. Mohamed Abdel Ati Wael Younis
Ass. Electrical and ICA

Consulting Centre for Quality and Calibration (CCQC)/
Eyad Abu hamam

Mr. Antti Auvinen
Hydraulic Engineer

Dr.Mazen Abualtayef
Ass. Hydraulic Eng

Ahmed Abu Quraan
Safety Engineer

Mr. Raine Ronnberg
Mechanical Eng.

Nabil Abu Shahla
Ass. Mechanical

Falah Salem Fakawi
Quantity Surveyor

Dr. Mohamed Ziara
Structural Eng.

Eyad Abu Warda
Ass. Structural Eng.

MBC
Surveyor

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NGEST Groundwater Model

- Model domain 17 x 23 km^2
- Part of the regional coastal aquifer
- Permeable layer in kurkar group 200…70 m thick
- Near Gaza border aquifer can be conceptualized as single layer unconfined aquifer
- Visual Modflow (v 4.2.015) tool
- Cell size 20x20 m^2 at NGWWTP site
- Boundary conditions
  - Constant head west
  - No flow north and south
  - General head east

Legend:
- New WWTP site
- Existing BL WWTP
- Gaza Strip
- The Costal Aquifer Boundaries

7   0   7   14   Kilometers

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Model base data

- Previous regional DYN model for southern part of the coastal aquifer

- Bottom of layer = saquia surface

- Groundwater observations at 26 points

- Drillholes at NGWWTP site and step drawdown pumping test at DB4 in 2002

- K-values of 30…35 m/d

- Effective porosity 0.25

- Recharge according to average seasonal rainfall with infiltration factor + assumptions of other components like irrigation and network leakages

- Abstraction from 46 municipal wells and ~1200 agricultural wells
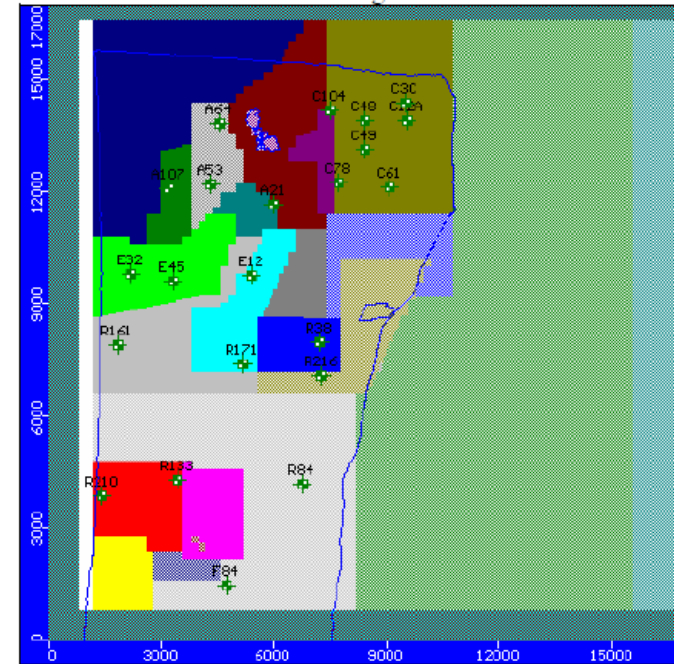
Groundwater level

