



*Autorità di Bacino  
dei Fiumi Liri-Garigliano e Volturno*

*Preliminary Version  
Of  
Surface Water and Groundwater  
Resources Government Plan*

*(Preliminare di Piano Stralcio per il governo della  
risorsa idrica superficiale e sotterranea)*

## REFERENCES FOR WATER RESOURCES PLANNING



**Planning process for water resources has been based on italian laws:**

- **L. 183/89 (soil defense)**
- **L. 36/94 (water use)**
- **D. Lgs. 152/99 (water protection from pollution risk)**

**and on Water Framework Directive 2000/60/CE (WFD).**

**The WFD has been transposed into italian legislation with the law D.Lgs. 152/06.**

**On the basis of D.P.S.I.R. methodology, Basin Authority has made a preliminar individuation of determinant and pressure systems, and now is going to complete D.P.S.I.R. application.**

# PRELIMINARY VERSION OF SURFACE WATER AND GROUNDWATER RESOURCES GOVERNMENT PLAN

## Planning activities

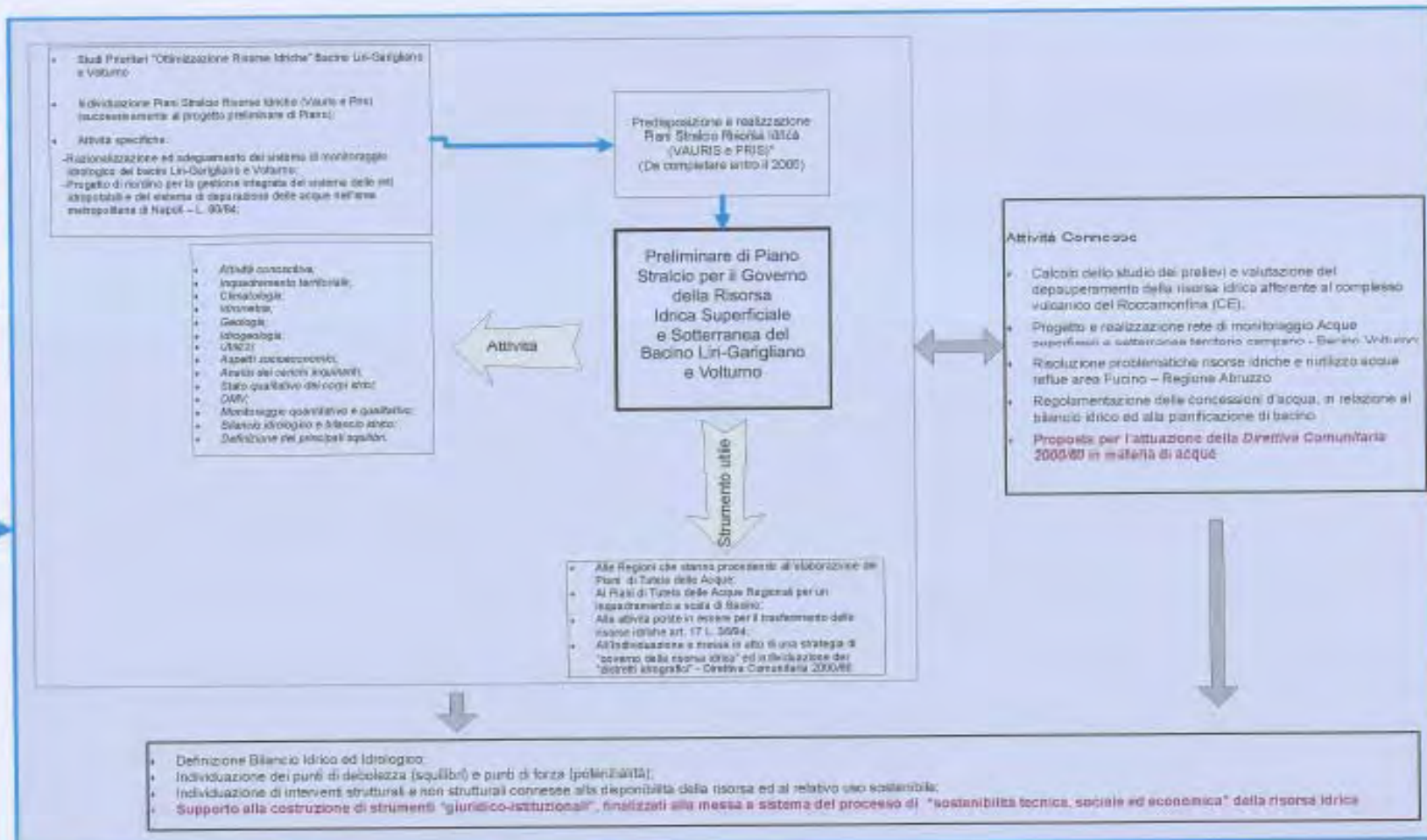
GROUNDWATER



SURFACE WATER



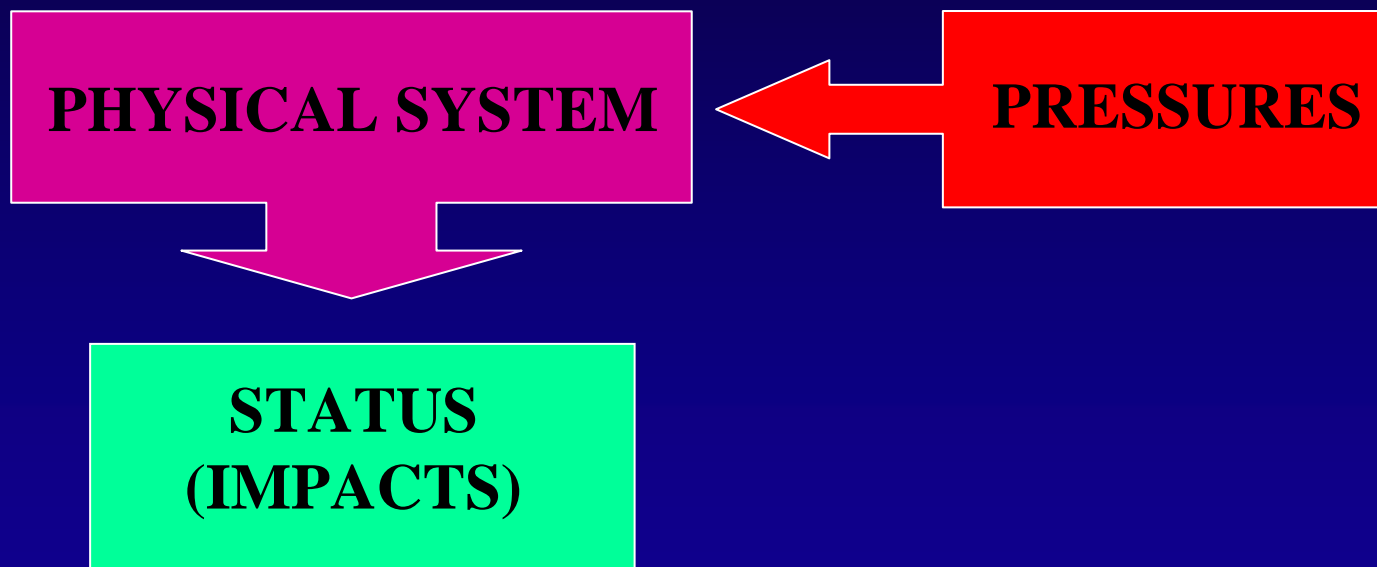
## PROCESSO DI PIANIFICAZIONE E PROGRAMMAZIONE PER IL GOVERNO DELLA RISORSA IDRICA AUTORITÀ DI BACINO DEI FIUMI LIRI-GARIGLIANO E VOLTURNO



\* VAURIS - Vincoli ambientali sull'utilizzo della risorsa idrica superficiale  
 PRIS - Protezione delle risorse idriche sotterranee  
 Per le specifiche attività vedere scheda allegata

# PLANNING PROCESS:

## FLOW CHART



# PRELIMINARY VERSION OF SURFACE WATER AND GROUNDWATER RESOURCES GOVERNMENT PLAN



First step of planning activities consisted in definition of physical system features for GROUNDWATERS and SURFACE WATERS.

