

# HYDRAULICS

COMPANY PROFILE AND  
STATEMENT OF CAPABILITIES 2023

# CONTENTS

<b>1</b>	<b>COMPANY PROFILE .....</b>	<b>3</b>
	ABOUT TECHNITAL .....	3
	<i>Description</i> .....	3
	<i>Services</i> .....	3
	<i>Organization and staffing</i> .....	4
	<i>Quality control</i> .....	5
	<i>Code of Ethics</i> .....	5
	<i>Sectors of Specialization</i> .....	6
<b>2</b>	<b>OUR EXPERIENCE .....</b>	<b>7</b>
	EXPERIENCE IN HYDRAULICS .....	7
	<b>APPENDIX A – COMPANY’S EXPERIENCE .....</b>	<b>33</b>
	WATER SUPPLY AND SEWERAGE	
	RIVER REGULATION AND WATER RESOURCE MANAGEMENT	
	HYDRAULIC AND HYDRODYNAMIC STUDIES	

# 1 Company Profile

## About TECHNITAL

### Description

TECHNITAL is a private joint stock company established more than 50 years ago (in 1964) and is one of the oldest engineering consultancy companies in Italy. Thanks to its high level of expertise, its dynamic nature and versatility, management autonomy and efficiency and its sophisticated hardware equipment and software libraries, the Company has been awarded large scale international and national projects by major public and private entities and by international funding organizations.

TECHNITAL's headquarters are situated in Verona, Italy. The organization abroad includes 15 between branches and subsidiaries in Algeria, Armenia, Bosnia & Herzegovina, Croatia, Djibouti, Georgia, Iraq, Kenya, Kosovo, Qatar, Tanzania, Trinidad & Tobago, Tunisia, Uruguay and Zambia and a number of local offices which is continuously changing according to the on-going international projects (at the moment there are 4 local site offices).

### Services

TECHNITAL is a dynamic company whose sectors of activity cover transport infrastructure (roads and motorways, railways, inland waterways, urban transport, ports and airports), hydraulics (water treatment and desalination plants, dams, aqueducts, sewerage systems, waste water treatment), maritime and coastal engineering, environment, energy (incineration and waste to energy plants, hydroelectric plants, solar plants, biogas plants), waste treatment (recycling plants, dump sites), buildings, architecture and urban planning.

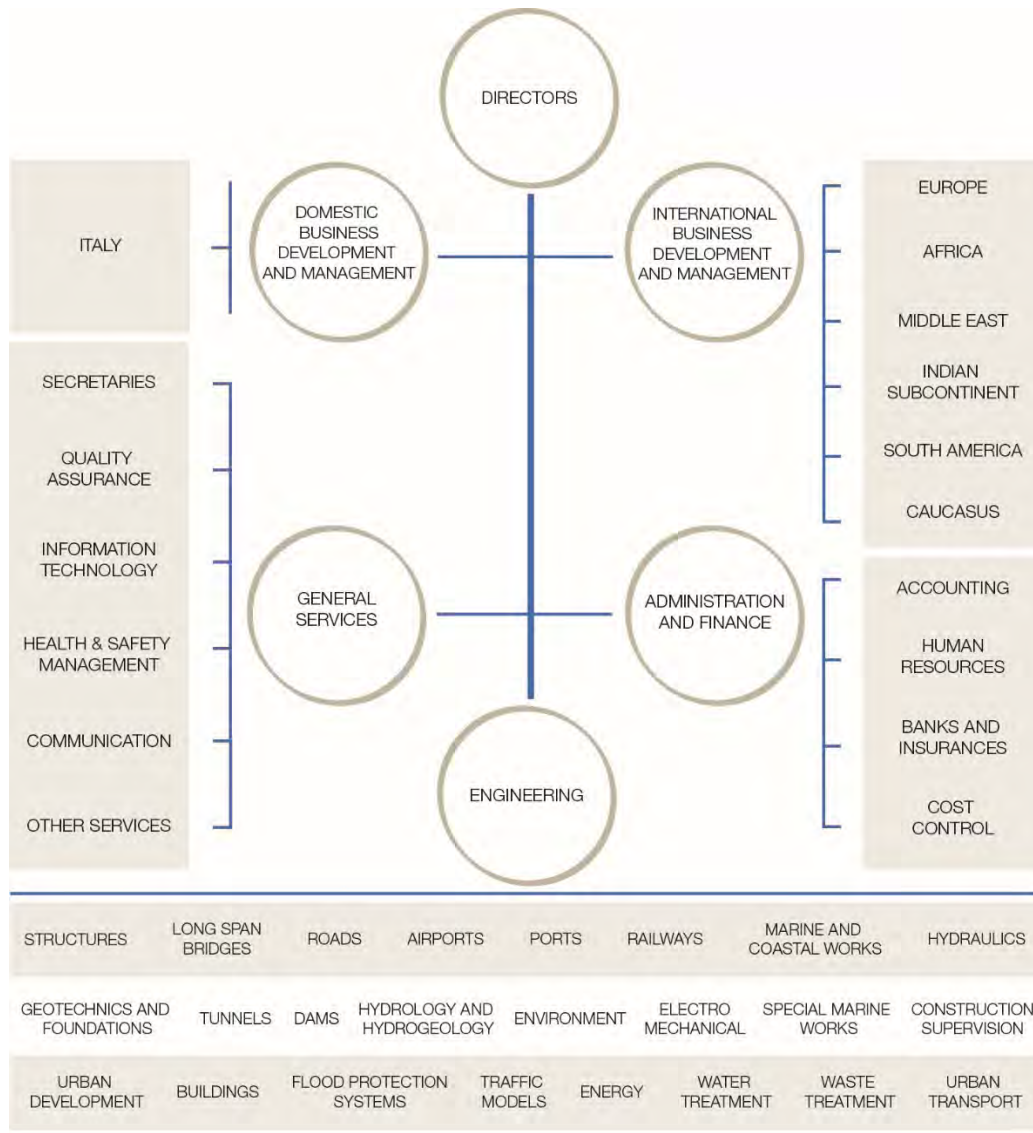
The company covers the full range of services, from planning and feasibility studies through to detailed design, works supervision and technical assistance:

- } project management
- } planning and economic-financial evaluation of investments
- } feasibility studies and technical-economic evaluations
- } all levels of design
- } environmental impact assessment and studies
- } traffic studies
- } procurement and assistance with tenders
- } construction supervision, quality assurance, testing and commissioning
- } co-ordination and supervision of research and laboratory tests
- } development of hydrodynamic and hydrogeological analysis and simulations
- } development and application of analysis methods and computer modelling.

TECHNITAL has worked in several countries world-wide: Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahamas, Benin, Bolivia, Bosnia & Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cayman Islands, Colombia, Croatia, Cuba, Cyprus, Czech Republic, Democratic Republic of Congo, Djibouti, Dominican Republic, Egypt, Ethiopia, Georgia, Germany, Ghana, Greece, Guatemala, Hungary, India, Iraq, Italy, Jordan, Kenya, Kosovo, Libya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Monaco, Montenegro, Mozambique, Nicaragua, Niger, Norway, Panama, Peru, Poland, Qatar, Republic of Haiti, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Slovenia, Somalia, Spain, Sudan, Syria, Tanzania, Togo, Trinidad & Tobago, Turkey, Uganda, Ukraine, U.A.E., United Kingdom, U.S.A., Uruguay, Venezuela, Yemen, Zambia.

Organization and staffing

TECHNITAL's multidisciplinary staff is organized according to the following chart:



**TECHNITAL's multidisciplinary staff includes about 250 professional employees covering the various aspects of the engineering services:** Transport, Hydraulics, Geotechnical, Marine & Coastal, Environmental Studies & Territorial Analysis, Structures, Electronic Data Processing & Systems Analysis, Quantity Surveying & Cost Estimation, Electromechanics, BIM/CAD/CAE, Works Supervision, etc.

Whenever required for the solution of specific problems, the home group is integrated by external consultants and specialists, both Italian and foreign. Seeking assistance and advice from colleagues, scientists, and academics throughout the world is part of TECHNITAL's policy of aiming for excellence.

Given the firm's considerable international experience, TECHNITAL's staff are perfectly at ease working in the main international languages (English, French, Spanish) and using international engineering codes (BS, ASTM, AASHTO, ASME, API and the like) and contract conditions (FIDIC and others).

### *Quality control*

TECHNITAL's activity is ISO 9001:2015 Quality System Management certified. The company is also certified ISO 14001: 2015 Environmental Quality Management, ISO 45001:2018 Occupational Health and Safety Management System and SA 8000:2014 Social Accountability Management System.

TECHNITAL has developed a company policy regarding quality control which is constantly being updated and applied, taking into account the costs to be sustained to achieve the objectives of quality and maximum benefit for both the Company and the Client. Thanks to its Quality Control System, TECHNITAL is capable of guaranteeing the quality of its services and of ensuring the Client that these services satisfy the required quality standards.

### *Code of Ethics*

Ethical and responsible decision making is very important for the company in terms of risk management and in order to keep actions within the ethical and legal boundaries.

For that reason, the company is adopting a Code of Ethics (available from the web site of the company) and conduct for its Executives and Directors and for all the Employees able to fulfil requirements for responsible decision taking. Such code aims at reducing the possibility of stepping outside behavioral limits set by the company.

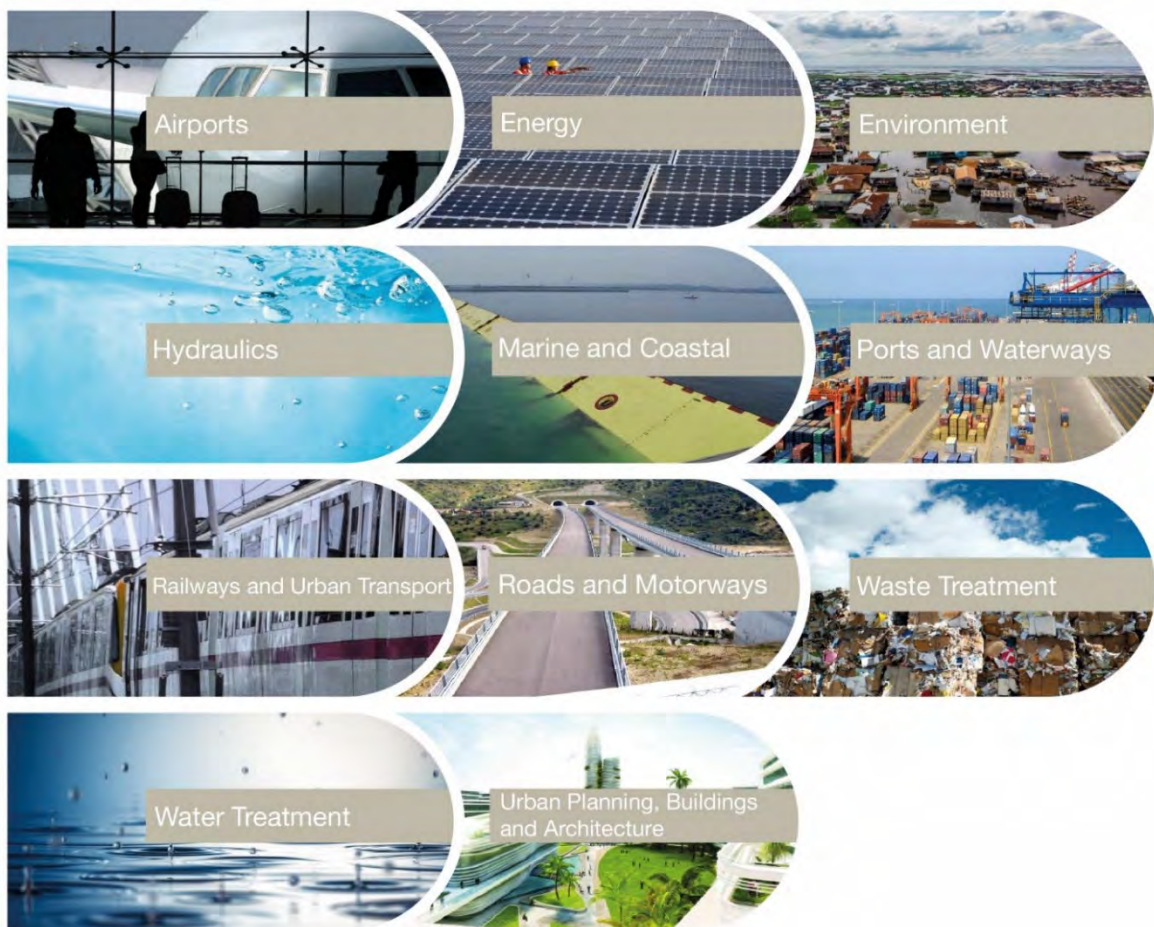
The Code of Ethics the company is adopting also meets the Organization, Management and Control Model pursuant to Italian Legislative Decree n. 231/2001.

*Sectors of Specialization*

TECHNITAL provides high-quality consultancy services in different areas of specialization: Roads and Motorways, Railways and Urban Transport, Airports, Ports and Waterways, Marine and Coastal Engineering, Environmental Engineering, Urban Planning, Buildings and Architecture, Hydraulic Engineering, Water Treatment, Waste Treatment, Energy.

In each of these sectors, TECHNITAL provides innovative project solutions to Government Agencies, International Financial Institutions and Private Sector Organizations.

Services provided by TECHNITAL include master plans, feasibility studies, techno-economical evaluations, traffic studies, mathematical and physical modeling, all phases of design from concept to detailed design, environmental impact studies and monitoring plans, tender document preparation and assistance in the procurement of works, construction supervision.



## 2 Our Experience

### Experience in Hydraulics

TECHNITAL's activities in the field of hydraulics cover a broad range, from sewerage and water distribution systems, waste water treatment, irrigation systems, dams, rivers regulation, channels and hydroelectric power plants.

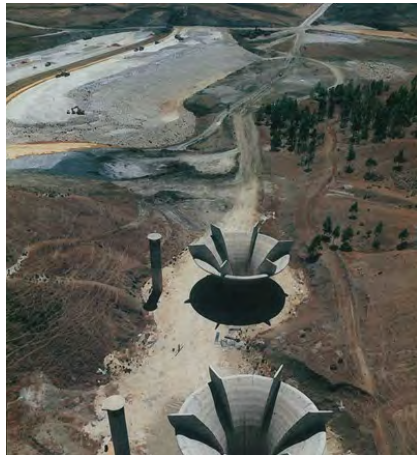
In this sector, TECHNITAL, counting on its consistent multidisciplinary operative structure and its technical and electronic equipment, has successfully undertaken and completed some important and difficult hydraulic projects, both in Italy and abroad, particularly where the identification of the best technical solution required the use of experienced experts of different complementary disciplines.

The group of highly specialized hydraulic engineers can in fact be supported by experts and senior engineers with specific know-how in the following fields:

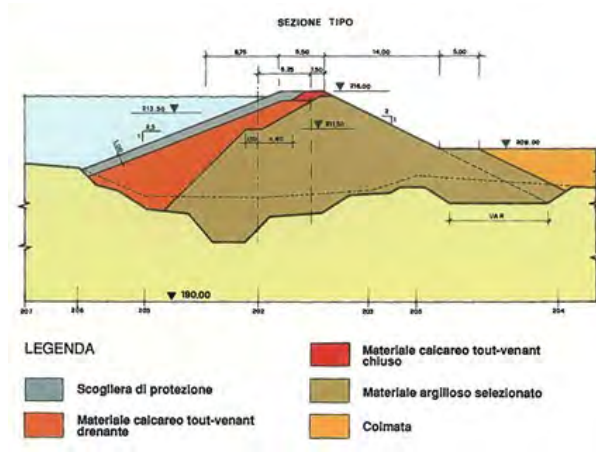
- } hydrology;
- } geology and hydrogeology;
- } geotechnics;
- } topographical surveying and mapping;
- } ecology;
- } agriculture and soil science;
- } mathematical modeling;
- } computerized graphic simulations;
- } quantity computation and cost estimates.

The services provided in this field include, among others: hydrological studies; geological and geotechnical studies; field measurements and monitoring; optimization of resources; preliminary, basic and final design of structures; feasibility studies and cost/benefit analysis; environmental impact assessment; cost estimates; technical specifications and Tender Documents; construction supervision and management.

TECHNITAL has a vast experience in relation to the design of **dams and irrigation canals** which includes several projects: Among others is worth to mention the **Sommatino earth dam on the Gibbesi River (Sicily)**; the **Val Taioli rockfill dam** and related hydraulic works for water catchment, and irrigation network; the **Adige-Guà irrigation canal** of 16,3 km; a gravity dam on the Ingagna River, Municipality of Mongrado, with a storage basin of 7 million m<sup>3</sup> for the irrigation of an area of 5,400 ha; **works for controlling the Brustolè landslide** at Arsiero which include **a dam on the Posina River**, a diversion channel, a retaining basin utilized for irrigation purposes; and **works for controlling the Spriana landslide** at Sondrio which include **a dam on the Mallero River** and a diversion channel partly in tunnel.



*Morning glory spillway Gibbsi Dam*



*Gibbsi Dam: section*

An interesting project covering several aspects of hydraulic engineering has been recently carried out in Afghanistan. The consulting services were in support of the PMO (Project Management Office) established under Nangarhar Valley Development Authority (NVDA) and the Northern Basin Development (NBD).

As far as the NVDA program is concerned, the project has covered a large irrigation scheme related to the entire valley and made of three hierarchic levels. As for the NBD the project has covered several items such as: (i) the 250 main canal structures; (ii) construction of Bangala Weir and refurbishment of Samarkandian Weir; (iii) construction of the flood protection embankment in Yanqi Qala; (iv) construction of gated headworks for the Yetim Tapa irrigation canal on the Amu Darya, and (v) emergency protection works for bank erosion control along selected reaches of the upper Amu Darya.

Technital had to prepare the detailed design and tender documents, assist the client in the bidding procedures for construction and supervise the construction.



*Samarkandian Weir*



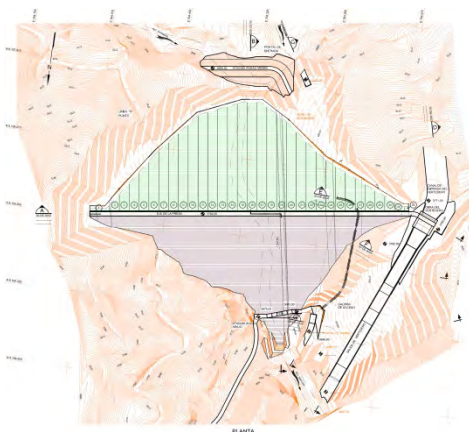
*Yetim Tapa Channel Weir*





*Position of the protection works along Amu Darya*

Among the important projects, it is worth to mention the final design of a dam on the Dora Riparia River, including water intake structure, off take channel, and ancillary works for the new Hydroelectric Power Plant of Pont Ventoux, in Val Susa (Italy). The company has carried out the design of an irrigation scheme in the Boghè plain, Mauritania; Identification study and preliminary design of six earth dams for the collection and utilization of surface run-off waters in Senegal; and the Baardheere Dam on the Giuba River in Somalia including a retaining basin of 4 million m<sup>3</sup>, hydraulic works, electric power generation substation and main irrigation channel. More recently the company has provided hydraulic and geotechnical assistance to the general contractors in relation to the construction of the Miscuni dam, near Cochabamba in Bolivia.



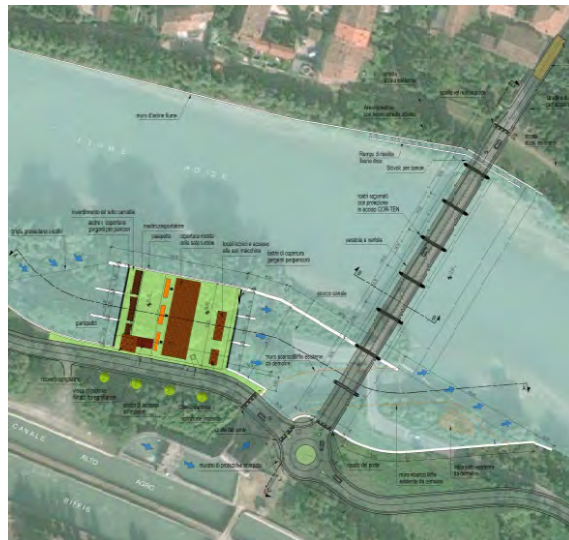
*Layout of the works of Miscuni Dam*



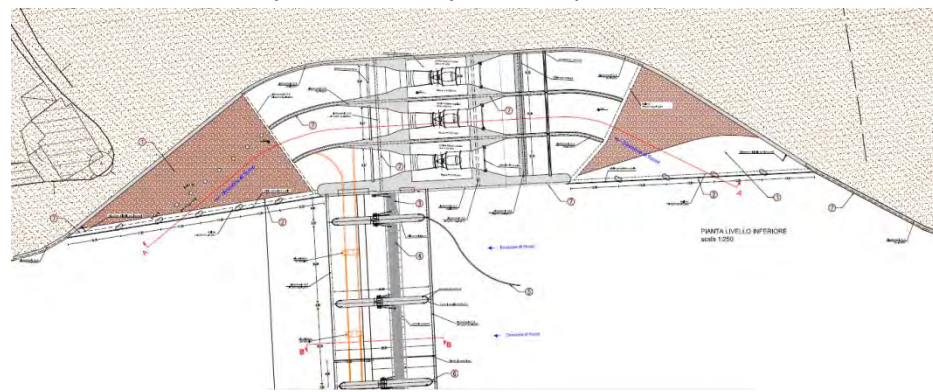
*Bottom discharge tunnel of Miscuni Dam*

In the specific field of hydroelectric plants the company can count on a number of projects such as:

- } Preliminary design of the upgrade of 7 hydroelectric plants in the Trentino Alto Adige Region, Italy
- } Valbona hydroelectric power plant reactivation – Italy
- } Detailed Design and Construction Supervision of a new hydro-electric plant of Arcè (Municipality of Pescantina) – Italy
- } Detailed Design and Construction Supervision of a new hydro-electric plant of Settimo di Pescantina – Italy
- } Due diligence and feasibility study of Pequin hydroelectric plant in Albania
- } Due diligence and feasibility study of the new hydroelectric plant Janiski Otok in Republika Srpska
- } Due diligence for Lukac and Dubrava hydroelectric plants – Bosnia & Herzegovina



*Lay-out of the new hydro-electric plant of Arcè*



*Lay-out of the new hydro-electric plant of Settimo*

As far as **river basin studies and river regulation and management** is concerned, it is worth mentioning the Project for the flood control of the Bisagno River and the Fereggiano, Rovare and Noce Streams in the city of Genova in which the recent flooding has caused a lot of victims. The project involves a series of works aiming to reduce the risk of flood of huge urban areas. In particular, these works include the improvement of the hydraulic section located in the mouth reach, interested by a multiple barrel box culvert; and the realization of a river diversion to reduce the peak discharges flowing in the original riverbed.

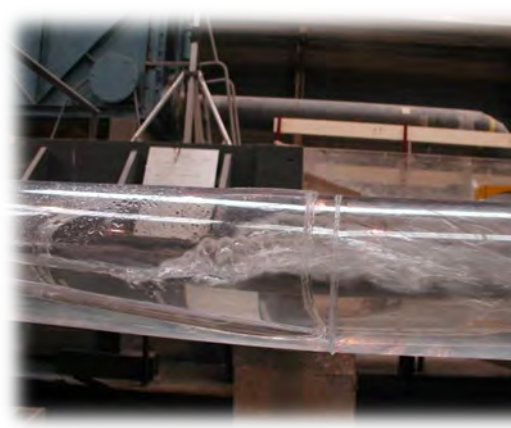
The project of the river diversion includes, for the Bisagno river, the following works: a) a river barrage equipped with n. 3 radial gates; b) a tunnel, with a horseshoe section with 9.5 m diameter, able to carry to the Tyrrhenian sea a portion of the flood discharges derived by a lateral weir; the total length of the tunnel is 6,650 m; c) three smaller diversion structures on the streams Fereggiano, Rovare and Noce, connected to the main tunnel through three tunnels 300 m length; d) a sea outfall structure of the main tunnel; e) two service tunnels.



*Diversion Scheme*



*New Gates*



*Physical model*

The project for the Flood Control Works of Agno – Guà River concerns the design of lamination and control works along the mentioned river. The new artificial flooding covers an area of about 30 hectares able to store a volume of about 900.000 m<sup>3</sup> of water in connection with another existing flooding area. Works includes also the construction of a connection structure with eight gates allowing the flooding of the lower basin when the upper is full.



*Layout of the Agno-Guà flood control works*



*Eight gates connection structure*

A further interesting project of the same field is the Flood Control Works of Bozzente River. It concerns the design of lamination works in an area with a practical total impermeability of the soil and where the infiltration is absent and the speed of the water flow in case of flooding is relevant. The basin of lamination is about 22 hectares for a storing volume of about 1.000.000 m<sup>3</sup> of water.



*Layout of the Bozzente River flood control works*

In addition to the projects already mentioned TECHNITAL has carried out several assignments:

- } river basin master plan studies in relation to major Italian rivers (Lemene, Livenza and Tagliamento rivers);
- } studies of water quality and water resources, water treatment, etc.
  - Piave and Brenta-Bacchiglione rivers
  - River Sarco - Lake Garda - River Mincio - Mantuan lakes system;
- } hydraulic - flood control studies:
  - Feasibility Study for mitigation works for the rivers Sana Nicola and Selingheddu – Olbia - Italy
  - Alpone river and its tributaries, in the province of Verona,
  - basins flood control for the Olona river in Lombardy
  - basins flood control for the Timonchio river in Veneto
  - basins flood control for the Tagliamento river in Friuli Venezia Giulia
  - basins flood control (named Anconetta) for the Fratta Gorzone river in Veneto
  - The Diversion of the Tagliamento river along the Cavrato natural channel, upstream the town of Bibione (Veneto) and works for the safeguard of the flooding along the downstream portion of the river
  - Mella and Grande rivers, in the province of Brescia during the Design of the Valtrompia Motorway.



*Discharge works on Olona river*

TECHNITAL has also carried out numerous projects of **water supply and sewerage systems** for various clients and municipalities.

Among others it is important to highlight the “**Restructuring of the Gela – Aragona Aqueduct**” in the South of Italy. The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela and by a desalination plant in Gela. The aqueduct is for potable flow of about 500 lit/s up to an elevation of 500 msl. The services were for design and work supervision of renewal of the entire water supply main, replacement of the existing fibreglass piping with a spheroidal cast iron pipe, and the modification of the hydraulic scheme of the main conveyor (81.8 KM), with the introduction of 3 tanks in tunnels along the line and booster type pumping stations instead of the existing ones with multistage vertical axis pumps and collecting tanks.



*Detail of the main pipe*



*Detail of a pumping station*



*Construction stage*

The Company is in charge of the Work Supervision of the **Basento – Brandano water scheme**: a complex water distribution scheme which covers the municipalities of Irsina, Genzano, Palazzo S.Gervasio and Banzi (about 5,200 hectares in the province of Potenza – South of Italy).

The works include a bored tunnel of about 4 km excavated with a TBM, a system of main distribution pipelines of about 12 km with 3 compensation basins connected with each other, and a distribution network of about 320 km.



*Detail of the TBM*



*Detail of a basin*



*Construction stage*



*Detail of the main pipe construction*

Another relevant project, in the same field of large supply and sewage schemes, is the **“Technical assistance for preparing grant applications and documentation award for regional development project infrastructure water and wastewater in Sibiu in the period 2016-2020 (MEDIAS)”** in Romania. The project addresses especially the rural localities in the area with investments to ensure the supply of drinking water and the establishment of wastewater collection and treatment systems in 4 main Urban agglomerates: Medias, Agnita, Dumbraveni and Seica Mare. The company is involved in design and tender documents preparation as well as work supervision for a quite complex system which covers different items. As far as water supply is concerned, it covers: about 135 km of supply network, 55 km of main conveyors, 7 pumping station, 5 chlorination stations, 3 water tanks, water intake, micro-power plants and other water treatment plants. As far as sewerage system is concerned, it covers about 200 km of sewerage network, about 45 pumping stations.

It is worth to mention also the **“Preliminary and Detailed Design of the Wastewater Treatment System of Ganvié (Benin)”**. The project “Reinventing the Lake City of Ganvié” is part of the Government’s action plan as one of the top priority projects of Benin in the tourism sector. Nowadays, the city of Ganvié consists mainly of stilted houses on the lake Nokoué with a population of around 37.000 inhabitants. The human presence together with presence of animal farms has generated serious conditions of pollution of the water of the lake (brackish water as the lake is in communication with the sea) which has led to deplorable hygienic conditions affecting fishing and touristic activities. The project’s objective is the identification of a wastewater collection and treatment system with reference to the future scenario with a resident population of 73.000 inhabitants plus the tourist population fluctuating around 11.000 people.



Other important projects are:

- *Restoration and improvement of the water supply and sewerage systems in the various towns damaged by earthquakes in both Friuli and Campania Regions;*
- *Sewerage systems of Pellestrina, S. Pietro in Volta and Sottomarina, outlying villages of the Venice Lagoon, in the context of the vast project to safeguard Venice and its lagoon;*
- *Storm water drainage network in the town of Conversano (Bari);*
- *New water supply system for the city of Venice;*
- *Optimization of investments for the management of water resources in the province of Verona;*
- *Sewerage systems and waste water treatment plants of Sorgà and Valpantena (province of Verona) and Trasimeno and Todi (province of Perugia);*
- *Reconstruction of the sewerage system in the port of Naples;*
- *Works to improve the wastewater sewerage system in the lake Garda basin: main collector of the eastern lake: Malcesine – Peschiera del Garda – Italy;*
- *Hydraulic Infrastructures (sewerage, storm water drainage and treated effluent system) for 8 urban districts of the city of Doha - Qatar;*
- *Pre-investment studies for drinking water, sanitation and solid waste management projects in rural areas, catchment basin of Chixoy hydroelectric dam - Republic of Guatemala.*



*Valpantena collector*

TECHNITAL has also designed hydraulic infrastructures for:

- ‡ *Porto Cervo Resort Village (Sardinia, Italy);*
- ‡ *Tourist Development of Fazenda Caeira in Bahía (Brazil);*
- ‡ *Jeddah Tourist City (Saudi Arabia);*
- ‡ *Biology Department of Padua University (Italy);*
- ‡ *Faculty of Education of the new University of Sebha (Libya);*
- ‡ *new Railway Compound and Workshops in Dammam ( Saudi Arabia);*
- ‡ *Umm Salal Phase 1 and Al Udaid Air Base (Qatar).*

*For water treatment projects, please refer to “Water Treatment” brochure.*

Special hydraulic/environmental projects include:

- ‡ *Hydrodynamic modelling of the lagoon of Venice;*
- ‡ *Extension of the catchment basin of the large lake Trasimeno in central Italy;*
- ‡ *Environmental protection of the River Sarca - Lake Garda - River Mincio - Mantuan lakes system, involving the definition of the principal alternative actions to optimize the water treatment system and the recycling of the treated waste water of the restrictions for water use;*
- ‡ *the Special Project for the Depollution of the Gulf of Naples;*

as well as numerous studies and pilot projects in relation to the program to reduce pollution of the Venice lagoon.

The most recent projects carried out in this field are illustrated more in detail in the following tables and project sheets.



TABLE A – COMPANY’S EXPERIENCE (For titles in **bold** type see project sheets in Appendix A)

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>WATER SUPPLY AND SEWERAGE</b>						
West Acireale sewer network - Italy	Special Commissioner UNICO DPCM	09/2022	Ongoing	Final Design, Detailed Design, Construction Supervision	1,470,250	50,000,000
Water adduction system from Montedoglio reservoir for Valdarno Aretino - Italy	Nuove Acque	05/2022	Ongoing	Feasibility study, Final Design, Detailed Design	376,351	27,672,523
Update and expansion of the sewage treatment system in the municipalities of Carini, Capaci and Isola delle Femmine - Italy	AMAP S.p.A. - Palermo	01/2022	Ongoing	Preliminary design	308,735	n.a.
<b>Feasibility study of the restoration works of the canal-bridges of the adductor called "Main Channel" of Sele Acquedotto" – Italy</b>	Acquedotto Pugliese	10/2021	Ongoing	Feasibility Study	122.878,35	17,000,000
Design consultancy services of primary urbanization works of sector S3 - Italy	Ravenna Port Authority	05/2021	Ongoing	Final Design	159,740.30	19,999,546
Framework agreement for studies for water derivation for drinking use - Lotto Gallura - Italy	Abbanoa	05/2021	Ongoing	Hydrogeological Surveys	651,157	n.a.
<b>Design of two submarine discharge pipelines in Rimini - Italy</b>	Heratech s.r.l.	06/2021	Ongoing	Preliminary Design, Final Design, Works Supervision	397,700	21,000,000
Reinforcement of the potable water distribution network in Turin - Italy	SMAT S.p.A.	01/2019	Ongoing	Final design. Detailed design. Works supervision	371,135	16,489,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Design, works supervision of the sewerage network and sewage plant of Olbia - Italy	Abbanoa S.p.A.	06/2018	Ongoing	Detailed Design, Works Supervision	854,777	2,310,000
<b>Sewerage system of the area Tonnarella - Trasmazzaro and link to the network of Mazzini seafont – Mazara del Vallo - Italy</b>	Municipality of Mazara del Vallo (Sicily)	11/2016	Ongoing	Detailed Design, Works Supervision	1,267,000	16,845,000
Technical assistance for preparing grant applications and documentation award for regional development project infrastructure water and wastewater in Sibiu in the period 2016-2020 (MEDIAS) – Romania	APA TARNAVEI MARI SA	06/2016	Ongoing	Feasibility Study, Detailed Design, Tender Documents, Technical Assistance	1,700,000	106,848,916
Detailed design of the by-pass of the 3-rod barrel, at the inlet of the flood protection basin "Anconetta" – Italy	Veneto Region	10/2020	12/2022	Detailed Design	178,000	10,700,000
<b>Wastewater Collection System and Treatment Plant in Ganvié – Benin</b>	Agence Nationale de promotion des Patrimoines et de développement du Tourisme (ANPT) - Benin	10/2020	03/2022	Preliminary Design, Detailed Design, ESIA, Tender Documents	1,215,002	27,213,292
Wastewater Network Works of Baqaa Camp in Ain Al Basha Region – Jordan	Water Authority of Jordan	11/2019	11/2021	Works Supervision	753,796	8,980,000
<b>Sewerage pressure main from Gorizia to Gradisca d'Isonzo (3rd Lot) - Italy</b>	Irisacqua Srl	11/2019	06/2021	Detailed design	228,288	7,263,655

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Construction of an underwater outfall of treated wastewater in the municipalities of Bisceglie, Corato, Molfetta, Ruvo and Terlizzi in Torre Calderino - Italy	Igeco Costruzioni S.p.A.	01/2015	02/2021	Detailed design	225,990	11,773,005
Sewage and water purification systems of the Amalfi coast in the municipalities of Minori and Maiori - Italy	Province of Salerno	06/2018	12/2020	Feasibility Study, Detailed Design. Works Supervision	656,570	14,229,333
<b>Engineering Design Services for Water supply Treatment Plant and network for Phase 1 Konza Techno City - Kenya</b>	KoTDA (Konza Technopolis Development Authority)	08/2018	07/2021	Concept/Preliminary, Detailed Design	1,177,740	41,000,000
<b>Consulting Services To Develop Water Supply And Sanitation Disaster Risk Preparedness Plan - Zambia</b>	Lusaka Water and Sewage Company Ltd	12/2018	12/2019	Preparation of the Inception Report, Risk Assessment Report, Disaster Risk Management Plan Completion of final DRMP Report	176,020	n.a.
<b>Basento-Bradano Water Scheme - Acerenza section Distribution - Banzi, Genzano, Palazzo S.F. and Irsinia - Italy</b>	The Authority for the Development of Irrigation and Land Transformation in Apulia, Lucania and Irpinia (E.I.P.L.I.)	08/2013	09/2019	Works supervision	1,800,000	73,000,000
<b>Vacuum foul sewerage network of the port of Naples, from Calata Beverello to Calata del Popolo (1st stage)- Italy</b>	Port Authority of Naples	02/2004	02/2018	Preliminary and detailed design Works supervision	587,288	5,533,733
<b>Sewerage network and Wastewater Treatment Plant in Vicenza - Italy</b>	Viacqua S.p.A.	09/2015	09/2017	Detailed Design	1,269,000	75,965,000
Upgrading and increasing of the capacity of the aqueduct in the municipality of Palù (Verona) - Italy	Acque Veronesi S.c.a.r.l.	03/2011	06/2016	Final and detailed design EIA Works supervision	98,680	1,255,055