- Observed level 2007-2008

Water Level Elevation - Hydrological Year 2007/2008
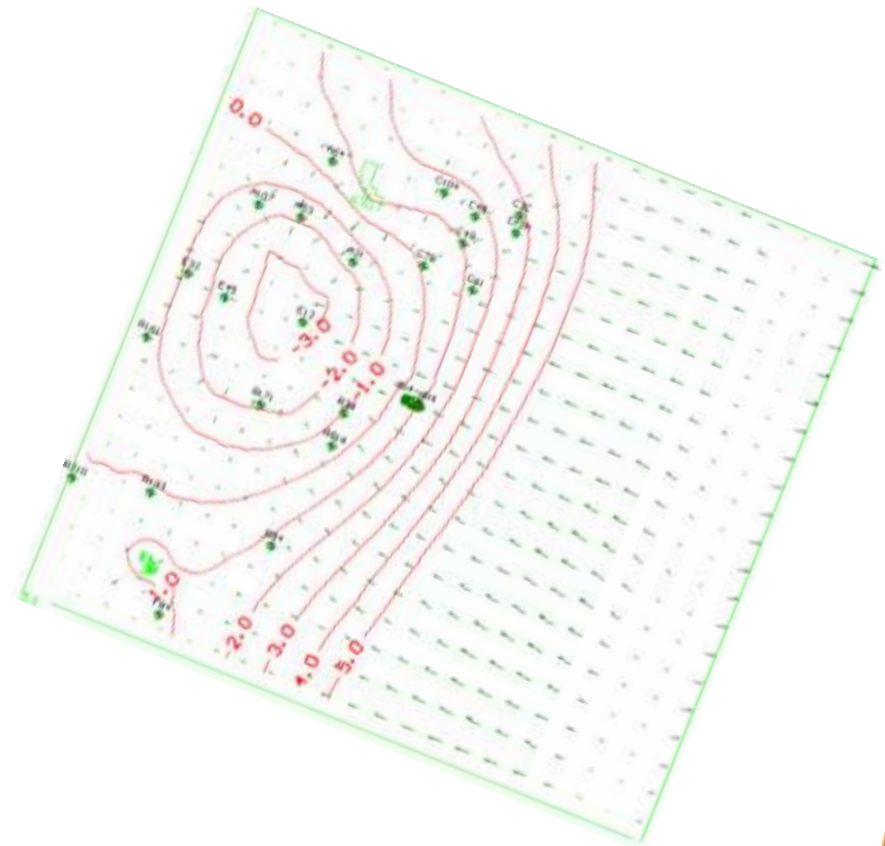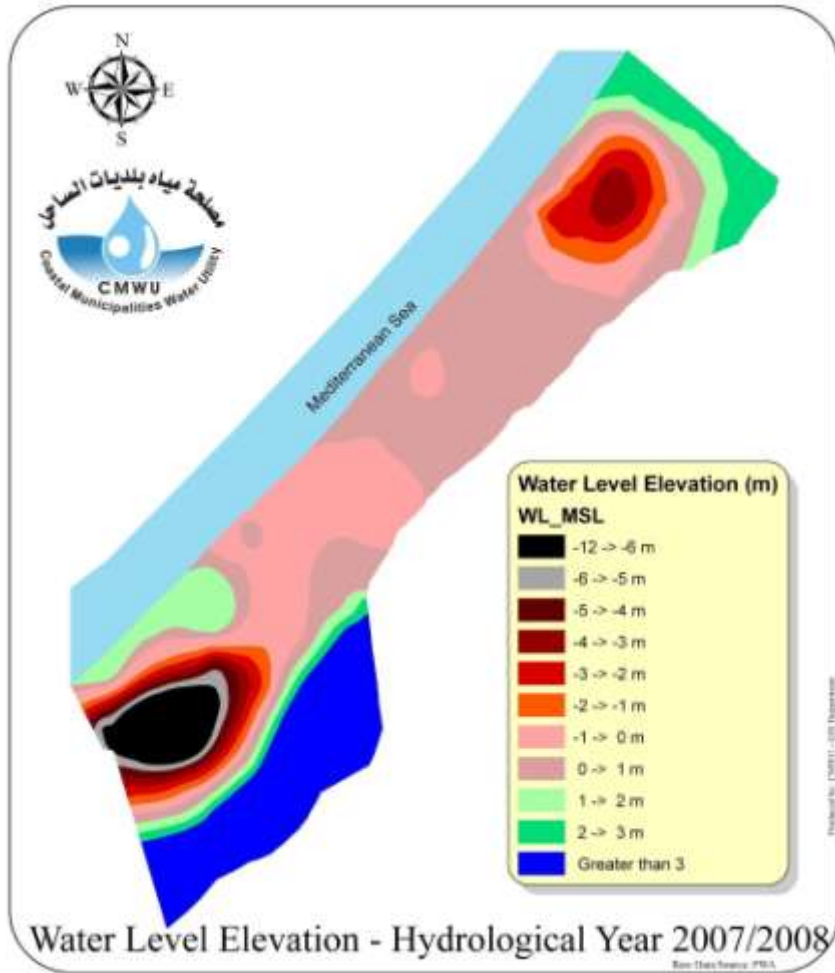
- Modelled steady state water level contours for 2007