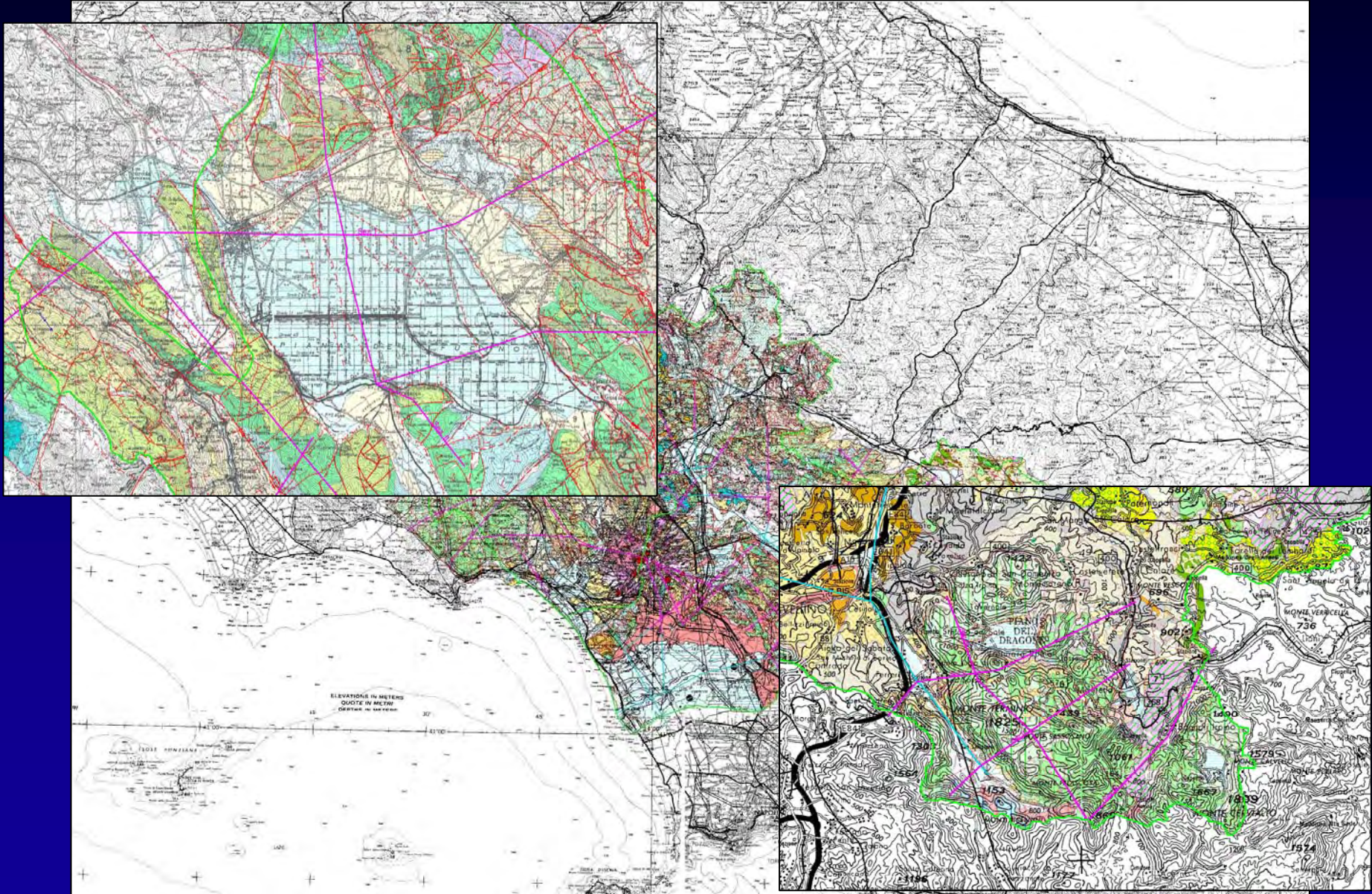
Description of physical system required analysis of following themes:

- geology and hydrogeology
- main groundwater bodies
- main natural and artificial surface water bodies,
- hydrology and climatology (rain, temperature, evapotranspiration, flow, etc.)
- hydraulics (morphology, River Functional Index)

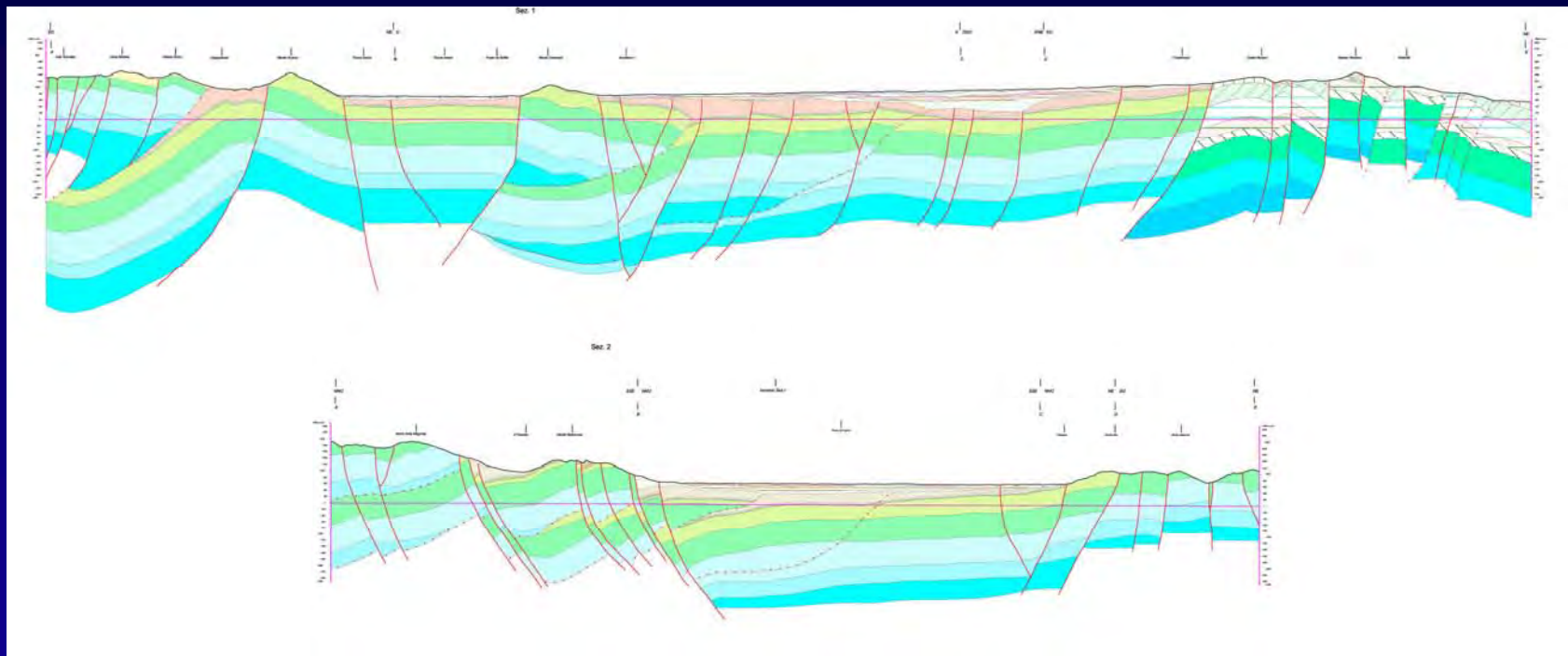
# GEOLOGICAL MAP



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del Fiume Tevere - Tevere, Arno e Volturno*