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Pre-investment studies for potable water, sanitation, and solid waste management of the rural area, including an aqueduct, for the communities located in the reservoir basin of the hydroelectric dam of Chixoy - Guatemala	Banco Interamericano de Desarrollo	08/2014	08/2015	Prefeasibility and feasibility studies, preliminary design	72,000	2,303,014
<b>Optimization of sewerage network in the district of Valpantena (Province of Verona) - Italy</b>	Acque Veronesi S.c.a.r.l. (Provincial water authority)	06/2010	08/2014	Prefeasibility study; Preliminary, detailed and final Design EIA	308,046	12,066,726
<b>Works for restructuring the Gela-Aragona aqueduct – Sicily - Italy</b>	Sicilia Acque	10/2007	03/2014	Works supervision	4,261,475	58,987,342
<b>Reconstruction of the sewerage network of the port of Naples from Calata Villa del Popolo to Calata Petroli (2nd stage) - Italy</b>	Port Authority of Naples	02/2004	05/2013	Preliminary, concept and final designs	543,390	18,498,796
<b>Stormwater drainage network in the town of Conversano (Bari) - Italy</b>	Municipality of Conversano – local town authority	02/2008	04/2013	Detailed design Works supervision	205,847	1,509,171
Wastewater sewerage system in the Lake Garda basin. Collector of the Southern Lake: Brancolino - treatment plant of Peschiera - Italy	Azienda Gardesana Servizi	09/2012	12/2012	Preliminary design	100,000	30,011,112
<b>Concept Designs of Roads and Infrastructure-Phase 2: drainage works – Doha, Qatar</b>	Urban Planning & Development Authority (UPDA)	04/2009	01/2012	Concept design, technical specifications	605,000	1,550,000,000 (overall project)
<b>Drainage system for the external eastern bypass of Milan (T.E.E.M.) - Italy</b>	Concessioni Autostrade Lombarde (Motorway Concessionaire of Lombardy)	07/2009	08/2011	Final Design, EIA	639,700	34,487,850
<b>Industrial Interchange, Doha Expressway “D” Ring Road: drainage works – Doha, Qatar</b>	Ministry of Municipal Affairs & Agriculture -PWA – Roads Affairs	08/2006	03/2011	Works supervision	360,000	150,000,000 (overall project)

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Design of revamping and restoration of the pumping system for emptying "medium" dry dock of the Arsenale di Venezia (Venice) – Venice, Italy</b>	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	03/2010	11/2010	Preliminary and detailed design	160,000	1,810,000
Foul sewerage network in the locality of Sorgà (Verona) - Italy	Acque Veronesi S.c.a.r.l. (Provincial water authority)	03/2010	11/2010	Feasibility study , preliminary and detailed design	52,500	2,814,490
<b>Optimization of investments and management activities of the integrated water service in the Province of Verona - Italy</b>	Acque Veronesi S.c.a.r.l. (Provincial water authority)	11/2009	07/2010	Studies and analyses	188,000	n.a.
Milan-Bologna High Speed Railway line – Lot 1.4: yard drainage network and culverts – Province of Piacenza - Italy	Grandi Lavori Fincosit S.p.A.	01/2003	12/2009	Construction design of hydraulic works	150,000	5,542,700
Storm water drainage network for Molini quay, in Marghera industrial port – Venice - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/2008	03/2009	Preliminary design	195,000	1,150,000
<b>Reclamation works in the domain area called the "Third Dyke": hydraulic drainage works – Venice - Italy</b>	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	12/2000	12/2006	Preliminary, final and detailed design	137,500	12,745,700
<b>Restructuring of the sewerage network of the municipality of Casamicciola, island of Ischia (Naples) – Italy</b>	Sogesid S.p.A. (Rome)	05/2002	01/2005	Preliminary and detailed design	150,000	12,000,000
<b>Al Udaid Air Base – Infrastructures – Qatar (sewerage and drainage)</b>	Rizzani De Eccher (Main Contractor)	11/2003	12/2004	General Master Plan Detailed Design of Lot 1	972,800	60,830,000
<b>Restructuring of Gela-Aragona acqueduct – Sicily – Italy</b>	Special Commissar for the Water Emergency (Sicily)	07/2002	03/2003	Preliminary and detailed design	2,978,000	17,378,500
<b>Sewerage system for Sottomarina – Venice Lagoon – Italy</b>	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	10/1988	12/2002	Concept, basic, preliminary and detailed design	85,700	2,685,600

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Sewerage system for Pellestrina – Venice Lagoon – Italy</b>	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/1987	12/2002	Concept, preliminary and detailed designs	262,000	6,663,000
Umm Salal Phase I in Doha - Qatar	Ministry of Municipal Affairs & Agriculture	10/2001	05/2002	Preliminary and detailed Design, Tender and contract documents	830,000	214,550,000
Shore protection works and storm water drainage system in Chioggia <i>insula</i> – Venice – Italy	<i>Venezia Nuova</i> Consortium for Ministry of Public Works - Water Board - Venice	12/1998	12/2001	Final and detailed design	147,600	6,346,000
<b>RIVER REGULATION AND WATER RESOURCE MANAGEMENT</b>						
New Barrier Against Salt-Water Intrusion at the Mouth of Adige River - Italy	Po Delta Reclamation Consortium	01/2022	Ongoing	Preliminary and Detailed Design	370,000	20,000,000
Design of the hydraulic risk mitigation interventions in Olbia - Italy	Municipality of Olbia	01/2022	Ongoing	Feasibility Study, EIA	1,655,799	120,000,000
Maintenance works of the Pertusillo dam - Italy	Commissioner for Dams by the Southern Apennine Basin Authority.	07/2022	Ongoing	Detailed Design	138,519	n.a.
Hydraulic restoration of the Biferno River downstream of the Ponte Liscione dam - Italy	Campobasso Province	05/2022	Ongoing	Detailed Design	509,472	n.a.
Design of the Lerno Dam - Italy	Ente Acque della Sardegna (ENAS)	09/2021	Ongoing	Feasibility Study, Final and Detailed Design	514,845.40	5,592,069

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Rehabilitation of the Ripaspaccata Dam in the countryside of Montaquila - Italy	Molise Region	09/2021	Ongoing	Final Design	345,577	16.823.215
Final Design of Fossatella Dam - Italy	Molise Region	09/2021	Ongoing	Final Design	980,347	42.701.871
Adjustment of the Rio Maltempo in Genoa - Italy	Municipality of Genoa	11/2021	Ongoing	Feasibility Study, Detailed Design	490.432,43	18.000.000
<b>Detailed and Final Design of the Restoration of the Po between the Secchia River Mouth and Ostiglia (Mantua) – Cirene Island - Italy</b>	Cave di Quingentole Srl, Granulati Donnini Spa	03/2021	Ongoing	Final and Detailed Design, EIA	530.000,00	27,000,000
Rehabilitation of Papardo Torrent (Messina) - Italy	Commissioner of Hydrogeological Instability of Sicily	02/2021	Ongoing	Final and Detailed Design, Works Supervision	316.454,78	5.600.000
Rehabilitaion/demolition of the High and Low Bunnari Dams (Sassari) - Italy	Municipality of Sassari	02/2021	Ongoing	Feasibility Study Final and Detailed Design	303.754,76	4.700.000
Rehabilitation of the San Filippo Torrent (Messina) - Italy	Commissioner of Hydrogeological Instability of Sicily	02/2021	Ongoing	Final and Detailed Design	268.867,62	12.784.335
Works supervision and coordination of safety in execution phase for the use of irrigation water from the Adige River through the Leb canal to replace the derivations from the Fratta river in the provinces of Verona and Padua - Italy	Consorzio di Bonifica Adige Euganeo	01/2021	Ongoing	Works supervision	583,010	26.470.892
Rehabilitation and Improvement of Govossai Dam" - Italy	Abbanoa S.p.A.	04/2021	Ongoing	Feasibility Study, Detailed Design, Works Supervision	515,875	9.750.867

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Rehabilitation of Gibbesi Dam - Italy</b>	Water and Waste Department of Sicily	11/2020	Ongoing	Feasibility Study, Final and Detailed Design.	306,800	30,000,000
Assessment of the seismic safety of the dam and existing buildings and Design of the Abutement of the Disueri Dam - Italy	Water and Waste Department, Sicily Region	05/2021	Ongoing	Final and Detailed Design	536,018	13,184,000
Assessment of the seismic safety of the dam and existing buildings and Maintenance Works Design of the Scanzano Dam - Italy	Water and Waste Department, Sicily Region	08/2021	Ongoing	Detailed Design	111,444	14,913,620
Design of the river defence works of Illasi River (VR) – Italy	Commissioner Tempesta VAIA Infrastrutture Venete Srl	10/2020	Ongoing	Preliminary and Detailed Design	159,000	20.636.991
<b>Rehabilitation of Villarosa Dam – Italy</b>	Water and Waste Department of Sicily	08/2020	Ongoing	Final and Detailed Design	185,453	13,274,000
<b>Rehabilitation of Poma Dam – Italy</b>	Water and Waste Department of Sicily	03/2021	Ongoing	Detailed Design – Structural and Hydraulic Design	210,010	25,784,000
<b>Rehabilitation of Sciguana Dam (Sicily) - Italy</b>	Sicily Region - Water and Waste Department	10/2020	Ongoing	Final and Detailed Design	247,005	29,000,000
<b>Stormwater detention basin "Pra' Dei Gai", Italy</b>	Regione Veneto – Flood Protection Department	03/2020	Ongoing	Final Design, Detailed Design, Works Supervision	900,125	22.604.168



PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Agno Guà River Storm Water detention basin in Trissino - Italy	Veneto Region	01/2020	Ongoing	Works Supervision	380,985	16,115,343
River regulation works of Vernazza Stream (Chiappeto) in Genoa - Italy	Municipality of Genoa	09/2019	Ongoing	Detailed Design, Works Supervision	522,752	12,486,000
Management, river defence works and road connections of the Bordonaro river (ME) – Italy	Government Commissioner against hydrogeological instability in the Sicilian Region	06/2019	Ongoing	Detailed Design, Works Supervision	170,032	2,063,000
Vernazza Torrent (Chiappeto) In Genoa - Italy	Municipality of Genoa	06/2018	Ongoing	Detailed Design, Works Supervision	1,274,282	12,486,000
<b>Flood control works on the Bozzente River - Italy</b>	Infrastrutture Lombarde SpA (LSPA)	09/2016	09/2022	Concept and Preliminary Design, EIA	155,000	8,860,236
<b>Flood diversion channel from Gorzone river to Adige river - Italy</b>	Consorzio di Bonifica Adige Euganeo	10/2019	04/2022	Final Design, Detailed Design	272,698	25,652,012
Design of the rehabilitation of Cumbidanovu Dam (Orgosolo) - Italy	Consortium of Central Sardinia	07/2020	01/2022	Final Design	1,155,338	52,665,358
Preliminary design of the upgrade of seven hydroelectric plants in the Trentino Alto Adige Region, Italy	Hydro Dolomiti Energia S.p.A.	02/2019	12/2021	Preliminary Design	692,000	200,000,000
<b>Rehabilitation of Zaffarana Dam – Italy</b>	Water and Waste Department of Sicily	12/2020	06/2021	Management Plan, Detailed and Final Design	95,327	1,377,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Upgrading of the dam of Persano sul Sele (Salerno) - Italy	Consorzio di Bonifica Destra Sele	05/2018	04/2021	Preliminary and Detailed Design	618,748	20,150,000
<b>Detailed Design and Construction Supervision of Arcè Hydroelectric Plant – Italy</b>	Iniziative Veronesi Srl	10/2017	05/2019	Detailed design; works supervision	1,280,000	17,763,000
<b>Detailed Design and Construction Supervision of Settimo Hydroelectric Plant – Italy</b>	Iniziative Veronesi Srl	04/2017	05/2019	Detailed Design; Works Supervision	1,280,000	20,807,000
<b>Flood Control Works on the Agno-Gua' River – Veneto Region</b>	Veneto Region Authority	06/2018	11/2018	Detailed Design	719,375	16,115,343
<b>Detailed design of the hydraulic by-pass spillway tunnel of Noce stream and of the Bisagno river hydraulic spillway tunnel - Italy</b>	Municipality of Genoa	10/2016	07/2018	Detailed Design	854,776	17,429,244
<b>Design of an alternative option for the mitigation measures for flood and hydrogeological risk of the city of Olbia, Italy</b>	Municipality of Olbia	12/2017	02/2018	Preliminary Design EIA	145,365	115,881,396
Tadjoura Port Flood Protection Urgent Works Design and Wadi Walwallè and Tributaries Hydraulic Intervention Model to Enhance The Port Area Resilience - Djibouti	Djibouti Port S.A	02/2017	12/2017	Detailed Design,	97,170	2,060,552

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Consulting Services supporting the Project Management Office (PMO) established under Nangharar Valley Development Authority (NVDA) and Northern Basin Development (NBD) – Afghanistan</b>	ADB – Asian Development bank; Ministry of Agriculture, Irrigation and Livestock – Nangharar Valley Development Authority (NVDA) and Ministry of Energy and Water – Northern Basins Development (NBD)	12/2011	06/2017	Detailed Design, Works Supervision	4,685,893	30,979,939
Due Diligence and Feasibility Study of Pequin Hydroelectric Plant (5.5 MW) along Pequin-Kavaje canal (Tirana) - Albania	AGSM Verona S.p.A.	11/2015	12/2016	Feasibility Study	39,520	15,000,000
Flood Prevention and Remedation Measures Design for the Tagliamento River	Veneto Regional Authority	04/2015	06/2016	Preliminary Design	360,000	154,000,000
Padua – Venice Waterway – Navigable Channel and Spillway of the Bacchiglione Brenta System	Veneto Regional Authority	04/2015	06/2016	Preliminary Design	700,000	330,000,000
Valbona hydroelectric power plant reactivation - Italy	AGSM of Verona – Veneto Region	09/2015	12/2015	Preliminary Design	146,000	69,100,000
<b>Flood control works on the Olona river – Lombardy – Italy</b>	AIPO (Agenzia Interregionale per il fiume Po)	12/2004	08/2014	Concept, Preliminary and Detailed Design; Works Supervision	590,000	10,883,200
San Martino drainage canal (lot n. 2) in the municipality of Apricena (Foggia) – Italy	Moteroc Srl	05/2014	07/2014	Final Design	116,000	2,385,859
Due diligence and feasibility study of the new hydroelectric plant Janiski Otoke in Republika Srpska	AGSM Verona S.p.A.	03/2014	06/2014	Due Diligence, Feasibility Study	45,000	17,700,000
Flood Control Of The Bisagno River - Genova- Italy	Municipality of Genoa	08/2013	04/2014	Final Design EIA	933,777	39,381,706

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Due diligence for the Lukac and Dubrava hydroelectric plants – Bosnia & Herzegovina	AGSM Verona S.p.A.	10/2013	02/2014	Due Diligence	60,840	n.a.
Flood Control Works On The Timonchio River – Veneto Region - Italy	Veneto Regional Authority	11/2010	02/2012	Concept, Preliminary and Detailed Design Works Supervision	1,115,700	24,882,800
Port of Tadjoura - Flood Protection Works – Republic of Djibouti	Ministry of Equipment and Transport - Republic of Djibouti	11/2010	04/2011	Preliminary and Detailed Design	50,000	3,000,000
Misicuni II Project – Dam and ancillary works on the Río Misicuni near Cochabamba: technical assistance - Bolivia	Consortio Hidroeléctrico Misicuni	09/2009	03/2010	Geological, geotechnical, hydraulic and hydrogeological studies	750,000	58,000,000
Flood protection works and infrastructures for the urban area of S. Erasmo (Venice) - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	12/1996	12/2009	Preliminary and Detailed Design	2,145,300	130,000,000
Flood control works on the Bisagno river and on the Fereggiano, Rovare e Noce streams - Italy	Province of Genoa	03/2003	07/2008	Detailed Design, EIA	2,913,000	153,427,600
New Valtrompia Motorway Link: Hydraulic Works (Dredging, Training, Banks Shaping and Flood Control) on the Mella and Grande Rivers, near Brescia	Brescia Padova Motorways Company	06/2002	10/2007	Concept, Preliminary and Detailed Design	99,300	6,622,200
Works to protect and re-define the mouth of the River Adige - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	05/1996	04/2005	Detailed Design	165,000	7,593,900
Arsursuyu Valley - Section 2D Gumusova – Gerede of the Anatolian Motorway Istanbul-Ankara - Turkey	Astaldi-Bayindir AS J.V.	12/2000	12/2002	Preliminary and Detailed Design	90,000	80,000,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Extension of the catchment basin of Lake Trasimeno – Italy</b>	Tiber River Basin Authority	04/1998	06/2000	Feasibility Study, Preliminary and Detailed Design, EIA	755,240	43,898,800
New ferry terminal at Tremestieri (Messina): hydraulic works - Sicily – Italy	Amadeus S.p.A.	11/1998	04/2000	Detailed Design	130,000	4,637,300
<b>Environmental protection of the River Sarca - Lake Garda - River Mincio - Mantuan lakes system - Italy</b>	Po River Basin Authority	02/1996	02/1997	Concept Design EIA	126,000	n.a.
Regimentation of the Alpone river and its affluents - Provinces of Verona and Vicenza - Italy	Ministry of Public Works - Water Board - Venice	09/1994	07/1995	Studies for the hydraulic regulation	48,500	51,646,000
<b>Hydroelectric power plant of Pont Ventoux in Val Susa – Italy</b>	Temporary Association of Spie Batignolles, Grandi Lavori Fincosit, Vianini, Condotte & Partners for AEM (municipal energy company) of Turin	06/1992	07/1993	Final Design	1,187,800	61,974,800
Protection works against landslides in Spriana - Sondrio, Italy	Ministry of Public Works	07/1987	06/1988	Preliminary Design	144,600	3,615,200
<b>Master plans for the Livenza, Lemene and Tagliamento River basins – Italy</b>	Hydrographic Office of the Venice Water Board - Ministry of Public Works	01/1984	12/1987	Studies for hydrology, hydrogeology, hydraulics and water quality	456,186	n.a.
<b>Irrigation schemes for agricultural development at Manatali (Mali) and Boghé (Mauritania)</b>	O.M.V.S. - Organisation pour la Mise en Valeur du fleuve Sénégal with Ministry of Agriculture (Mali) and National Development Co. (Mauritania)	01/1982	12/1986	Feasibility Study, Concept, Preliminary and Detailed Design Tender documents	413,200	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
<b>Study of the possibilities of storing and using surface run-off water for agriculture - Senegal</b>	Ministry of Hydraulics - Senegal (fin. Italian govt.)	01/1983	12/1985	Feasibility Study; Preliminary Design	299,600	10,329,100
<b>Dam on the Gibbesi river in Sicily - Italy</b>	Mazzi S.p.A. for the Sicilian Mines Organization	01/1971	12/1983	Preliminary and Detailed Design	433,800	30,987,400
<b>HYDRAULIC AND HYDRODYNAMIC STUDIES</b>						
Design of the water streams of regional hydrographic network - Italy	CIPNES - Industrial Consortium of Gallura	11/2022	Ongoing	Feasibility Study, Detailed Design	106,500	n.a.
Rehabilitation of Serra del Corvo Dam - Italy	Extraordinary Commissioner of the Government	06/2021	Ongoing	Investigations and studies, seismic revaluation	262,116	n.a.
Framework Agreement for the assignment of professional geological services for plant and network works in the water, energy and environment sectors- Italy	Heratech	04/2021	Ongoing	Geological studies	126,260	n.a.
Hydrological and hydraulic analysis of the watercourses belonging to the water reticulum and of the relative civil works of art of bypassing, along the railway network of Ferroviord - Iseo branch - 30 civil works - lot 3 - Italy	Ferroviord S.p.A.	04/2021	Ongoing	Hydrological and hydraulic analysis	97.072,36	n.a.
Consulting services for the preparation of the general plan for the hydrological protection of the territory of Olbia (Sardinia) - Italy	Municipality of Olbia	09/2020	Ongoing	Master Plan	339,783	n.a.
<b>Program for recovering the reservoirs capacity of dams in: Ponte Pià, Caseres, Pian Palù, Ala e Mori - Italy</b>	Hydrodolomiti Energia – Trento	03/2018	10/2019	Analysis of the sediment accumulation and study of their removal	28,750	1,864,976

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Interventions to mitigate the instability of the hill where the cathedral of Agrigento is located – Italy	Sicily Region	05/2019	02/2020	Final Design and Detailed Design	424,332	19.224.077
Groundwater modelling of the “Fusina” industrial area in Venice harbour - Italy	ALCOA TRANSORMAZIO NI S.r.l.	09/2013	09/2014	Groundwater modelling	79,000	n.a.
Updating of the hydrogeological study of the impact of a containment cut-off wall in the Venice Industrial Harbour of Marghera, Venice – Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	04/2008	06/2012	Groundwater modelling	1,130,000	n.a.
Dewatering and control system for the gate location basin on the seaside at Malamocco Inlet, Venice - Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	02/2011	09/2011	Detailed Design	396,000	n.a.
Master Plan for the morphological and environmental rehabilitation of the Venice lagoon - Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	01/2003	12/2007	Feasibility Study, EIA, Detailed Design	1,210,000	n.a.
ISAP - Research on the sediments and waters in channels of Porto Marghera and the facing areas of Venice lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	11/2006	06/2007	Water and sediment quality study	100,000	n.a.
Modelling the hydro-geological impact of a containment cut-off wall in the Venice industrial harbour of Porto Marghera – Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	12/2003	04/2007	Groundwater modelling	1,053,130	n.a.
Design and implementation of the pumping system to accelerate the consolidation and settlement of an embankment at Malamocco inlet, Venice – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2004	12/2005	Design of the dewatering system	500,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Dry basin at Chioggia inlet for the prefabrication of giant concrete structures to be floated to location for the construction of the flood barriers, Venice - Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	01/2004	12/2005	Design of the dewatering system	1,500,000	66,500,000
Hydrodynamic models for the study of sea tides in the Venice lagoon and further applications - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	09/2001	09/2004	Hydrodynamic modelling	628,500	1,859,200
Dry basin at Lido inlet for the prefabrication of giant concrete structures to be floated to location for the construction of the flood barriers, Venice - Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	01/2002	12/2003	Design of dewatering system	4,700,000	58,200,000
Study of the water resources of the Brenta - Bacchiglione rivers for the river basin master plan - Italy	Isonzo, Tagliamento, Livenza, Piave, Brenta and Bacchiglione River Basin Authority	03/1996	09/2000	Water supply study, proposal of remedial works	72,800	n.a.
Karavasta Lagoon Wetland Management Project - Albania	European Commission - Phare programme	03/1995	12/1996	Technical Assistance	340,000	n.a.
Master Plan for the Piave River Basin: study of the Water Resources: 1st Phase - Italy	River Basin Authority for the Isonzo, Tagliamento, Livenza, Piave and Brenta-Bacchiglione rivers	02/1996	11/1996	Modelling Studies	80,600	n.a.
Study of the water resources of the Piave river for river basin master plan - Italy	Isonzo, Tagliamento, Livenza, Piave, Brenta and Bacchiglione River Basin Authority	02/1996	11/1996	Water Supply Study, Proposal of remedial works	80,600	n.a.
Hydrodynamic study of the lagoon of Mar Piccolo for the establishment of a new fish market – Taranto - Italy	Edilfer S.p.A.	03/1990	07/1990	Mathematical modelling of hydrodynamic conditions	31,000	n.a.



## Appendix A – Company’s Experience

## Water Supply and Sewerage

# FEASIBILITY STUDY OF THE RESTORATION WORKS OF THE CANAL-BRIDGES OF THE ADDUCTOR CALLED "MAIN CHANNEL" OF SELE ACQUEDUCT

Location:	Basilicata, Italy
Client:	Acquedotti Pugliesi S.p.A.
Services:	Feasibility Study
Period:	10/2022 - Ongoing (12/2022)
Construction cost:	€ 17,000,000

## Project Description:

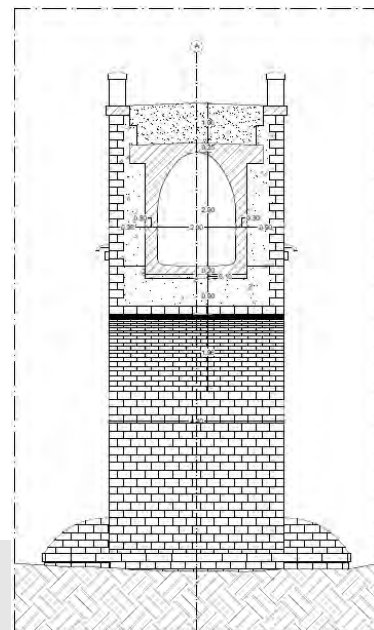
The project focus is the improvement of the hydraulic and structural condition of three canal bridges in operation. Two of the bridges, built around 1910, are on arches (400 and 180 meters) and one is on beams (150 meters), and they transport around 300 liters of water per second.

The project involves the plan and execution of investigations (geotechnical and structural) and surveys, the production of the DOCFAP (evaluations of the possible design alternatives) and the preliminary design. The seismic analysis and design shall be done in accordance with UNI EN 1998 and the technical standards for construction (NTC 2018), with reference to historical buildings with high artistic value.

The team defined structural and geotechnical investigation plans for each bridge. Then a simultaneous specific campaign of survey and visual inspection led to the production of detailed drawings and reports, including a detailed report on damages for each bridge that describes and locates each defect detected outside and inside of the bridges.

The following design phases has required a precise analysis of the surveys, the investigations, and the inspection results, which has led to the formulation and evaluation of possible design alternatives by cost/benefit comparison.

Once selected the optimal solution, the team has provided the design of the works that will stop the leakage and the structural improvement necessary to withstand the seismic actions according to the latest codes and standards.



# DESIGN OF TWO SUBMARINE DISCHARGE PIPELINES IN RIMINI

Location:	Rimini, Italy
Client:	Heratech s.r.l.
Services:	Preliminary and Detailed Design, EIA
Period:	06/2021 - 09/2021 (Preliminary Design) Ongoing (Final Design 06/2022)
Construction cost:	€ 21,000,000

## Project Description:

The project is about the preliminary and final design of the three submarine pipelines for the discharge at sea of the wastewater of a part of Rimini city. These pipelines represent one of the various interventions on the sewerage network of Rimini aiming at solving the problems of an old and inadequate system.

Specifically, the intervention concerns the realization of:

- n. 2 outfall conduits serving the water collection tanks called Colonnella 1 and Colonnella 2, which are side by side and parallel.
- 1 sea discharge pipeline serving the Rodella basin.

The first part of the pipeline crosses the beach, the remaining part is buried on the sea bottom. The two sites, Rodella and Colonnella, are about 2 km apart.

The southern area of Rimini, where the above-mentioned works will be implemented, is equipped with a mixed sewage system where the urban wastewater and the rainwater are collected.

The adopted solution consists in coated steel pipelines with a nominal diameter (DN) of 2000 mm (external diameter = 2032 mm, thickness = 16 mm) which have, each, a terminal discharge system consisting of inclined nozzles for the diffusion of the collected flows into the sea.

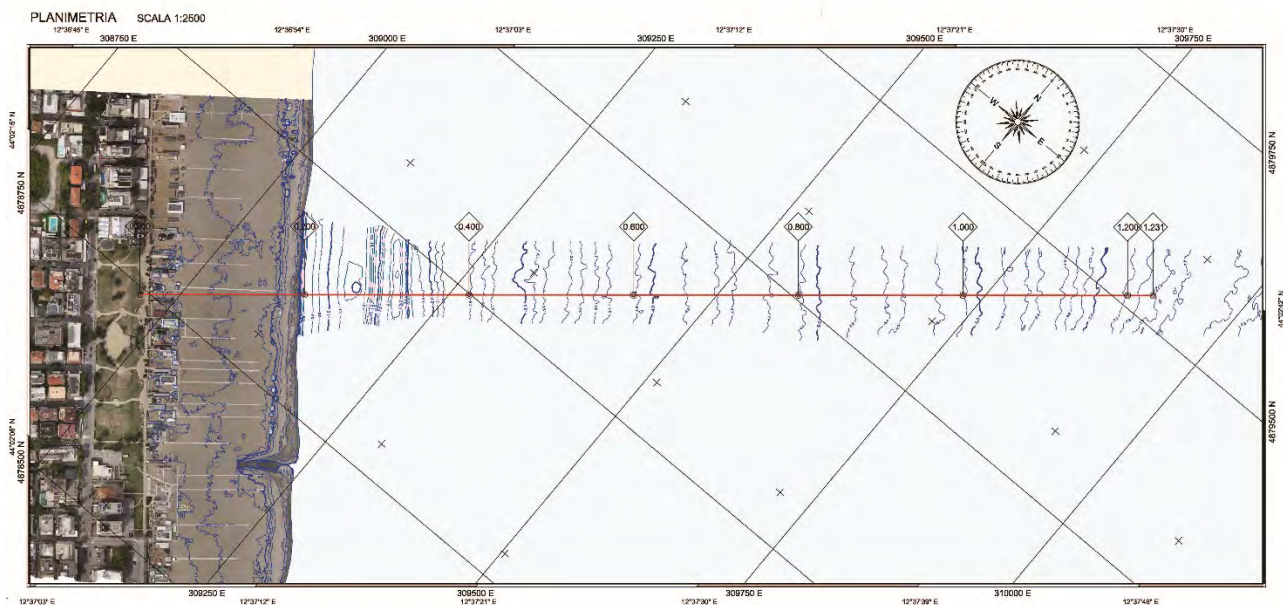
The length of each of the three pipelines in the part on land and on the beach is about 197m. The sea stretches have an extension of about 1151m for the two Colonnella pipelines and a length of 1034m for the Rodella pipeline.

In order not to incur in possible interferences between the discharges for the two parallel conduits of Colonnella, an angular deviation of 30° at about 1076m from the shoreline has been studied in order the conduits to diverge and distance the terminal diffusers of each conduit from each other.

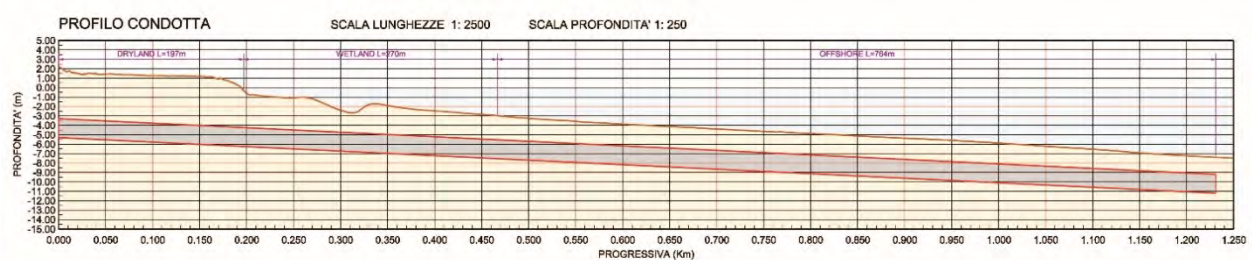
The value of the maximum flow rate discharged to the sea has been estimated in 6 mc/s for each of the two pipelines of Colonnella and 7 mc/s for the pipeline of Rodella.

The pipelines are buried along the entire route, both on the beach and in the sea, with approximately 2m of overburden along the entire length of the pipelines.

The project was prepared in accordance with both current national and local/regional regulations.



Lay out Plan of Rodella discharge



Rodella pipeline alignment section



# PRELIMINARY AND DETAILED DESIGN OF THE WASTEWATER TREATMENT SYSTEM OF GANVIÉ

Location:	Ganvié (Sô-Ava), Benin
Client:	ANPT (Agence Nationale de promotion des Patrimoines et de développement du Tourisme)
Services:	Preliminary Technical Study, Preliminary Design, Detailed Design, Environmental and Social Impact Study (ESIA), preparation of Bidding Documents
Period:	12/2020 – 03/2022
Construction cost:	approx. 27,213,292 €

## Project Description:

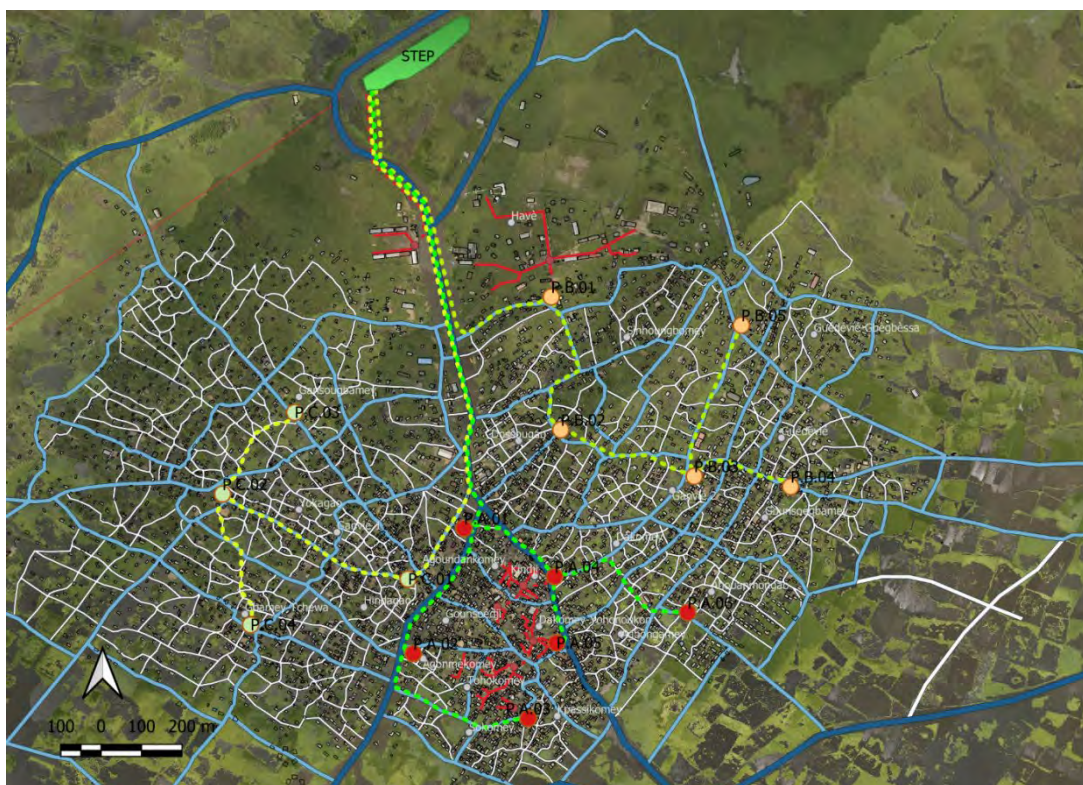
The project "Reinventing the Lake City of Ganvié" is part of the Government's action plan as one of the top priority projects of Benin in the tourism sector. Nowadays, the city of Ganvié consists mainly of stilted houses with a population of around 37.000 inhabitants. The project's objective is the identification of a wastewater treatment system with reference to the future scenario with a resident population of 73.000 inhabitants in 2038, along with a fluctuating tourist population estimated in approximately 11.000 people. The designed works are the following:

Centralised Wastewater Treatment Plant (WWTP): complete treatment system (73.000 PE) with elimination of organic materials and nutrients and final disinfection in compliance with legally binding emission limits. The water line has been designed to minimize the energy consumption and the sludge production. It is structured as follows: Fine screening; Grit removal; Equalisation-homogenization and pumping; Anaerobic treatment UASB; Nitrification, denitrification and dephosphatising with activated sludge; Secondary sedimentation; Chemical disinfection. The sludge line is structured as follows: Pre-thickening; Anaerobic digestion; Post-thickening; Dehydration with belt filter press. The biogas generated through the anaerobic treatment UASB and through the anaerobic digestion of the activated sludge and of the sewage sludge is stored in a gasometer and, after a proper pre-treatment (elimination of humidity, hydrogen sulphide and siloxane), is used for energy recovery (production of electricity and heat) in a co-generation plant.



Collective sanitation system: composed of main collection points (15) equipped with pumping stations which, through successive lifts, are capable to convey the wastewater to the WWTP. The collection points are designed so as to ensure easy construction and adequate integration in the typical local landscape.

Phyto-purification system for individual treatment: including a pre-treatment unit (septic tank) and a treatment unit (phyto-purification with submerged flow, with filter beds or floating beds).



# DETAILED AND FINAL DESIGN OF THE LOW-PRESSURE SEWER FROM GORIZIA TO GRADISCA D'ISONZO (3rd LOT)

Location:	Gorizia Province, Italy
Client:	Irisacqua S.r.l.
Services:	Detailed design
Period:	11/2019 – 06/2021
Construction cost:	7,263,655 €

## Project Description:

The rationalization project of the Gorizia sewage system foresees for the centralization of the sewage system, in order to optimize the treatment system managed by Irisacqua and protect the Isonzo river, which falls within the sensitive area "Draining basin of coastal waters and the Marano and Grado lagoon".

The Isonzo river, declared a sensitive area after the approval of the Area Plan (June 2005), is currently not suitable for receiving the final discharges of the water treatment plants of Gorizia and Gradisca d'Isonzo, unless major structural interventions are carried out on the existing plants. The alternative pursued by the project is the definitive diversion and centralization of the discharges.

The preliminary design project was divided in 3 lots: 1) Enlargement and enhancement of the Staranzano WWTP; 2) Low-pressure sewer from Gradisca d'Isonzo to Staranzano; 3) Low-pressure sewer from Gorizia to Gradisca d'Isonzo.