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Studied scenario

Year	Infiltration m^3/d	BOD Conc. mg/l	Recovery m^3/d
2009	15 000	70-100	
2010	15 000	70-100	16500
2011	15 000	70-100	16500
2012	15 000	70-100	16500
2013	15 000	70-100	16500
2014	15 000	70-100	16500
2015	**35 600**	**10**	**39160**
2020	**35 600**	**10**	**39160**
2025	**35 600**	**10**	**39160**
2030	**35 600**	**10**	**39160**

- Performance of recovery wells was simulated using Modpath particle tracking and MT3D contaminant transport modules

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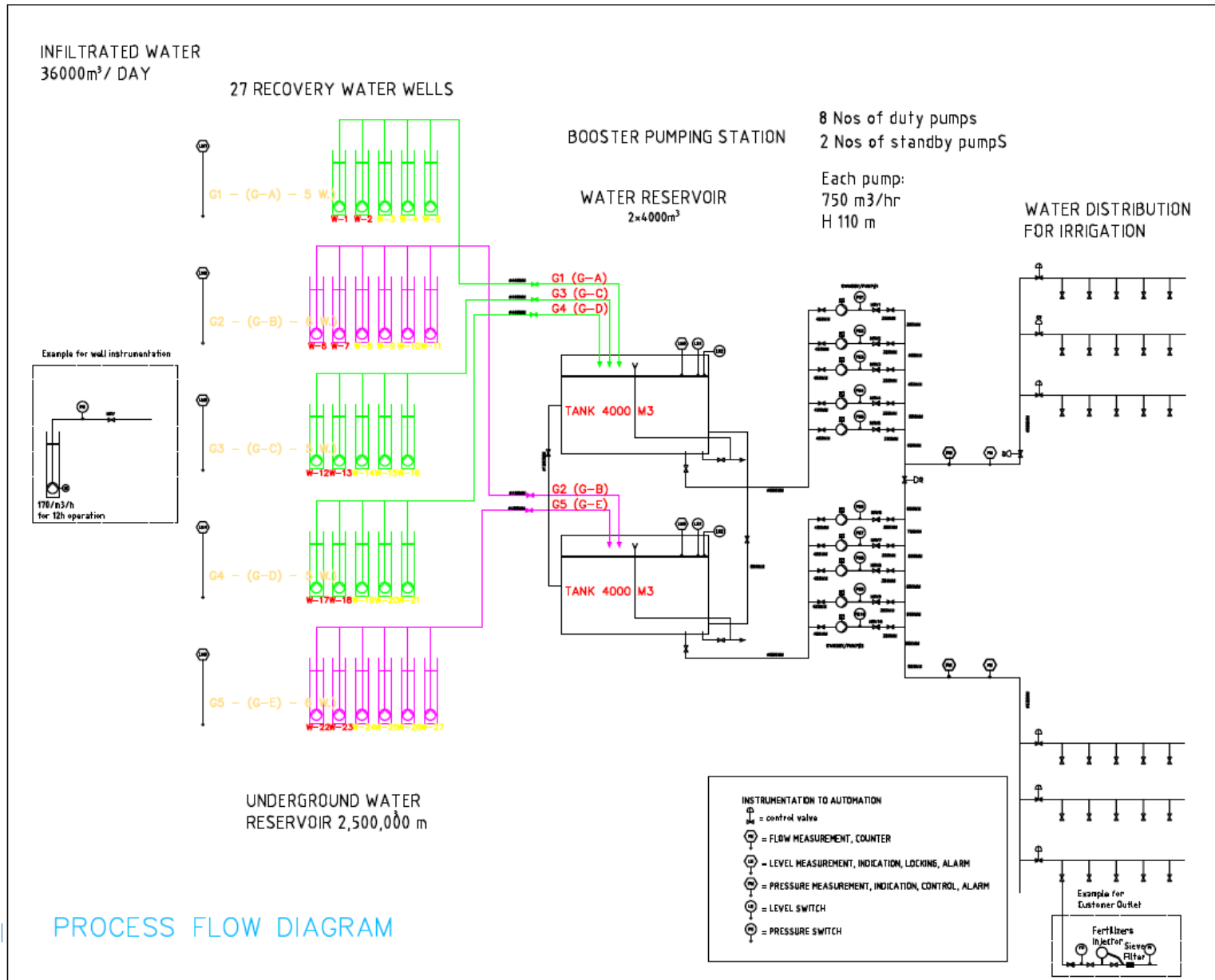
Model indications

