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PHYTOTECHNOLOGY

**FOR THE REMEDIATION OF A SITE OF COMMUNITY
IMPORTANCE: THE AREA “PONDS AND SALT PANS OF
PUNTA DELLA CONTESSA” (BRINDISI)**

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**PHYTOTECHNOLOGY FOR THE
REMEDIATION OF A SITE OF
COMMUNITY IMPORTANCE: THE
AREA "PONDS AND SALT PANS OF
PUNTA DELLA CONTESSA"
(BRINDISI)**



Politecnico
di Bari



SUSTAINABLE REMEDIATION



Sustainable Remediation:

A remediation project whose net benefit to human health and the environment is maximized through the careful use of resources via a decision-making process shared with stakeholders, taking into account environmental, social, and economic considerations.

Green Remediation:

Selection and implementation of effective and efficient remediation techniques and technologies, considering local and global environmental aspects that are not typically addressed in traditional screening: Energy, Atmospheric Emissions, Water Resources, Soil/Ecosystem, and Waste.

In this context, sustainability assessments are based on the definition of indicators that summarize, in a relatively simple and communicable form, the impact of a specific activity within the remediation project.

CLASSIFICATION OF REMEDIATION TECHNOLOGIES



IN SITU

Treatment is carried out on the contaminated matrix without removing or extracting it



EX SITU - ON SITE

The contaminated matrix is removed and treated at facilities within the site



EX SITU - OFF SITE

The contaminated matrix is treated in facilities located off-site

CLASSIFICATION OF REMEDIATION TECHNOLOGIES



BIOLOGICAL

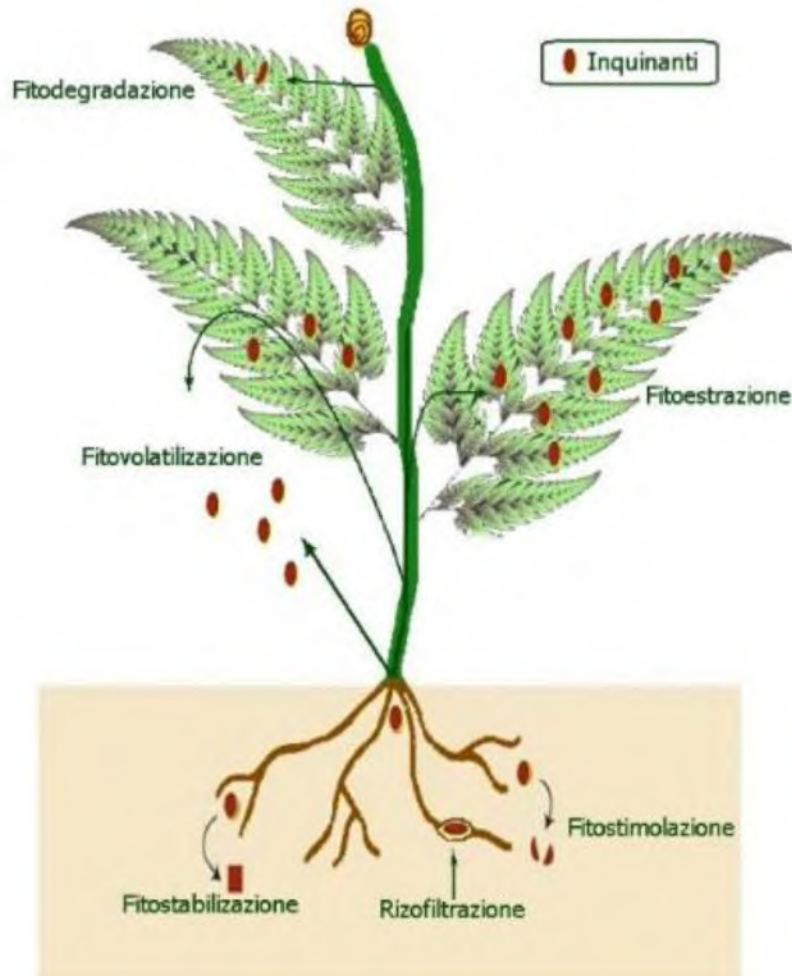


**CHEMICAL-
PHYSICAL**



THERMALS

PHYTOTECHNOLOGY



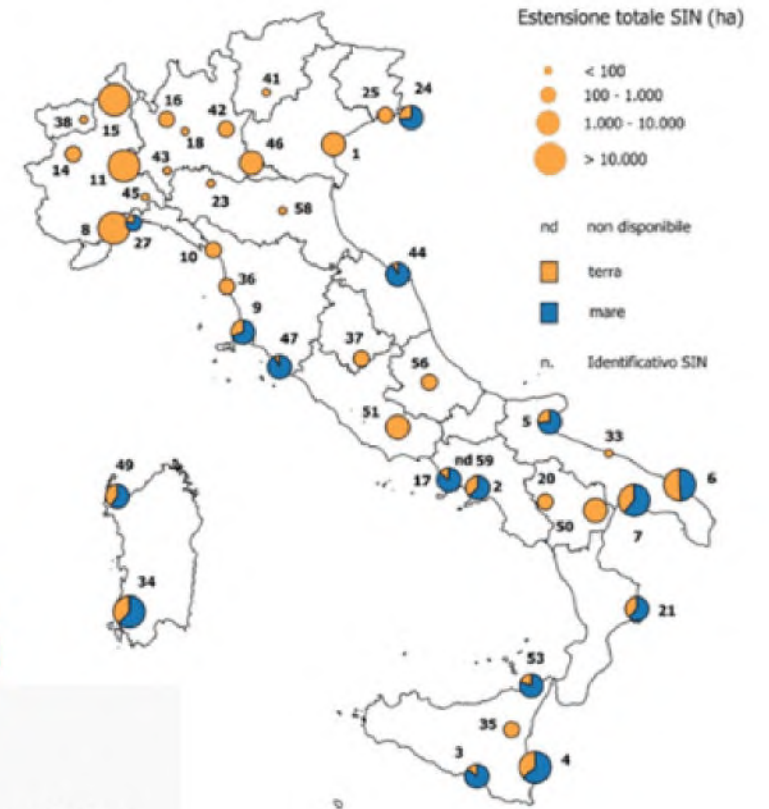
- Exploit the ability of plants to remove, immobilize or transform inorganic and organic compounds present in environmental matrices. Plant species are selected for their ability to:
 1. extract from the soil and accumulate heavy metals;
 2. reduce the mobility of pollutants;
 3. decompose compounds;
 4. ...