Technital provides the detailed and final design of the new sewer GFRP DN700 mm (about 12 km long). Services include structural analyses and verifications on steel pipe crossings: the crossing of the Isonzo river by clamping the piping to the deck of the existing bridge on the A34 highway and the crossing the discharge channel of a hydroelectric plant by means of a bridge-tube.



# ENGINEERING DESIGN SERVICES FOR WATER SUPPLY TREATMENT PLANT AND NETWORK FOR PHASE 1 KONZA TECHNO CITY

Location:	Machakos County, Kenya
Client:	DELMA UK (ICM Group); final Client: KoTDA (Konza Technopolis Development Authority)
Services:	Concept/Preliminary, Detailed Design (approved for construction)
Period:	08/2018 - 07/2021
Construction cost:	Cost of works: WTP approx. Euro 16 million; water supply network approx. Euro 25 million

## Project Description:

The Konza Technology City (KTC) is a project of the Government of Kenya (GoK), implemented through EPCF (Engineering, Procurement, Construction and Finance) by the Konza Technopolis Development Authority (KoTDA), under the Ministry of Information and Communication Technology (MOICT). Konza City will be constructed over a 5000-acre land, located approximately 60 Km south of Nairobi Center. The city is designed to allow phased development, and Phase 1 includes various types of land uses and infrastructures that would support future phases of development. The project, implemented through EPCF (FIDIC Silver Book), concerns the development of a new smart technology city of about 28'000 inhabitants.

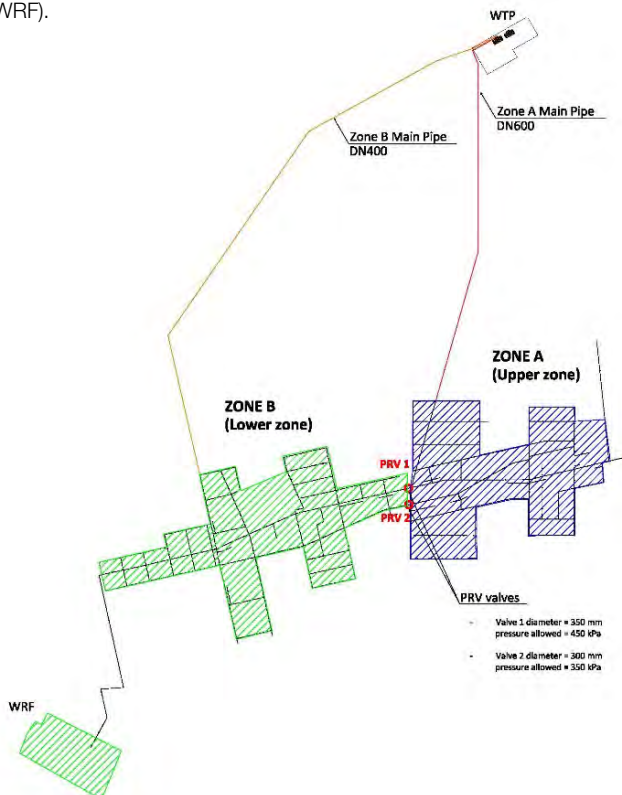
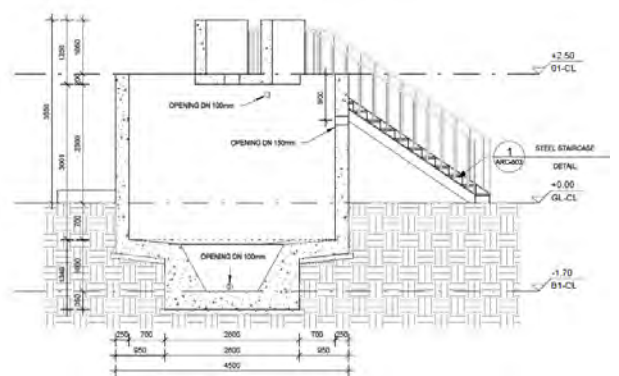
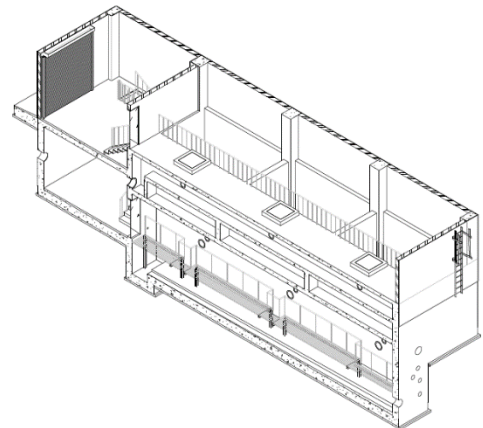
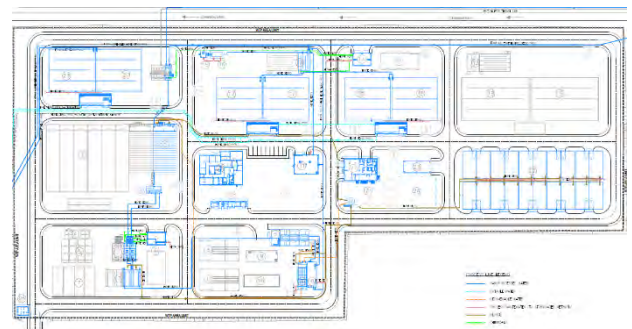
The Water Supply network for Phase 1 comprises two Main Water Lines, from the Water Treatment Plant (WTP), supplying water to the city through approx. 48 km of pipelines spanning from DN160 to DN600 and approx. 2 km of 2" for house connections. Also, it provides water for fire protection too through a widespread network of fire hydrants.

The Water Treatment Plant is designed for Phase 1 (28'000 equivalent population); nevertheless, it allows for future expansion up to the complete development of Konza Techno City (Phase 4 - 182,500 PE). It is designed in compliance with the requirements set out by the National Environment Management Agency (NEMA) in 2006 Kenyan Environmental Management and Coordination (Water Quality) Regulations.

The Water Treatment Plant treats water from different sources: presently from boreholes and Nol Turesh aqueduct, while Thwake Dam will cater for the future development phases. Also, WTP may potentially treat water from the Wastewater Reclamation Facility (WRF).

The WTP includes the following units: preliminary treatment building; pre-sedimentation; coagulation distribution chamber; coagulation; flocculation; coagulant-flocculant storage building; sedimentation; filtration; fresh backwash storage; spent backwash storage; UV disinfection; chemical disinfection; disinfectant storage building; RO feed tank; RO system; potable water storages; non-potable water storage; gravity thickening; sludge drying; dried sludge storage; electrical building; administration building; maintenance & storage buildings; guard house

The instrumentation and control system is integrated into the smart-city concept for Konza.





# CONSULTING SERVICES TO DEVELOP WATER SUPPLY AND SANITATION DISASTER RISK PREPAREDNESS PLAN

Location:	Lusaka, Zambia
Client:	Lusaka Water and Sewage Company Ltd
Services:	Preparation of the Inception Report, Risk Assessment Report, Disaster Risk Management Plan; Completion of final DRMP Report
Period:	12/2018 – 12/2019
Construction cost:	n.a.

## Project Description:

Lusaka Water and Sewerage Company Limited (LWSC) is the main water and sewerage utility and service provider for Lusaka Province. The Company's mission is "to provide quality water and sanitation services at commercially and environmentally sustainable levels to the delight of our customers and other stakeholders". The **Lusaka Sanitation Program (LSP)** is financed by four International Financing Institutions (IFIs) focusing on the upgrade and expansion of sanitation facilities within the city of Lusaka. The four IFIs are the African Development Bank (AfDB), the World Bank (WB), the German Development Bank (KfW) and the European Investment Bank (EIB). LSP aims to **increase access to sustainable sanitation services to Lusaka's residents especially the urban poor and strengthen LWSC's capacity to manage sanitation services**. The program aims at addressing one of Zambia's most **binding** constraints to economic growth through infrastructure investment in Lusaka, the rapidly urbanizing capital.

This consultancy is focused on two of the four main components of the program:

### Component I: Climate resilient Sewerage Infrastructure Development

### Component II: Decentralized Sanitation and Hygiene Education

The **main objective** for water managers is to ensure or maintain an adequate level of service, that is to say, 'service-ability'. Serviceability requires taking into consideration not only the characteristics of flood events (hazard probability and intensity) but also their consequences on the urban receiving environment (vulnerability, elements at risk). The **specific objective** is to prepare the Water Supply and Sanitation Sector Disaster Risk Management Plan, which will strengthen institutions, mechanisms and capacities at all levels, in particular at the community level that can systematically contribute to building resilience to hazards and disasters.



The **scope** of the consultancy will include, but not limited to the following tasks:

- Assess all potential natural hazards and disasters triggered by climate change that are likely to affect the infrastructure and the communities
- Estimate the extent of damage resulting from such disasters to the infrastructure and surrounding communities.
- Identify the various sector institutions and the level of preparedness to deal with the natural hazards and disasters likely to affect the infrastructure and surrounding communities.

- Identify the institutional capacities that require strengthening in order to effectively address the negative effects of climate change.
- If necessary, propose alternative institutional arrangements (including their terms of reference) that can best respond to the disasters especially at a community level.
- Identify the communities which are at higher risk of exposure to these disasters and propose the short and long term interventions necessary to counter the effects.
- Develop a comprehensive Disaster Risk Management Plan (DRMP) that will adequately respond to the identified potential natural disasters.
- Provide a mechanism and an outline of activities detailing how the DRMP will be effectively implemented.
- Develop an integrated disaster risk management information and communication system in order to enhance timely decision making on the project, including emergency communication methods (alert protocols) available and accessible to the Disaster Management Committees (DMCs).
- Prepare a Disaster Management Operations Manual (DMOM) to guide key institutions achieve the best and proactive disaster management practice across the sector.

### Description of actual services provided within the assignment:

- Preparation of the Inception Report
- Preparation of The Risk Assessment Report
- Preparation of The Disaster Risk Management Plan
  - Completion of final DRMP Report
- Activities After Risk Measures
  - Calculating residual risks to identify which areas focus when developing the DMOM
  - Conduct Occupational Health and safety training workshop
  - Conduct Domestic Water Treatment Training
  - Conduct DRR Awareness Campaigns
- Activities for Preparation of the DMOM Report
- Submission of Integrated Disaster management and Risk information system
- The services provided include data collection, data analysis, organization of workshops and consultations with the stakeholders, trainings for all the stakeholders (institutions, communities, technicians, etc.).

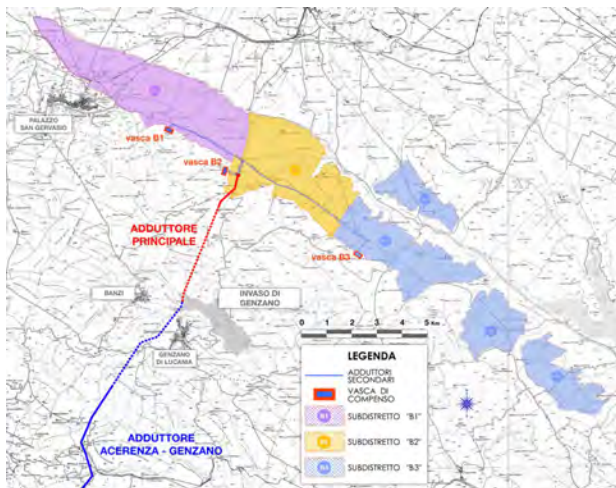
# BASENTO-BRADANO WATER SCHEME – ACERENZA SECTION DISTRIBUTION - BANZI, GENZANO, PALAZZO S.G. AND IRSINIA

Location:	Basilicata Region - Italy
Client:	The Authority for the Development of Irrigation and Land Transformation in Apulia, Lucania and Irpinia (E.I.P.L.I.)
Services:	Works Supervision
Period:	08/2013 – 09/2019
Construction cost:	€ 73,000,000

## Project Description:

The project concerns the construction of water supply and distribution works for irrigation purposes within the Basento - Bradano water framework and it covers various municipalities of the Bradanese plateau (about 5.200 hectares in the Province of Potenza – South of Italy).

The area is located in the plain of the Basentello valley, on the right bank of the river, starting immediately upstream of the Serra del Covo reservoir, going up to the immediate vicinity of the urban settlement of Palazzo S. Gervasio. The altitude ranges from a minimum altitude of 350 m to l.m. at a maximum altitude of 430 m s.l.m.



The works include a bored tunnel of about 4 km excavated with a TBM, a system of main distribution pipelines of about 12 km with 3 compensation basins connected with each other, and a distribution network of about 320 km.

More in details the features of the adduction works included in the project can be divided into:

### Main Adduction Works

- Cut and cover tunnel by Acerenza  $\varnothing$  3,200, maximum capacity 10.8 mc / s;
- Cut and cover tunnel to and from the Genzano reservoir  $\varnothing$



3,200, maximum capacity 10.8 mc / s;

- Hydraulic distributor Porter and tower in Genzano;
  - Tunnel  $\varnothing$  3,200, maximum capacity 10.8 mc / s;
  - Tower and disconnection tank on the Marascione ditch;
  - Guard house;
  - Steel roof conduit  $\varnothing$  3.000, maximum capacity 10.8 mc / s;
  - Underground conduit.  $\varnothing$  3,000, max. capacity 10.8 mc / s;
- Hydraulic distributor in Marascione.



### Secondary Adduction Works

- Adductor B1 to the centrifugal V1- PRFV.  $\varnothing$  800, maximum flow rate 0.407 mc / s;
- Adductor B2 to the centrifugal V2-PRFV.  $\varnothing$  600, maximum flow 0.315 mc / s;
- Adductor B3 to the centrifugal V3- PRFV.  $\varnothing$  900, maximum flow 0.558 mc / s;
- 3 compensation basins for a total of about 50,000 cubic meters
- Pumping stations for the compensation basins.

### Distribution works

- Distribution network for the various sub-district for a total of 320 km of minor pipes.

The tunnel has a length of about 4000 m and is characterized by a constant slope of 0.2% which will allow to transport the water



collected at the Genzano entrance towards the Marascione entrance for a maximum capacity of 10.8 mc / s. The tunnel is characterized by a variable coverage (Hmax = approx. 140 m) and during operation it will be subjected to an internal hydraulic pressure of about 1 bar. The excavation takes place by means of a shielded TBM.



# VACUUM FOUL SEWERAGE NETWORK AND STORMWATER SYSTEM OF THE PORT OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Coordination of all the surveys and investigations (topography, geophysical inspections, tests with tracer flows), Preliminary and detailed design, works Supervision
Period:	02/2004 – 12/2008 (Preliminary and Detailed Design) – 02/2018 (Work supervision)
Construction cost:	€ 5,533,733

## Project Description:

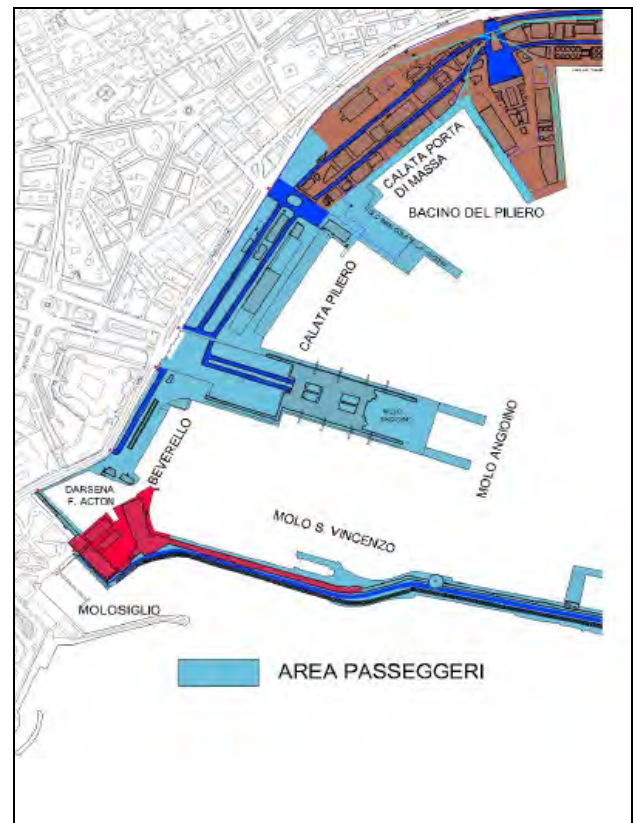
Within the general project of reconstruction of the sewerage network of the Port of Naples, a special project has been undertaken for the first part of the harbour, the commercial and tourist part, which is located between “Calata Beverello” and “Calata di Villa del Popolo”. The project concerns the design of a vacuum foul sewerage system for the area of interest, and the reconstruction/improvement of the existing storm water sewage network.

The vacuum system is composed of a main network of HDPE pipes, with an average operating vacuum of -40 kPa/-70 kPa provided by 3 vacuum pumps placed at the end of the network. The pipes are characterised by positive and negative slopes, in the typical scheme of a water supply network. The main network is connected to a smaller secondary network to which all the houses/offices are connected, through a vacuum valve for every 50 equivalent inhabitants, likewise operating in vacuum regime.

The vacuum valve is placed inside a gathering concrete duck’s nest, which is maintained at atmospheric pressure and in which all the wastewater is conveyed from the building pipes: when the minimum required vacuum of -15 kPa is reached, and when 40 litres of wastewater are gathered in the duck’s nest, a pressure water level pipe activates and opens the valve, so that at least the 40 litres of wastewater are sucked into the network, carrying with them also a volume of air; when the volume of air passes through the valve, the valve itself goes into atmospheric pressure condition, and then closes automatically until the required conditions are re-established.



The gathered wastewater is sent within three minutes to a vacuum station, where normal pumps send it on to the final place of disposal, which is the new wastewater treatment plant designed in the other part of the general project for the reconstruction of the sewerage system of the Port of Naples. The storm water of the commercial/tourist area of the port has been reconstructed or newly designed, in order to partly reuse the existing concrete mixed sewerage network where possible, and to provide new storm water sewer lines in those areas which do not have any.



# SEWAGE NETWORK AND WASTE WATER TREATMENT PLANT IN VICENZA

Location:	Vicenza - Italy
Client:	Viacqua S.p.A.
Services:	Detailed Design, EIA
Period:	09/2015 – 09/2017
Construction cost:	€ 75,965,000

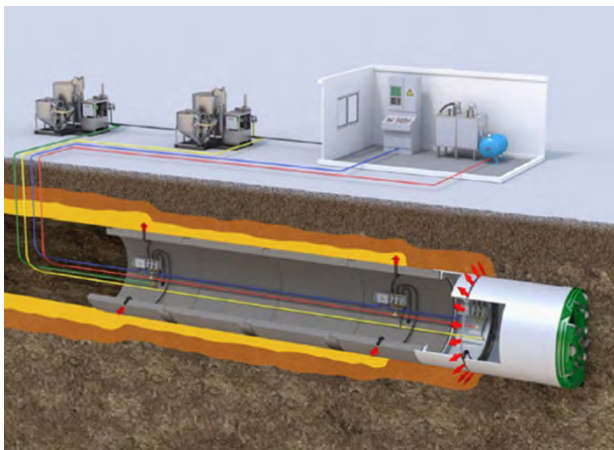
## Project Description:

The project is for the rationalization of the sewage system and centralization of the wastewater treatment of the city of Vicenza in the north of Italy.

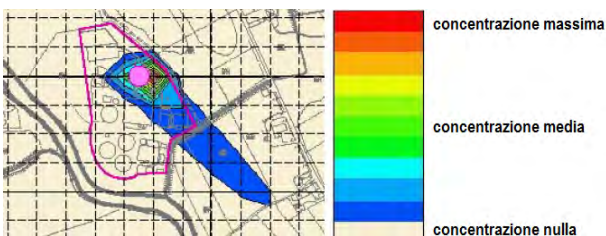
The project includes:

- (i) the expansion of the wastewater treatment plant (WWTP) of Casale (City of Vicenza), from 92,000 equivalent inhabitants to 240,000 equivalent inhabitants;
- (ii) the conversion of the WWTP S. Agostino (100.000 equivalent inhabitants), with adjustment of the electromechanical works of the existing water-pump and the construction of a new interception device for the incoming collectors and a new primary treatment and pumping system (up to  $3Q_m = 3,350 \text{ m}^3/\text{h}$ ) to Casale, and the treatment of overflow water;
- (iii) the connection between S. Agostino and Casale with a 5.5 km pressure forcemains (double pipeline ductile iron DN 600);
- (iv) the decommissioning of n. 6 minor WWTPs (from 1,100 AE to 22,000 AE), with the construction of the same number of pumping stations (plus 3 intermediate) to the existing network: pipelines in ductile iron (6.5 km DN 400 / 500) and in HDPE (5.7 km from DN 200 / 225).

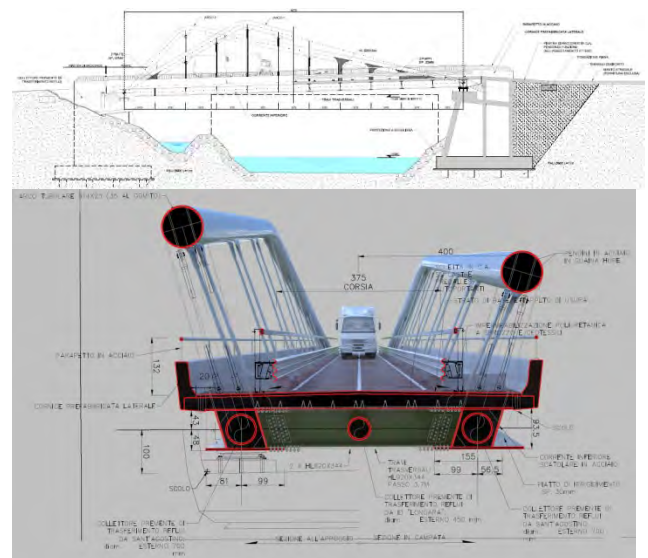
The design has dealt with the physical constraints of the morphology of the territory (8 crossings of watercourses, 770m micro-tunneling DN 2500 mm of the Berici hills, 480m of double DN 600 Horizontal Directional Drilling).



The design has also dealt with the anthropic infrastructures (2 crossings of the A4 motorway, 4 crossings of regional roads and provincial, 2 rail crossings) and resolution of different interferences (storm drainage, sewage, aqueduct, gas, military oil pipeline, liquid oxygen pipeline, telecommunications, power lines).



The main objectives included the optimization of pipeline tracks, in terms of: pipeline length, constraints, expropriation / occupancy charges, access during execution and maintenance, curves and special pieces minimization; technical-economic optimization of pumps / pressures; improvement of hydraulic functioning; analysis of piezometric profiles and water hammer analysis and mitigation.



The company has also carried out the Environmental Impact Assessment (EIA) of the extension of the City of Vicenza WWTP. The EIA has included the programmatic reference frameworks, project reference and environmental reference, with the evaluation of the impacts on the atmosphere, soil and subsoil, surface and underground waters, noise, vegetation, flora, fauna and ecosystems, landscape, socio-economic aspects.

# OPTIMIZATION OF SEWERAGE NETWORK IN THE DISTRICT OF VALPANTENA

Location:	Valpantena (Verona) – Italy
Client:	Acque Veronesi – Provincial Water management authority
Services:	Prefeasibility study; Preliminary, detailed and final Design; EIA
Period:	06/2010 – 08/2014
Construction cost:	€ 12,066,726

## Project Description:

The district of Valpantena was provided with a primary pipeline of combined sewerage network (length 16 km), which serves the following towns: Dorighi, Bellori, Lugo, Stallavena, Grezzana, Marzana, Quinto and Poiano.



Originally, all the secondary networks were of mixed type, and only Marzana and Quinto were provided with separated foul and surface drainage sewerage systems. The sewage was conveyed to the wastewater treatment plant of the city of Verona.

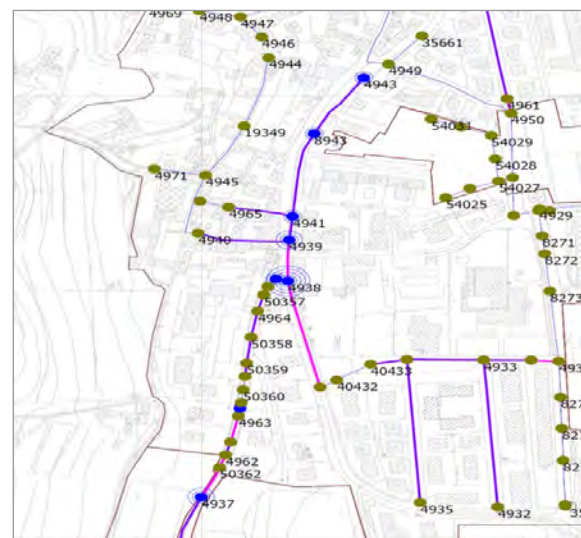
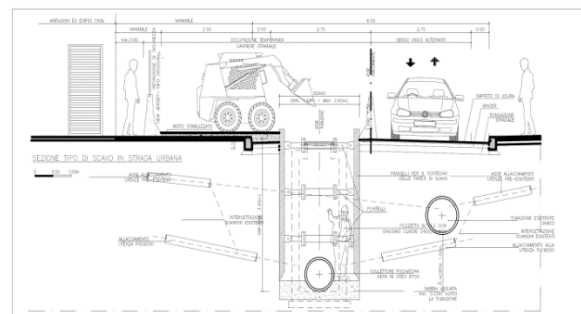
This situation required the optimization of the sewerage network through the study of four design options:

- Option 1: strengthening and upgrading of the existing primary pipeline (Total length of intervention: 13 km);
- Option 2: separation of the two networks, the main collector and the secondary pipelines. Upgrading of the existing network to be used as the new surface drainage sewer and realization of a new foul sewerage network. (Total length of intervention: 48 km)
- Option 3: separation of the two networks, the main collector and the secondary pipelines. Upgrading of the existing network to be used for foul sewage and realization of a new surface drainage sewerage network. (Total length of intervention: 43 km)
- Option 4: separation of the two networks, as follows:

Main Sewer: upgrading of the existing network to be used as the surface drainage sewerage and realization of a new foul sewerage network;

Secondary Networks: upgrading of the existing network to serve the foul sewage and realization of a new surface drainage sewerage network (Total length of intervention: 4 km).

Based on this sensitivity analysis of the facts, the client will choose the solution to be developed in subsequent phases of the project (preliminary, final and detailed design).



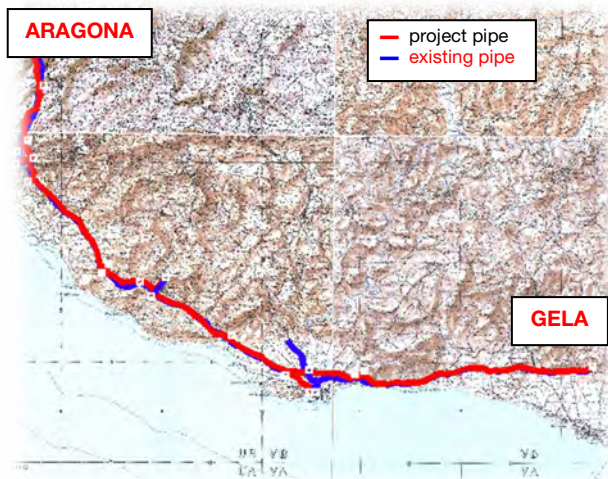
# SUPERVISION OF WORKS FOR THE RESTRUCTURING OF THE GELA – ARAGONA AQUEDUCT (89.5KM)

Location:	Sicily, Italy
Client:	Sicilia Acque S.p.A.
Services:	Supervision of Construction
Period:	10/2007 – 03/2014
Construction cost:	€ 86.892.500

## Project Description:

The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela. The water is desalinated in the desalination plant inside the Gela petrochemical complex and subsequently mineralised. By means of a series of pumping stations the potable water (approx. 500l/s) is conveyed to Licata, Agrigento and Aragona, at an elevation of +500 m a.s.l.

The project consists in the renewal of the entire water supply main, replacing the existing fibreglass piping with a spheroidal cast iron pipe, and a general modification of the hydraulic scheme of the main conveyor (81.8 km), with the introduction of 3 tanks in tunnels along the line and booster type pumping stations instead of the existing ones with multistage vertical axis pumps and collecting tanks.



The new water supply system, which will also be connected to the water supply system of Favara di Burgio, the Voltano aqueduct and the conduit from the Blufi dam, can satisfy the potable water demands of the entire south-central area of Sicily. The tanks in tunnels, which have a total capacity of over 20,000 m<sup>3</sup>, can provide not only a daily but a seasonal regulation of the water supply. Moreover, the tunnels allow the temperature regulation of the water supply which tends to be rather high owing to the desalination system (multi flash) used upstream

The booster type pumping stations with revolution gage to control the parallel pump groups permits the optimization of the pumps' operation, minimizing energy waste and protecting the piping against water hammer phenomena due to sudden pump arrests.

The design system offers great reliability in terms of durability of materials (spheroidal cast iron instead of fibreglass), protection against irregular movement phenomena (inverter and revs gage) and general redundancy of the system (interconnection of the conduits and parallel pumps).

Furthermore, for the energy point of the view the operation of the whole system has been optimized, allowing significant savings with respect to the present situation.

Technital executed the services in association with Studio Altieri (lead company), SIS and Omniservice, Technital's share being 50%.



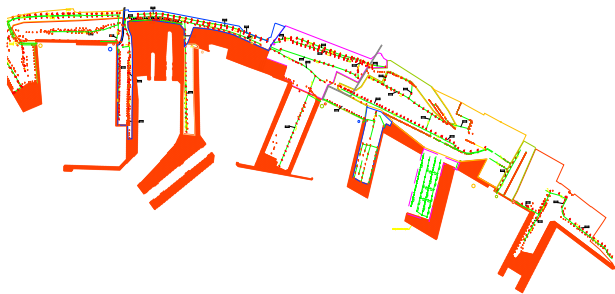
# RECONSTRUCTION OF THE SEWERAGE NETWORK OF THE PORT AREA OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Coordination of all the preliminary studies, surveys and investigations, Concept and Preliminary Designs. Construction Supervision
Period:	02/2004 – 05/2013
Construction cost:	€ 18,498,796

## Project Description:

The project regards the complete reconstruction of the sewerage network for the port of Naples, from Calata Villa del Popolo to Calata Petroli. The existing sewerage collection system of the port mixes the civil and industrial discharges with the rainwater collected in the gulleys of the roads and yards.

Furthermore, the port area is crossed by some major emergency discharge conduits of the city of Naples, which come into operation when the city's pumping stations cannot handle all the sewage collected in the urban (mixed) sewerage network and convey it to the treatment plants.



The first part of the task entrusted to TECHNITAL consisted in an investigation aimed at defining the present situation of the existing sewerage system, including the layout of the sewers and the location of all the related structures (pits, gullies, tanks, etc.).

This investigation is carried on by site topographical surveys, visual inspections, geophysical investigations e.g., con geo-radar, use of tracer flows.

The second part of the contract concerns the verification of the existing network and, consequently, the design of new networks where the existing one presents some fails. The design network will be divided into a storm water network, which will be based on the existing mixed network shape, and will collect rainwater and discharge the storm water, after de-oiling treatment, into the sea; the foul water network design, instead, will be completely new, and the new network will convey the sewage from all the civil activities to a new treatment plant located in the port.

The contract therefore includes the concept and the preliminary designs of the new, divided sewerage system, which will transform and improve the existing mixed sewerage network into the new storm water sewerage network and will provide a completely new foul sewerage network.

The contract was carried out in association with Acquatecno, Sistemi Integrati and Sisipi Progin. TECHNITAL's share of the contract was 35%.





# STORM WATER SEWERAGE NETWORK IN THE TOWN OF CONVERSANO

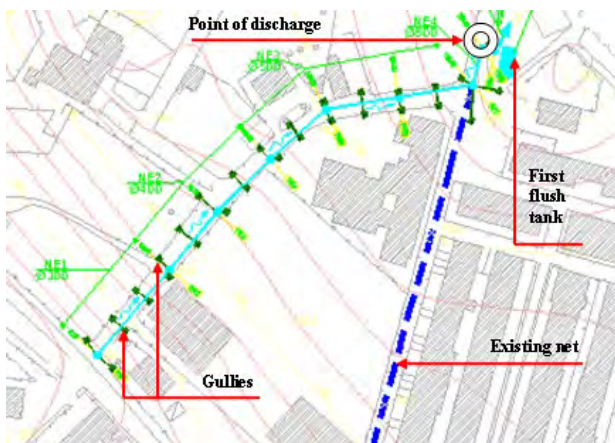
Location:	Conversano (Bari), Italy
Client:	Municipality of Conversano – Local town Authority
Services:	Detailed design, Construction Supervision
Period:	02/2008 – 04/2013
Construction cost:	€ 1,509,171

## Project Description:

The town of Conversano was provided with partial storm sewerage network, which was even totally absent in certain parts of the town. The previous system of bar screens, pipelines and gullies directed the storm water towards some drainage wells, arranged in various parts of the town and provided with different diameters and depths. To integrate this situation, it was necessary to design new and more complete parts of the storm sewerage network towards the town.



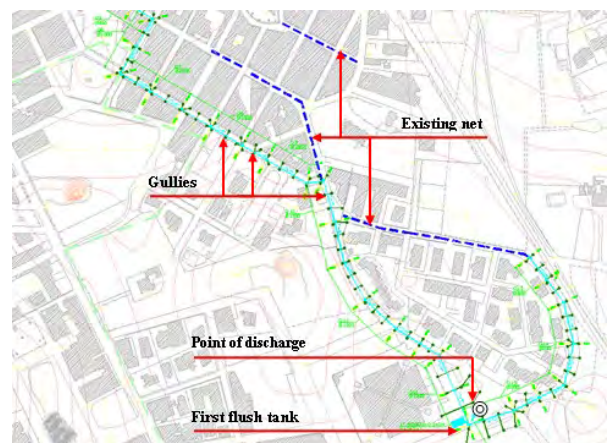
The entire area of intervention was restricted to two main zones, denoted as the "North-East part" and the "West part". In particular, it was necessary to design a completely new sewerage network, thus connecting the main square of the town with these 2 zones, where the new drainage open cuts are supposed to be dug.



Both the zones were designed to host a single pipeline, with gullies disposed along its length every 5-10 meters. Unfortunately, the conformation and the spatial disposition of the streets prevented the laying of secondary pipelines along smaller streets. Both the lines present these common aspects:

- *First-rain collection tank*: water coming from the main pipeline runs through a couple of catch basins, to consequently arrive in the first-rain tank, placed below ground level and covered with a concrete pavement.
- *Floating valve*: this is a particular control setup of the first-rain tank so that, in case of a surplus of storm water coming from the main pipeline, and consequent total filling of the tank, the entrance gate of the tank itself is closed by the valve.
- *Oil-filter tank*: this part of the first-rain tank, situated at the end of it, is designed to separate oils and hydrocarbon compounds from the water.

*Drainage open cut*: after being separated from oils and other polluting compounds, water arrives in these drainage points, dug quite far from the centre: this decision derives from the need to have enough space to arrange together all the final parts of the network, a target impossible to achieve in the middle of the town. These drainage open cuts, which substitute the previous drainage wells, which were decidedly inefficient, allow water to finally reach the natural ground.



# CONCEPT DESIGN OF ROADS & INFRASTRUCTURES - PHASE 2: DRAINAGE WORKS

Location:	Doha, Qatar
Client:	Urban Planning & Development Authority (UPDA)
Services:	Topographic Surveys - Geotechnical Investigations - Drainage Design - Utilities relocation - Specifications and Cost Estimates
Period:	04/2009 – 01/2012
Construction cost:	€ 1,550,000,000 (overall project)

## Project Description:

The project scope comprises the full design of eight packages within the State of Qatar with a total area of 30 sq. km. and a *total length of roads equal to approximately 385 km*. The project scope also comprises the assessment of the environmental impacts and the definition of the mitigation measures and of the monitoring activities to be performed in the later design stages.

Packages 7, 8, 11, 14 and 17 are empty areas which have been recently sub-divided into residential areas with small commercial outlets. These areas will require complete infrastructure and roads design.

Packages 9, 12 and 13 are densely populated areas with commercial streets located in the heart of the city and will involve major redevelopment.