# GEOLOGICAL CROSS SECTIONS OF FUCINO PLAIN

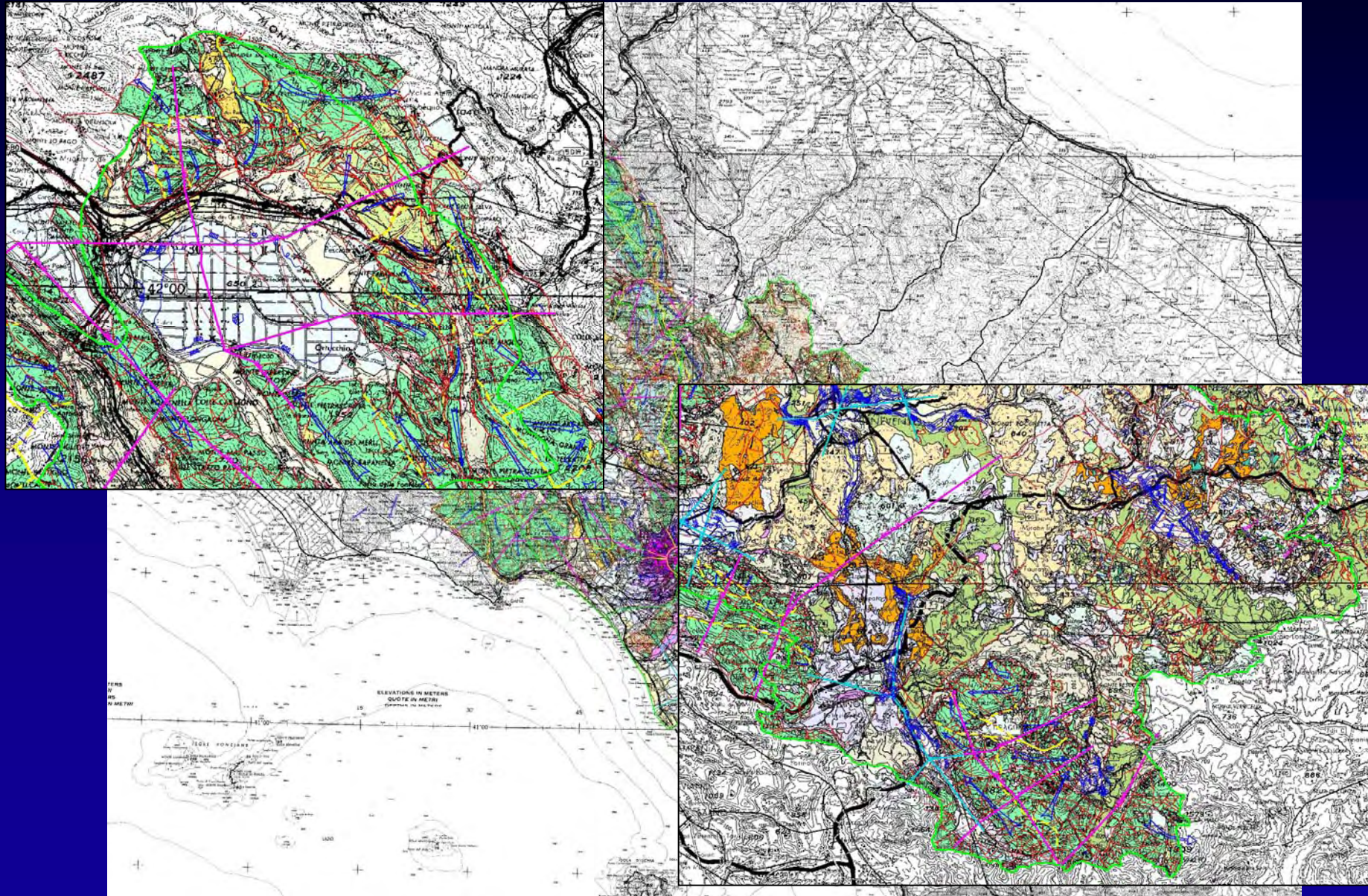




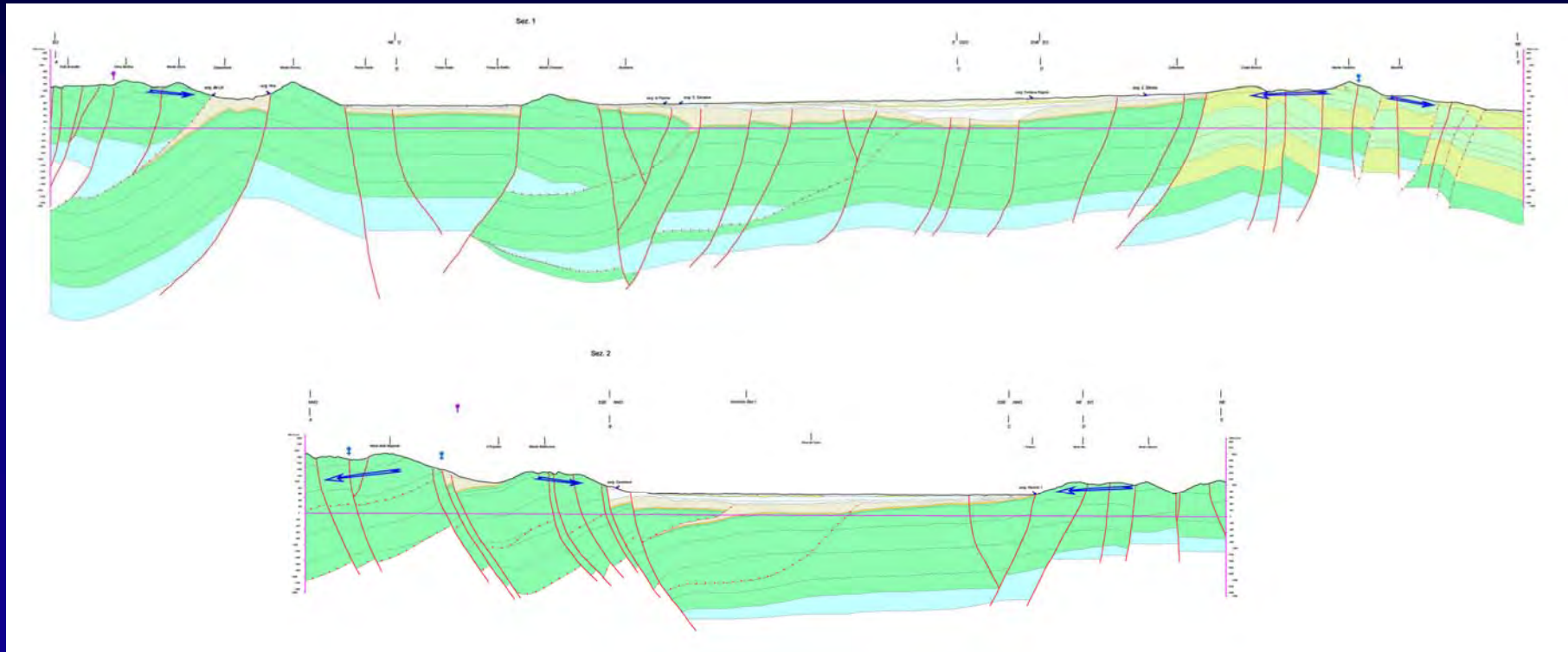