BENEFITS	DISADVANTAGES
Ecological activity improvement	Long recovery time
High environmental sustainability	Applicable to surface soil
Cost, energy and material savings	Crop growth dependent on weather and agronomic factors

SIN – Sites of National Interest

Identified in relation to the characteristics of the site, the quantities and hazardousness of the pollutants present, and the significance of the impact on the surrounding environment in terms of health and ecological risk, as well as harm to cultural and environmental heritage.

Need **remediation** of different environmental matrices.



Currently, the total number of SINs is **42**



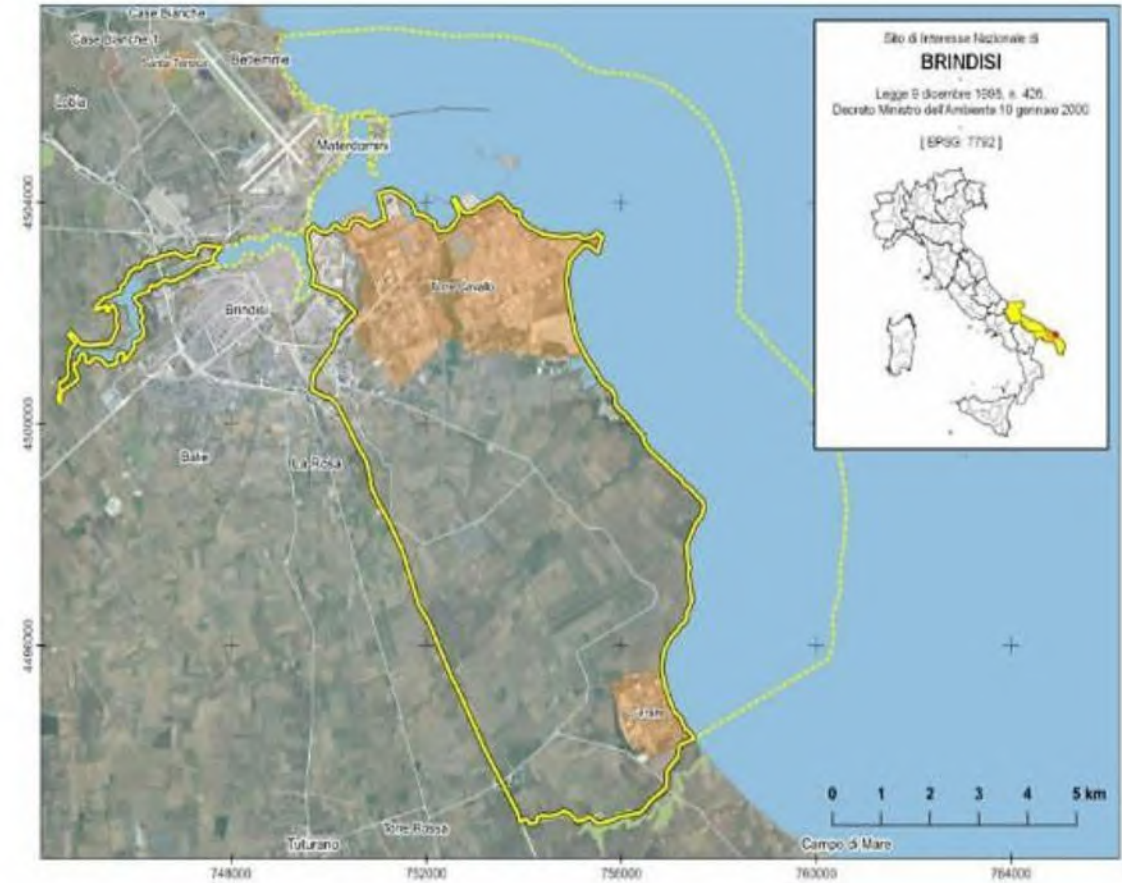
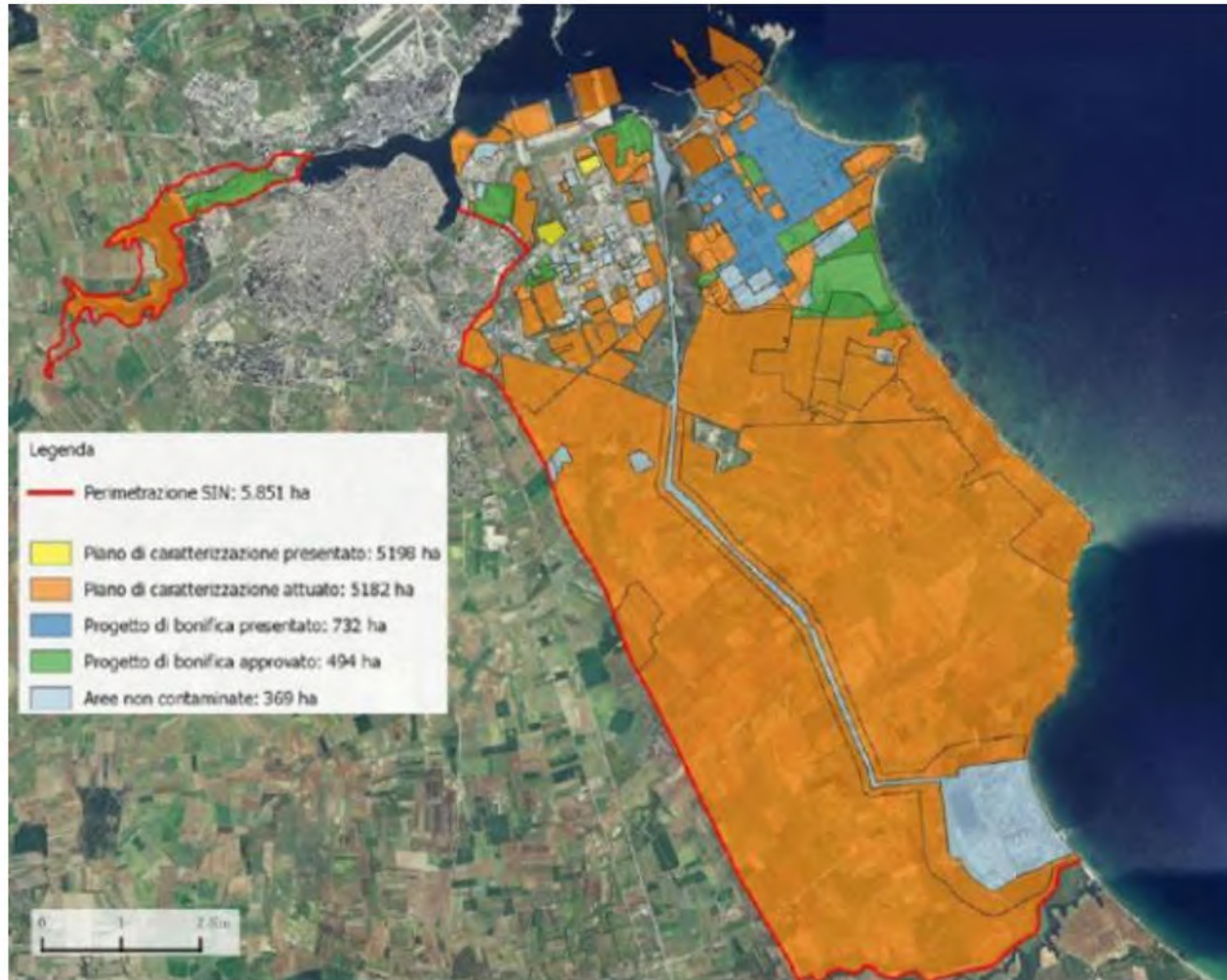
The total area of SINs on the ground is approx. **170.000 ha**