The project includes, in general, the following activities:

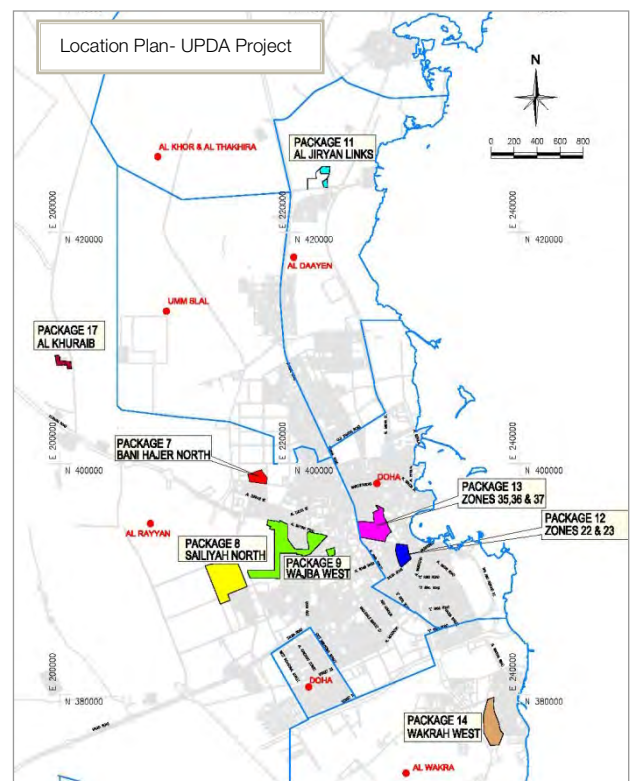
- Master Plan;
- Transportation Master Plan of Qatar and Sub-Area Models;
- General Traffic and Zones Development for 20 years extension;
- Traffic Modelling and Study;
- Hydrological study;
- Study & Evaluation of Foul Sewerage, Treated Sewage Effluent, Storm Water Drainage and Irrigation Systems;
- Topographical and Geotechnical (pavement, materials) Study;
- Environmental Impact Assessment;
- Design of Roads and Infrastructures.

The infrastructure works will consist of urban redevelopment of areas, such as change of the residential area land use from single family villas to multi-storey to higher (G+7) buildings which will induce a remarkable increase in the traffic generation and changes to drainage systems.

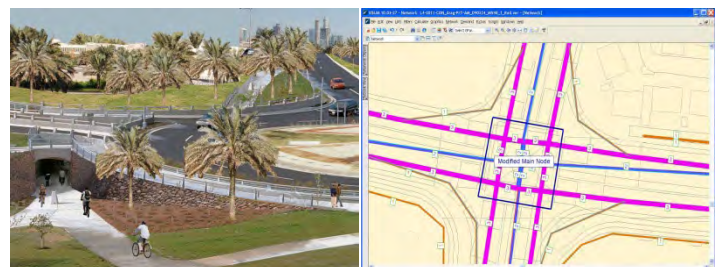
The project is located in 8 different areas across the state of Qatar. The scope of work incorporates the design of stretches of road linking into subdivisions and adaptation to the existing and future requirements and ongoing projects adjacent to the project area. The Project area comprises 2932 ha.

The required works includes the following elements:

- Services investigation;
- Ground investigation;
- Topographic surveys;
- Environmental investigation (air quality, noise, soil and groundwater, terrestrial ecology);
- Traffic surveys/ traffic impact analysis;
- Road network and road corridor plans;



- Detailed Road design;
- Surface water drainage design;
- Foul Sewage
- Treated sewerage effluent (T.S.E);
- Environmental Impact Assessment Study
- Street lighting design and
- Landscaping design.



Grade – separated Roundabout & VISUM Model bikeway crossing

The project is divided into stages:

- Conceptual design Options and presentation of concept options;
- Concept design; and
- Cost Estimates.



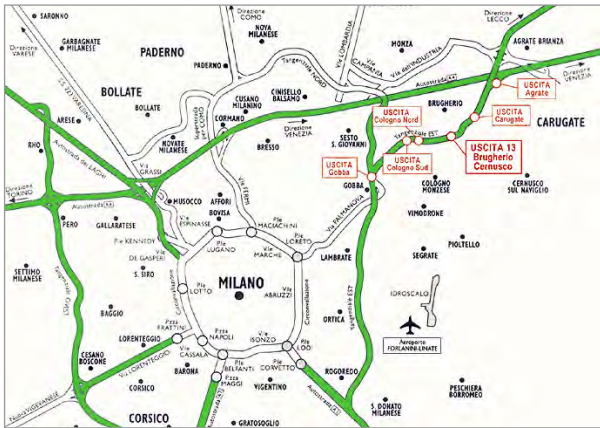
Typical Road Section

# DRAINAGE SYSTEM FOR THE EXTERNAL EASTERN BYPASS OF MILAN (T.E.E.M.)

Location:	Milan, Italy
Client:	Concessioni Autostrade Lombarde (Motorway Concessionaire for Lombardy Region)
Services:	Final Design, EIA
Period:	07/2009 – 08/2011
Construction cost:	€ 34,487,850

## Project Description:

The storm water drainage system was conceived and designed in order to protect the environmental quality of the precious hydrological system crossed by the design motorway. The surrounding areas are, in fact, crossed by a large drainage network formed by a great quantity of rivers.

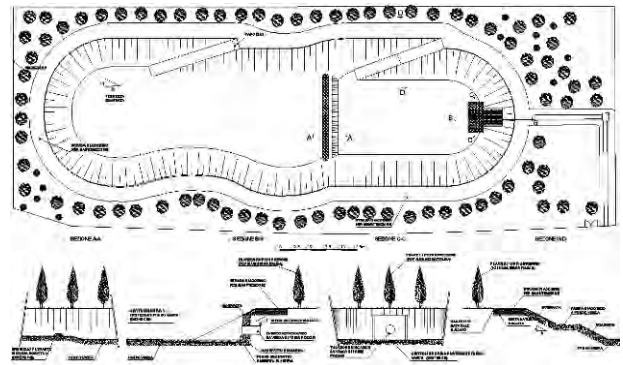


In order not to modify the hydrologic regime and the water quality in the existing rivers, which will host the collected water from the motorway surface, the collection scheme included some first flush treatment plants (approximately one plant every 1 km along the motorway), for the treatment of the polluted first flush of storm water and also for the lamination of the flows conveyed to the final disposal points.

The design was developed with the creation of typical drawings and plans showing the location of all the elements involved in the collection and treatment of the storm water, namely:

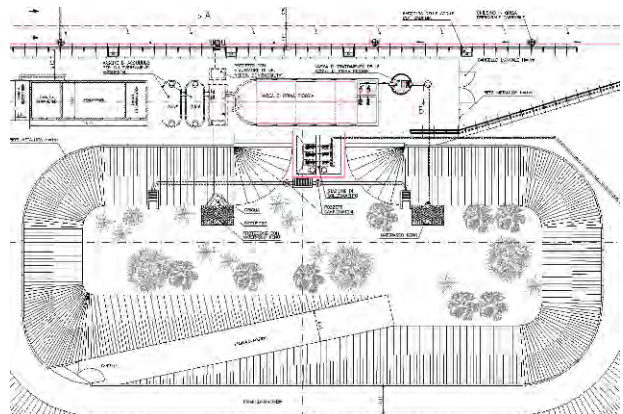
- parts for the collection and conveyance;
- lamination tanks obtained with ground stripping, and connected pumping stations;
- retention treatment tanks for the first flush storm water.

The hydraulic scheme for the collection and conveying of the roadway runoff water changes with the level of the motorway, which means that the scheme for the parts of the motorway in cuttings is different from that of the sections which are on embankments above the average ground level of the surrounding area. In the first case, the sewers collect the entire amount of the surface runoff water through a triangular gutter with area drains placed at fixed intervals, from which the water is conveyed to main pipes below the motorway level. In the lower points of the road profile, flood attenuation tanks were designed, with a bottom lining inside the tank made of stones and plants, thus giving the lamination tank a role similar to phyto-depuration tanks.



The scheme for the embankment parts presents two distinct series of pipes ensuring the perfect division of the first flush from the rest of the rained volumes. The collection structures on the sides of the road are designed to collect only the first flush and direct it to the pipe below the road surface, while the remaining volumes overflow down the embankment through little open culverts to a dispersion trench at the bottom of the levee. Once the first flush is over, the remaining volume raining on the road will be collected into the manholes with spillways in case of overflowing.

Some phyto-depuration basins were designed at the discharge of the first flush treatment plants, in order to enhance the water treatment and improve the water quality conveyed to the final places of disposal, namely the rivers around the motorway.



The contract was carried out in association with S.I.N.A., S.P.E.A., Milano Serravalle, Girpa, and Proiter. TECHNITAL was the lead company in the association and the firm's share of the contract amounted to 40%.

# CONSTRUCTION SUPERVISION OF THE INDUSTRIAL INTERCHANGE: DRAINAGE WORKS

Location:	Doha - Qatar
Client:	Ministry of Municipal Affairs & Agriculture - Roads Affairs Department
Services:	Works Supervision and Site and Quantity Surveying
Period:	08/2006 – 03/2011
Construction cost:	€ 150,000,000

## Project Description:

The project works are located in Doha city and consist in the upgrading to a 4-level interchange of the existing Salwa Road / East Industrial Road / Al Furosiya Street Junction, otherwise known as the "Industrial Roundabout".



The works include the construction of the following Drainage Systems:

- Surface water drainage (including microtunnelling (approx .length of 2.4m internal dia pipe 9,000m) The pipe is located at average depth of 20m, total volume of excavation is approximately 40,000 m<sup>3</sup>)
- Earthworks
- Sewerage
- Storm water pumping station.

The construction of the interchange modified the existing utilities of the area, such as foul sewerage, water, electricity, TSE and stormwater. The design focused to replace all the utilities intercepted, and in particular the foul sewerage and storm water systems. For the sewerage all the house connections intercepted were replaced and the collector pipes which gather all the dwellings and dispose to the main trunk.

The project area was not provided with a positive system for the surface water drainage, since the existing system was base on soakway and trench soakway. The surface water use to be drained into the manholes and infiltrated into the ground. Due to the raising of the ground water around Doha, infiltration systems are no longer recommended, and a pipe network system was provided. The interchange storm water network was connected to the Abu Hamour network (ABHO), which was design to drain half of the city. The ABHO disposes into the sea. The construction of the ABHO is not completed yet and the design of the Industrial interchange included the design a 2.4m diameter microtunell, which is part of the main trunk of the ABHO. The surface water network was connected to the main ABHO.

The supervision team for the drainage works consisted of the following:

- 1 Resident Engineer
- 1 Materials Engineer

- 1 Drainage Engineer
- 1 Quantity Surveyors
- 1 Planning and Schedule Engineer
- 2 Site Inspectors (materials, drainage).



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- 2 Site Inspectors (materials, drainage).



The services provided by TECHNITAL included:

- a. General supervision, including design checks and the proposal of any necessary alterations to the design
- b. Site supervision, including reviewing and assessing the Contractor's work, preparing all necessary reports, records, cost estimates, variation orders, certificates, etc.

- c. Quality Assurance, including monitoring of laboratory test activities, checking the Contractors' materials and equipment, etc.
- d. Post-Contract Quantity Surveying including monthly checks on works completed, monthly schedules and evaluations, records of materials deliveries, plant and manpower, etc.
- e. Project Management, including dealing with claims and outstanding works during the construction contract maintenance period.

The Contract was administered in accordance to the FIDIC Rules (Red Book). The Consultant's Resident Engineer has assumed the role of "Engineer's Representative, the "Engineer" role being kept by the Director of Roads/Drainage Department of the Ministry.



# DESIGN OF REVAMPING AND RESTORATION OF THE PUMPING SYSTEM FOR EMPTYING THE “MEDIUM” DRY DOCK OF THE ARSENAL OF VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice
Services:	Preliminary and Detailed Design
Period:	03/2010 – 11/2010
Construction cost:	€ 1,810,000

## Project Description:

The northern area of Venice Arsenal is a key site for the management and maintenance activities for the MO.S.E. (flood protection) system of Venice lagoon. The area is currently used for ship maintenance and docking operations and is provided with two dry docks (“medium” and “large” dry dock) suitable for the unloading operations of the barriers.

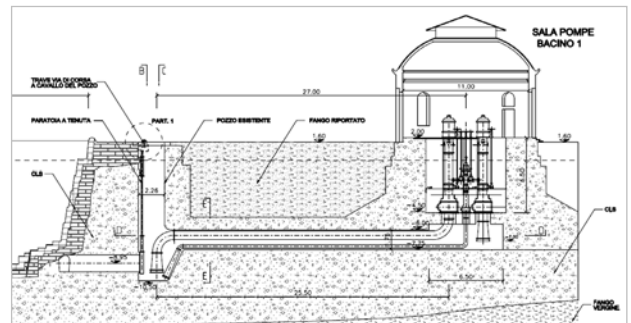


The structures in the northern area of the Venice Arsenal, including the medium dry dock and the pumping system for emptying it, have an architectural and artistic value since they were built in the 19th century.

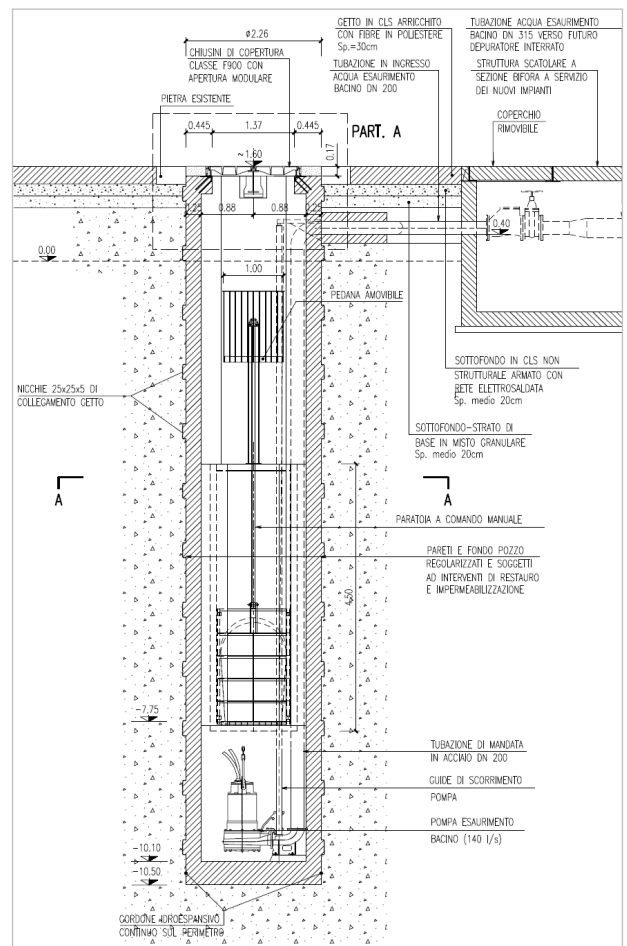
The emptying system of the “medium” dry dock was based on two vertical pumps with a flow discharge of 2,500 m<sup>3</sup>/h each: by a system of iron pipelines (s = 700 mm), the pumps took the water from the bottom of the dry dock (-9.00 m, measured on the mean sea level) to the Lagoon. The pumps and the connected pipes and valves system, installed in the earlier part of the 20th century, had many problems like corrosion, leakages and mechanics frictions that involved a sensible reduction of the pumped flow and hence longer times for emptying operations.

In order to reduce this time and improve the reliability of the system for the medium-long term period, the old pumps and the pipeline system were removed and new vertical pumps with a 5.300 m<sup>3</sup>/h each flow discharge, were installed. The pumping system was also provided with a small auxiliary pump (350 m<sup>3</sup>/h) and a vacuum priming pump. Since the pumps had a dry installation, to prevent the surging of cavitations at the impellers when the water level is lower than the impellers (low values of the available NPSH), inverters were provided to control the electric motors revolutions. With this configuration the dry dock could be emptied in less than 3 hours.

The bottom of the sump was -4.5 m below the mean sea level and the walls presented much seepage; to restore the integrity of the walls and ensure their sealing and prevent corrosion of the flanges of the new pumps, the installation of bentonite panels and concrete cast counter walls was provided.



In addition to the restoration of the pumping station, the project also included the installation of a supplementary pump (140 l/s with a head of 21,00 m) within a well in connection with the dock, placed at -11,00 m below mean sea level. This pump not only ensured the completion of the emptying of the dry dock, but also through pressure pipeline (350 m long, DN 315 mm) could send the process water to the treatment plant planned for the area.



# OPTIMIZATION OF INVESTMENTS AND MANAGEMENT ACTIVITIES OF THE INTEGRATED WATER SERVICE

Location:	Province of Verona, Italy
Client:	Acque Veronesi S.c.a.r.l. (Public water authority for the Province of Verona)
Services:	Cognitive studies and analyses; Feasibility studies; Technical and economic advisory services
Period:	11/2009 – 07/2010
Construction cost:	N.A.

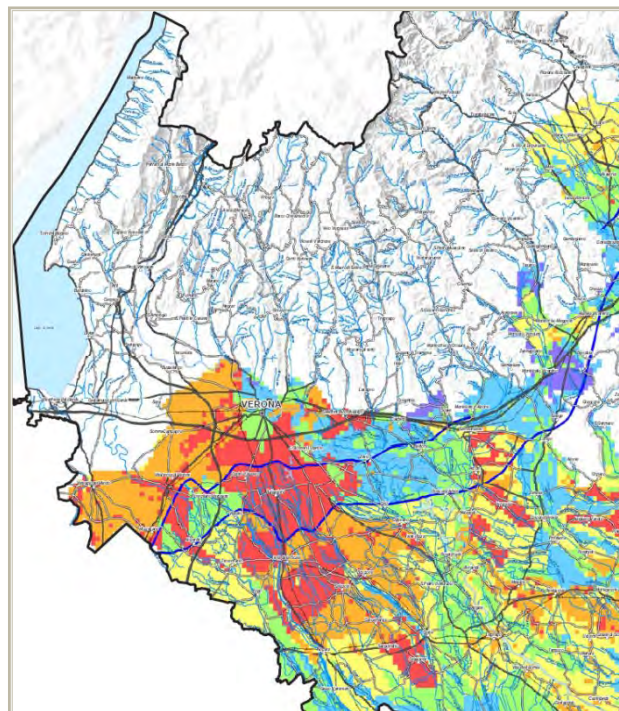
## Project Description:

Acque Veronesi S.c.a.r.l. appointed Technital S.p.A. for the support activity in the analysis and planning of all the interventions and designs expected for the future, in the province of Verona.

In particular, this activity concerned the analysis of all the water supply systems, sewerage networks and wastewater treatment plants present in the province of Verona, and the preparation of feasibility studies, in order to define the most urgent interventions.



The analysis activity consisted in the support to the reconnaissance of all the systems studied and the functional analysis of the installed sewerage networks, water distribution systems and wastewater treatment plants: this led to the revision and updating of all the technical information concerning the conditions and the efficiency of the studied infrastructures and, furthermore, to the identification of urgent interventions, such as the improvement of the existing facilities, the provision of new networks, treatment plants and water supply systems, and the optimization of the hydraulic service throughout the province. This analysis activity also led to the definition of an updated and improved plan for the future technical and economic management of all the facilities studied.



The feasibility studies concerned, in a more specific way, the identification of all the critical situations in terms of loss of efficiency, damages or inadequacies, within the above-mentioned infrastructures, in order to identify the most urgent interventions. Once these interventions were identified, a restricted group of them was chosen, depending on the possibility of carrying out the interventions within the year 2010.

The studies concerned mainly on the following topics:

- Priority of a particular intervention;
- Technical and economic feasibility of a particular intervention;
- Analysis of alternative solutions, in order to improve the efficiency of existing infrastructures;
- Definition of the achievable targets with the intervention.

These activities allowed Acque Veronesi to outline the design activity for the whole year 2010 and, furthermore, to plan the entire amount of investments for design activity, infrastructure development and management up to the year 2013.

# RECLAMATION WORKS IN THE DOMAIN AREA CALLED THE "THIRD DYKE": HYDRAULIC DRAINAGE WORKS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice
Services:	Preliminary, Final and Detailed design of shore protection works (physical barrier and drainage system)
Period:	12/2000 - 12/2006
Construction cost:	€ 12,745,700

## Project Description:

The project envisaged the reinforcement of the lagoon banks in order to avoid pollutants from the soil being released into the lagoon, by means of a physical barrier around the lagoon, with a shoreline road, and a groundwater drainage system including its conveyance to treatment plants.



Layout of the drainage system of the island

The priority intervention of this reclamation and making safe of the so-called "Third Dyke" area was the reinforcement and protection of the lagoon shore to avoid the seepage of contaminants from the surrounding soil, given that it constitutes the boundary of the Oil Refinery island, one of the most heavily polluted sites in the critical Porto Marghera area.

The physical barrier envisaged consists of a plastic diaphragm, extending the full length of the shore. This diaphragm has a low permeability coefficient serving to intercept the polluted water and is laid on a clayey stratum, thereby impeding any exchange of water between the lagoon and the water table of the island.

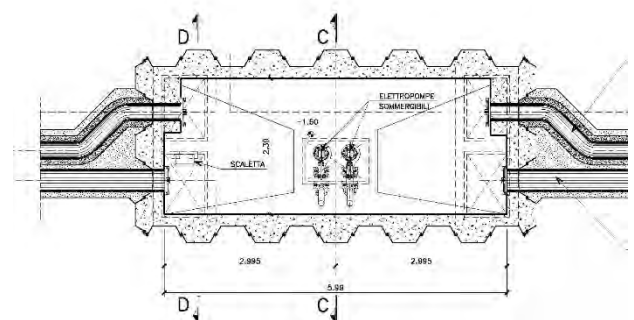
Once it is joined up with the similar works foreseen for the other banks of the island, the whole Oil Refinery Island will be isolated from the lagoon by an impermeable barrier.

To avoid the increase of the island's water table, due to the storm water no longer being able to drain into the lagoon, the project envisaged an articulated drainage network to keep the level of the water table under control, intercepting the contaminated water and conveying it treatment plants.

In the provisional phase of the operation of the drainage system (until August 2008), there was still no final destination for the polluted water but, after it reaches full regime, the polluted water is conveyed to treatment at the Fusina Treatment Plant, one of the most important in Italy, designed by the Veneto Region.

The groundwater drainage system along the Third Dyke is 1011 m long, and consists of perforated drainage conduit in PEAD, nominal diameter 315, laid horizontally at -0.50 m below sea level, surrounded by a gravel layer approximately 15 cm thick to increase the filter surface and wrapped in geo-textile (400 g/m<sup>2</sup>) to prevent the passage of fine particles. Concrete gullies at regular 25 m intervals, with + 0.20 m overflow threshold, siphon off the excess water into two parallel drains which conveys it to the collecting tank (6.00 x 2.40 m) at the middle of the barrier. The useful volume of the tank is  $V_{regime} = (1.30 - 0.50) \times (6.00 \times 2.40) = 11.52 \text{ m}^3$ .

One of the two submerged pumps (one is standby) then conveys the water to the treatment plant.



Layout of the collection tank

The gradient of the collector drains has been kept to a minimum (0.064%), to limit excavation in the contaminated soil of the island. The entrances to the collectors and to the conduits are protected by gates.

During the provisional operation phase, the water is conveyed south and discharged into a gully for this purpose on the drainage network of the Vittorio Emanuele III Channel, whence it is periodically removed to a treatment plant. Once the system is fully operative, the water will be conveyed north and discharged into the VESTA network which conveys it to the Fusina treatment plant



# RESTRUCTURING OF THE SEWERAGE NETWORK OF THE MUNICIPALITY OF CASAMICCIOLA ON THE ISLAND OF ISCHIA

Location:	Ischia (Naples) - Italy
Client:	Sogesid S.p.A. (Rome) for the Ministry of Public Works
Services:	Specialist support to the preliminary and detailed design, geotechnical and topographic investigations and surveys
Period:	05/2002 – 01/2005
Construction cost:	€ 12,000,000

## Project Description:

The existing sewerage system of the municipality of Casamicciola consists of a network of plastic pipes which collect both sewage and rainwater from surface runoff. The networks, which serves less than 30% of the population, is seriously under-scaled and during heavy rain pipes and gullies often burst with consequent flooding of cellars and basement areas.



The purpose of the project is to separate the rainwater and sewage by creating two separate pipe systems: in particular, the existing system, as far as it can be re-utilised, will serve to collect the rainwater and a new network will be built to collect the sewage.

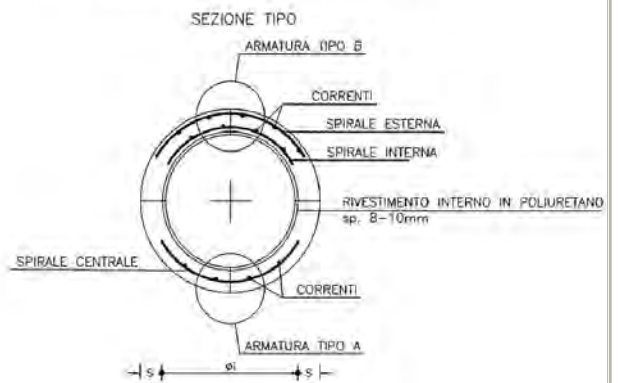


The sewage will be pumped to the nearby municipality of Lacco Ameno where a treatment plant for civil sewage is under construction. The new system will serve almost 80% of the population.

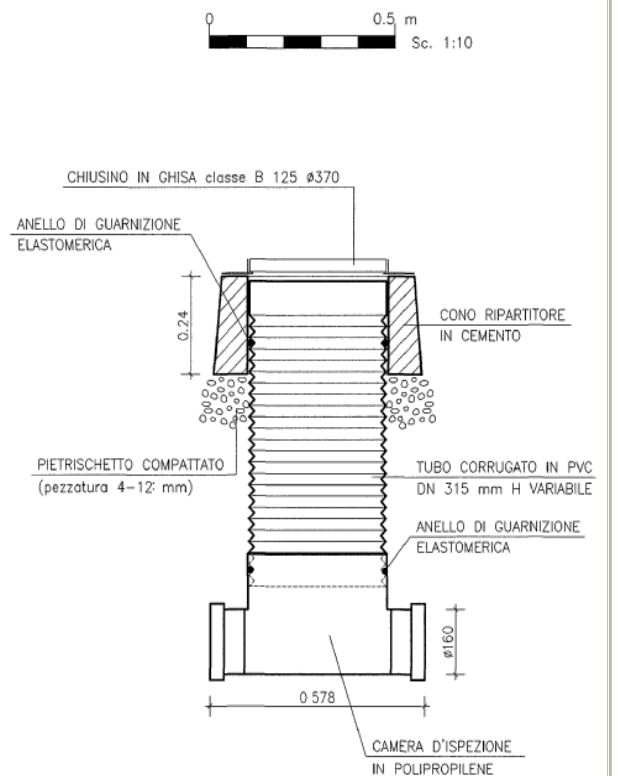
One of the main activities involved was the survey of the present situation carried out using both traditional methods (topographic survey and definition of the levels of the gullies) and modern techniques (video inspections and endoscopic investigations).

The design also took into consideration the question of the thermal waters as Casamicciola has numerous thermal installations which discharge into the municipal sewerage system.

## Pipe reinforcement in polyurethane concrete



## Detail of gully for user connections



In the project, being carried out in association with Baratta-Majolino (lead company) and Studio Altieri, Technital is providing specialist support for the preliminary and detailed design and related surveys.

# INFRASTRUCTURE DEVELOPMENT OF AL-UDAID AIR BASE

Location:	Al Udaid, Qatar
Client:	Rizzani De Eccher (Main Contractor)
Services:	General Master Plan ; Detailed Design of Lot 1
Period:	11/2003 – 12/2004
Construction cost:	€ 60,830,000

## Project Description:

The Project includes the General Master Plan and Detailed Design of Supporting Infrastructure and Utilities of the Qatar Air Force Base of Al Udaid.



In particular, the Project includes:

### 1. Road Network and Paved Areas

- Design of approx. 25 km of single and double carriageway distribution network including junctions, roundabouts and tie-ins;
- Design of road networks within development areas, including parking areas, facility accesses, bus-stops and sidewalks;
- Design of road corridor stormwater drainage;
- Design of traffic signs and road markings;
- Design of combined utilities plans indicating existing and proposed services and proposed diversions and service ducts;
- Design of ducting for street lighting network.

### 2. Sewerage Network

- Design of approximately 18km of building connections, collector mains, gravity outfalls and pumping mains serving various area of the base;
- Design of four sewage pumping stations and flow balancing facility;
- Design of Septic/Conservancy tanks (if gravity connection to network not viable);

### 3. Water Distribution Networks

- Evaluation of supply with regards acceptable flow rate, residual pressure and reliable duration;
- Computer modelling to define extensions or reinforcing requirements to the feeder ring main;
- Extensions and reinforcing of existing ring mains;
- Evaluation of ground / elevated storage needs and mechanical plant requirement, to supply domestic and fire flow demands;
- Design of fire mains and domestic networks up To and including supply point at each facility.

### 4. High, Medium and Low Voltage Electrical Network

- Establish primary sources of power to the site and location of primary supply points within the site;
- Evaluate existing sub-station infrastructure and assessment of their suitability;
- Location and design of sub-stations, including detailed electrical arrangements; and architectural and structural design of housings;
- Detailed design of HV and MV and LV cable network;
- Provision of all detailed drawings, plans, layouts, standard details, supporting calculations, specifications and schedules of quantities as required for the completion of construction works.

### 5. Street and General Area Lighting

- Design of Street and General Area Lighting including road lighting, general area lighting, parking areas.

### 6. Site Communications

- Design of a Site Communications Ductbank System to connect the various areas of the base.

### 7. Surface Water Drainage and Site Grading

- Areas within and adjacent to the various development areas are to be graded to ensure that existing and proposed facilities and works are adequately protected from surface storm water run-off, resulting from a 1 in 10 year storm event. Grading of the above-mentioned sites has been designed to take cognizance of watersheds, storm flow paths and localised depression areas such that run-off is conveyed safely away from development facilities.

# DESIGN FOR THE RESTRUCTURING OF THE GELA – ARAGONA AQUEDUCT (89.5KM)

Location:	Sicily, Italy
Client:	Special Commissar for the Water Emergency (Sicily) for Regional government of Sicily
Services:	Preliminary and Detailed Design, Safety Plan, geotechnical and topographic surveys.
Period:	07/2002 – 03/2003
Construction cost:	€ 17,378,500

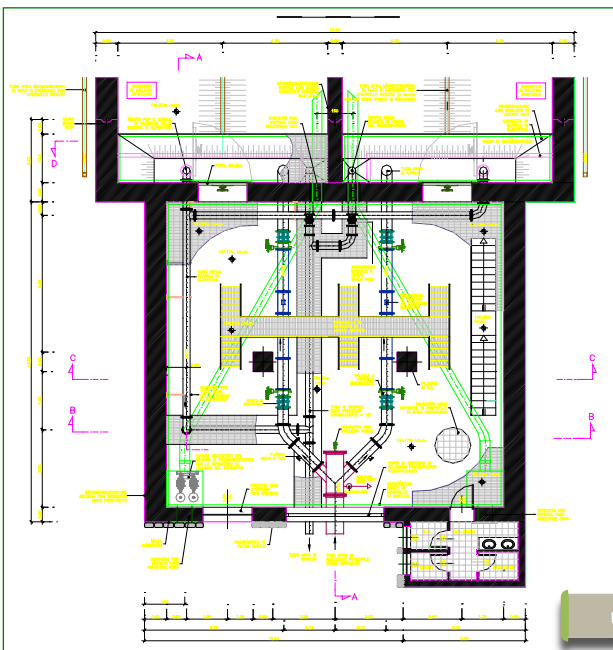
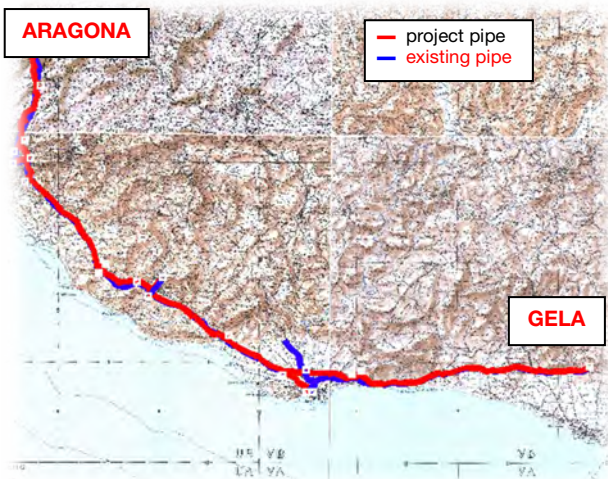
## Project Description:

The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela. The water is desalinated in the desalination plant inside the Gela petrochemical complex and subsequently mineralised. By means of a series of pumping stations the potable water (approx. 500l/s) is conveyed to Licata, Agrigento and Aragona, at an elevation of +500 m a.s.l.

The project consists in the renewal of the entire water supply main, replacing the existing fibreglass piping with a spheroidal cast iron pipe, and a general modification of the hydraulic scheme of the main conveyor (81.8 km), with the introduction of 3 tanks in tunnels along the line and booster type pumping stations instead of the existing ones with multistage vertical axis pumps and collecting tanks.

The new water supply system, which will also be connected to the water supply system of Favara di Burgio, the Voltano aqueduct and the conduit from the Blufi dam, can satisfy the potable water demands of the entire south-central area of Sicily. The tanks in tunnels, which have a total capacity of over 20,000 m<sup>3</sup>, can provide not only a daily but a seasonal regulation of the water supply. Moreover, the tunnels allow the temperature regulation of the water supply which tends to be rather high owing to the desalination system (multi flash) used upstream.

The booster type pumping stations with revolution gage to control the parallel pump groups permits the optimization of the pumps' operation, minimizing energy waste and protecting the piping against water hammer phenomena due to sudden pump arrests.



The design system offers great reliability in terms of durability of materials (spheroidal cast iron instead of fibreglass), protection against irregular movement phenomena (inverter and revs gage) and general redundancy of the system (interconnection of the conduits and parallel pumps).

Furthermore, for the energy point of view the operation of the whole system has been optimized, allowing significant savings with respect to the present situation.

Technital executed the project in association with Studio Altieri (lead company), SIS and Omniservice.

Technital's share is 25%.

Valve chamber in the tank named "Rocca Corvo"

# SEWERAGE SYSTEM FOR SOTTOMARINA IN VENICE LAGOON

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works – Water Board - Venice
Services:	Concept, basic, preliminary and detailed design
Period:	10/1988 – 12/2002
Construction cost:	€ 2,685,600

## Project Description:

TECHNITAL carried out the Preliminary and Detailed design of the sewerage network for the town of Sottomarina in the context of the project to protect Sottomarina from the high tides.

The new sewerage network, consisting of a free surface flow system for mixed sewage, was designed to connect the local sewerage system (prior to the start of the works connected directly to the lagoon by means of sewers having little or no gradient) to the treatment plant operated by the Municipality of Chioggia, thereby achieving the double objective of reducing the discharging of organic waste into the lagoon and preventing the tidal flow from rising up through the rainwater gullies.



The sewage is disposed of by pumps located in 3 pumping stations, either directly into the lagoon (when there is sufficient rainfall to guarantee adequate dilution) or conveyed to the treatment plant (when there are high concentrations of organic wastes).



The project affects the entire historic centre, the system having a total length of 950 m. Ten pumps with a flowrate of 0.3 m<sup>3</sup>/s were installed, for a total applied capacity of approximately 300 KW.

The works have been completed.



# SEWERAGE SYSTEM FOR PELLESTRINA IN VENICE LAGOON

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works – Water Board - Venice
Services:	Concept, preliminary and detailed design
Period:	06/1987 – 12/2002
Construction cost:	€ 6,663,000

## Project Description:

In the context of the project to protect Pellestrina from the high tides TECHNITAL carried out the Preliminary and Detailed Design of the sewerage network for the township of Pellestrina (4200 inhabitants).



The new sewerage network, consisting of a free surface flow system for mixed sewage, is designed to operate for a certain period until the Municipality of Venice sets up a treatment plant connecting the secondary sewerage pipes from the houses and the lagoon. These sewers, which have little or no gradient, are kept clear by the tidal flow.



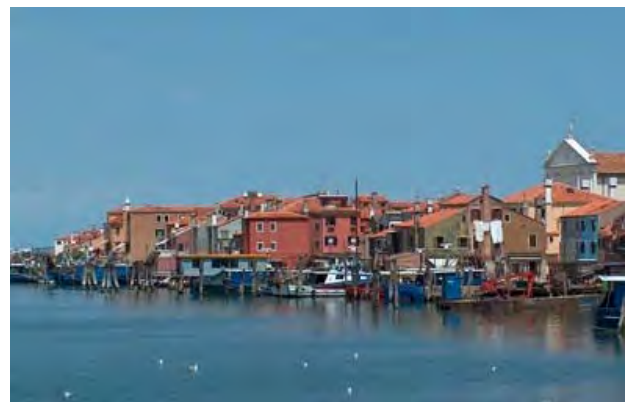
The system will operate in this period only in occasion of the high tides, when the sewerage outlets into the lagoon have to be closed to prevent the tidal flow from rising up through the rainwater gullies.



The sewage is disposed of by pumps located in 7 pumping stations, which at present convey it directly into the lagoon by means of underwater pipes and diffusers and which in the future, when the new treatment plant has been built, will provide the necessary head to convey the sewage there.

The project affects the entire historic centre, the system having a total length of 2800 m. Twenty-one submerged pumps with sequential operation have been installed, for a total applied capacity of approximately 300 KW.

The works have been completed.