# HYDROGEOLOGICAL MAP



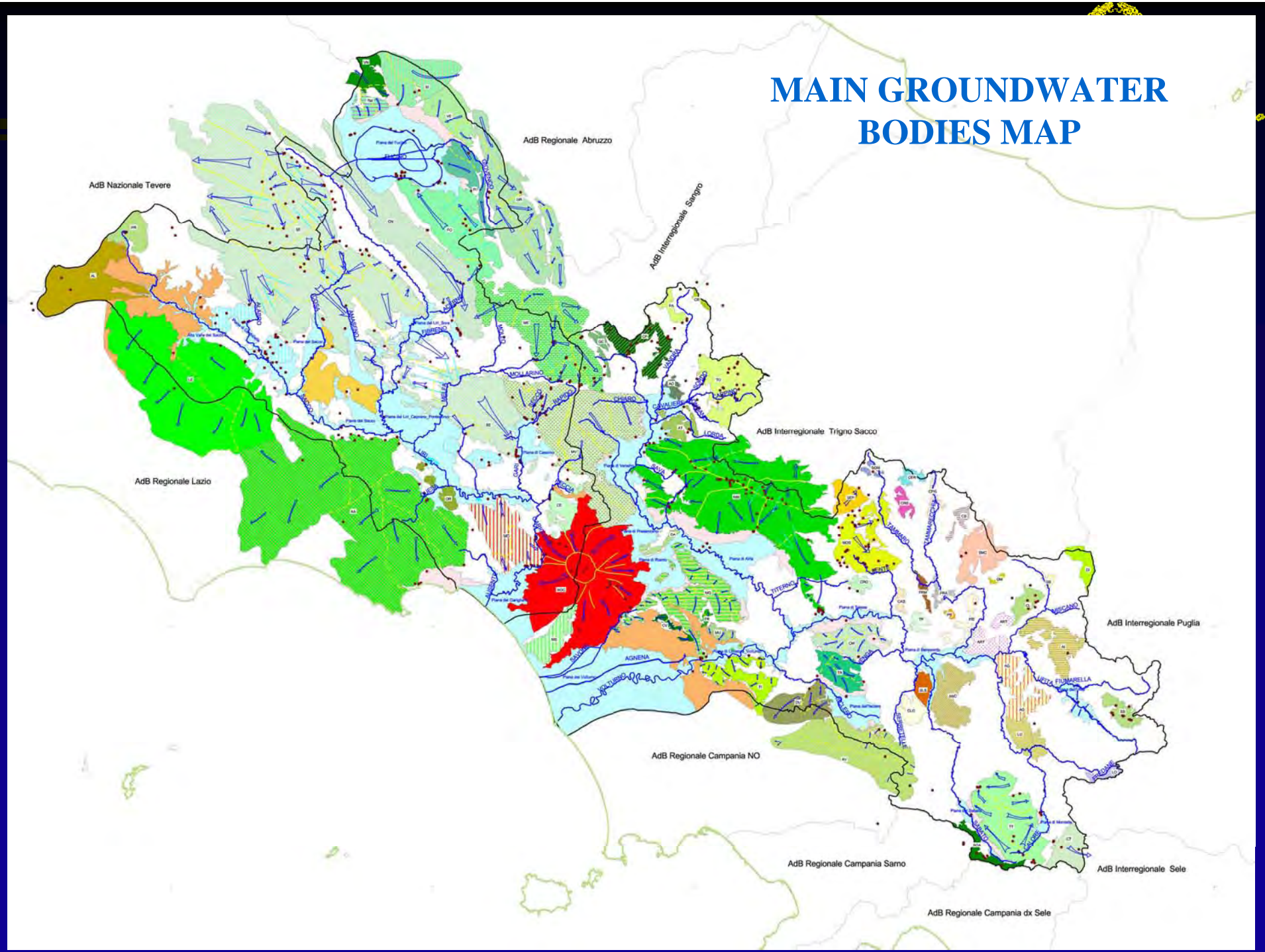
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# HYDROGEOLOGICAL CROSS SECTIONS OF FUCINO PLAIN