The total extent of the SIN areas at sea is approx. **77.000 ha**

SIN BRINDISI

Area of about 5.700 ha of land and 5,600 ha of sea



The perimeter area includes:



The Industrial Cluster;



The Petrochemical Cluster;



The Electric - Energy Cluster;



Agricultural areas;



Contessa Salt Pans;



Cillarese reservoir;



Marine areas

POLIBA – ASSET

As part of the **collaboration agreement** between the Polytechnic University of Bari and the Regional Strategic Agency for Sustainable Development of the Territory of the Apulia Region (ASSET), the Environmental Technologies research group is focused on studying **sustainable solutions for the remediation of the national interest site (SIN) in Brindisi**. The activity is centered on the development of **innovative methodologies for the management of contaminated sites**: from environmental characterization to the selection and implementation of innovative treatment technologies.



The **New Program Agreement** for defining the safety and remediation interventions of the areas within the National Interest Site of "Brindisi," signed by the Ministry of Ecological Transition (MITE), the Apulia Region, and the Municipality of Brindisi (registered by the Court of Auditors on 15/10/2021, no. 2862), foresees **five interventions**.

INTERVENTIONS UNDER IMPLEMENTATION

1

Site-specific risk analysis in ASI zone

Conducting supplementary investigations aimed at developing the site-specific risk analysis.



2

Characterization of the village of St. Peter

The residential site underwent an environmental characterization plan and a study aimed at selecting the best remediation technology.

INTERVENTIONS UNDER IMPLEMENTATION

3

Securing and remediation of the water table at Costa Morena and Fiume Grande

Performing supplementary investigations aimed at constructing the environmental status of the aquifer for the design and execution of interventions.

4



5

Reclamation of Ponds and Salt Pans of Punta della Contessa

This is a contaminated site of community importance for biodiversity conservation.