## River Regulation and Water Resource Management

# DETAILED AND FINAL DESIGN OF THE RESTORATION OF THE PO BETWEEN THE SECCHIA RIVER MOUTH AND OSTIGLIA (MANTUA) – CIRENE ISLAND

Location:	Italy
Client:	Cave di Quingentole Srl, Granulati Donnini Spa
Services:	Final and Detailed Design, EIA
Period:	03/2021 - Ongoing
Construction cost:	€ 27,000,000

## Project Description:

The project concerns the realization of interventions aimed at the morphological redevelopment and the hydraulic safety of the section of the Po River between Camatta and the Ostiglia meander, passing through the Secchia River Mouth. These interventions are to be considered as the first phase of the master plan for the section between the Secchia River Mouth and the Boschina Island.

The main intervention involves the remodeling of the floodplain area on the left bank called Cirene Island, in order to modify the meander of Ostiglia, thus implementing the provisions of the General program for the management of alluvial sediments of the riverbed (PGS) (AdBPo, 2007). This intervention is achievable under Project Financing

The main objective of the project is to improve hydraulic safety in a section of river which appears to be significantly compromised, both due to incorrect anthropogenic interventions and to an intrinsic propensity of the river to erode the foot of the embankments generating settlements (Ostiglia, Revere and also Quingentole).

In addition, the objective is to improve the condition of navigability of a section of the river in an environmentally friendly manner.

To pursue the objectives described above, the following interventions are envisaged:

- the remodeling of the floodplain area at the Ostiglia meander (Cirene Island), including the artificial handling and removal of lithoid material
- the rise of the right main bank of the Po River in the stretch from Quingentole to Revere, having a high risk of overlapping
- the rise of the right main embankment of the Po River in the stretch from the Secchia River Mouth to Sabbioncello
- the rise of the right main embankment of the Po River in the stretch upstream of the Secchia River Mouth, between it and Camatta, as formally requested by AIPo.

The arrangement of the area of the Cirene Island mainly involves the movement of alluvial sediments deposited in the floodplain for a volume of 5.5 million m<sup>3</sup>.

An additional excavation of about 450,000 m<sup>3</sup> is also planned at the Caimani oxbow, divided into an initial dredging to open the oxbow and periodic maintenance dredging, to guarantee the operation of the vessels serving the plant therein available to the Dealer.

The overall duration of the interventions is 12 years.

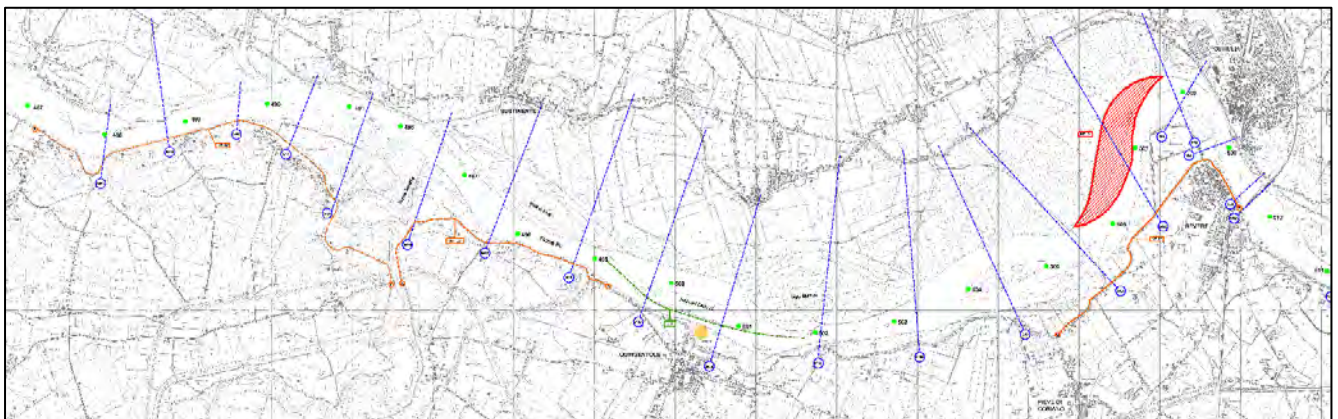
The arrangement of the section of the Po covered by the project is part of a general plan for reducing the hydraulic risk with the contextual renaturalization of the river which provides for the morphological and environmental recovery of the riverbed and riparian areas.

The first relevant intervention consists in the removal of 5.5 million m<sup>3</sup> of lithoid material, with the simultaneous handling and relocation of 1.5 million m<sup>3</sup> of material, to remodel the floodplain on the left hydraulic River Po, in correspondence with the Ostiglia meander. This intervention will make it possible to modify the field of motion of the flow in approach to the meander, ensuring a more regular entry to the curve and such as to reduce the erosive phenomena at the foot of the Revere embankment. At the same time, the new hydrodynamic configuration that will be obtained will make it possible to make the flow motion downstream of the meander more dynamic where, in the current conditions, instead, there is a large deposit area, both on the right and on the left side.

Finally, from the point of view of hydraulic safety and the restoration of navigability conditions, which are the two objectives of the project, the most relevant effects will be:

- reduction of tangential stresses at the foot of the Revere embankment.
- increase in the carrying capacity of the flow exiting the Ostiglia meander with consequent reduction of the sedimentation effect visible both on the right and on the left side in the areas immediately downstream of the meander.

The project also plans to carry out a specific activity of closing some cavities that represent a significant risk from the hydraulic point of view since they endanger the stability of the embankment: this is the case of the cavity at the foot of the Ostiglia embankment, in Revere and Sabbioncello.



The cavities are filled with part of the material from the excavations of the Cirene Island and from the periodic dredging of the Caimani oxbow. Part of the non-marketable fine material coming from the excavations, located in the upper layer, just below the vegetation cover, is intended to be used for closing the cavities.

In addition, some environmental monitoring activities are planned to be carried out on the Rodi oxbow. The monitoring will consist, first, in the biennial reconstruction of the sections of the emerged part and of the submerged part, using topobathimetric surveys, which will have the purpose of verifying the growth of the deposits or the natural opening in the oxbow. Biennial reports will be produced showing both a sediment balance calculation in the stretch of interest, and the comparison topobathimetric sections associated with the various monitoring phases. The reports will be accompanied by a critical analysis of the evolution in progress which may also make use of mathematical modeling.

In addition, 6 samplings of the deposited lithoid material will be carried out, to reconstruct the granulometric curve and, therefore, to evaluate any variations also in the type of material.

Together with the observations related to the morphology, an analysis of the vegetation will finally be carried out, to evaluate its evolution during the concession period.





# REHABILITATION OF GIBBESI DAM

Location:	Sicily, Italy
Client:	Water and Waste Department of Sicily
Services:	Feasibility Study, Final and Detailed Design
Period:	11/2020 - Ongoing
Construction cost:	€ 30,000,000

## Project Description:

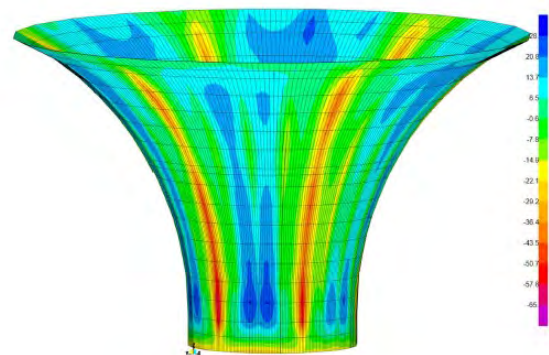
The dam on the Gibbesi torrent was built between 1969 and 1983, it is an earth structure with a vertical central core, immersed in a compact impervious clay base formation. The height of the dam is 30 m (L. 584/94); the volume is equal to 1,72 Mm<sup>3</sup>. The maximum quote of the reservoir is 231,50, the maximum level of regulation is 229,00 and the minimum level is 219,00. The crown, at an altitude of 236.00 m above sea level, is 607 m long and 8 m wide.

The project is about the seismic evaluation of the dam and of the structural works of the plant, study of the neutral pressures and of the filtration motions in the dam and in the banks, technical and economic feasibility, final and detailed design of the extraordinary maintenance of the connection road between the guard house and the sluice gate well, re-efficiency of the monitoring and control instrumentation of the dam and of the banks of the Gibbesi dam in the territory of the Municipality of Sommatino (CL) managed by the Sicilian Region.

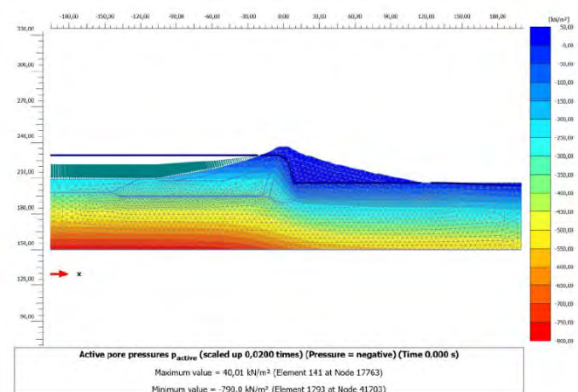
The analyses consist in the seismic evaluation of the dam and ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The services provided are the following: evaluation of the seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve its structural conditions, starting from the seismic verification and other related investigations. Interpretative study of neutral pressures and filtration motions in the dam and banks, technical and economic feasibility, final and detailed design of the road connecting the guardhouse to the sluice gates, re-efficient monitoring, and control instrumentation.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie rods, piles, hooping, reinstatement of concrete covers.



Surface drains and structural modelling



Modelling of filtration motion

# REHABILITATION OF VILLAROSA DAM

Location:	Enna, Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Final and Detailed Design
Period:	08/2020 - Ongoing
Construction cost:	€ 13.274.000

## Project Description:

The Villarosa dam was built between 1969 and 1972, and it is located on the Morello Stream, tributary of the Southern Imera River, in the territory of the Villarosa Municipality. The reservoir is intended for irrigation use in favor of the Consortium of Reclamation 6 of Enna, which takes care of the management of networks under the reservoir. The dam is in loose material with a sealing core and has a straight-line structure and a trapezoidal cross section. The dam is 33,40m high, the height of the crest is 396,00m asl, the planimetric development is 450m. The dam volume is 1,56Mm<sup>3</sup>. The maximum retention quote is 393,71m asl, the maximum regulation 392,50m asl and the minimum regulation 372,00m asl

The activities include the seismic inspections of the ancillary works of the dam, management project of the reservoir, the final and detailed design and safety coordination during the design phase of the interventions of extraordinary maintenance of the discharges of the Villarosa Dam managed by the Sicilian Region.

The analyses consist in the seismic evaluation of the dam and the ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018) as well as the reservoir management project.

The following services are provided: the reassessment of seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions of the dam, from the seismic verification and other related investigations. Reservoir management project, final and detailed design, and the safety coordination during the design phase, for the extraordinary maintenance of the discharge systems

The proposed seismic upgrading interventions concern the surface outlet with the chutes and regulation gates, the intake tower, the access walkway to the intake tower, the bottom outlet gallery, the guard house, and the dissipation tank.



# REHABILITATION OF POMA DAM

Location:	Palermo, Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Detailed Design - Structural and Hydraulic design
Period:	03/2021 - Ongoing
Construction cost:	€ 25.784.000

## Project Description:

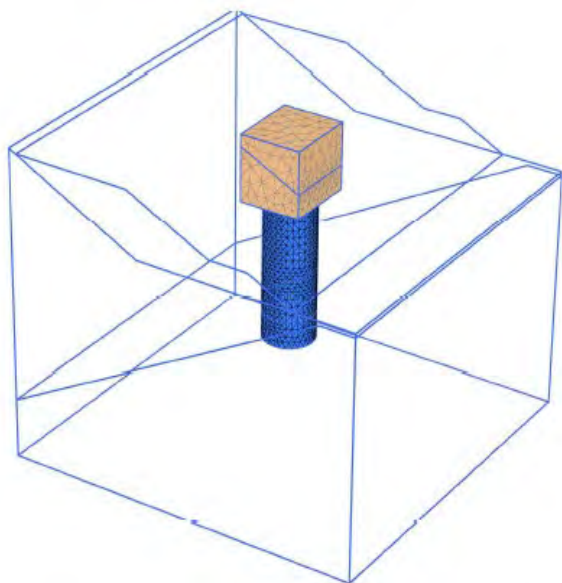
The Poma dam is located on the Jato River in the territory of Partinico (Palermo province) and it was built between 1964 and 1970. It is in loose materials with internal core of seal inclined upstream. The height is 58.60 m, and it generate a reservoir of 3.90 km<sup>2</sup> (at the height of maximum flood), with a maximum capacity of 78.3 Mm<sup>3</sup>.

The project consists of the seismic inspections of the dam and ancillary works, geotechnical study, geognostic investigations on reinforced concrete structures and related laboratory tests, study of the hydrological-hydraulic reevaluation of the dam.

The analyses consist in the seismic evaluation of the dam and ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The services provided are the following: the reassessment of seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions from the seismic verification and from other related investigations; hydrological-hydraulic evaluation, seismotectonic study.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie-rods, piles, hooping, reinstatement of concrete cover.



# REHABILITATION OF SCIAGUANA DAM

Location:	Enna, Sicily - Italy
Client:	Sicily Region - Water and Waste Department
Services:	Final and Detailed Design,
Period:	10/2020 - Ongoing
Construction cost:	€ 28.442.000

## Project Description:

Sciaguana Dam was built between 1984 and 1992, and it is located between the municipalities of Agira and Regalbuto in the province of Enna. The destination of the reservoir is for irrigation use by the Land Reclamation Consortium 6 of Enna, which takes care of the management of the networks of the distribution to an area of 1665 hectares of irrigated fields. The dam is of the loose material type with a sealing core and has a straight structure and a trapezoidal cross section with a width of 9.00 m at the crown and 258.75 m at the base. The structure tests are still in progress and the relative operations started on 11/03/1997.

The project consists of the seismic inspections of the dam main structure body and ancillary works, geotechnical study, geognostic investigations, tests on reinforced concrete structures, drafting of the final and the detailed design, safety coordination during the design phase of the extraordinary maintenance works on the drains and embankments downstream of the Sciaguana Dam in the municipality of Agira (EN).

The analyses consist of the seismic evaluation of the dam and the ancillary works in light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The following services are provided: the assessment of seismic safety, the execution of the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions from the seismic verification and other related investigations. Final and detailed design and safety coordination during the design phase, for the extraordinary maintenance of the bottom outlet plants.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie-rods, piles, hooping, reinstatement of cover irons.



# FINAL DESIGN, DETAILED DESIGN AND SUPERVISION OF WORKS OF THE DETENTION BASIN CALLED “PRA’ DEI GAI”

Location:	Prà dei Gai, Italy
Client:	Regione Veneto
Services:	Final Design, Detailed Design, Works Supervision
Period:	03/2020 – ongoing
Construction cost:	€ 22,604,168

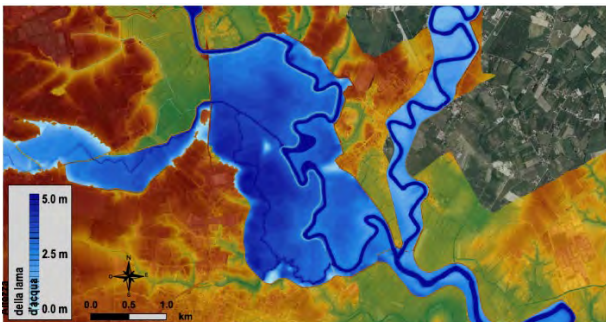
## Project Description:

The project deals with a detention basin located at the Prà dei Gai land in the norther-east Italy in Treviso district. The basin aims at temporarily retain floodwater during flood events in the Livenza river, before the confluence of the tributary Meduna.

Scope of the work consists of mitigation of flood damages during high water events and reduce the peak flow downstream.

Livenza river extends 111 km in length and it covers a catchment of approximately 2,200 km<sup>2</sup>. The Cellina and Meduna rivers represent main tributaries, giving the main contribution to flood due to the mountain catchments.

The identified area comprises a 750 ha large countryside, which currently is submerged by water as far as the water level in Livenza increases; nonetheless, when the peak flood flow passes, the basin is already filled, and its volume does not concur to the moderation of flood.



Therefore, the project provides the construction of 6 km long river bank to separate the Livenza river from the Prà dei Gai land and a 150 m long spillway equipped with 10 sluice gates to divert the flood volume into the detention land. This arrangement permits to exploit the Prà dei Gai land for flood control. Other secondary facilities are designed to manage the store of captured volume, i.e. reinforcement of existing banks, and for releasing water flow after the recession of flood hydrograph.



To support the design process, many efforts have been implemented to simulate the propagation of flood wave into the basin land in an accurately manner. In particular, a 2-d numerical model has been applied to investigate the filling process of the detention land and two physical models have been applied for two scopes:

- A physical model in 1:20 geometric scale, implemented in Froude similitude, to simulate the prototype of the spillway structure. The sought data concern the discharge coefficient at the change of gate opening ratio
- A physical model in distorted geometric scale (1:500 horizontal, 1:50 vertical), to simulate the propagation of the captured flow into the detention basin.

Hydraulic modelling activities implemented during the final design:

- Hydrological Model
- 2-D numerical model for hydrodynamic simulation of flood propagation along the rivers
- 2-D numerical model for flood propagation inside the detention basin
- Physical model in geometric scale 1:20 of the spillway structure at the intake of the detention basin
- Physical model in distorted scale 1:500 (horizontal) and 1:50 (vertical) to simulate the propagation of the floods inside the detention basin.



# FLOOD CONTROL WORKS ON THE BOZZENTE RIVER

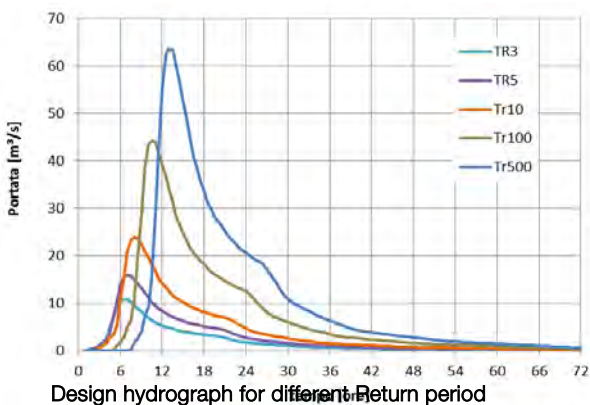
Location:	Italy
Client:	Infrastrutture Lombarde SpA (ILSPA)
Services:	Concept and preliminary design, EIA
Period:	09/2016 – 09/2022
Construction cost:	€ 8,860,236

## Project Description:

The project concerns the design of lamination and control works of the floods of Bozzente river, which represents the main artery of a group of water courses, most of which flow through built-up areas. The main problem in these areas is the total impermeability of the pavement, so that the normal infiltration flux through the ground is almost completely absent.

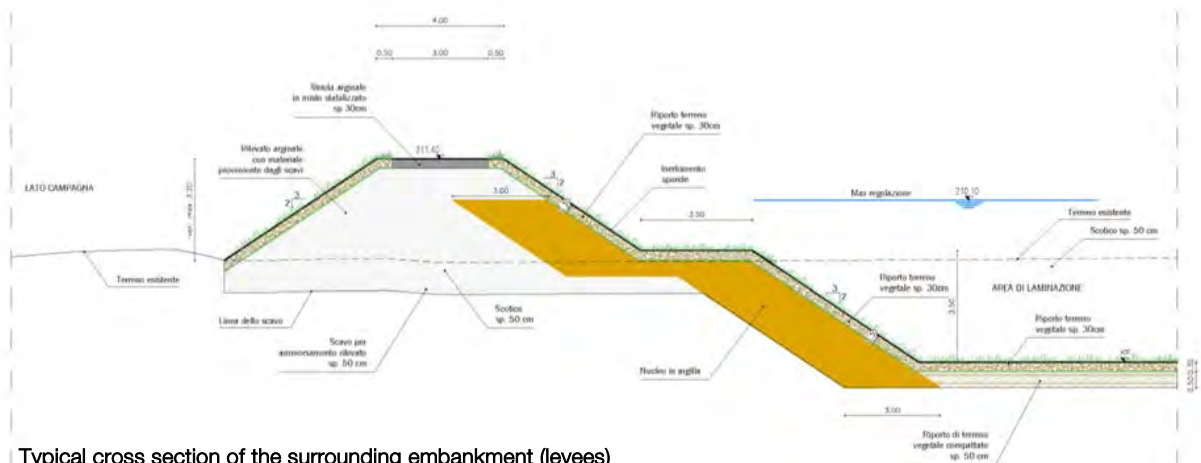
The existing conditions of the river Bozzente allow the flow for about  $11\text{m}^3/\text{s}$  without flooding. This matter required the design and realization of an artificial flood area, in order to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields. The area is located on the hydrographic right side.

- The area consists of a single basin. The right levee is reshaped to create an overflow which allow the water to fill the basin when the water level into the river rises to the critical level. The maximum discharge allows to flow into the river is limited to about  $11\text{m}^3/\text{s}$ , the extra flow is diverted into the basin. The volume necessary to reduce the pick flow to the above is about  $1,000,000\text{ m}^3$ . The basin area has an extension of about 22 ha and it is surrounded by an embankments for an extension of about 2,000 m, with an high of maximum 4 m over the existing ground level.
- The project data required to dig the ground surface inside the basin for a depth of maximum 7m, in the upstream side of the basin, to a minimum of about 5m.
- a security overflow of about 120 m was designed, reshaping the left river levee.
- The outflow is realized with a double box culvert with a cross section of 2 m X 1.5 m, regulated by slice gates. The outflow shall be open when the flood event is ending and the water level into the river is shallow.
- The water flowing out of the basin, is discharged into the river reach through a channel which connects the outflow with the river.
- The flood control basin is designed for a 1 in 100 years event, in accordance with the results of the hydrological and hydraulic studies.



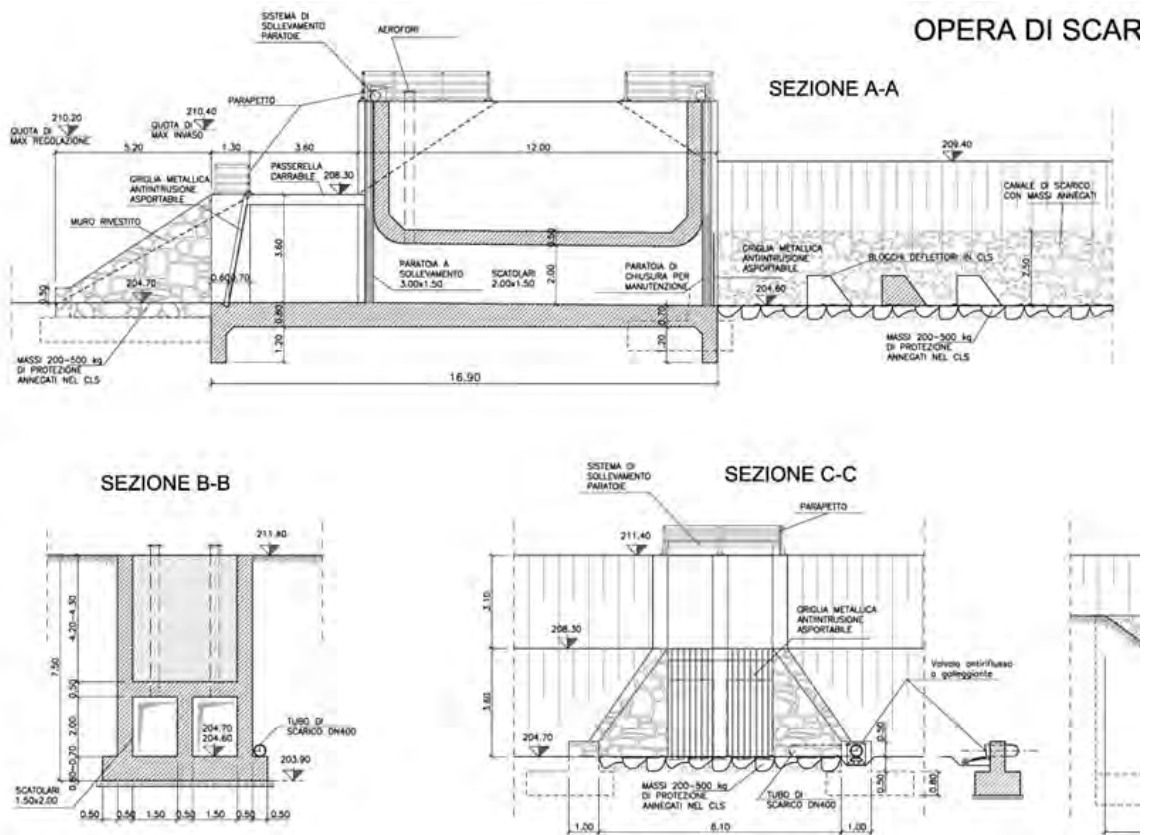
## SEZIONE TIPO 2

Scala 1:100





Preliminary design – Plan on the interventions



Outfall



# FINAL AND DETAILED DESIGN OF THE FLOODS DIVERSION CHANNEL FROM GORZONE RIVER TO ADIGE RIVER

Location:	Province of Padova, Italy
Client:	Consorzio di Bonifica Adige-Euganeo
Services:	Final Design, Detailed Design
Period:	10/2019 – 02/2022
Construction cost:	€ 23,837,571

## Project Description:

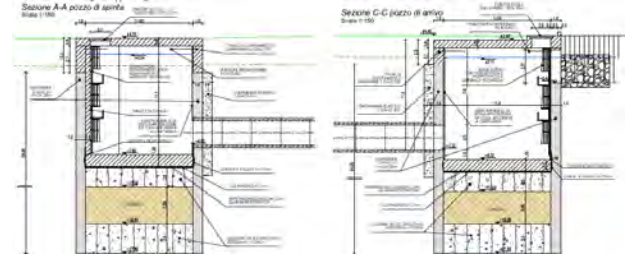
The project deals with the construction of a channel for diversion of floods from the Gorzone river to the Adige River. The Gorzone river crosses the floodplains in northern-east Italy, and it is long about 93 km; its basin covers an area of about 1,350 km<sup>2</sup>, and it is designated to drainage low-lying lands in the surrounding area. At this last scope, the Gorzone receives the flow contribution from approximately n° 30 drainage/pumping plants, which discharge in the river approximately 100 m<sup>3</sup>/s during floods.

Despite of that, Gorzone river has not the flow capacity to tackle the flood coming from pumping plants when long duration precipitations occur. Therefore, local authorities have forbidden discharging in Gorzone during floods, and this causes huge flooding in the upstream countryside.

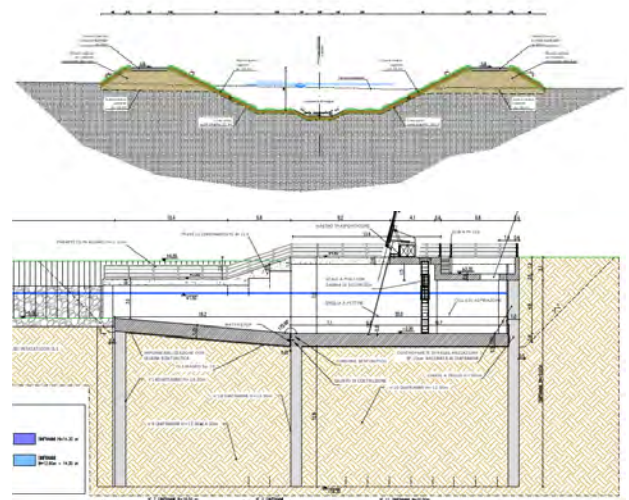
The project pursues to divert the flow coming from a pumping plant called Cà Giovannelli, normally discharged in Gorzone river, in a new stream channel. The new channel carries the flow to a new pumping station, which pumps the water upwards into the Adige River, by surpassing the riverbank with steel penstocks. Two DN2500 concrete conduits are provided for linking Ca' Giovannelli with the new diversion channel; the conduits under cross the riverbed of Gorzone, and are placed with Microtunneling (MTBM) technology, for a length of 250 m. Two shafts are provided for launching and receiving the MTBM. They are approximately 12 m deep and about 11m x 12m in plan; they are carried out within 1m thick diaphragm walls, initially used for excavation and subsequently incorporated in permanent station walls. Downstream the receiving shaft, the new diversion stream channel extends for 2 km from the receiving shaft to the new pumping station. The diversion channel is designed to conduct about 16 m<sup>3</sup>/s coming from Ca' Giovannelli and further 10 m<sup>3</sup>/s from Sabbadina channel, which is crossed by the channel path. The new channel has a flow section of about 30 m<sup>2</sup>, a slope of 0.1%, and it is constructed by massive excavation of terrain volume, entirely re-used for banks execution.

At the junction with Sabbadina channel, two hydraulic boxes 2m x 2m wide allow the diversion channel underpassing the Sabbadina; an intake structure equipped with n°4 3m x 3.40 m sluice gates

convey maximum 10 m<sup>3</sup>/s from Sabbadina to the diversion channel to prevent flooding.



The diversion channel reaches the final pumping plant, which discharges the entire flow in the Adige River. The pumping station comprises n°9+1 pumps and as many pipelines, which are set up on the Adige bank. A new hydraulic facility is provided at the discharge of the pipelines to prevent flow erosion.



# REHABILITATION OF ZAFFARANA DAM

Location:	Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Management Plan, Detailed and Final Design
Period:	12/2020 - 06/2021
Construction cost:	€ 1,377,000

## Project Description:

Zaffarana dam has been included in the National Plan for Dams, which aims to increase the safety of 101 large dams in Italy. Zaffarana dam is located in the territory of the Municipality of Trapani. The project concerns the extraordinary maintenance and safety works (i.e. with special emphasis to the dredging for the desilting of the bottom outlet and management of sediments) and the designing of the Reservoir Management Plan, according to art. 114 of the Legislative Decree 152/2006 and subsequent amendments.



Zaffarana dam has been included in the National Plan for Dams, which aims to increase the safety of 101 large dams in Italy. Zaffarana dam is located in the territory of the Municipality of Trapani.

The project concerns the extraordinary maintenance and safety works (i.e. with special emphasis to the dredging for the desilting of the bottom outlet and management of sediments) and the designing of the Reservoir Management Plan, according to art. 114 of the Legislative Decree 152/2006 and subsequent amendments.

The main characteristics of the reservoir are as follows:

- Maximum height of the reservoir: 84.30 m above sea level.
- Maximum level of regulation: 82.60 m above sea level
- Surface area of the reservoir at maximum height: 0,24 Km<sup>2</sup>
- Total volume of reservoir (Ministerial Decree 24/3/1982): 1,25 x 106 m<sup>3</sup>
- Reservoir volume (L. 584/1994): 0.9 x 106 m<sup>3</sup>
- Regulation volume: 0.75 x 106 m<sup>3</sup>
- Laminating volume: 0.35 x 106 m<sup>3</sup>
- Underlying catchment area: 7.6 km<sup>2</sup>.
- Maximum design flood flow rate: 225 m<sup>3</sup>/s

The project includes in the first stage sediments dredging at the bottom outlet (about 20.00 m<sup>3</sup>) and discharging inside the geotubes located around the lake. The lake is to be emptied, and the bottom and surface outlets will be repaired while maintenance work (concerning the drainage cabin, sluice gates, guard house) will be performed.

When the extraordinary works will end the project envisages the refill of the lake.

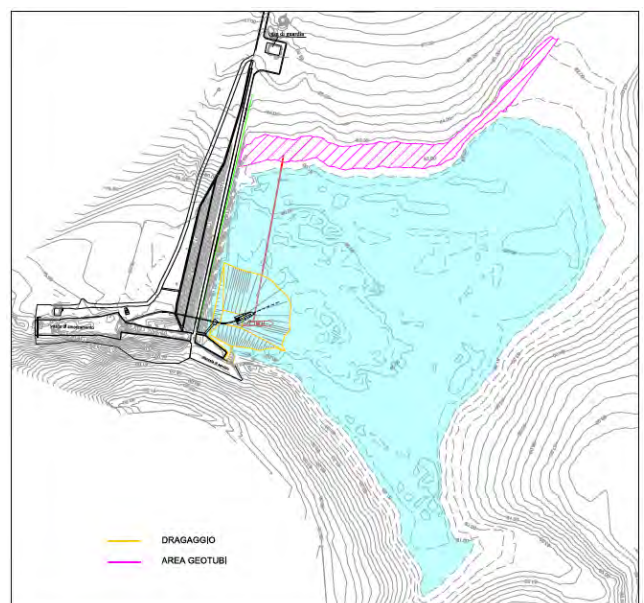
The second stage of the project is for the dredging of the reservoir (approximately 428.000 m<sup>3</sup> of sediments) to recover the original useful volume.

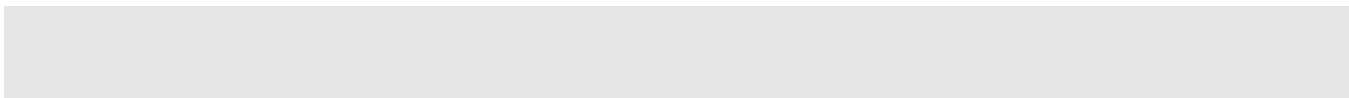
Different sediment management solutions have been compared in terms of cost/benefit:

- a. Dredging and dumping sediments around the lake to build morphological structures. The new structures, in addition to favouring on-site reuse of sediments, will also prevent soil runoff from the surrounding agricultural lands. This solution will not require land expropriation.
- b. Dumping of sediment in an agricultural land located around the lake. This solution will require land expropriation.
- c. restoration of disused quarries. This solution will require the transport of sediments outside the project area and constraint to wait for the formal approval of the Environmental Redevelopment Plan (PRA) of the quarry.
- d. transport of the sediments to a landfill. This situation was the worst in terms cost/benefits.

The selected solution was solution a) (shown in the figure) as it does not require expropriation being built on land owned by the Region of Sicily and maximises the on-site reuse by storing around the lake as much sediment as possible.

The new morphological structures will also protect the lake by runoff and create a boundary line of the Region's property. The new embankments will be able to accommodate a service road for routine maintenance operations.





# DETAILED DESIGN AND CONSTRUCTION SUPERVISION OF ARCE' HYDROELECTRIC PLANT

Location:	Arcè di Pescantina (Verona) - Italy
Client:	Iniziative Veronesi Srl
Services:	Detailed design, works supervision
Period:	10/2017 – 05/2019
Construction cost:	€ 17,763,000

## Project Description:

The project is for an hydro-electric plant along the Adige river in the section between Santa Lucia and Arcè di Pescantina.

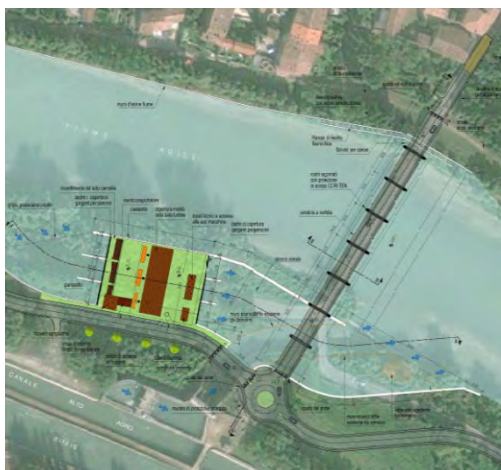
The plant has been designed to have a very low environmental impact, as it immediately returns waters downstream and it exploits just a part of them whereas the outstanding part keeps on flowing freely.

In addition to the works concerning the hydro-electric plant, the project foresees the requalification and strengthening of the bridge called "Arcè di Pescantina bridge" on the Adige river. It allows the road link between Arcè and Bussolengo.

The main project features are:

- a lock with 5 flap gates on the bottom, at the Adige river talweg level, for the purpose of supporting the river level and creating the hydroelectric leap;
- a new bridge supported by 7 new piles in riverbed with deck made up of prefabricated beams each with a 18.00 m span and a prefabricated beam with 20.50 m span;
- a fish ladder on the left bank;
- a canoes slide on the left bank;
- a completely underground hydro-electric plant on the right bank, in the Bussolengo Municipality, with intake upstream of the bridge and outlet immediately downstream;
- road link on the Bussolengo side and access road to the plant area;
- small works of road adaptation and link on the Pescantina side.

The hydro-electric plant will be placed in an uncultivated area along the river on the right bank. The river hydraulic flows intake will be just upstream of the river and the flows outlet will be just downstream.

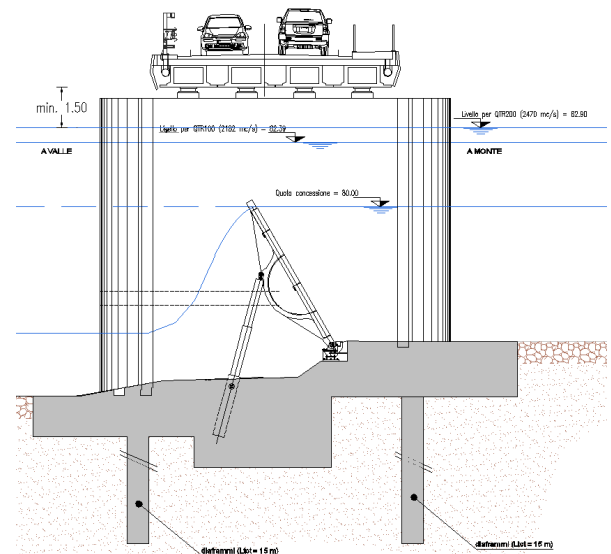


All the hydraulic works related to the plant will be underground and at the same level as the river talweg which is far below ground level.