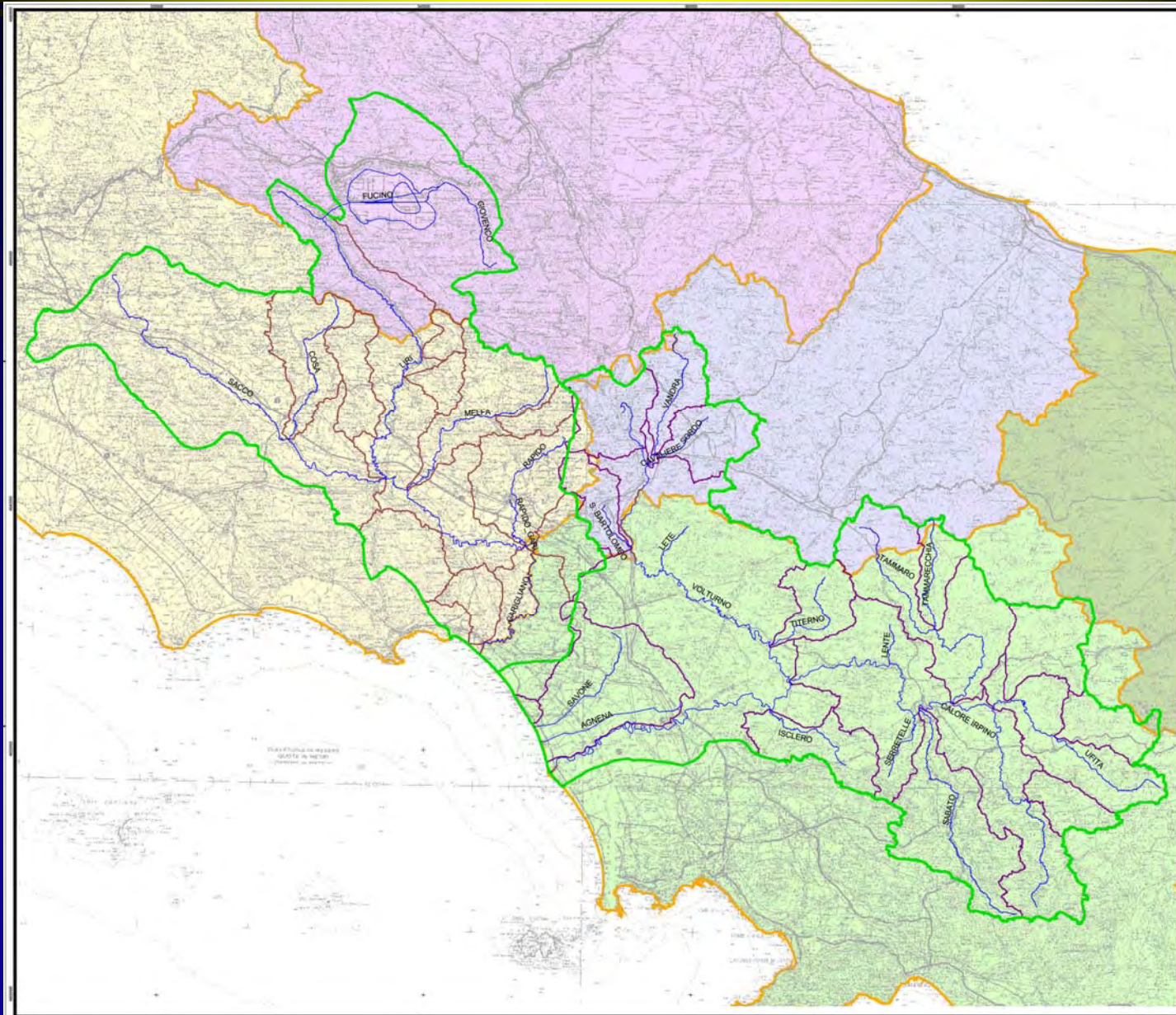
# MAIN GROUNDWATER BODIES MAP



# RIVER NETWORK AND RELATED SUB-BASINS



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## LEGENDA

- Limiti sottobacini fiume Liri-Garigliano
- Limiti sottobacini fiume Volturno
- Idrografia principale