CASE STUDY: Ponds and salt at Punta della Contessa



- By R.L. of Dec. 23, 2002, the **Regional Nature Park** named “Saline Punta della Contessa” was established.
- Under the EU *Natura 2000* program, the Apulia Region has proposed the Regional Nature Park as a **Site Of Community Importance** (SCI IT 9140003) and **Special Protection Zone** (SPA IT 9140008)

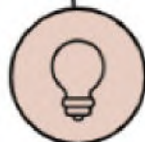
Processo di bonifica



1) Caratterizzazione ambientale e modello concettuale



2) AdR - Obiettivi di Bonifica



3) Indagini integrative



4) Tecnologia di bonifica



5) Monitoraggio

ENVIRONMENTAL CHARACTERIZATION

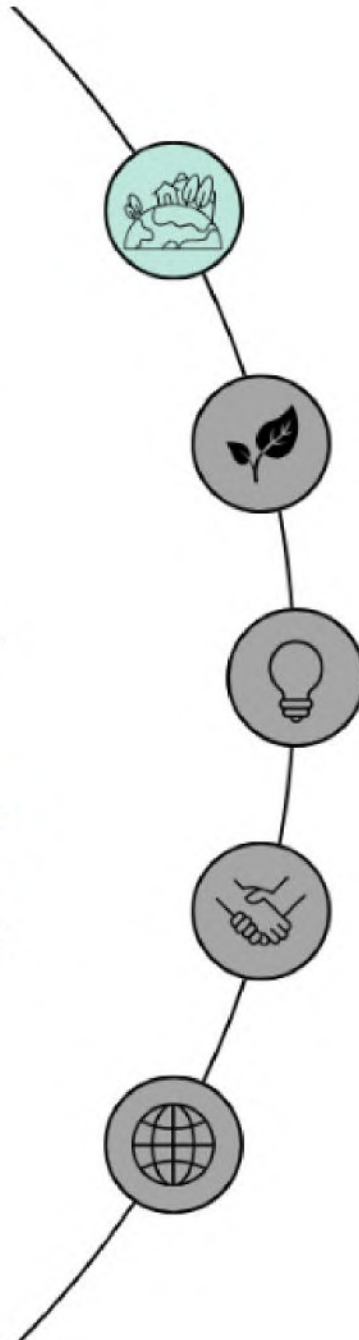


● 111 Surveys → 252 Soil samples

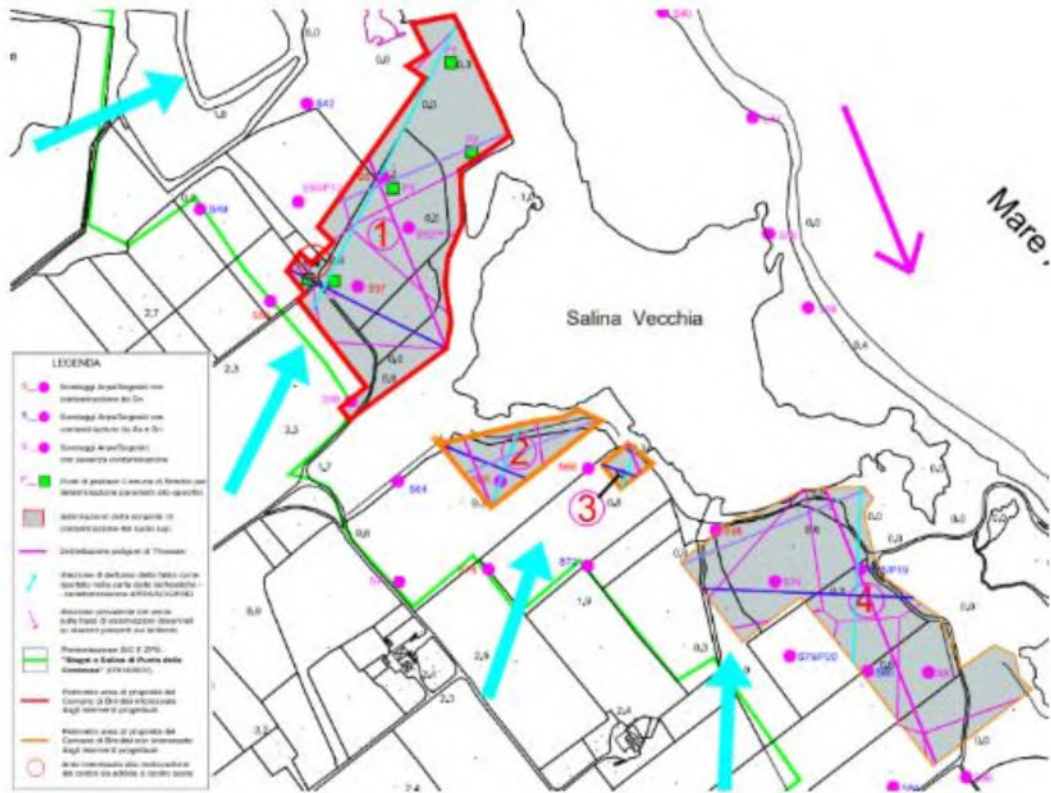
● 25 Piezometers → 25 Groundwater samples

Analytical results were compared with **CSCs** for **public, private and residential green use sites**.

Arsenic was compared with the **anthropogenic background value** defined for the Brindisi SIN and approved by MiTE (surface soil **32.0** mg/kg and subsoil **52.7** mg/kg).