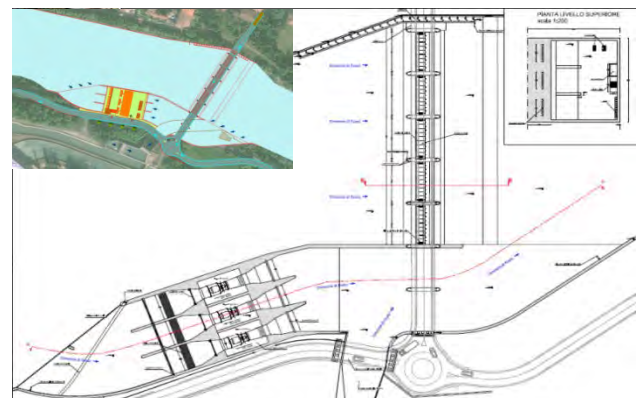
The plant emerging works are just some access works containing the screen remover to clean the intake grids and the equipment delivering the energy produced.

The hydro-electric plant will produce about 3 MW power for an annual total of about 21.2 GWh; the energy produced will be then entering into the grid by a connection with a medium voltage line already existing.

The lock is made up of five spans, each is 16.5 m wide and they are regulated by as many flap gates, with a water retention level of 79.95 m above sea level, i.e. 5 cm less than the higher free surface (80.00 m above sea level.).



Taking into account the dimensions of the lock piles, each of which is 1.5 m, the lock total width is 95.6 m; in addition to such width 15 m length below the first left bridge span is to be added. Such 15 m length is left free for the public equipped area. The flap gates movement is controlled and regulated by a hydraulic mechanism which triggers the two cylinders at the end of each gate. The cylinders are placed at the back of the gates and they are embedded in the riverbed piles in order to avoid damaging the devices during extraordinary floods. The maximum grade of operating gates is 60° horizontally. The hydraulic plant pipes are placed in a water-tight inspection shaft which can be checked. It is closed by ballasted sheets or concrete slabs, and it is placed downstream of the gates. Guide rails have been set upstream and downstream of the gates to close the span by means of mobile boards if it is not possible to carry out otherwise the extraordinary maintenance operations on the mechanical devices. The project envisages along its length an accessible inspection shaft where the hydraulic and electric systems pipes are located.



# DETAILED DESIGN AND CONSTRUCTION SUPERVISION OF SETTIMO HYDROELECTRIC PLANT

Location:	Settimo di Pescantina (Verona) - Italy
Client:	Iniziative Veronesi Srl
Services:	Detailed design, work supervision
Period:	04/2017 – 05/2019
Construction cost:	€ 20,807,000

## Project Description:

The project is for an hydro-electric plant along the Adige river in the section between Pescantina and Verona.

The plant has been designed to have a very low environmental impact, as it immediately returns waters downstream and it exploits just a part of them whereas the outstanding part keeps on flowing freely.

In addition to the works concerning the hydro-electric plant, the project includes the requalification and strengthening of the bridge called "Settimo di Pescantina bridge" on the Adige river. It allows the road link between Pescantina and Bussolengo.

The main project features are:

- a lock with 5 flap gates on the bottom, at the Adige river talweg level, for the purpose of supporting the river level and creating the hydroelectric leap;
- a new bridge supported by 5 new piles in riverbed with deck made up of prefabricated beams each with a 18.50 m span;
- a fish ladder on the left bank;
- a canoes slide on the left bank;
- a completely underground hydro-electric plant on the right bank, in the Bussolengo Municipality, with intake upstream of the bridge and outlet immediately downstream;
- road link on the Bussolengo side and access road to the plant area;
- small works of road adaptation and link on the Pescantina side.

The hydro-electric plant will be located in the area where a plant for the treatment of stones and marbles along the river on the right bank used to be operative. The river hydraulic flows intake will be just upstream of the river and the flows outlet will be just downstream.



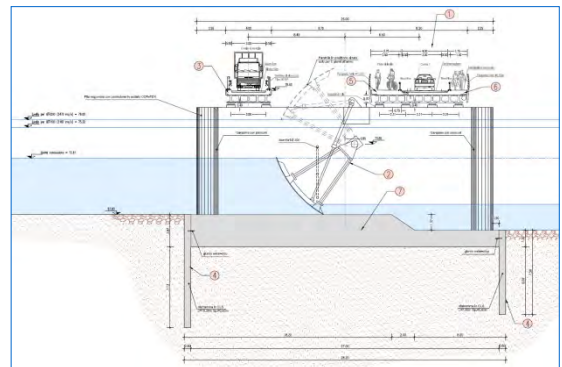
The area occupied by the plant will be about 45 m wide and about 100 m long in parallel with the river. All the hydraulic works related to the plant will be underground and at the same level as the river talweg which is far below ground level. The surface over the plant and the intake and outlet channels will be occupied upstream by a large garden and parking area, downstream of the new road link to the bridge, near the 18th century Corno Church.

The area surrounding said church will be rearranged and improved and even expanded in respect to the existing one.

The plant emerging works are just some access works containing the screen remover to clean the intake grids and the equipment delivering the energy produced.

The hydro-electric plant will produce about 3 MW power for an annual total of about 21.3 GWh; the energy produced will be then entering into the grid by a connection with a medium voltage line already existing.

The lock is made up of five spans, each is 17 m wide and they are regulated by as many flap gates, with a water retention level of 72.56 m above sea level, i.e. 5 cm less than the higher free surface (72.61 m above sea level.).



Taking into account the dimensions of the lock piles, each of which is 1.5 m, the lock total width is 92.5 m; in addition to such width the canoes slide 2.5 m width and the fish ladder total 7.1 m width are to be added. The total width of the works in the riverbed is therefore more than 100 m. The flap gates movement is controlled and regulated by a hydraulic mechanism which triggers the two cylinders at the end of each gate. The cylinders are placed at the back of the gates and they are embedded in the riverbed piles in order to avoid damaging the devices during extraordinary floods. The maximum grade of operating gates is 60° horizontally. The hydraulic plant pipes are placed in a water-tight inspection shaft which can be checked. It is closed by ballasted sheets or concrete slabs and it is placed downstream of the gates. Guide rails have been set upstream and downstream of the gates to close the span by means of mobile boards if it is not possible to carry out otherwise the extraordinary maintenance operations on the mechanical devices. The project envisages along its length an accessible inspection shaft where the hydraulic and electric systems are located.

# FLOOD CONTROL WORKS ON THE AGNO-GUA' RIVER

Location:	VENETO, Italy
Client:	Veneto Region
Services:	Detailed Design
Period:	06/2018 – 11/2018
Construction cost:	€ 16,115,343

## Project Description:

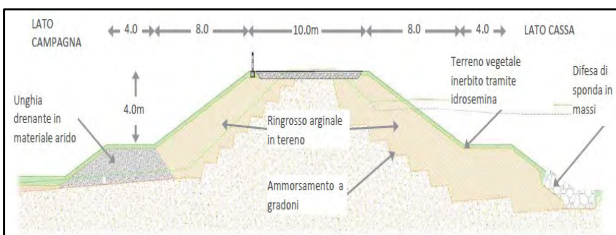
In recent years there have been numerous floods in northern Italy, including, in particular some very important in the Veneto region.

To avoid these floods and to protect the towns and cities along the Agno-Guà river a project of flood control works has been developed by Technital S.p.A and others Associated Consultants.

This flooding Area is strictly connected by another flooding area in the northern part of the river (under construction, realized on the basis of another project), throughout a structure realized in the middle embankment. It is composed of a eight gates, which allow the flooding of the lower basin, when the upper one is full.

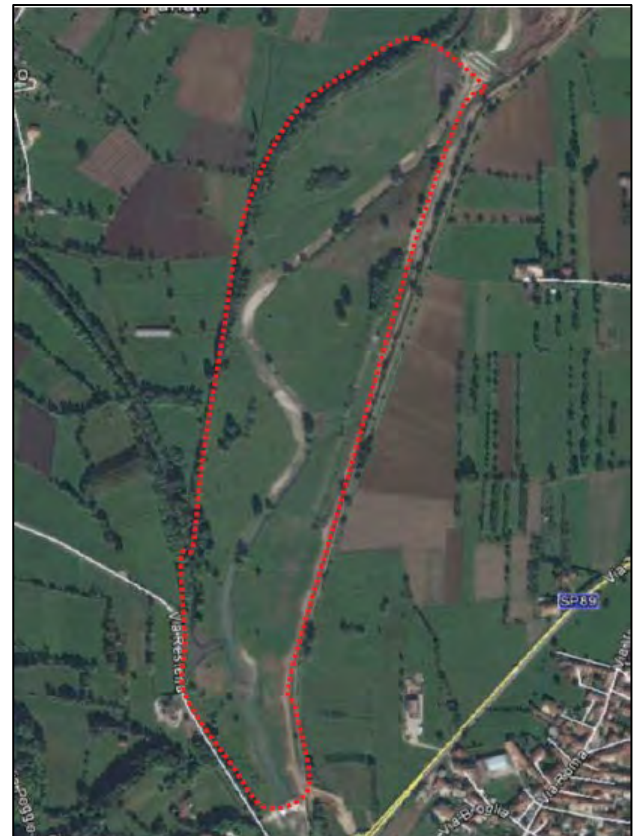


Here the left levee of the river has been re-shaped for an extension of about 1300 m, in order to avoid risks and physically separate the river area from the farmland and urban area of Arzignano. The re shaped of the levees is both in the internal and external side of the structure.



At the toe of the levee there is a protection of stone of 200-500 kg. The right levee are re-shaped only in the internal side of the basin. The project also includes the arrangement of two streams (Restena and Dugale) in correspondence of their entry into the new flooding area.

Downstream from the middle embankment, in this project there are two bridges and a stabilization threshold.



The project also includes some environmental interventions, such as the planting of new trees, grassing of the banks, the creation of a cycle path on the top of the embankments.





# DETAILED DESIGN OF THE HYDRAULIC BY-PASS SPILLWAY TUNNEL OF NOCE STREAM AND OF THE BISAGNO RIVER HYDRAULIC SPILLWAY TUNNEL

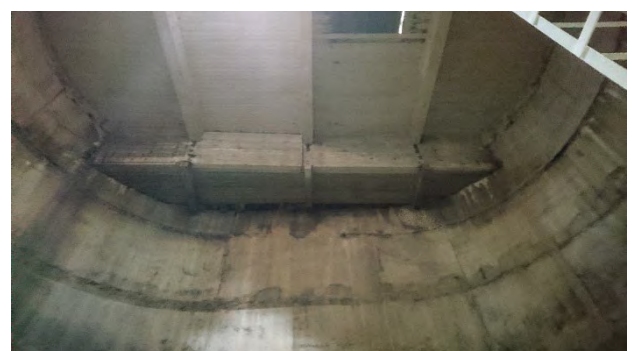
Location:	Genova - Italy
Client:	Municipality of Genoa
Services:	Detailed Design, Tender Specifications
Period:	10/2016 - 07/2018
Construction cost:	€ 17,429,244

## Project Description:

The project is related to hydraulic work for the Rio Rovare intake (between the interception structure and the channel of entry to the vortex), and, as far as Rio Noce is concerned, to hydraulic works located between the Delio Repetto school and the Fereggiano tunnel under construction.

The Rio Rovare intake works concern the upper part of the Rio Rovare, i.e., the section between Rio Rovare upstream and the connection with the existing downstream structure. The works envisaged are for a U-shaped interception structure of about 85 m, the partition structure of about 4 m, the entrance structure up to the vortex of about 51, the continuity structure about 99 m long and the ventilation well about 57 m deep. The intervention is located in an urban area, so particular attention has been paid to the construction site and to the interference of the new works with existing buildings by implementing a monitoring system.

The works related to Rio Noce consist in a pipeline of about 375 m realized with micro tunnelling with an internal diameter of 2,5 m, various wells along the channel, an inlet channel about 35 m long, the drop/work shaft below the Carena shaft, the dissipation chamber of about 22 m, the connecting tunnel of about 234 m, the access structure and the access shaft of about 11.85 m.







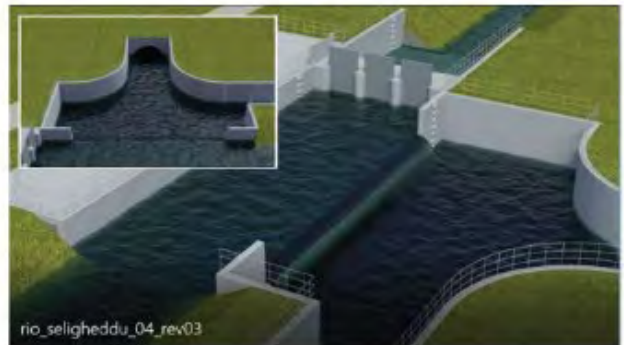
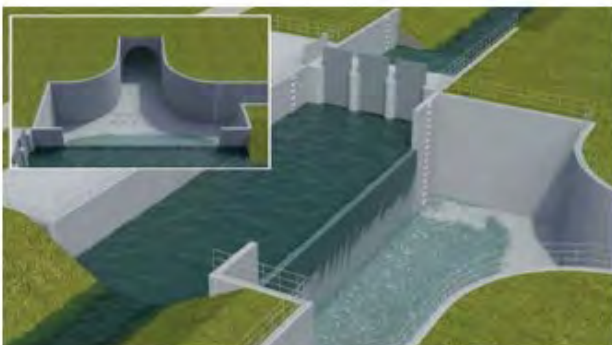
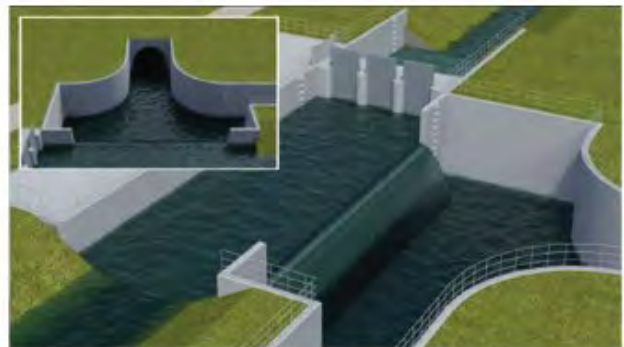
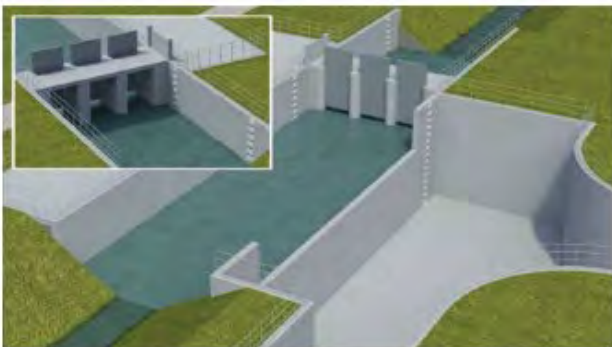
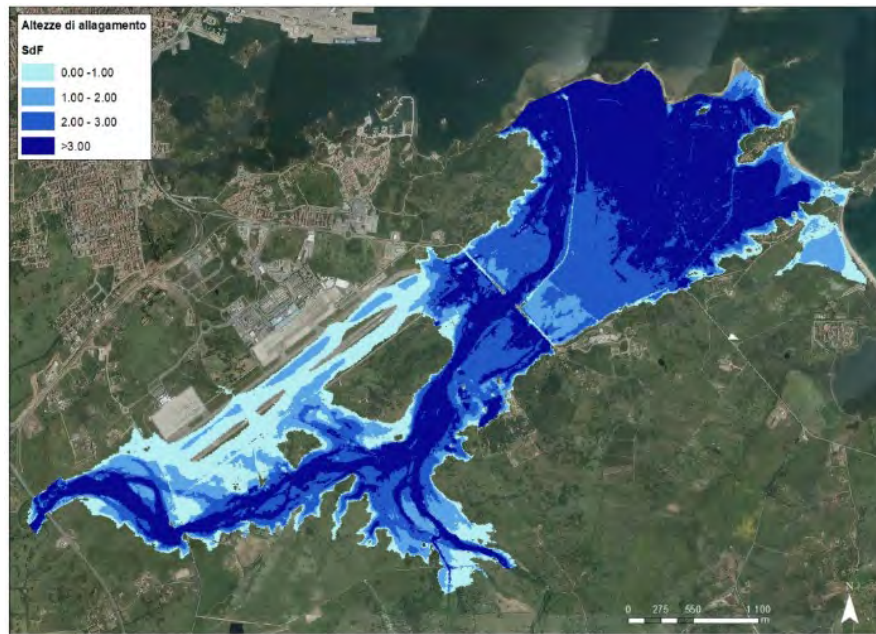
Design od interventions.

The project has foreseen interventions to limit the water entering the urban area through:

- construction of a flood control basin on the Rio Seligheddu with 600,000 m<sup>3</sup> of reservoir.
- construction of a flood diversion tunnel (length 11.4 km, diameter from 5 m to 8 m) capable of intercepting the watercourses surrounding the city of Olbia, draining the flood water in the Rio Padrongianu.
- construction of secondary tunnel to connect the several rivers intercepted to the main diversion tunnel.

Other interventions were included in the design, in particular regarding the upgrade of existing watercourses through the urban area of the city, described as follow:

- upgrading of the existing river courses in the city area, for a total length of 15 km;
- demolition and reconstruction of 20 road bridges.
- construction of diversion channels upstream of the existing burrier reaches, in order to exclude them from their function as receptors of watercourses, since it has been verified that it is not economically, environmentally and socially convenient to adapt them. Therefore, only sewer water receptors have been provided for graves.



# CONSULTING SERVICES SUPPORTING THE PROJECT MANAGEMENT OFFICE (PMO) ESTABLISHED UNDER NVDA AND NBD

Location:	Mazār-i-Sharīf, Yangi Qala, Jalalabad -Afghanistan
Client:	ADB; Ministry of Agriculture, Irrigation and Livestock and Ministry of Energy and Water
Services:	Detailed design, works Supervision
Period:	12/2011 - 06/2017
Construction cost:	€ 30,980,000

## Project Description:

The contract has two components: NVDA (Nangarhar Valley Development Authority) irrigation system (under the Ministry of Agriculture, Irrigation and Livestock) and the MEW NBD (Northern Basins Development) irrigation system and Flood Management (under Ministry of Energy and Water)

### The MAIL NVDA Component

The Consortium had to assist the PMO with responsibility for:

- (i) the design, procurement and construction supervision for the rehabilitation and upgrade (R&U) of the NVDA irrigation system;
- (ii) the preparation of a business plan for corporatizing NVDA and improving its profitability;
- (iii) the establishment of Irrigation Associations (IAs), to participate in irrigation management (PIM) and (iv) providing OFWM and improved agricultural practice demonstrations at selected sites.

For R&U of the irrigation system, the services include:

- (i) the preparation of the detailed design for a single international competitive bidding (ICB) contract covering the main, secondary, and tertiary irrigation canals;
- (ii) the assistance to the PMO with the procurement of the civil works services;
- (iii) the supervision to ensure the construction works and to certify progress payments;
- (iv) the assistance to the PMO to assure that safeguards measures in line with ADB's relevant policies are in place;
- (v) the establishment and implementation of a results-based project management, monitoring and evaluation system.

In particular, the Consortium had to prepare the detailed design for all the restoration and upgrading works of the main, secondary and tertiary irrigation canals, include them in the international tender package and, with assistance of the procurement specialist, prepare the tender documents and assist in advertising the work, issuing invitations to bid, responding to queries from prospective bidders, evaluation of bids and carrying out post-qualification of the successful bidder, all in compliance with both MAIL/NVDA procurement procedures and ADB's Procurement Guidelines.

### The MEW NBD and Flood Management Components

The contract involves three international competitive bidding (ICB) contracts covering:

- (i) the 250 main canal structures (designs are complete and bidding underway);
- (ii) the construction of Bangala Weir and refurbishment of Samarkandian Weir;
- (iii) the construction of the flood protection embankment in Yanqi Qala, construction of gated headworks for the Yetim Tapa irrigation canal, and on the Amu Darya, and emergency protection works for bank erosion control along selected reaches of the upper Amu Darya



The Consultant had to:

- (i) prepare detailed designs and bill of quantities,
- (ii) assist the PMO procure civil work contracts following the ADB (2010) Procurement Guidelines, as amended from time to time, and
- (iii) supervise construction and act as "the Engineer".



To ensure sustainability, the consultants will assist the PMO to review O&M fund flows, and develop options for O&M financing to be adopted and implemented by MEW. Under this contract the Consultant will:

- review the previous designs of the new Bangala Weir and existing Samarkandian Weir and the cause and extent of the damage the latter suffered in the 2009 flood;
- review best practice in diversion weir and intake design, in dynamic rivers, discuss and agree with the PMO the design procedure, standards, timeline and responsibilities;
- organize and supervise site investigations (soil, topography, hydrology), finalize location of Bangala Weir and its general layout including its intake and flood protection works;
- prepare the hydraulic design of Bangala Weir including arrangements for safe passage of flood flows, energy dissipation and to avoid sedimentation and seepage problems etc;

- supervise the structural design and detailing of Bangala Weir by PMO staff including the preparation of the bill of quantities and construction specifications etc;
- undertake similar activities for the rehabilitation and upgrading of existing Samarkandian Weir and improvement of the operational control of the Samarkandian and Narhi Shahi weirs;
- assist the O&M Engineer to ensure that sound operational guides and an optimal sediment management plan are prepared and implemented for the improved weirs.





# FLOOD CONTROL WORKS ON THE TIMONCHIO RIVER

Location:	Veneto Region , Italy
Client:	Veneto Regional Authority
Services:	Concept, Preliminary and Detailed design; works supervision
Period:	11/2010 - 02/2012
Construction cost:	€ 24,882,800

## Project Description:

The project concerns the design of lamination and control works of the floods of Timonchio river, which represents the main artery of a group of water courses, most of which flow through built-up areas.

This situation required the design and realization of an artificial flooding area, in order to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields. The flooding area was divided in two smaller basins, an upper and a lower one.



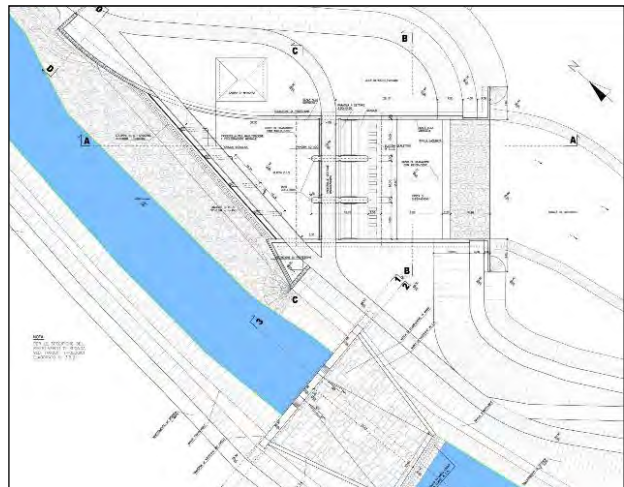
The project area has an extension of about 100 hectares, which is divided into 60 hectares for the upper basins and 40 hectares for the lower one.

The total volume of water which can be stored in the area is about 4.6 million m<sup>3</sup>, divided into 2.8 million for the upper and 1.8 million m<sup>3</sup> for the lower basin.

The two areas are located on the hydrographic left side, connected to each other. The whole flooding area consists of a series of two descending smaller basins: the primary stage, which occurs in the upper basin, concerns the collecting of the surplus water from the main artery of the Timonchio river. Here the left levee of the river has been re-shaped, in order to avoid risks and physically separate the river area from the farmland and urban area of Caldogno.

In the lower basin it has been necessary to continue the re-shaping of the left levee, thus separating the new artificial flood zone from the previous main riverbed. In the lower basin the restitution work was placed, likewise with the re-shaping and reinforcement of the left levee to protect the town and separate it from the flood area. The entire project area was surrounded by an embankment to create an artificial basin and contain the flood into the basins. The total extension of these embankments is about 4400m. The two basins are physically interrupted by an embankment of about 850m, which is roughly located in the middle of the project area.

The connection between the river and the basins is provided by a lateral structure, created on the upstream side of the basins. It is composed by a crested weir regulated by three radial gates. The total width of the weir is about 30m, divided into three gates.



The connection between the upper and lower basins is provided by a structure realized in the middle embankment. It is composed of a four barrels culvert, regulated by four sluice gates, which are open to allow the flooding of the lower basin, when the upper one is full. The connection structure consists of a 100m spillway.

At the lowest point of the project is the restitution structure, which allows the emptying of the basins at the end of the critical event.

The consortium formed by Beta Studio Srl (leader), TECHNITAL S.p.A. (40%) and CSP Srl, has also been awarded the construction supervision which is expected to start during 2013.



# FLOOD PROTECTION WORKS OF THE PORT OF TADJOURA

Location:	Republic of Djibouti
Client:	Ministère de l'Équipement et des Transports of the Republic of Djibouti
Services:	Preliminary and Detailed design
Period:	11/2010 – 04/2011
Construction cost:	€ 3,000,000

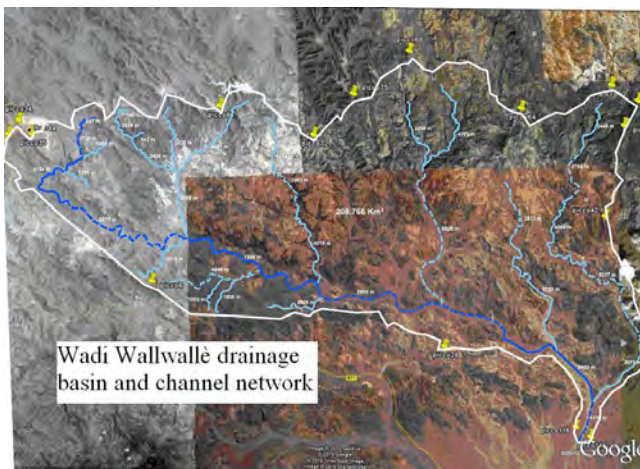
## Project Description:

The extension of the port of Tadjoura is part of the Djibouti Government plan to develop the regions of the Country. The project area develops for 1,5 km over the eastern part of the alluvial fan of Walwallè wadi and protection works against floods are necessary.



In arid regions there are no perennial surface flows and the annual runoff volume is usually concentrated in the form of floods of short duration but sizable magnitude. When the intensity of the rainfall is extremely high, flash-floods characterized by rapid rise-times, very high peak-discharges and high sediment transport may occur.

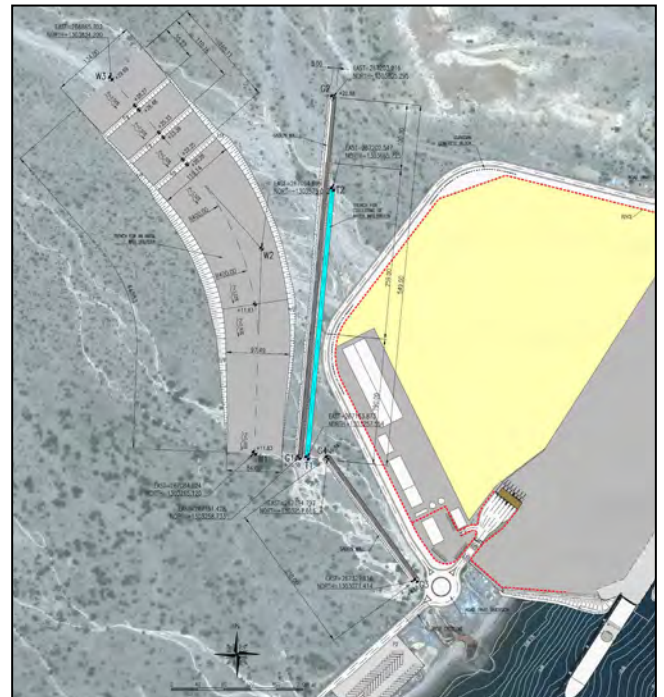
Therefore a study of the whole involved area, focused on the Walwallè drainage network and watershed morphology, was carried out. Information about arid and semi-arid hydrology was taken from other Djibouti wadi data and from literature. Peak discharges and sediment transport capacity were estimated.



Based on those calculations flood protection gabions walls and dug canals were properly designed to achieve the primary objective that is to ensure that the potential for overtopping failure is minimized.

The total height of the protection works, TH, that is the sum of the canal depth, CD, and the wall height, WH, is able to accommodate

variable flowpaths and hydraulic characteristics, including potential sediment deposition associated with canal slope and width reductions.



Hereafter are presented some general criteria that were adopted to design the geometry of the protection works:

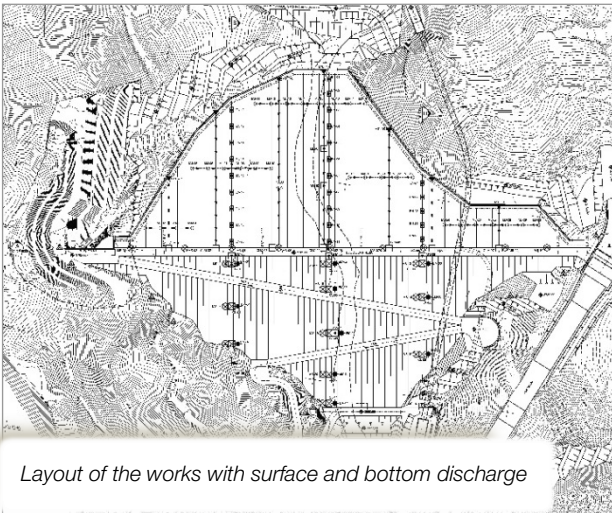
- a single gabions wall, about 550 m long, was designed to address the flow of both wadi Walwallè and a minor tributary. The protection wall anchors extend beyond the lateral limits of the fan, over a geologically inactive area for a length of 100 m. Another gabions wall, 230 m long, is located on the western side of the port to further protect it and convey water to the sea;
- the orientation between the flow directions and the dike alignment is as small as possible taking into account the presence of the port area downstream the wall;
- the gabions wall design height, WH, varies between 4,5 m for the lower bend reach and 2,5 m for the anchor reach and the cross-section area of the wall varies in the range of 11-16 m<sup>2</sup>/m.
- the canal for the initial diversion of the Walwallè wadi was designed with a bend radius as long as possible. There are three gently sloped steps (about 50 m long each) and a large horizontal bed 225 m long downstream the end of the wall in order to reduce flow velocity;
- the canal is at a minimum distance of about 20 m from the gabions wall in order to prevent toe scour;
- drainage trenches are at the downstream side of the gabions walls since the structures are permeable.

# MISICUNI II PROJECT - DAM AND ANCILLARY WORKS ON THE RIO MISICUNI NEAR COCHABAMBA: TECHNICAL ASSISTANCE

Location:	Bolivia
Client:	Consorcio Hidroeléctrico Misicuni
Services:	Geological, geotechnical, hydraulic and hydrogeological studies
Period:	09/2009 – 03/2010
Construction cost:	€ 58,000,000

## Project Description:

The project concerns the construction of a 120 m high earth dam on the Rio Misicuni, north of the city of Cochabamba, Bolivia, at an altitude of 3800 m a.m.s.l. The structure will create a reservoir of 185 million m<sup>3</sup> of water, which will be the most importante source of potable water for the city of Cochabamba. In successive future phases, the water source will also be used for the generation of electricity.



*Layout of the works with surface and bottom discharge*

The project envisages a cofferdam and a diversion tunnel which will also be used for the bottom discharge. The surface discharge will be of the ski-jump type with a stilling basin. The upstream face is in concrete slabs. The dam core is in homogeneous material with anti-filtration diaphragms which extend into the abutments.



*Geological investigations at the dam location*

The peak flow rate considered for scaling the surface overflow is 2300 m<sup>3</sup>/s, discharge which is attenuated at the rate of 1200 m<sup>3</sup>/s, while the peak flow rate for the provisional diversion is 180 m<sup>3</sup>/s.

The Consorcio Hidroeléctrico Misicuni, the group of contractors that was awarded the contract, led by GLF Construction Corporation (USA), contracted TECHNITAL to carry out specialist

geotechnical and hydraulic studies and evaluations to verify the design.



The services carried out by TECHNITAL comprised:

- the supervision of the initial geotechnical-geological investigation works, executed both for the localization of construction materials and for the evaluation of the geology at the dam site;
- the evaluation of the efficiency of the existing design, both regarding geotechnical-geological and hydraulic aspects;
- the identification of new borrow areas with the specific aim of optimizing the design of the dam with alternative solutions;
- the verification of the dimensions of the bottom discharge tunnel and the stilling tank
- the definition of an alternative design solution based on an analytical study and computational analysis.



*Bottom discharge tunnel*

The main goal was to minimize and optimize the excavations in the light of the additional geological investigations regarding the characteristics of the dam core, and the surface discharge works and stilling tank. These tasks were achieved through specific site investigations, combined with and completed by design computational analysis and evaluations based on the data gathered.



# FLOOD PROTECTION WORKS AND INFRASTRUCTURES FOR THE URBAN AREA OF SAN ERASMO

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works
Services:	Preliminary and Detailed Design
Period:	12/1996 – 12/2009
Construction cost:	€ 130,000,000

## Project Description:

In the context of the vast programme of works to save Venice from flooding and restore the natural environment of the Venice lagoon, for which TECHNITAL is the sole designer, are numerous projects to protect the various islands and townships of the lagoon. One of these is regards the locality of S. Erasmo.



The project aims primarily to protect the settlement of S. Erasmo from flooding due to the high tides. The scope of the design has been extended, with the approval of the Municipality of Venice and the Water Board, to include other objectives identified in the Master Plan of the island.



In particular, the works include: the construction of quay walls, urbanisation works for 5 zones, and works to restore the hydro-geological balance of the lagoon and invert the degradation process, eliminating its causes.

To achieve this last objective the following works are envisaged:

- vivification of the canals, today largely filled in, with

appropriate shore protection works in the stretches subjected to stronger currents and therefore more susceptible to erosion;



- halting the process of degradation of the natural and historical features, such as the once coastal beach at the south-western tip of the island;
- reduction of the pollution load in the lagoon deriving from civil wastes by means of constructing of a sewerage system
- interposing septic tanks between the houses and the lagoon;
- reducing the nutrient load discharged in to the lagoon.



The services performed include surveys and investigation, preliminary and detailed designs of shore protection works, roads, quay walls, sewerage and water treatment systems.

# FLOOD CONTROL OF THE BISAGNO RIVER AND OF THE FEREGGIANO, ROVARE AND NOCE STREAMS

Location:	Genoa, Italy
Client:	Province of Genoa
Services:	Detailed design, EIA, physical model studies
Period:	03/2003 – 07/2008
Construction cost:	€ 153,427,600

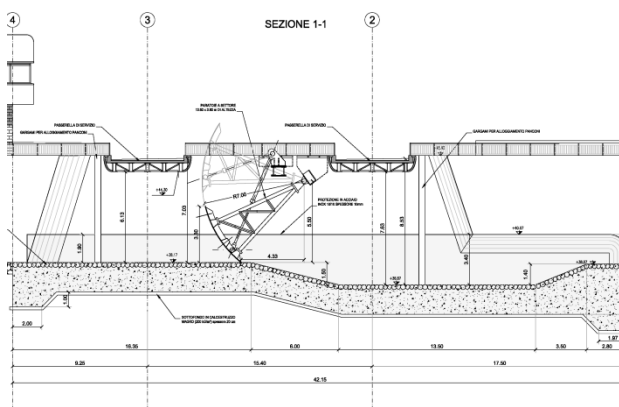
## Project Description:

Studies conducted by the River Basin Authority, developed within the Basin Master Plan, underlined the risk of flooding of Genoa by the Bisagno river and the Fereggiano, Rovare and Noce streams. Such risk derives from the strong difference between the capacity of the river itself and the peak discharge with a return period of 200 years.



The project foresees a series of works due to reduce the risk of flood of huge urban areas. In particular, these works include:

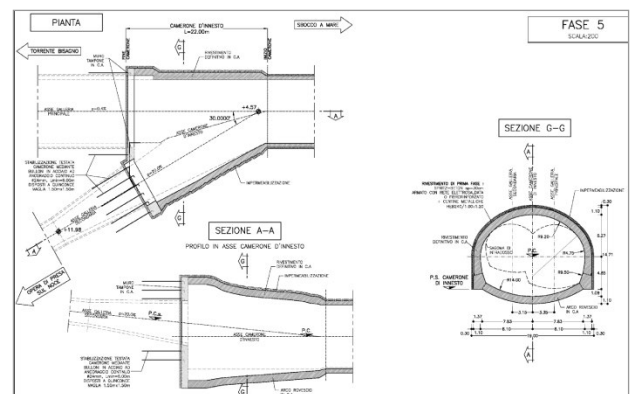
- Improvement of the hydraulic section located in the mouth reach, interested by a multiple barrel box culvert;
- realization of a river diversion to reduce the peak discharges flowing in the original riverbed.