Limiti Amministrativi

Limiti Regionali

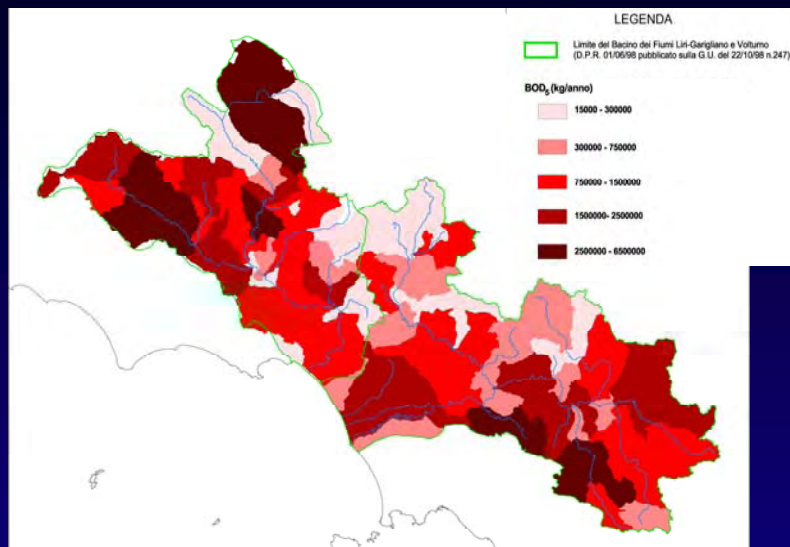
- ABRUZZO
- CAMPANIA
- LAZIO
- MOLISE
- PUGLIA

Limite del Bacino dei Fiumi Liri-Garigliano e Volturno  
(D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)

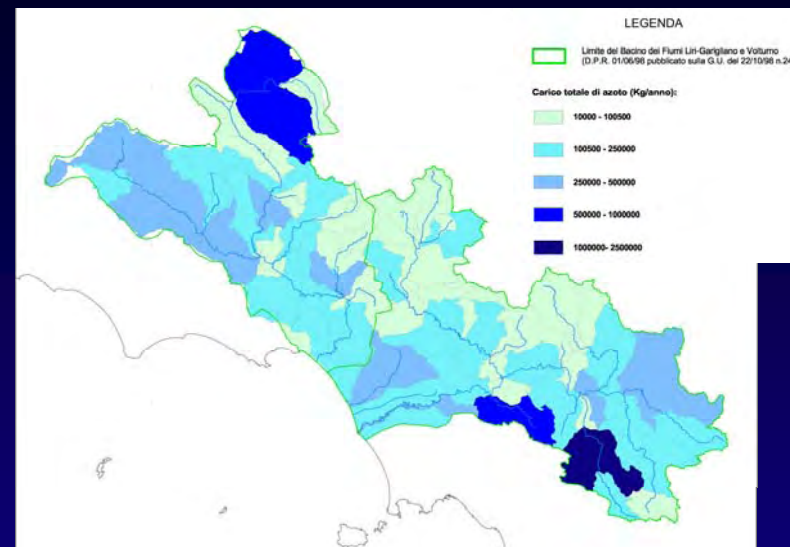
# PRESSURES

- Potential pollutant loads
- Water requirement
- Main water exploitation points
- Main interregional water resources transfers
- Wastewater discharge points and treatment plants
- Land use map
- Urbanization map