ENVIRONMENTAL CHARACTERIZATION

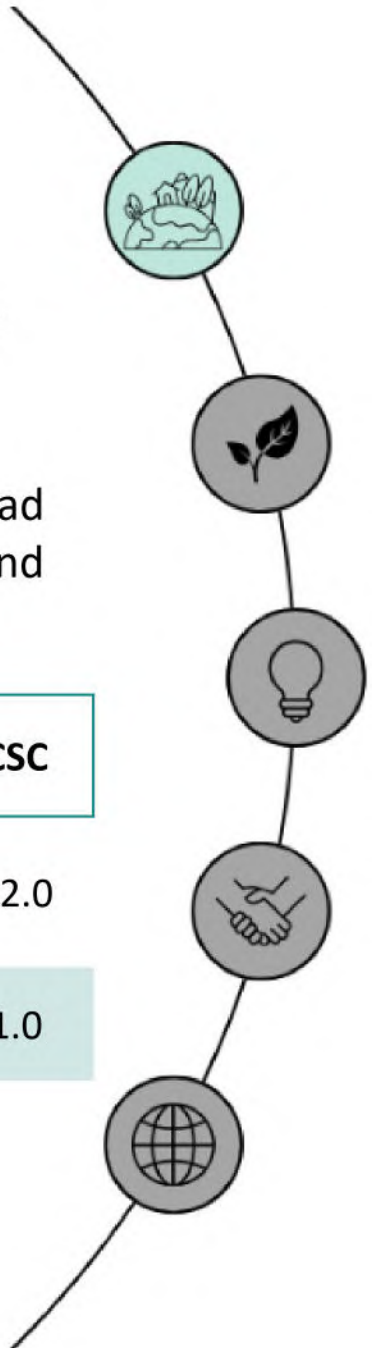


Characterization activities allowed the identification of **four potential sources of contamination** at the surface soil, characterized by SRCs.

The analytical results show:

- For the **soil matrix**, point exceedances of CSCs for As as well as widespread contamination by Sn.
- For the **water matrix** widespread exceedances for Sulfates and Mn and organic compounds of industrial origin.

	CRS				CSC
	Area 1	Area 2	Area 3	Area 4	
As	53.3	39.3	10.2	46.6	32.0
Sn	2.5	2.7	1.8	3.2	1.0



CONCEPTUAL MODEL

SORGENTI DI CONTAMINAZIONE

Sono state identificate 4 potenziali sorgenti di contaminazione in corrispondenza del Suolo Superficiale.

BERSAGLIO UMANO

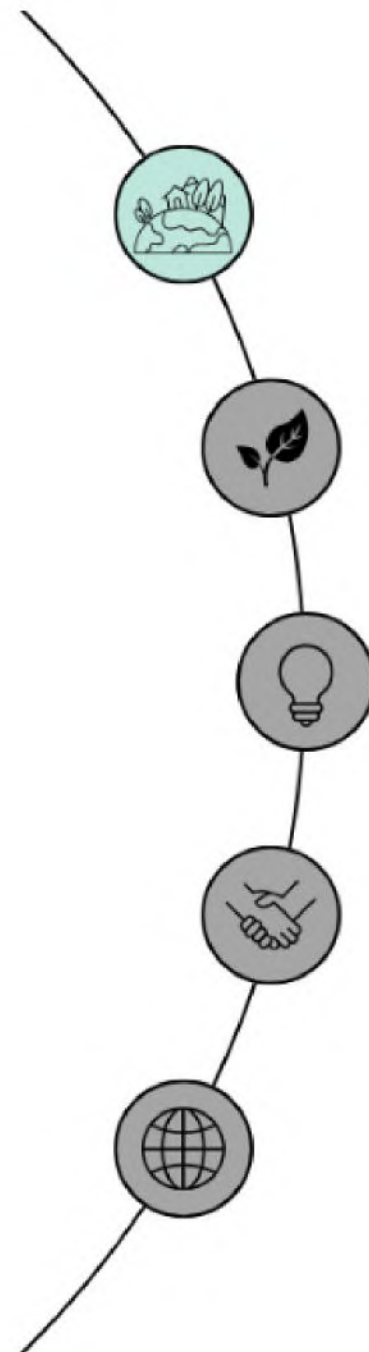
Recettore uomo (lavoratore e/o fruitore) presente sia all'interno dell'area (*on-site*) sia all'esterno dell'area (*off-site*)

PERCORSI DI MIGRAZIONE

I percorsi di esposizione considerati sono: ingestione di suolo, contatto dermico, inalazione di polveri outdoor e indoor.

BERSAGLIO AMBIENTALE

Recettore ambientale, si determina il rispetto delle CSC per la falda al POC (punto di conformità)



CONCEPTUAL MODEL

6 SCALA 1:100 ottobre 2014 **PROGETTO ESECUTIVO PER LA REALIZZAZIONE DEL CENTRO DI SOSTA**
PLANIMETRIE E DOCUMENTAZIONE FOTOGRAFICA

PIANTA STATO DI FATTO PIANTE DI PROGETTO

COMUNE DI BRINDISI
 REGIONE PUGLIA – P.O. FESR 2007-2013 – Asse II – Linea di intervento 2.5 – Azione 2.5.4
 ELABORAZIONE DELL'ANALISI DI RISCHIO SU AREE DI PROPRIETA' DEL COMUNE DI BRINDISI SITE NEL PARCO NATURALE REGIONALE "SALINA DI PUNTA DELLA CONTESSA" CONTERMINI ALLA ZONA UMIDA DELLA SALINA VECCHIA