The project of the river diversion includes, for the Bisagno river, the following works:

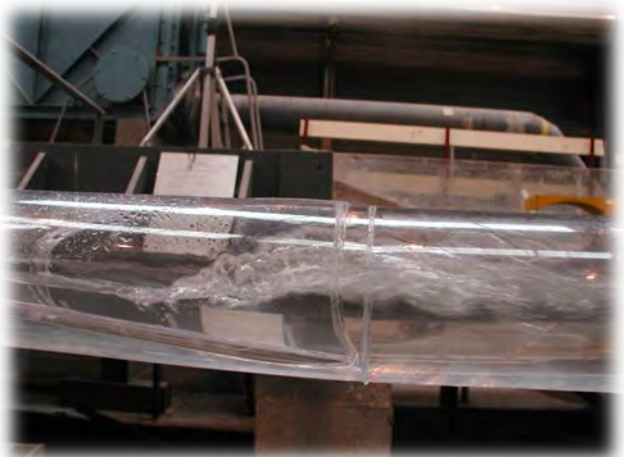
- a river barrage equipped with n. 3 radial gates;
- a tunnel, with a horseshoe section with 9.5 m diameter, able to carry to the Tyrrhenian sea a portion of the flood discharges derived by a lateral weir; the total length of the tunnel is 6,650 m;
- three smaller diversion structures on the streams Fereggiano, Rovare and Noce, connected to the main tunnel through three tunnels 300 m length;
- a sea outfall structure of the main tunnel;

- two service tunnels.



To verify the hydraulic behaviour of the main structures, a series of tests have been performed on n. 6 physical model with regards:

- diversion structures at the Bisagno river and at the Fereggiano, Rovare and Noce streams;
- tunnel confluence between the main tunnel and the tunnel coming from the Fereggiano stream;
- sea outfall structure.



The physical model tests allowed the evaluation of:

- the behaviour of the barrage, of the radial gates and of the lateral weir at the Bisagno barrage;
- the wave field in front of the outfall structure and the jet stream dissipation;
- the stability of the rock revetment at the outfall structure;
- the hydraulic confluence between the main tunnel and the tunnel coming from the Fereggiano stream;
- the hydraulic behaviour of the diversion structures (vortex shafts) located at the Fereggiano, Rovare and Noce streams.

# HYDRAULIC WORKS ON THE NEW VALTROMPIA MOTORWAY LINK, ON THE MELLA AND GRANDE RIVERS

Location:	Brescia, Lombardy, Italy
Client:	Brescia – Padova Motorway Company
Services:	River dredging and training, banks shaping and flood control structures - Concept, Preliminary and Detailed Designs
Period:	06/2002 – 10/2007
Construction cost:	€ 6,622,200 (hydraulic works)

## Project Description:

The project concerns the design of river training interventions, banks re-shaping and flood control structures in the crossing sections of the Mella and Grande rivers, which interfere with the construction of the new connection between the Brescia-Padua A4 highway and the valley area called Valtrompia, nearby the city of Brescia.



Bank protection works downstream of the bridge

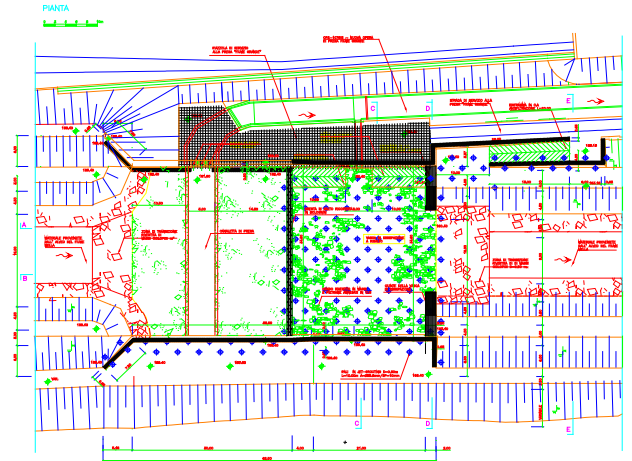
The works designed were as follows:

- New flood plain: in order to provide a floodable area and prevent all the risks to the built-up area of Campagnole di Concesio, a new flood plain has been designed beyond the right bank of the river, obtained by dredging the river bank for a length of approximately 700 m, while the talweg was reinforced with an improved bed made of rocks coming from the lateral dredging;



River training works at Campagnole di Concesio

- Sills for the Collebeato bridge protection: in order to ensure the safety of the deck system of the Collebeato bridge, an existing sill placed before the bridge was reduced by 2 m, while a new one has been designed 200 meters after the bridge: this intervention should reduce the water level by about 2 m under the bridge section;



- Dissipation basins and new intake structures on the Grande River: the Grande River, which flows near the Mella River, has been selected for the intake of water in order to maintain the hydraulic level of the Mella River near the existing sill during the dry season. For this purpose, a couple of dissipation basins in the Grande River near the new intake structures have been designed, in order to increase the water level of the Grande near the structures. A 32 m wide rock-based plateau filled with concrete has been designed, surrounded by vertical straight rock walls filled with concrete; a 2 m high sill and a minor dissipation basin for containing the hydraulic jump have been designed and placed after the first basin.



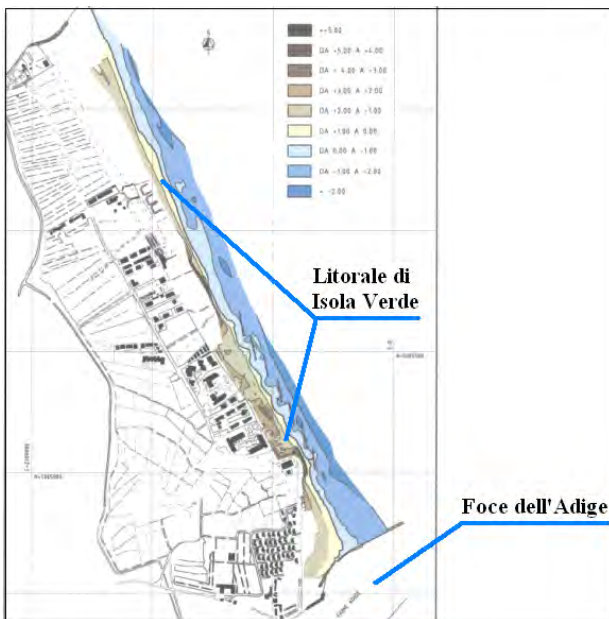
Intake work on the Grande River

# WORKS TO PROTECT AND RE-DEFINE THE MOUTH OF THE RIVER ADIGE

Location:	Veneto Region, Italy
Client:	Venezia Nuova Consortium for the Water Board (MoPW) - Venice
Services:	Geotechnical, bathymetric, sedimentological, chemical and microbiological studies and investigations; Physical model studies; Detailed Design
Period:	05/1996 – 04/2005
Construction cost:	€ 7,593,900

## Project Description:

The project for re-defining and protecting the mouth of the Adige is part of a larger contract for the protection of Isola Verde littoral which extends for some 2.5 km between the mouth of the Brenta River in the north and the Adige in the south.



The works in the last section of the Adige river were intended to:

- create the minimum flow river bed,
- permit safe navigation through the river mouth,
- foster the dispersion of fresh water from the Adige towards deeper waters,
- reinforce the existing protection works at the mouth
- contain the beach replenishment foreseen for the adjacent littorals.

Field investigations were carried out to determine the hydrodynamic characteristics of the river and the nature of the sediments in the riverbed. Subsequently, model studies were executed to determine the optimal configuration of the river mouth for the dispersion of pollutants carried by the river.

A physical model study carried out of the river mouth and the entire stretch of coast made possible the definition of the best configuration of the left breakwater at the mouth for spreading the pollutants without interfering with river navigation.

Geotechnical, bathymetric, sedimentological, chemical and microbiological studies were carried out by means of bores and surveys and the testing of samples.

The Detailed Design foresaw the realization of seven groynes along the coast of *Isola Verde*, to protect the coastline from erosion.



The river works included:

- extension seawards of the northern breakwater to a depth about -1.5 m
- re-definition of the earthen part of the breakwater
- excavation of the low water flow riverbed to a depth of -4.5 m and re-use of the excavated material for the nourishment of the littoral.

# ANATOLIAN MOTORWAY

Location:	Gumusova-Gerede Section, Turkey
Client:	Astaldi-Bayindir AS J.V.
Services:	Preliminary and Detailed Design
Period:	12/2000 – 12/2002
Construction cost:	€ 80,000,000

## Project Description:



TECHNITAL has been awarded a contract by the contractors Astaldi-Bayindir AS J.V. responsible for the construction of the Gumusova-Gerede section (Stretch 2D) of the Anatolian motorway (Istanbul-Ankara) regarding the structural design of 3 viaducts across River Arsarsuvu and related seismic isolation system.

In particular the activities entrusted to TECHNITAL include:

- Final and detailed design of 2 viaducts in a seismic area: Viaduct 2 (length 1200 m), Viaduct 3 (400m), including the design of seismic isolation system and dynamic analyses of a further viaduct, Viaduct 4 (700m), in accordance with the American AASHTO standards.

- Hydraulic design & riverbed training: In this case the tasks include the preliminary and final design of hydraulic works along the motorway alignment (approx. 4 km) and the training of Arsarsuyu river and its tributaries.
- Assistance to the Client during construction and supervision of the whole design.



# EXTENSION OF THE CATCHMENT BASIN OF LAKE TRASIMENO

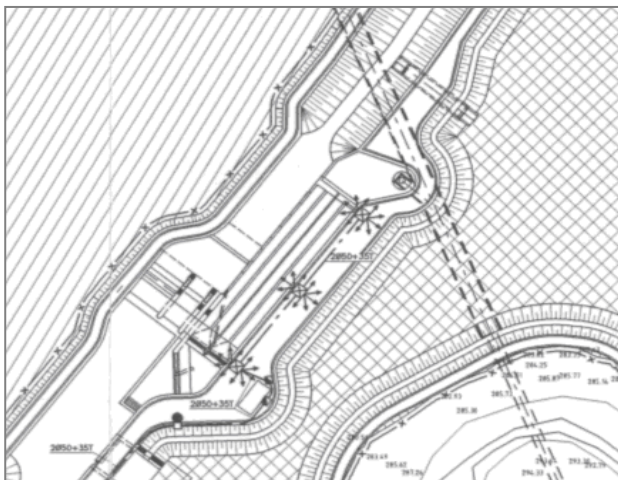
Location:	Umbria Region, Italy
Client:	Tiber River Basin Authority
Services:	Preliminary and Detailed Design
Period:	04/1998 – 06/2000
Construction cost:	€ 43,898,800

## Project Description:

Lake Trasimeno is located in the central-western part of Umbria region, near the regional boundary with Tuscany. With its 128 km<sup>2</sup> surface, it is the fourth largest lake of Italy. It is also a unique swamp environment (maximum depth 6 m) of great natural and landscape significance, which is the home to numerous species of fish and also the natural habitat of a variety of birds.

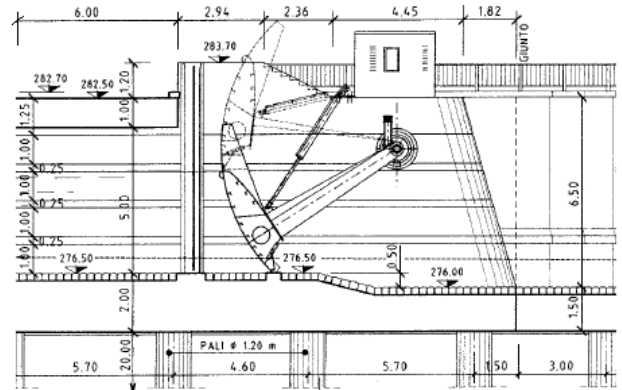


This rich natural environment has been seriously threatened by the depletion of the water in the lake. The steady lowering of the hydrometric level of Lake Trasimeno has been observed since the 1960's, and it became evident that it was necessary to extend its catchment basin, in order to provide a constant afferent water volume to avoid the lowering beneath a certain fixed level.

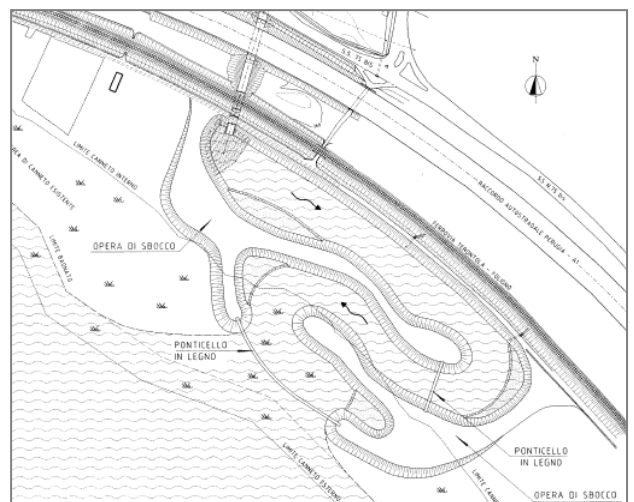


The preliminary design foresaw a work to collect water from the Tiber River. Subsequently, during the Detailed Design phase, it was decided to create a diversion of the Niccone stream, situated 13 km away to the north, and thus obtain the required water volume. The intervention regarded two different parts:

- *Diversion of the Niccone stream:* a stringer was foreseen, to deviate the normal path of the stream's flow, with a sill and two vertical-lift.



- gates, one of which was designed as a spillway gate: these gates will have the role of controlling the water volume by-passing the diversion and continuing in the natural flow course. After the diversion stage, a "collection" stage was established, with a bar screen for the retention of transported raw bed materials, followed by a two-bed settling basin, for the sedimentation of small-granulometry sand; the settling basin is then directly connected with the adduction tunnel. The diversion work required an intervention for the rescaling of both natural levees of the stream.



- *Outfall and entry work in Trasimeno Lake:* this part of the project was given very careful consideration, in order not to modify too drastically the natural environment of the lake shores. In order to achieve this result, the outfall area has been located not directly on the shore (so that it would not be necessary to dig the shore itself), and an artificial "lagoon" was created in a grassy field in front of the lake: a series of smooth bights were designed, from the outfall point of the tunnel to the entry section in the lake, following an "S" profile so that the incoming water volume reaches sub-critical hydrodynamic conditions, and enters the lake basin smoothly.

# ENVIRONMENTAL PROTECTION OF THE SARCA RIVER - LAKE GARDA - MINCIO RIVER - MANTUAN LAKES SYSTEM

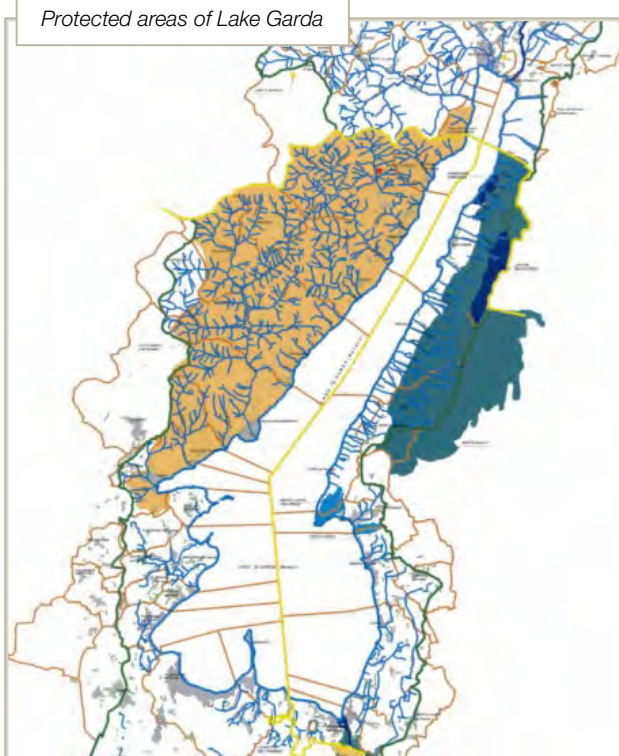
Location:	Italy
Client:	Po River Basin Authority
Services:	Concept design, EIA
Period:	02/1996 – 02/1997
Construction cost:	N.A.

## Project Description:



Sarca river

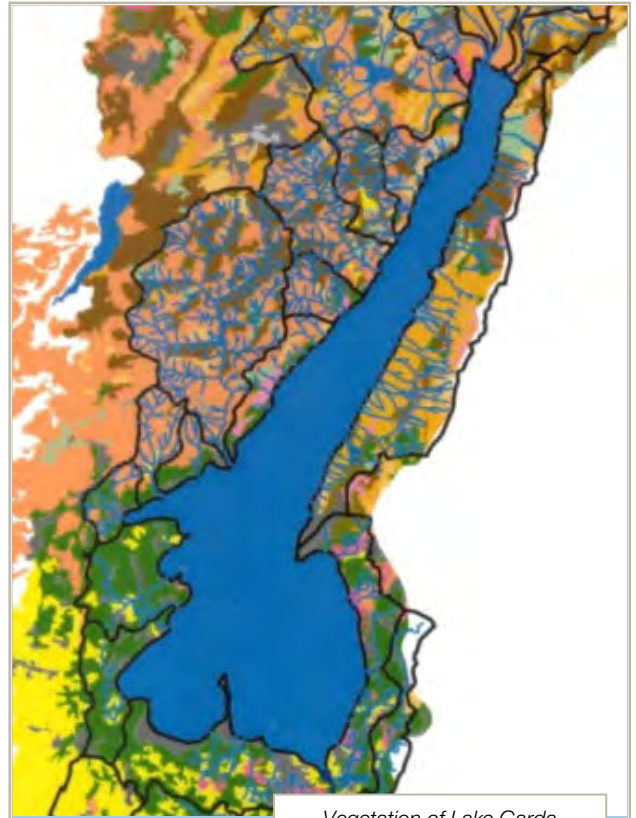
The aim of the study is to define an exhaustive framework of knowledge regarding the environmental quality of the area and to supply the elements needed to:



Protected areas of Lake Garda

- improve the quality of the water in the basin in relation the integrated and optimum use of the water resource, taking into consideration the tourist-recreational prerogative of the area;

- define the principal alternative actions to optimize the water treatment system and the recycling of the treated waste water;
- define the restrictions for using both the water and the land, identifying criteria, standards and regulations to reduce the impact of anthropogenic activities on the territory;
- identify the tools required for monitoring the efficacy of the actions.



Vegetation of Lake Garda



Mantua lakes

# HYDROELECTRIC POWER PLANT OF PONT VENTOUX IN SUSA VALLEY

Location:	Piedmont Region, Italy
Client:	Temporary Association of contractors (Spie Battignoles, Grandi Lavori Fincosit, Vianini, Condotte) for "Azienda Elettrica Municipale (AEM)" of Turin
Services:	Final design
Period:	06/1992 – 07/1993
Construction cost:	€ 61,974,800

## Project Description:

The AEM of Torino has tendered the construction of the new Hydroelectric Plant of Pont Ventoux, in Val Susa, which foresees the partial utilisation of Dora Riparia River waters.



The project was carried out in association with Electricité de France and Coyne et Bellier of France.



The project includes:

- the main diversion structure constituted by a dam on Dora Riparia River, a water intake structure and all ancillary works;
- a free surface offtake canal constructed in tunnel for a length of 14 km and a peak flow of 30 m<sup>3</sup>/sec.;
- a regulating reservoir in Val Clarea of 560,000 m<sup>3</sup> capacity, constituted by a 33 m. high dam and bypass canal;
- pressure tunnel of 2.75 km in length connected to a pressure steel pipeline of 685 m. in length and 2.8 m. dia.;
- electric power plant of 388 GW;
- ancillary works such as access roads and tunnels, restitution canal etc.

*Works under construction and after completion*





# MASTER PLANS FOR THE LIVENZA, LEMENE AND TAGLIAMENTO RIVER BASINS

Location:	Veneto and Friuli Venezia Giulia Regions, Italy
Client:	Hydrographic Office of the Venice Water Board - Ministry of Public Works
Services:	Studies for hydrology, hydrogeology, hydraulics and water quality
Period:	01/1984 – 12/1987
Construction cost:	N.A.

## Project Description:

The purpose of the Master Plan of the three river basins is the hydrological and hydraulic protection of the soils, the sustainable socio-economic development of the area, the preservation of natural resources, the depollution of waters and soils.

The area concerned by the study consists of the catchment basins of the rivers Livenza, Tagliamento e Lemene, for a total area of approx. 6.000 sqared km., located in the Veneto and Friuli Venezia Giulia regions.

The Study includes preliminary investigations and collection of existing documentation and data, collection and elaboration of hydrological data, running of mathematical simulation models, geological surveys, measurement and monitoring, analysis.

The Master plan is divided in three phases. TECHNITAL, in Joint Venture with Hydrostudio and SGI, has been awarded the 1<sup>st</sup> Phase of all three river basins and the 2<sup>nd</sup> Phase for the Livenza river basin.



*Livenza river*



*Tagliamento river*



*River basins*

# IRRIGATION SCHEMES FOR AGRICULTURAL DEVELOPMENT AT MANANTALI (MALI) AND BOGHÉ' (MAURITANIA)

Location:	Manantali, Mali – Boghé Mauritania
Client:	Organisation pour la mise en valeur du fleuve Senegal (OMVS) - Ministère de l'Agriculture du Mali - Financing by Italian Ministry of Foreign Affairs.
Services:	Feasibility Study; Concept, Preliminary and Detailed Design; Tender documents
Period:	01/1982 – 12/1986
Construction cost:	N.A.

## Project Description:

As the title reveals, two distinct projects are involved under the same contract. Both projects are aimed to implement irrigation schemes in local agriculture with the scope of increasing annual harvest so that agriculture is no longer dependent on the desultory floods.

The engineering services awarded to TECHNITAL included: preliminary research and investigations, mathematical simulation models, topography, hydrological studies, geological surveys, laboratory testing, preliminary and final design of 3.000 ha irrigation scheme, tender documents.



In the case of **Mali**, the areas in question are those along the Bafing River (an affluent of River Senegal), downstream of the Manantali dam, under construction at the time of the project, for a total extension of approx. 3.000 ha. In **Mauritania** the areas concerned are located in the Boghé plains, on the right banks of River Senegal.



# STUDY OF THE POSSIBILITIES OF STORING AND UTILISING SURFACE RUN-OFF WATER FOR AGRICULTURE

Location:	Senegal Sardinia, Italy
Client:	Ministère de l'Hydraulique - Senegal, with financing from the Italian Government
Services:	Feasibility study, preliminary design
Period:	01/1983 – 12/1985
Construction cost:	€ 10,329,100

## Project Description:

The climatic changes witnessed in the Sahel area over the past twenty years have had serious repercussions also in Senegal, with decreasing rainfall, reduction of agro-pastoral products and consequent droughts.

This Study comes in the context of the Senegalese Government's decision to investigate the possibility of constructing surface water retaining dams and related irrigation schemes, in an area of about 30.000 km<sup>2</sup>.

The Study, awarded to a Joint Venture between TECHNITAL and INC, included:

- identification of all most suitable areas for the construction of retaining dams and irrigation schemes, through a aerial photographs interpretation, site surveys, socio-economic studies and feasibility evaluations;
- identification of six priority sites to be further investigated;
- detailed topographic, pedological and geological surveys on priority sites;
- preliminary design of retaining structures and irrigation schemes for each of the six priority sites.



# DAM ON THE GIBBESI RIVER IN SICILY

Location:	Sicily, Italy
Client:	Mazzi S.p.A. for the Sicilian Mines Organization
Services:	Identification studies, Preliminary and Detailed Designs of the hydraulic works and ancillary structures
Period:	01/1971- 12/1983
Construction cost:	€ 30,987,400

## Project Description:

The project was launched to foster the industrial development of the Licata plain, thus providing water resources to local inhabitants and industries and to support the agricultural development scheme of 1100 ha. along the Gibbesi river.



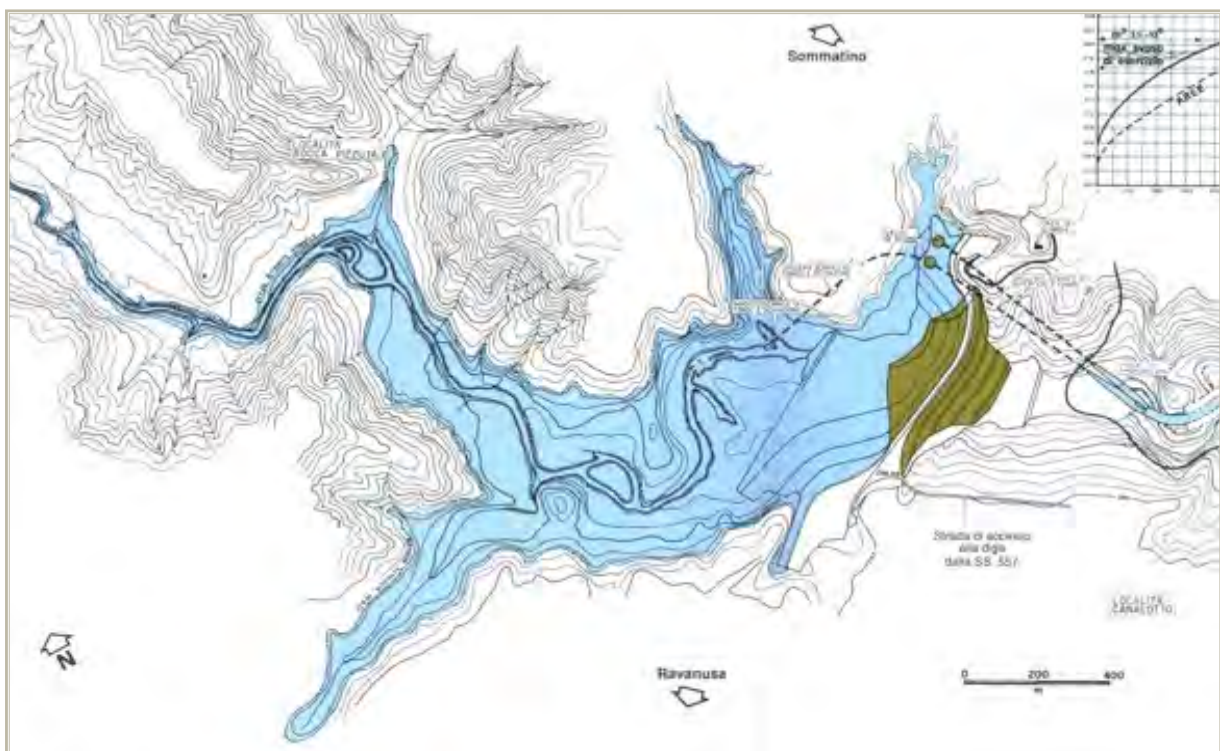
The rockfill dam, located some 4 km from the junction between Gibbesi and Salso rivers, has a length of 607 m. and a maximum height of 46 m. The catchment area, at the dam site, is 116 km<sup>2</sup> and the reservoir volume obtained is 11,4 million m<sup>3</sup>.

The project, in addition to the dam, also includes:

- access and internal road network;



- bottom and surface discharge structures: tunnels, shaft spillways, gates, etc.;
- energy dissipation structure and distribution channels;
- aqueduct, 28km long and with a flow-rate of 950 litres/second, from the reservoir to the storage tank of Reppelino in the Licata Plain;
- ancillary works.



## Hydraulic and Hydrodynamic Studies

# PROGRAMME FOR THE RECOVERY AND PRESERVATION OF THE VOLUME OF THE DAM RESERVOIRS: PONTE PIA', CARESER, PIAN PALU', ALA E MORI (Trentino, Italy)

Location:	Trentino, Italy	
Client:	HydroDolomiti Energia, TN	
Services:	Programme for the recovery and preservation of the volume of the dam reservoirs	
Period:	03/2018 – 10/2019	
Construction cost:	€ 1,864,976	cost of services: € 28,750

## Project Description:

Programmes for the restoration and conservation of reservoir volumes in the Walnut, Sarca and Adige basins (for the Careser, Pian Palù, Ponte Pià, Ala and Mori reservoirs) and pursuant to Ministerial Decree of 30 June 2004, Circular PAT no. 449612 of 26 September 2016 and subsequent notes and the competent legislation on the subject, concerning the various extended concessions pursuant to Presidential Decree no. 4/98 and subsequent amendments and addendum.

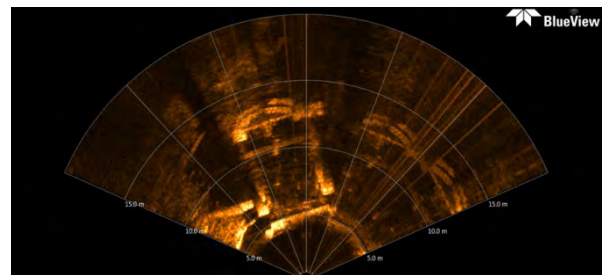
One of the major problems in the management of reservoirs is represented by the burying, that is the progressive accumulation of sediments that reduces the storage capacity and can limit the functionality of watercourses and plants, sometimes to the point of completely precluding it.

The silting up of the reservoir is linked to the sedimentation of eroded soil and rock particles in the catchment area upstream or from the banks of the reservoir.

The deposition of a high solid content has a direct impact on the maintenance, cost and efficiency of hydraulic works and mechanical devices in artificial reservoirs. Burying can also cause serious problems for tributaries and effluents, as well as for the quality of water and its ecosystems.



In order to implement the Plan, each dam was assessed in terms of its territorial framework, and information was gathered on the construction of the dam, as well as of the relative useful volumes, maximum storage and regulation. Quantitative-qualitative descriptions have been made for each basin upstream and downstream of the dams. Climatic data that may have influenced the quantity of material sedimented in the reservoir (flows, rainfall) have been analyzed. Finally, the results of the bathymetric surveys carried out over time were evaluated, with the aim of accurately quantifying the volumes of sediment deposited in the reservoir and in the vicinity of the bottom outlets.



The chemical-physical characteristics of the sediments to be removed were then evaluated and the possible post-excitation management of the sediments was defined.

Each Plan provides for the analysis of all possible sediment management solutions from a BAT (Best Available Technology) and BEST PRACTICE perspective that carefully evaluates potential impacts on the environment, territorial context, costs and benefits. Each management possibility has been analyzed, evaluated and compared with the others in order to identify the best solution for each reservoir and its territory.



Finally, a Monitoring Plan was proposed, where necessary, for the environmental parameters to be carried out before, during and after the sediment's removal operations.

# INTERVENTIONS TO MITIGATE THE INSTABILITY OF THE HILL WHERE THE CATHEDRAL OF AGRIGENTO IS LOCATED

Location:	Agrigento – Sicily - Italy
Client:	Sicily Region
Services:	Final and Detailed Design
Period:	05/2019 - 02/2020
Construction cost:	€ 19.224.077

## Project Description:

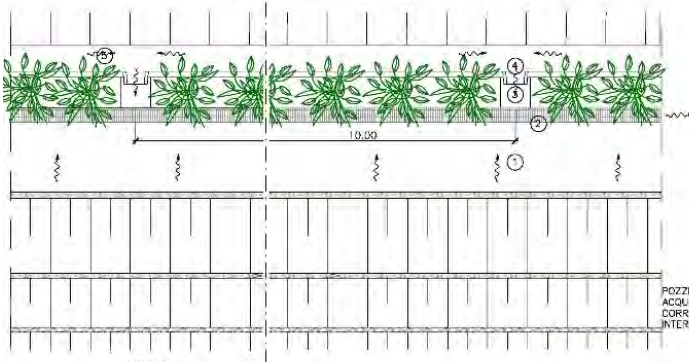
Because of its orographic and hydrogeological conformation, the project area, has been affected for centuries by the instability phenomena involving the Cathedral and the buildings of the diocesan area. The various and numerous interventions adopted over the centuries, mostly of a structural nature, have not stopped the process. The project area includes the site of the Cathedral and the slope that bounds the north side of the city of Agrigento. The Cathedral, whose construction began in the eleventh century, was located on a ridge east-west oriented. The city has developed on the south side, which with a gentle slope descends to the bottom of the valley, while the north side is steep, with a slope between 40 and 50 degrees and height up to 40m. Its instability was manifested along the ridge with a crack that affects the Cathedral, then extends eastward to the church of Sant 'Alfonso and westward to the Diocesan Museum.

The intervention of consolidation of the slope consists in the construction of 5 lines of concrete beams, between 304 and 324 m above sea level, with a total length of about 1,000 m, with micro piles and tie rods. The consolidation work has been studied and conceived minimizing the impact of the works on the site and on its environment. The beam acts both as a walkway and as ditch for the rainwater collection channel. The hydraulic measures adopted for the slope aims at managing the infiltration and regimentation of water, it consists in collection elements, ditches, and channels, to collect water and convey it to the foot of the slope. Inside the crowning beam a channel will be realized on the back of the upstream micro piles, for the collection of water from the slope, which will flow into the collection channel at the foot of the wall in micro piles. It is planned the realization of reinforced micro piles  $\Phi$  250 mm, according to three orders for alignment at a distance of 0,50 - 1 m, a crowning beam in reinforced concrete with 2 x 2 m section and anchoring tie-rods, at a distance of 1 m with variable free length in relation to the position of the anchorage and the local stratigraphy, with a foundation of 9 m.



SCHEMA DI DISPOSIZIONE DEGLI ELEMENTI DI DRENAGGIO - PIANTA

0 0.80 1.60 m

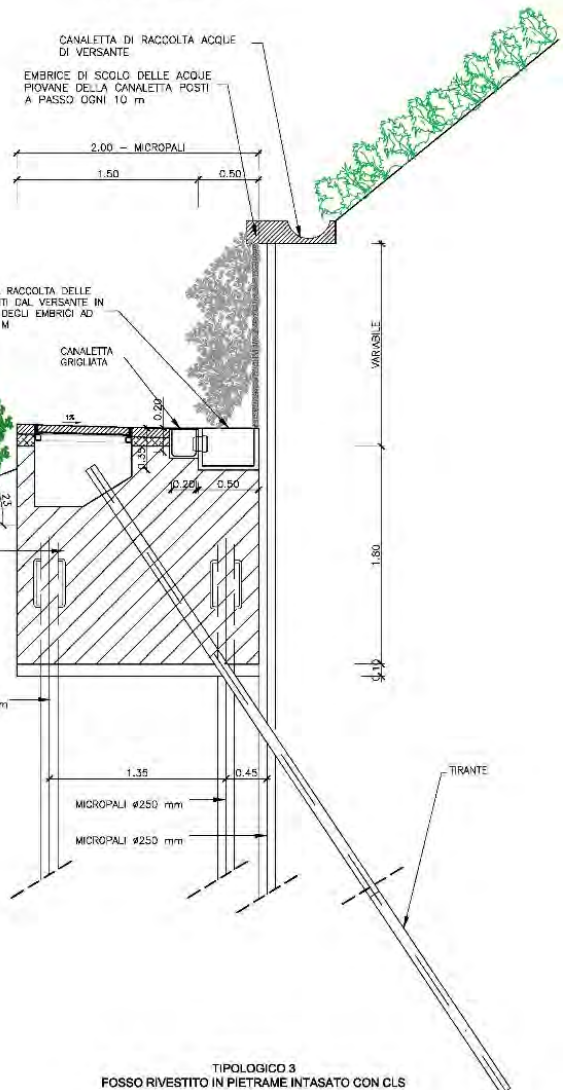


LEGENDA

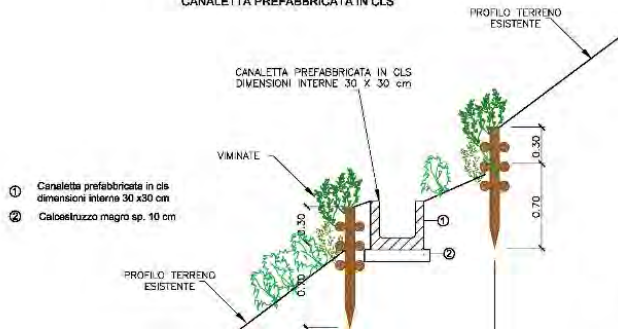
- ① PAVIMENTAZIONE IN TERRA STABILIZZATA NATURALE
- ② CANALETTA GRIGLIATA
- ③ POZZETTO DI RACCOLTA ACQUE DI VERSANTE
- ④ EMBRICE DI SCOLO DELLE ACQUE DI VERSANTE I=10.00 m
- ⑤ CANALETTA DI RACCOLTA ACQUE DI VERSANTE

SEZIONE TIPOLOGICA1

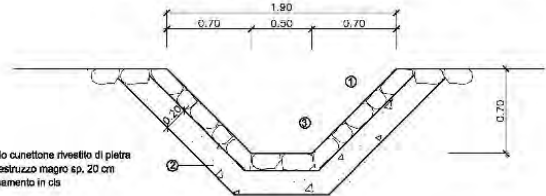
0 0.40 0.80 m



TIPOLOGICO 2  
CANALETTA PREFABBRICATA IN CLS



TIPOLOGICO 3  
FOSSO RIVESTITO IN PIETRAME INTASATO CON CLS  
LUNGO VIA GIARDINELLO





# UPDATING OF THE HYDROGEOLOGICAL STUDY OF THE IMPACT OF A CONTAINMENT CUT-OFF WALL IN THE VENICE INDUSTRIAL HARBOUR OF MARGHERA, VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Groundwater modelling
Period:	04/2008 - 06/2012
Construction cost:	N.A.

