The 3rd International Conference on Sustainable Remediation

Conference Theme 3: “GREENING” REMEDIATION

Fusina Treatment Wetland – From Remediation to Sustainable Water Management (Italy)

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Agenda

- Project History
- Remedy and Design Features
- Treatment Highlights
- Sustainability Aspects
Human Modifications to Venice Lagoon

Agriculture
Urbanization and Industrialization
River Diversion
Stabilization of Lagoon shorelines
Dredging

Result = Decline of Fragile Ecosystem
Progetto Integrato Fusina

New, stricter lagoon discharge criteria (Venice Master Plan 2000)

Solutions:
- Pipeline to sea
- Various WWTP system upgrades
- 100ha polishing treatment wetland

Expected benefits:
- Cleaner lagoon
- Restoration of lost habitat
- Source of water for reuse
- Public amenity
Progetto Integrato Fusina: Relevant Players

CUSTOMER

Joint Venture of:

Impresa di Costruzioni Ing. E. Mantovani S.p.A.
ECOFUSINA S.c.a.r.l.
P.M.S.I. S.c.a.r.l.
REMFUSINA S.c.a.r.l.

DESIGNER

REGIONE DEL VENETO
Segreteria regionale all'ambiente e ai lavori pubblici
Direzione regionale tutela dell’ambiente

Design Lead Mr. G. Zanovello

Technical Support for Wetland Design
CASSA DI COLMATA

MIRA

PORTO MARGHERA

FUSINA WWTP

Layout of Infrastructure
Project Site in 1950s: Natural Wetlands
Project Site in 1960s: Cassa di Colmata
Cassa di Colmata: 2000’s

Formerly salt marshes area filled with dredged lagoon sediments

Close to the industrial complex

Overall surface 144 ha

Average elevation 2m

Uneven soil texture and filling

Mostly covered with herbaceous spontaneous vegetation
Fusina Wetlands Today
Contaminated Site Management

- Site contamination related to historical burial of sediments from industrial channels dredging.
- Extensive Site Characterization.
- Removal of hot spot areas and wastes.
- Capping of residual contamination with clean backfill.
- Physical hydraulic containment (bentonite slurry wall) to:
  - Reduce potential leaching
  - Minimize loss of treated water
  - Reduce brakish water and salinity intrusion
Integrated Design

Remedy plan integrated with constructed wetland design accounting for:

- Future area use
- Existing topography (flat) and landscaping constraints on Venice Lagoon
- Treatment needs
  - Gravity flow
  - Parallel lines for robust O&M
- Cost
  - Soil excavation and backfilling volumes
  - Availability of vegetation to populate the marsh areas
Design Features

Marsh Zones: 30-50cm depth

Deep Zones: 130-150cm depth

Bird Nesting Islands

1 cell flows in series with 2 parallel cells
Native Vegetation

- Juncus effusus
- Nymphaea alba
- Phragmites australis
- Typha laifolia
- Schoenoplectus lacustris
- Potamogeton crispus
- Ruppia maritima
Wetland Layout Provides Effective Hydraulics and Treatment

- Direction of flow determined by existing topography to minimize earthmoving.
- Shape and orientation of deep zones minimizes wind-wave action and earthwork.
- Friction losses balanced between parallel cells.
Treatment Highlights

- 100 hectare
- 4000 m$^3$/hr - 2x during storm
- Polishes treated domestic and industrial effluent to Lagoon discharge standards
- Effluent will be sold back as cooling water at petrochemical complex
Jul-Nov 2008 1-ha Pilot Monitoring
Current Treatment

- 2011: completion of the Fusina wastewater treatment facility upgrade and conveyance infrastructure, and startup period.
- Wetland is currently operating full scale.
- Average flow rate of 2000 m$^3$/h.
- OUT Concentrations from the wetland at or near irreducible concentrations, indicating that the wetland is performing within expectations.
- Nitrogen reduced by 70-75%, with outlet nitrate-nitrogen below detection limits.
- Phosphate-phosphorus is reduced by 70-75%.
- BOD and COD are typically below detection levels entering and exiting the wetland.
Use of Macrophytes in Water Pollution Control 2010
Civil Engineering NEWS

ENVIRONMENTAL ENGINEERING

Italy's Largest Constructed Wetlands Begins Accepting Wastewater

At the end of April the largest constructed wetlands in Italy began receiving treated effluent from a nearby wastewater treatment plant (WWTP), the culmination of more than 30 years of efforts to improve water quality in the Lagoon of Venice, the water body in which the famed city is situated. With a

region initiated an ambitious plan to enhance wastewater treatment capabilities in Fusina, an area located along the western shore of the Lagoon of Venice directly opposite Venice. The project included the expansion and upgrade of Fusina's WWTP and the construction of a pipeline to discharge wastewater from the facility into an increased intake of water, the industrial, and groundwater.

Domestic and industrial wastewater, including a 1,500 m contributing area, is treated at the WWTP and then dispersed to the wetlands for treatment that

Civil Engineering JUNE 2013
Sustainability Aspects

- Remediation of a degraded site at the edge of the Venice Lagoon.
- No consumption of greenfield.
- Minimizing soil movements.
- Implementation of “green” technology, to polish wastewater to high quality standards for industrial reuse or discharge.
- No power consumption, no chemical dosing and fuel CO$_2$ emissions.
- CO$_2$ trap.
Sustainability Aspects

- Recreation of vital ecosystem functions and enhancement of natural habitat for wildlife.
- Use of local vegetation species.
- Cost-sustainable project (project financing scheme supported by water fee).
- Educational and recreational attraction for tourists and local population.
- Stakeholder involvement from the early feasibility stage
  - Direct experience of success CTW projects developed elsewhere in the World and meeting with local stakeholders.
  - Detailed design tailored specifically to the Venice Lagoon environment.
- Potential fly wheel for other projects and support scientific community.
THANKS for your ATTENTION

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