PROGETTO PER LA REALIZZAZIONE DEL CENTRO DI SOSTA
ENDER VISTE PROSPETTICHE

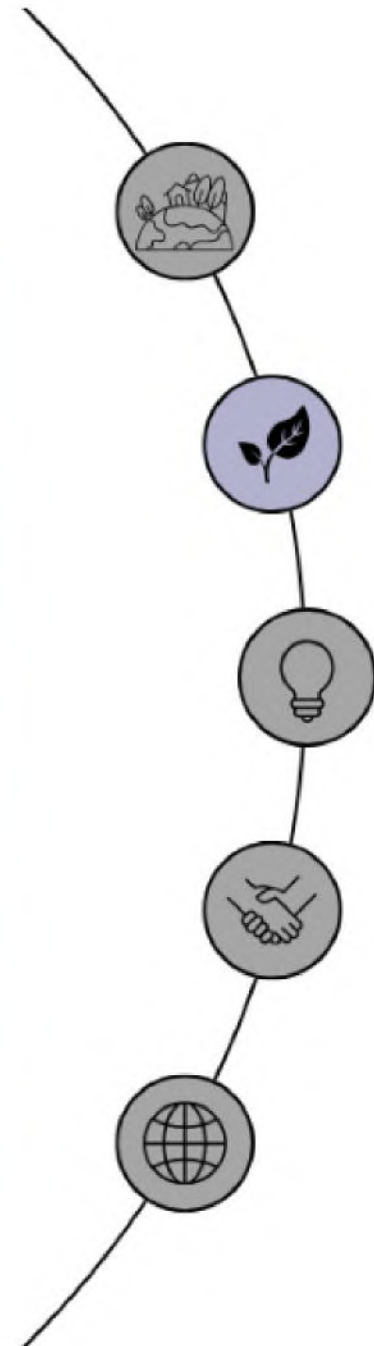
PIANTA IMPALCATO COPERTURA

COMUNE DI BRINDISI
 REGIONE PUGLIA – P.O. FESR 2007-2013 – Asse II – Linea di intervento 2.5 – Azione 2.5.4
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RISK ANALYSIS

AREA	CONTAMINANT	CRS (mg/kg)	R	HI	CSR (mg/kg)	Background value (mg/kg)
1	Arsenic	53.3	1.4 10⁻⁴	2.5	3.9	32.0
	Pond	2.5	-	5.6 10 ⁻⁵	-	
2	Arsenic	39.3	1.0 10⁻⁴	1.8	3.9	32.0
	Pond	2.7	-	5.9 10 ⁻⁵	-	
3	Pond	1.8	-	3.9 10 ⁻⁵	-	
4	Arsenic	46.6	1.2 10⁻⁴	2.2	3.9	32.0
	Pond	3.2	-	7.0 10 ⁻⁵	-	



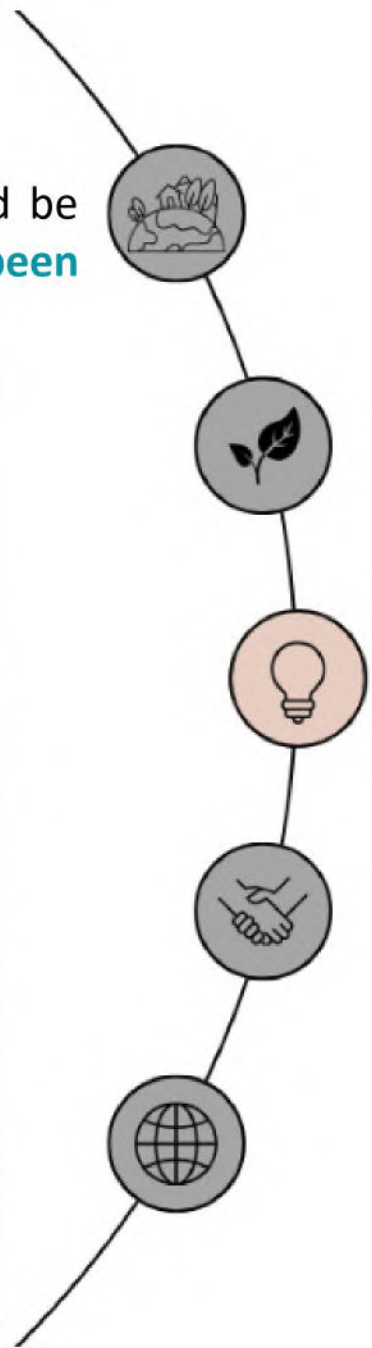
SUPPLEMENTARY INVESTIGATIONS

In order to carry out appropriate remediation, a campaign of supplementary investigations should be planned to define the extent of pollution in surface soil in areas where an **unacceptable risk has been found regarding Arsenic**.

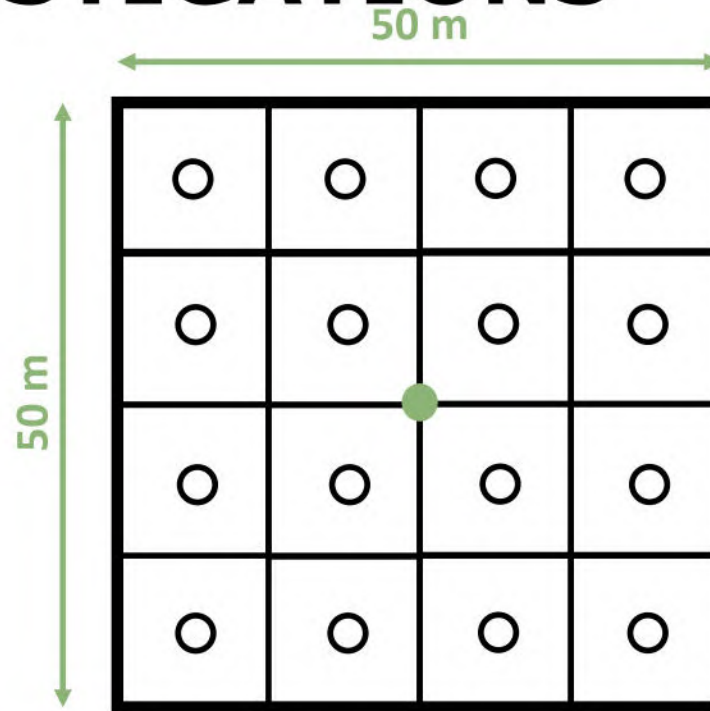
● 17 surveys (area 1)