- Infiltrated water can be well captured by the planned wells

- Retention times to the nearest wells are about 1.3 years

- Aquifer allows for bigger daily well yields, say 2000…3000 m³/d
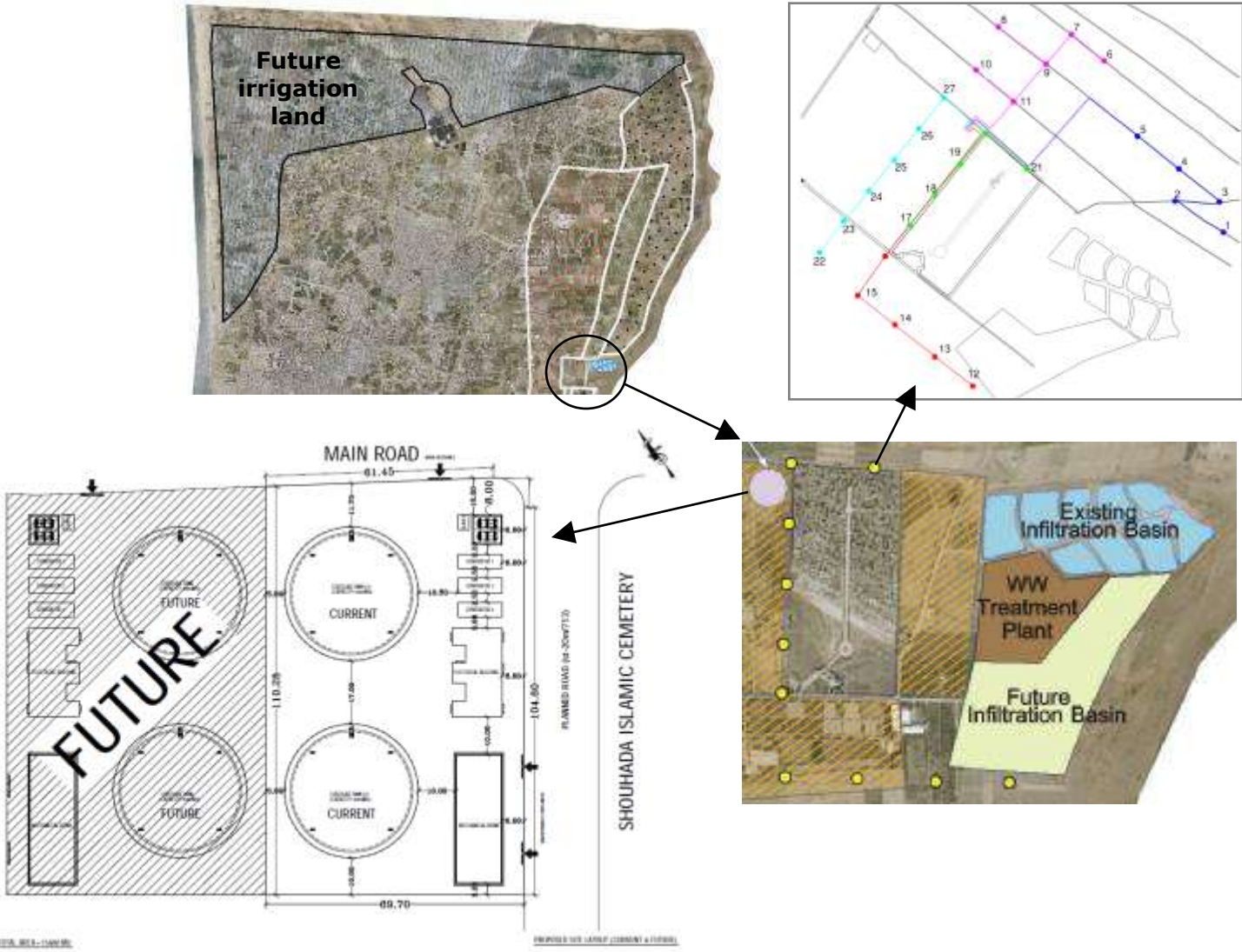
- Groundwaters of Gaza keep depleting…
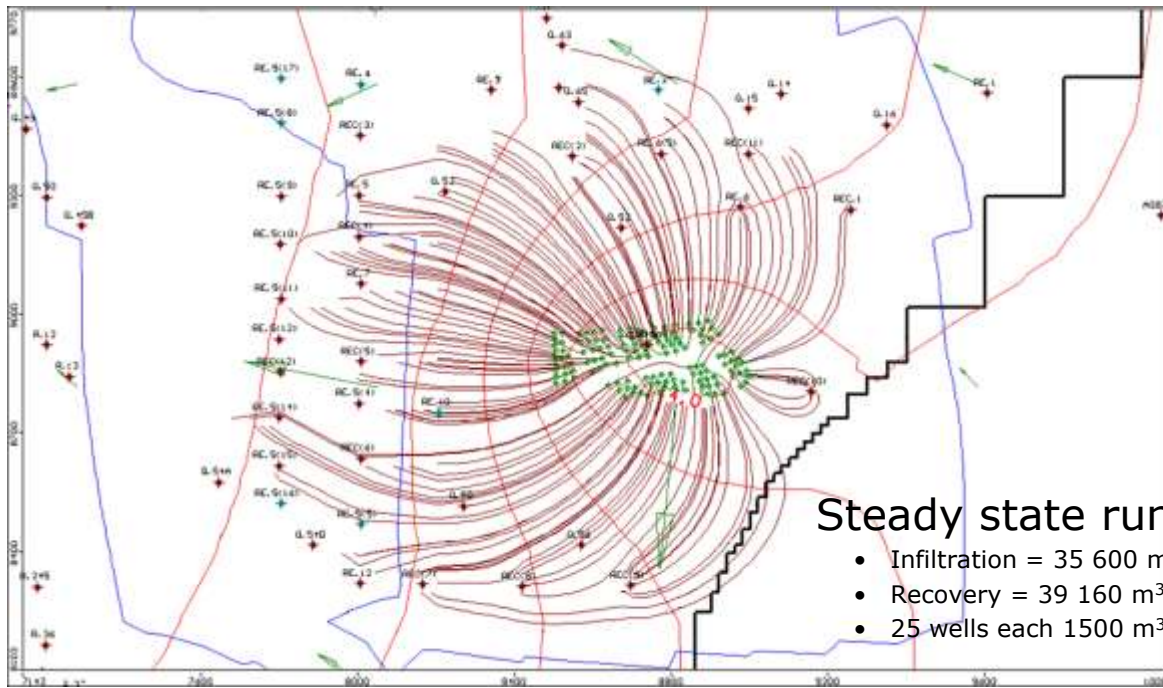
Steady state run for 2. step
- Infiltration = 35 600 m³/d
- Recovery = 39 160 m³/d
- 25 wells each 1500 m³/d screened at -30…-10

Effluent Recovery Scheme

PROCESS FLOW DIAGRAM

Scheme area and future extensions

Irrigation trunk lines

Legend
- Basin
- Rainfed
- Citrus
- Unfruitable Citrus
- Olive
- Unfruitable Olive
- Vegetables
- Fruits
- Almond