## Project Description:

This study consisted of the updating of the previous modelling study, concluded in 2007.

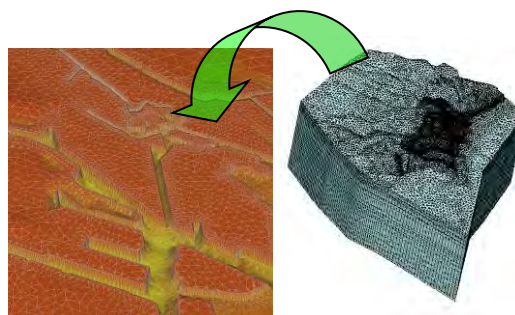
Within the general project of decontamination activities called MISE in the S.I.N. (Site of National Interest) area of Porto Marghera (Venice, Italy), the Italian Ministry of Environment asked the Venice Water Authority, *Magistrato alle Acque* (MAV), to limit the water exchange between the contaminated soils and the lagoon waters within the SIN. MAV, through its concessionary *Consorzio Venezia Nuova* (CVN), has planned construction of a continuous 56.8 km long cut-off wall made of steel sheet piles along the entire harbour channel banks. The diaphragms are driven into the lagoon bottom down to a depth ranging between 15 and 25 m below sea level. Since such a cut-off wall constitutes an impermeable barrier to groundwater flow from the mainland toward the lagoon, CVN commissioned Technital to carry out a study on the expected impact of the cut-off wall on the natural flow regime of the shallowest aquifers.



The modelling study, completed in 2007, based on the geological and hydrological information available to date, was developed to verify the efficiency of the continuous cut-off wall.

Successively, the study was updated with additional data, in order to more accurately describe underground litho-stratigraphy. In particular, 5 new detailed litho stratification sections were reconstructed in addition to the previous 12 sections, which were updated with many new data. A detailed reconstruction of the harbour litho stratigraphy was available from about 2000 boreholes and geotechnical tests. Furthermore, 8 deep litho stratification sections were reconstructed on the basis of data from about 160 artesian wells.

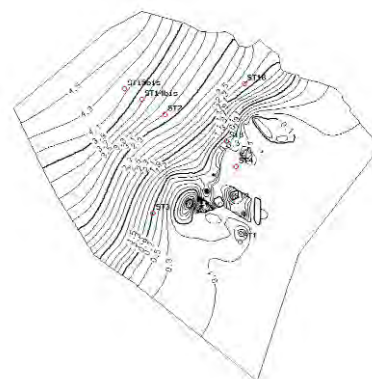
Following the updating of the stratigraphic conceptual model, the hydrogeological conceptual model was also updated with data from about 500 new piezometers and 250 Lefranc tests. The conceptual model of pollution was then updated and various maps showing the concentration of pollutants were prepared.



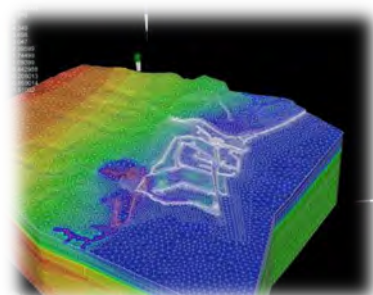
Groundwater flow modelling was performed according to the FEFLOW 6.0 code. FEFLOW solves the classical groundwater flow equation by linear finite elements (triangular prisms) in space and a finite different scheme in time.

The model was completed with the introduction of local hydrography, the drainage system along industrial channels, and artesian deep wells which could allow the connection between deep aquifers and the shallow aquifer system.

The 3-D model was calibrated using the piezometric levels recorded in 2006 in a number of wells scattered across the study area, and then validated by a different data set.



The model allowed the performance of many simulations designed to describe the effect of the planned diaphragms along harbour channel banks and further possible diaphragms at the back of the port area.



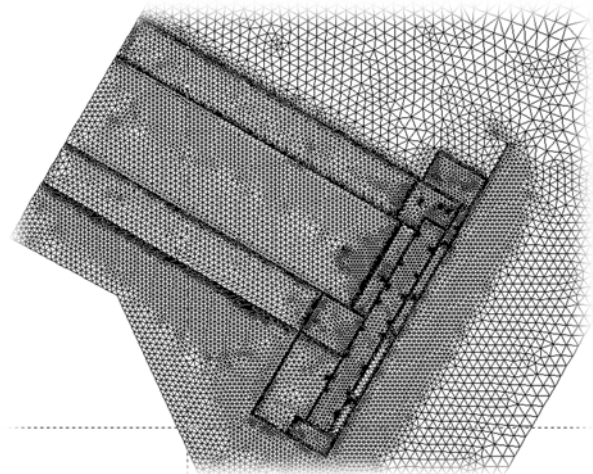
# DEWATERING AND CONTROL SYSTEM FOR THE GATE LOCATION BASIN ON THE SEASIDE AT MALAMOCCO INLET, VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Detailed design
Period:	02/2011 – 09/2011
Construction cost:	N.A.

## Project Description:

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and losses of sediments from the lagoon, has been started by the opening of construction sites for about eight years.

On the southern side of the port entrance of Malamocco a basin has been created to provide a site for the location of gate on the sea side; another basin has been created for the location of gate on the lagoon side.

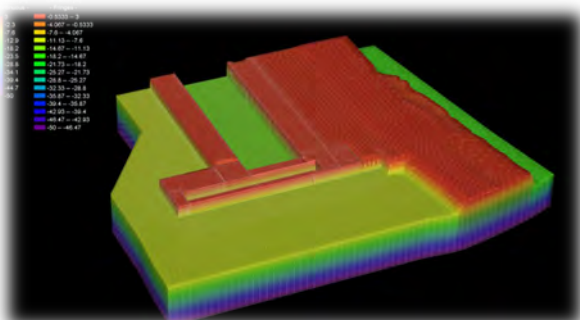
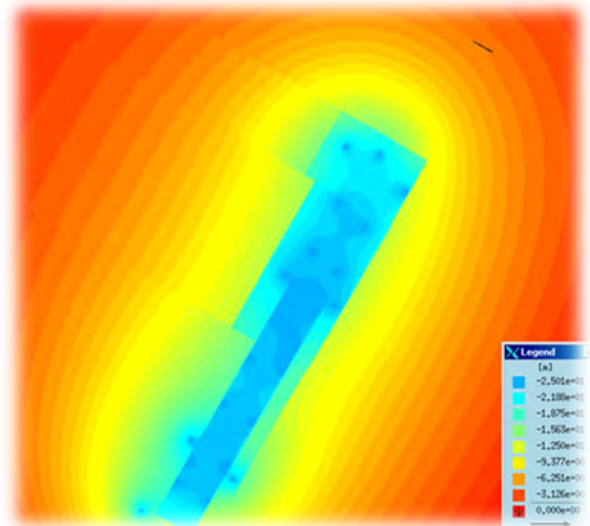


On the basis of the calculation results dimensions of the well system (number, geometry, and location) have been obtained, necessary to guarantee the stability of the excavation ground during works.

The site on the seaside measures 126 m by 14 m; the depth of the basin is about 14 m and it's protected by a metal sheets system. Also the adjacent areas, where other civil works are located, are protected by a metal sheets system.

A study of a dewatering and control system for the location basin of gate on the seaside, has been necessary in order to control underwater pressure and to guarantee the stability of the excavation ground.

On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests), a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network. Groundwater flow modelling has been performed by the FEFLOW 6.0 code (Diersch, 2010), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.

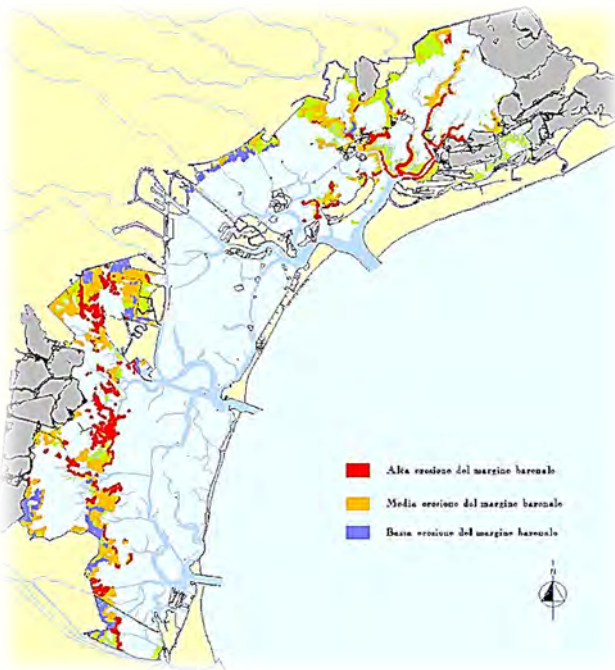


# MASTER PLAN FOR THE MORPHOLOGICAL AND ENVIRONMENTAL REHABILITATION OF THE VENICE LAGOON

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Feasibility study, environmental impact assessment. Support activities included land use and GIS studies for mapping of pollution sources. Detailed design
Period:	01/2003 – 12/2007
Construction cost:	N.A.

## Project Description:

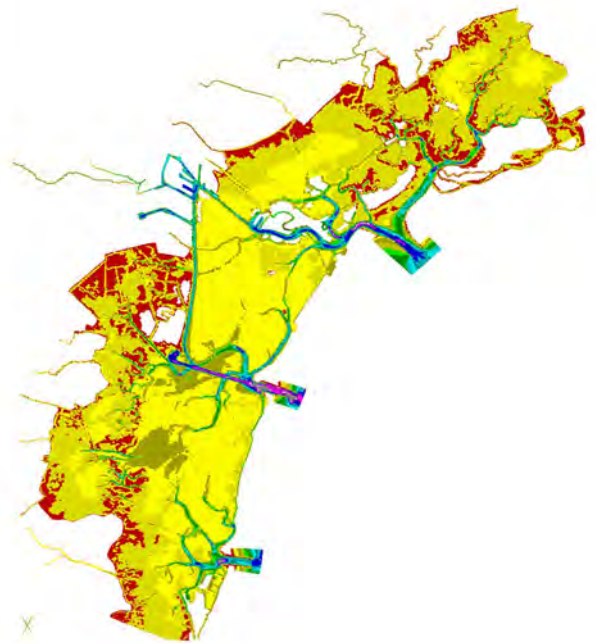
In the context of the Project for the protection of Venice and its Lagoon from the devastating effects of high tides, one of the major problems to be dealt with is that of the conservation of the lagoon ecosystem and its biodiversity, threatened by the human use (fishing, clam harvesting, navigation, urban development) and the present negative environmental conditions (sea level rise, subsidence, erosion).



The Project undertaken by TECHNITAL has as the primary objective the understanding of the causes of morphological and environmental deterioration and the identification of possible interventions to reduce the causes and to preserve and (when possible) restore the natural conditions of the ecosystem to acceptable levels in the shortest time possible.

To this end the following activities were performed:

- creation of a relational data bank and data processing with the aid of GIS for the automatic production of thematic maps
- detailed description of the environmental situation of the lagoon, including aquatic life, vegetation, natural habitats, sediment and water quality, morphological features.
- detailed description of the present human use of the lagoon and their impact on the environment



- preliminary analysis of interventions needed to improve the environmental conditions, by use of mathematical models specifically implemented
- definition of management scheme to control and monitor the lagoon environment.

The main measures proposed to restore and preserve the lagoon environment were:

- Creation of freshwater habitats along the lagoon border to enhance the ecological value.
- Construction of tidal flats and marshlands to restore the lagoon's natural hydrodynamic patterns
- Protection of eelgrass beds for bottom protection
- Preservation and restoration of natural habitats by protecting and planting salt marshes species in areas under stress.
- Definition of guidelines for the practical construction of morphological structures (type of materials, equipment, technical solutions to dispose the dredged material etc.)
- Definition of mitigation measures to reduce the impact of human activities (i.e., clam harvesting)
- Design of pilot interventions.

# ISAP PROJECT: RESEARCH ON THE SEDIMENTS AND WATERS IN THE CHANNELS OF PORTO MARGHERA AND THE FACING AREAS OF VENICE LAGOON

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Coordination of water and sediment quality study
Period:	11/2006 – 06/2007
Construction cost:	N.A.

## Project Description:

Modeling activities were commissioned as part of the ISAP project to assess the congruency between industrial discharges monitored in the area of Porto Marghera in the lagoon of Venice and the concentrations of pollutants in port waters determined by measurements performed during measurement surveys specifically performed as part of the study.

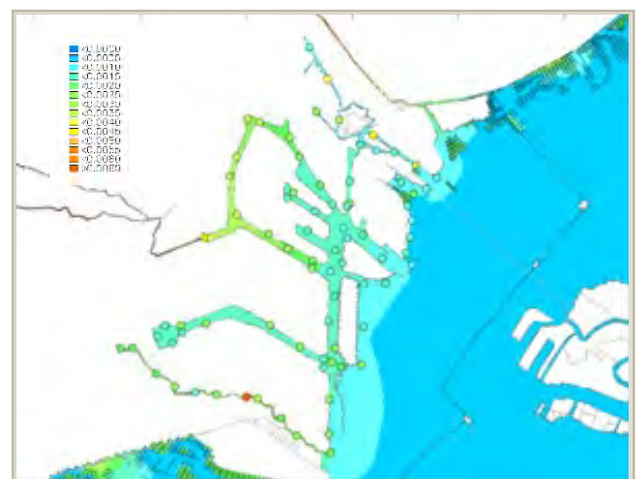


A check of the ability of the model to represent dispersion of the area under examination compared the measured and the calculated salinity values. A test of congruency between measured concentrations and monitored discharges compared calculated and measured concentrations of arsenic, lead and copper.

The study took place in three phases:

1. analysis of water column quality data in the industrial channels of Porto Marghera and determination of the analyses that could be considered as conservative tracers or with decay in the first order;
2. design and testing of the dispersion model which, considering the pollutants coming both from industrial waste and from rivers that discharge in the area of interest reproduces the fields of concentration of the tracers being considered which were then compared with those measured.
3. parametric analysis to determine the expected range of variability of concentration of pollutants considered in relation with various marine-weather scenarios and to assess the "exchange" between the industrial area and the surrounding lagoon areas.

A detailed model of the area under examination, dynamically connected with the overall model of the Lagoon of Venice, was developed to carry out this analysis.



The model showed a good ability to represent dispersion in the area under examination, both in 2-D and in 3-D layouts. It was possible to check that measured concentrations are substantially congruent with declared discharges.

# MODELLING THE HYDROGEOLOGICAL IMPACT OF A CONTAINMENT CUT-OFF WALL IN THE VENICE INDUSTRIAL HARBOUR OF PORTO MARGHERA

Location:	Porto Marghera Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Groundwater modelling
Period:	12/2003 - 04/2007
Construction cost:	N.A.

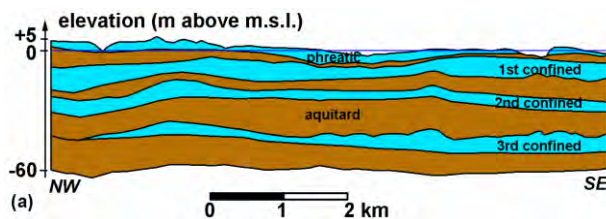
## Project Description:

A major source of non-biodegradable organic and inorganic pollutants is represented by Porto Marghera, a port and petrochemical complex on the central-west side of the Venice lagoon. Porto Marghera is classified as "Site of National Interest" (SIN). Within the general project of decontamination activities called MISE, the Italian Ministry of Environment asked the Italian Water Authority (Magistrato alle Acque MAV) to limit the water exchange between the contaminated soils and the lagoon waters within the SIN. MAV, through its concessionary Consorzio Venezia Nuova (CVN), has planned construction of a continuous 56.8 km long cut-off wall made of steel sheet piles along the entire harbour channel banks. The diaphragms are driven into the lagoon bottom down to a depth ranging between 15 and 25 m below sea level. Since such a cut-off wall constitutes an impermeable barrier to groundwater flow from the mainland toward the lagoon a study has been commissioned by CVN to Technital on expected impact of the cut-off wall on the natural flow regime of the shallowest aquifers.

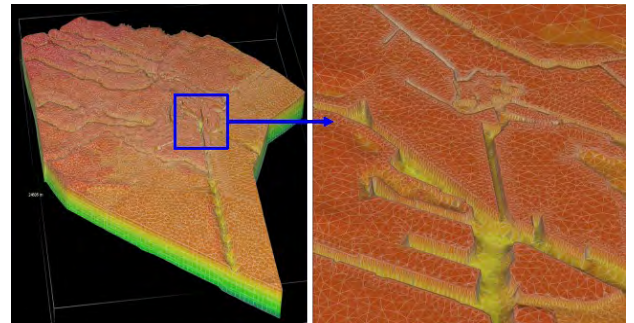


A modelling study based on the geological and hydrological information available to date has been developed to verify the efficiency of a continuous cut-off wall planned along the channels of the Venice industrial harbour to reduce the groundwater discharge into the lagoon. The diaphragm is intended to create an impermeable barrier to the flow of polluted groundwater from the harbour subsurface to the lagoon area.

A detailed reconstruction of the harbour litho stratigraphy is available from more than 1300 boreholes and geotechnical tests, and several electrical resistivity sections have been integrated and used to reconstruct 12 detailed litho stratification sections.



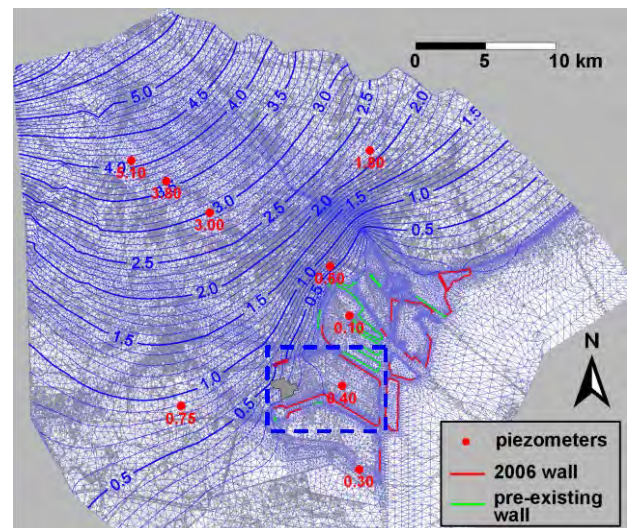
Maps of the depth and the thickness of the geological layers have been created and the spatial variability of the layer geometry has been investigated.



Several pumping tests along with about 350 Lefranc tests have somewhat allowed for the characterization of the hydraulic conductivity  $k$  in the various aquifers:  $k$  ranges between  $10^{-4}$  and  $10^{-5}$  m/s.

Pumping test interpretation by the traditional Theis-Jacob method provides a specific elastic storage between  $10^{-3}$  and  $10^{-4}$ .

Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005). FEFLOW solves the classical groundwater flow equation by linear finite elements (triangular prisms) in space and a finite different scheme in time.



The hydrological simulations accurately reproduce the heterogeneous litho stratigraphy in the Venice coastland down to 50-70 m depth below m.s.l.

The model has been calibrated using the piezometric levels recorded in 2006 in several wells scattered across the study area.

# DESIGN AND IMPLEMENTATION OF THE PUMPING SYSTEM TO ACCELERATE THE CONSOLIDATION AND SETTLEMENT OF AN EMBANKMENT AT MALAMOCCO INLET

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Embankment seaside for a prefabrication area for the gates elements. Design of wells system to control underwater pressure below the basin, during the prefabrication of the structural elements of the gates
Period:	01/2004 – 12/2005
Construction cost:	N.A.

## Project Description:



Since the beginning of the 1900's, high waters have become more frequent and intense. This can be attributed to the combined effect of a rise in a sea level (eustasy) and a drop in land level (subsidence). As a result, urban centres in the lagoon area are today 23 cm lower in relation to sea level than they were at the beginning of the 20<sup>th</sup> century.

To defend the cities of Venice and Chioggia, other urban areas in the lagoon and the entire lagoon basin from the destructive effects of medium/high tides and the devastating effects of exceptional tides, the MOSE system has been designed. The MOSE system consists of various types of structure with integration between mobile barriers (rows of gates) and fixed elements ("complementary measures") and works together with local measures that raise banks and public walkways (up to 110 cm in Venice).

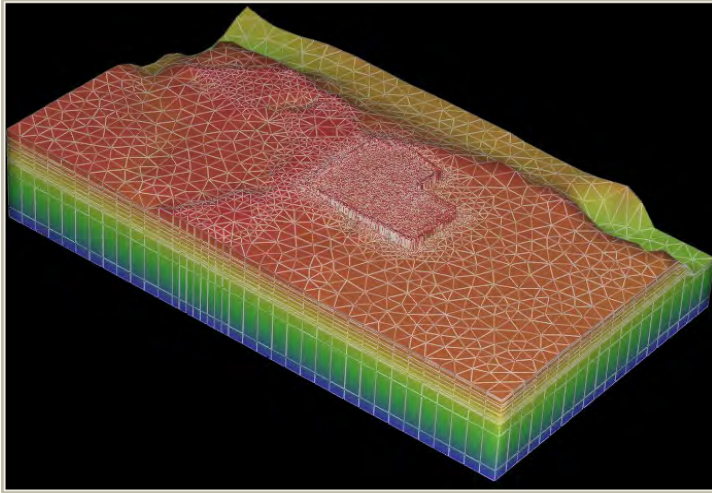
The mobile barriers are the heart of the MOSE system and consist of rows of gates installed in the inlet channels. When inactive, the gates are full of water and lie in caissons on the seabed where they are completely invisible and do not modify exchanges between the sea and lagoon. In the event of risk (high tides), the gates are filled with compressed air which replaces the water, they rotate around the axis of the hinge until they emerge and block the tidal flow entering the lagoon.

The complementary structures on the other hand involve construction of a breakwater outside each lagoon inlet, and raising the bed at Malamocco from -16 m to -14 m.

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high floods and losses of sediments from the lagoon, started on 3 April 2003.

On the southern side of the port entrance of Malamocco an embankment area has been created to provide a site for the prefabrication of the gates elements. The embankment is made of sands coming from the nearby excavation activities and measures 450 m by 400 m towards land and 250 m towards the sea. The sand layer reaches 0.50 m above m.s.l. Above the sand layer are several layers of granular material, compacted by an 18-ton roller. The final height is about 2.50 m above m.s.l.





Based on stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network.

Groundwater flow modelling was performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition. Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity  $k$  and the elastic specific storage  $S_e$  in the various aquifers. Pumping test data interpretation by the traditional Theis-Jacob method provided a specific elastic storage estimation.

Based on the calculation results dimensions of the well system (number, geometry, location) have been obtained, necessary to guarantee stabilization and consolidation of the embankment.

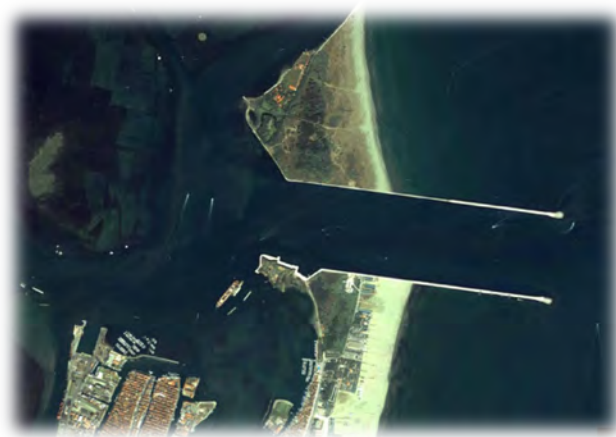
# DRY BASIN AT CHIOGGIA INLET FOR THE PREFABRICATION OF GIANT CONCRETE STRUCTURES TO BE FLOATED TO LOCATION FOR THE CONSTRUCTION OF THE FLOOD BARRIERS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Seaside basin and prefabrication area for the structural elements of the row of gates. Design of wells system for control of under-water pressure below the basin, during the prefabrication of the structural elements of the row of gates
Period:	01/2004 – 12/2005
Construction cost:	€ 66,500,000

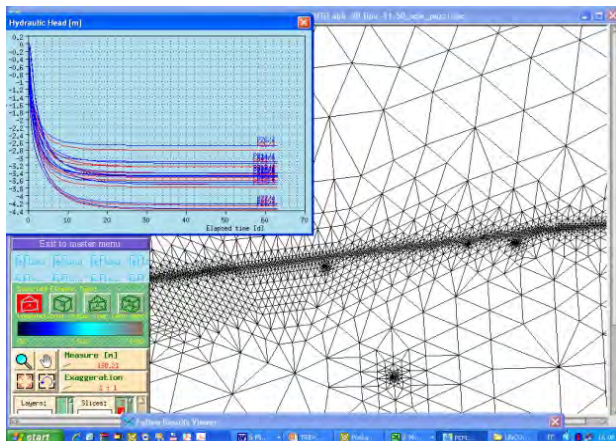
## Project Description:

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and against losses of sediments from the lagoon, has started with the opening of construction sites for about eight years.

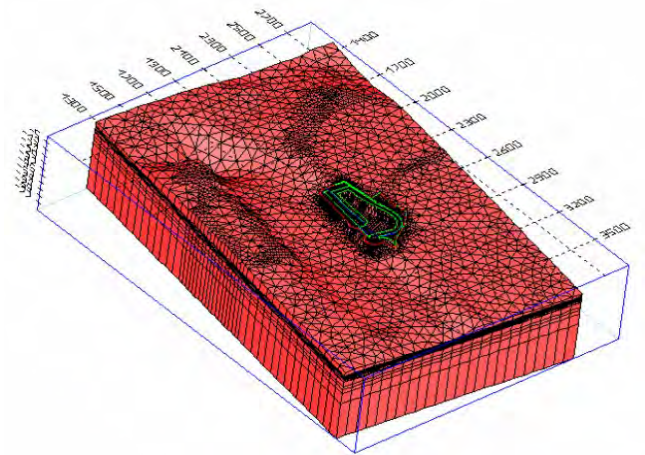
At the Chioggia inlet the excavation site located at the seaside has total surface of about 80.000m<sup>2</sup>, a depth of 12.50m and is protected by a metal sheets system.



On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network.



Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.



Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity  $k$  and the specific storage  $S_s$  in the various aquifers.

Pumping test data interpretation by the traditional Theis-Jacob method provided for a specific elastic storage between 10<sup>-4</sup> and 10<sup>-5</sup> m<sup>-1</sup>.



Based on the calculation results dimensions of the well system (number, geometry, location) have been obtained, necessary to guarantee the stability of the excavation ground.



# HYDRODYNAMIC MODELS FOR THE STUDY OF SEA TIDES IN THE VENICE LAGOON AND FURTHER APPLICATIONS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for the Ministry of Public Works
Services:	Hydrodynamic modelling
Period:	09/2001 – 09/2004
Construction cost:	€ 1,859,200

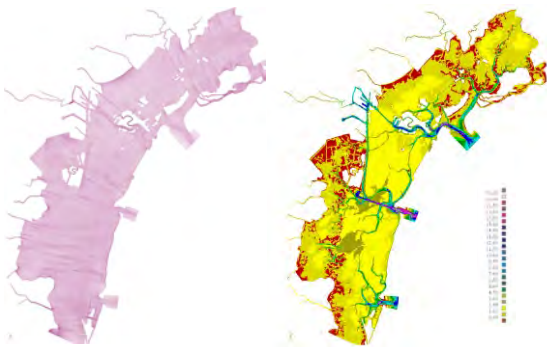
## Project Description:

The Water Authority for the lagoon of Venice, decided to develop a hydrodynamic mathematical model of the lagoon. This new model uses a curvilinear grid with a finite differences schematization that can be easily connected to water quality and/or morphological modules, to provide a hydrodynamic base for environmental analysis. Technital was appointed for the calibration of this model for its application in forecasting the tidal events, to protect Venice from the risk of flooding.

To achieve this goal, a number of schematizations of the selected model had to be developed and the model had to be calibrated in the best possible way. The mathematical model chosen to develop the new hydrodynamic model of the lagoon of Venice was Delft 3-D Flow, the hydrodynamic module of a suite of models developed by Delft Hydraulics Laboratory (The Netherlands). In order to implement the model, the Venice lagoon was schematized in three configurations:

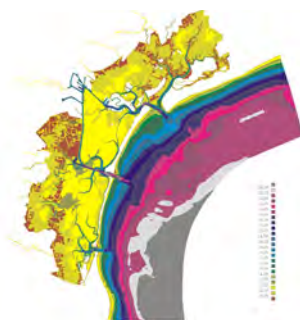
- *Basic Configuration* - the lagoon itself and rivers discharging into it - the extent of the model is limited to the lagoon, with open boundaries at the entrances of the lagoon and the part of the rivers entering the lagoon which are influenced by the tides.

**Basic configuration: ~ 75.000 cells**



- *Complete System* – the lagoon itself, rivers discharging into it and part of the Adriatic Sea

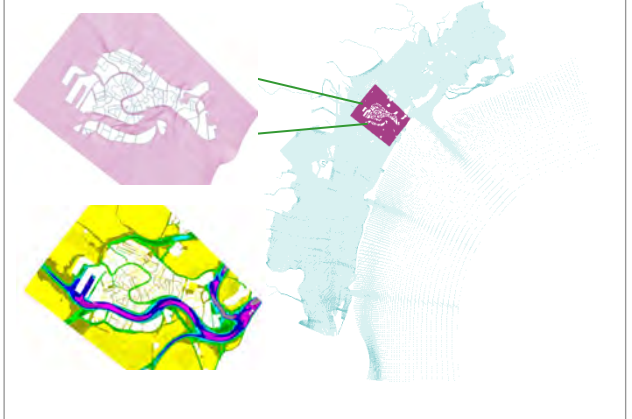
**Complete system: ~ 85.000 cells**



– the domain of the model is extended by including a part of the Adriatic Sea covering a coastal stretch of approximately 40 km along shore and 15 km cross-shore.

- *Venice town* – a detailed model of the canals of the Venice, where the domain is extended sufficiently far away from the city to include areas of exchanges between the city itself and the lagoon. This model is connected to the general model of the lagoon using the domain decomposition techniques.

**Venice town: ~ 40.000 cells**



The model is able to reproduce not only water levels at various tide-gauges, but also to represent the flow distribution and velocity field in the main hydraulic nodes in the lagoon; for this purpose, the model was calibrated both on water levels and fluxes. The application of a finite differences hydrodynamic model working on a curvilinear grid allowed the creation of a computational tool to be used as base for the development of future models of Venice lagoon.

The hydrodynamic model base was used to implement other important simulation models for the Venice Lagoon environment, such as an ecological model, a morphological model, and model for the study and simulation of the dispersion dynamics of petroleum derived compounds, which is currently used for the monitoring activity of the petro-chemical district in Porto Marghera, near Venice.

# DRY BASIN AT LIDO INLET FOR THE PREFABRICATION OF CONCRETE STRUCTURES TO BE FLOATED FOR THE CONSTRUCTION OF THE FLOOD BARRIERS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Seaside basin and prefabrication area for the structural elements of the row of gates. Design of wells system for control of under water-pressure below the basin, during the prefabrication of the structural elements of the row of gates
Period:	01/2002 – 12/2003
Construction cost:	€ 58,200,000

## Project Description:

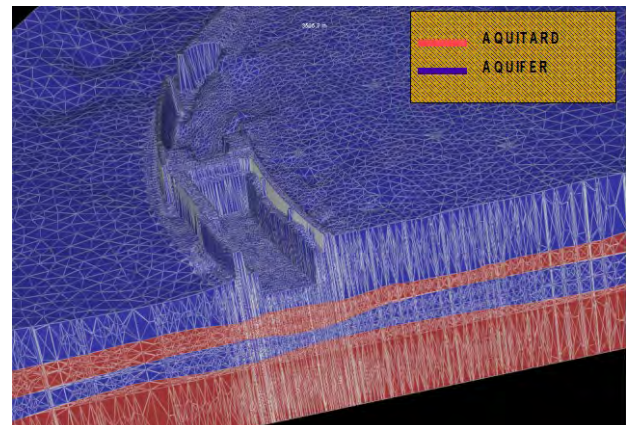
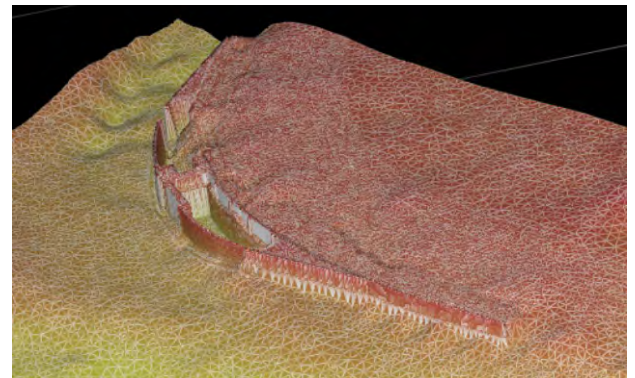
The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and losses of sediments from the lagoon, has been started by the opening of construction sites for about eight years.

At the Lido (Treport) inlet the excavation site's total surface is more than 50.000m<sup>2</sup> with a depth of 12 m protected by a metal sheets system on the seaside and a diaphragm on the land side.



On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network. Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.

Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity **K** and the specific storage **S<sub>s</sub>** in the various aquifers.



Pumping test data interpretation by the traditional Theis-Jacob method provided a specific elastic storage between  $10^{-4}$  and  $10^{-5}$  m<sup>-1</sup>.



Based on the calculation results dimensions of the well system (number, geometry, and location) have been obtained, necessary to guarantee the stability of the excavation ground.

# MASTER PLAN FOR THE BRENTA - BACCHIGLIONE RIVER BASIN: STUDY OF THE WATER RESOURCES, 1ST PHASE

Location:	Veneto Region, Italy
Client:	River Basin Authority for the Isonzo, Tagliamento, Livenza, Piave and Brenta-Bacchiglione rivers
Services:	Water supply study, proposal of remedial works
Period:	03/1996 - 09/2000
Construction cost:	N.A.

## Project Description:

A river basin Master Plan is a programmatic instrument for the hydraulic and hydro-geological protection of soils, the conservation of natural and environmental resources and the promotion of a development compatible with the productive sectors of an area defined by the physiographic limits corresponding to the catchment basin.

The present project concerns the second phase of the development of the Plan in relation to the Brenta-Bacchiglione Rivers, involving a catchment area of some 6000 km<sup>2</sup>.

This phase includes the completion of the framework of knowledge regarding the quantity and quality of the water resources, the development of a mathematical model to analyse the capacity of the basin to satisfy the local water demand, and the application of the model to study various intervention schemes for improving water quality and supply. The study will provide concrete proposals for remedial measures and environmental recovery actions.



# KARAVASTA LAGOON WETLAND MANAGEMENT PROJECT

Location:	Albania
Client:	European Commission - PHARE Programme
Services:	Environmental studies and evaluations, hydrological and morphological studies, surveys, design and construction of observation tower
Period:	03/1995 – 12/1996
Construction cost:	N.A.

## Project Description:

The project aims at the provision of support to wetland management in the Karavasta Lagoon, along the Albanian coast, which covers 4,330 hectares and borders the southern part of the Divjaka National Park. Immediate and strict protective measures must be taken, notably to safeguard the existing colony of *Pelicanus Crispus* and other endangered bird species.

The programme will foster social development of the wetland making an optimal but sustainable use of the economic potentials of the area for the eco-tourism, fisheries and compatible economic activities involving local inhabitants.



*TECHNITAL*, in association with *Station Biologique de la Tour du Valat* of France and *Ecotourism Ltd.* of UK, was entrusted by the European Commission, PHARE Programme, to perform, the following activities:

- propose a management plan for the area (future Ramsar site);
- organise and equip the monitoring and enforcement of the rules of the Ramsar site;
- propose a plan for the development of international eco-tourism;
- develop a model of the key hydrological process influencing the

lagoon environment and a propose a plan for remedial actions;

- propose a plan for the improved management and exploitation of the fisheries resources in the lagoon;
- produce a holistic picture of the value of the lagoon system for breeding aquatic birds.

To understand the functioning of the ecosystem as well as the dynamics of the socio-economic system, the project tasks aimed to

- describe the trends of the socio-economic system through a Participatory Rural Appraisal
- analyse the legal and institutional context
- evaluate the potential of the site for ecotourism development and assess the carrying capacity of the site
- evaluate the hydrobiological importance of the channels which connect the lagoon with the sea.
- define measures to improve fishery in the lagoon
- assess the natural value of the site by mapping the flora and fauna habitats and conducting a field survey of the water bird communities.





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