● 4 surveys (area 2)

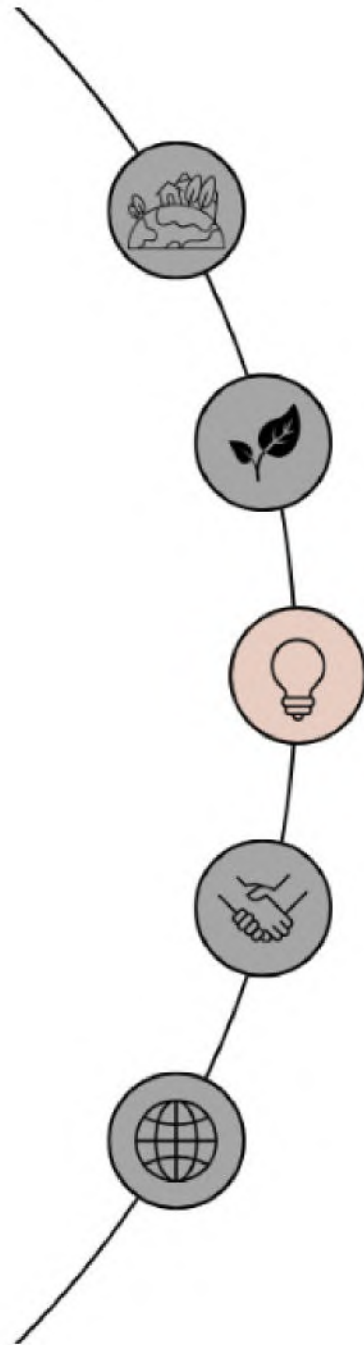
● 16 surveys (area 4)



SUPPLEMENTARY INVESTIGATIONS



Starting from a 50x50 mesh (as stipulated in the **Operating Protocol** of the Brindisi SIN), **the location of the survey points** will be defined in more detail by means of a expeditious survey with the portable **X-ray fluorescence spectrometer**.

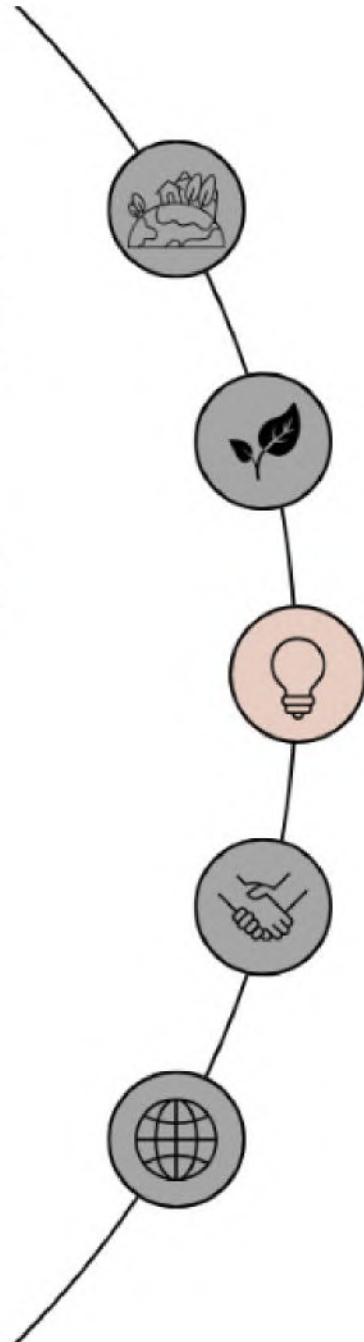


VINCA



Impact assessment is the preventive process to which any plan, program, project, intervention or activity that may significantly affect a Natura 2000 site or proposed site must be submitted.

In order not to affect habitats in the affected areas, surveys will be carried out using **hand-held core drills**.



Pur tuttavia, per completezza di informazione, posto che le indagini in argomento sono propedeutiche all'eventuale esecuzione successiva di interventi di bonifica (fitorisanamento) da condurre nell'area, si rammenta che:

- il Regolamento del Piano di Gestione della ZSC/ZPS "Stagni e Saline di Punta della Contessa" (IT9140003) approvato definitivamente con Deliberazione della Giunta Regionale n. 2258 del 24 novembre 2009 stabilisce che:
 - o ex art. 10 – "Tutela della flora", comma 4 e 5:
 - 4. *Ai fini della tutela del patrimonio genetico locale non è consentito impiantare nel territorio del SIC/ZPS specie, ecotipi e varietà estranee alla flora spontanea dell'area. E' inoltre vietato impiantare individui vegetali che, pur appartenendo nominalmente all'Elenco delle entità autoctone del territorio, provengono da altre regioni, definite dall'art. 2 D. Lgs. 386/2003;*
 - 5. *I divieti di cui al comma 4 si applicano agli individui completi nonché alle singole parti utilizzabili per la propagazione agamica, quali talee, propaggini, rizomi, ecc., o deputate alla diffusione non vegetativa, quali semi, ecc.;*
 - o ex Art. 11 – "Tutela degli habitat" comma 1:
 - a) *all'interno del SIC/ZPS non è consentito trasformare, danneggiare e alterare gli habitat d'interesse comunitario;*
 - d) *tagliare e danneggiare la vegetazione naturale e seminaturale acquatica sommersa e semisommersa, riparia ed igrofila erbacea, arbustiva e arborea, salvo specifica deroga rilasciata dall'autorità di gestione, per comprovati motivi di natura idraulica e idrogeologica, nonché per ragioni connesse alla pubblica incolumità.*
 - o Ex Art. 13 – Opere di riqualificazione, recupero e ripristino ambientale:
 - 1) *Gli interventi di riqualificazione, recupero e ripristino ambientale sono finalizzati al graduale recupero della naturalità attraverso la rimozione delle cause dirette di degrado del SIC/ZPS e l'innescio spontaneo di meccanismi di riequilibrio, senza apporti di materia e/o energia.*

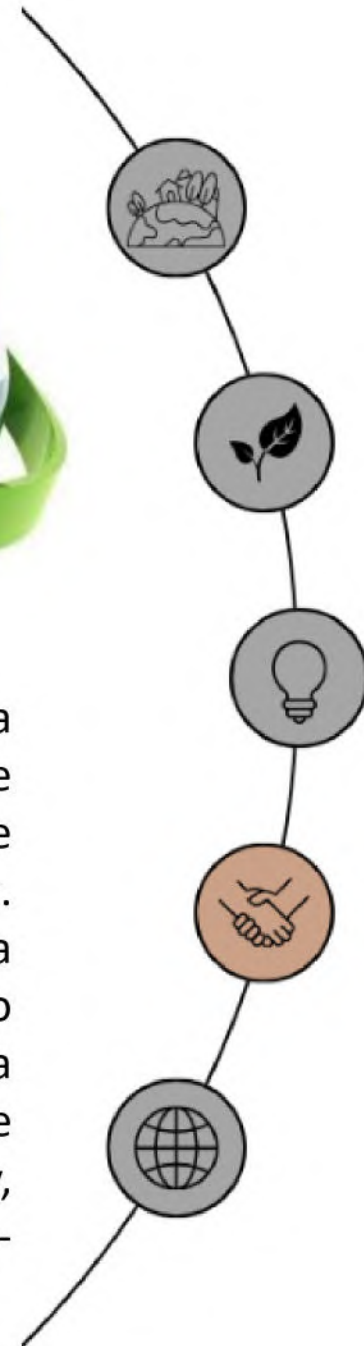
REMEDIATION TECHNOLOGY

The **Punta della Contessa Salt Pans** represent a regionally important nesting site for avifauna, so adequate protection of the area, aimed at its conservation and development, is considered essential.

For these reasons, considering the environmental characteristics of the site under investigation and the source of contamination, so-called **phytoremediation** was identified as a possible remediation alternative.



The minimum requirement for applying a **phytotechnology** to a contaminated site is that the matrix itself be compatible with plant growth and development. Being a nature reserve, the Punta della Contessa Salt Pans site lends itself well to this type of phytotechnology by hosting a wide range of plant associations that are well differentiated floristically, ecologically and physiognomically-structurally.

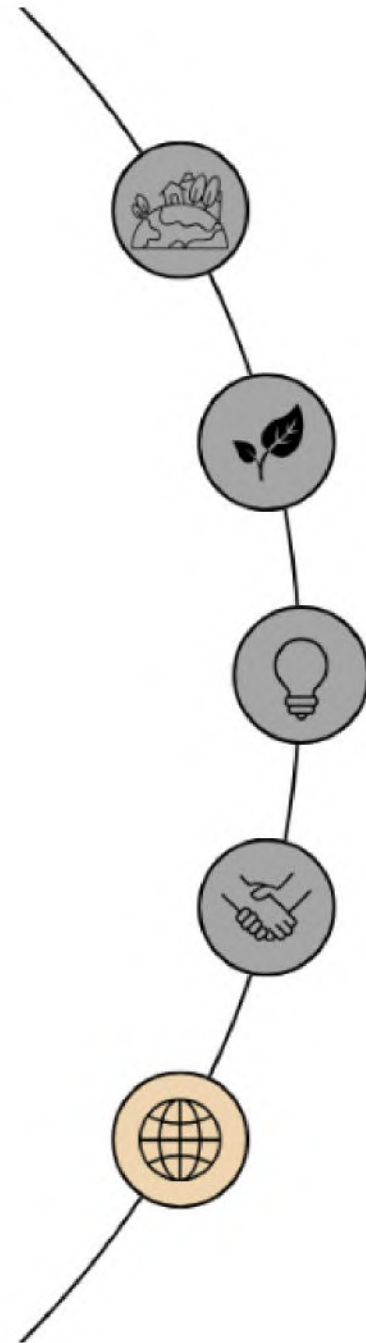


MONITORING



The *fern Pteris vittata*, for example, is a particularly efficient species for As removal because it has a fast growth rate and accumulates up to 27 g/kg (dry weight) of As in its fronds (the leaves of ferns).

Through micro-XRF it is possible to monitor the concentration of As during Pteris growth and assess when ferns have reached maximum accumulation in the leaves, optimizing the phytoremediation process.



THANK YOU FOR YOUR ATTENTION!