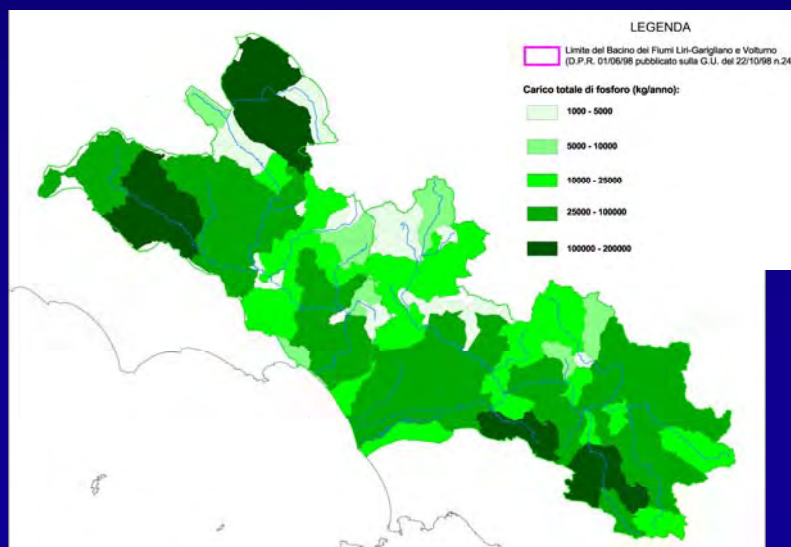
# POTENTIAL POLLUTANT LOADS



**BOD<sub>5</sub>**



**N total**

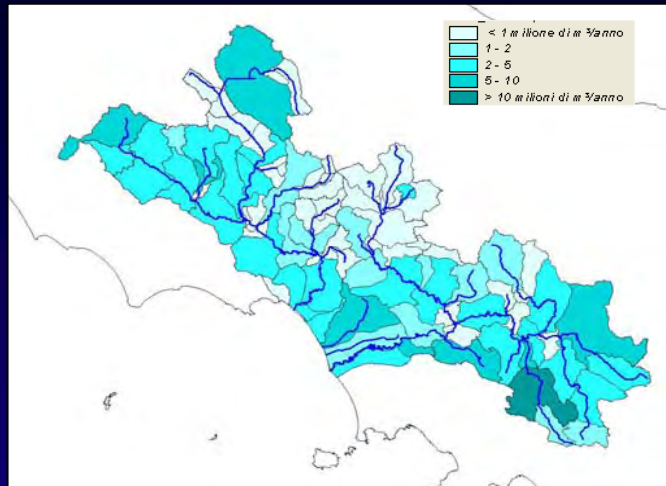


**P total**

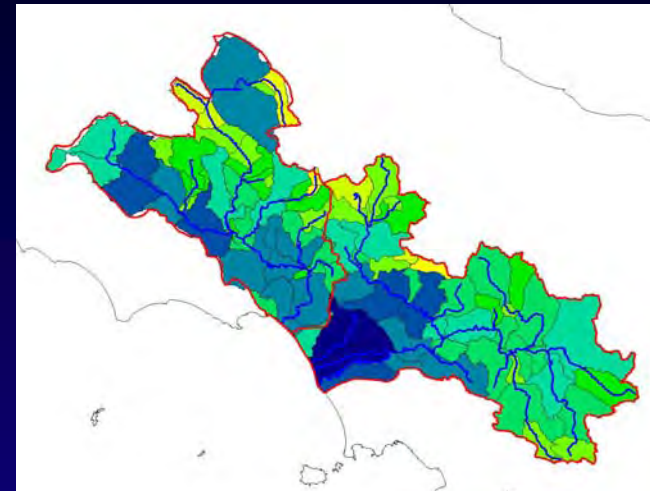
# WATER REQUIREMENT



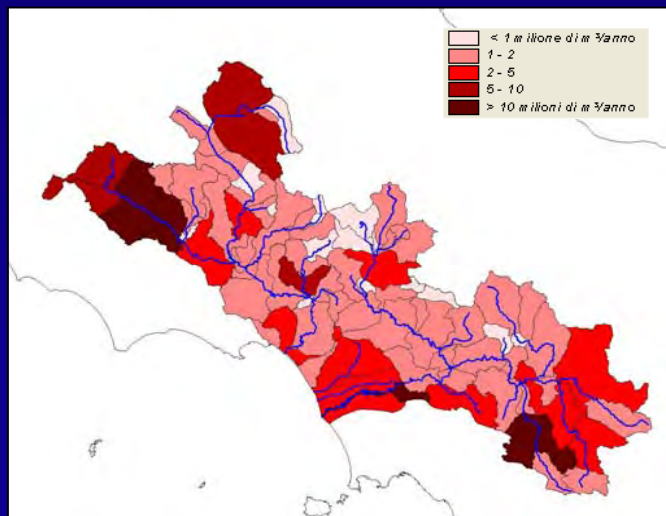
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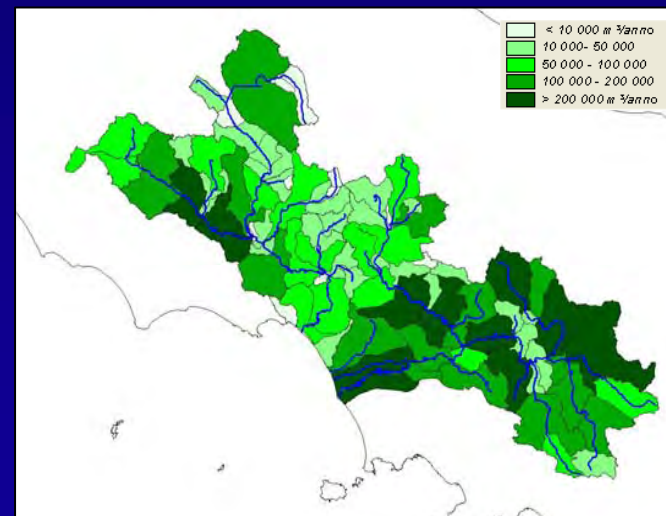
**Drinking water**



**Irrigation water**



**Breeding water**

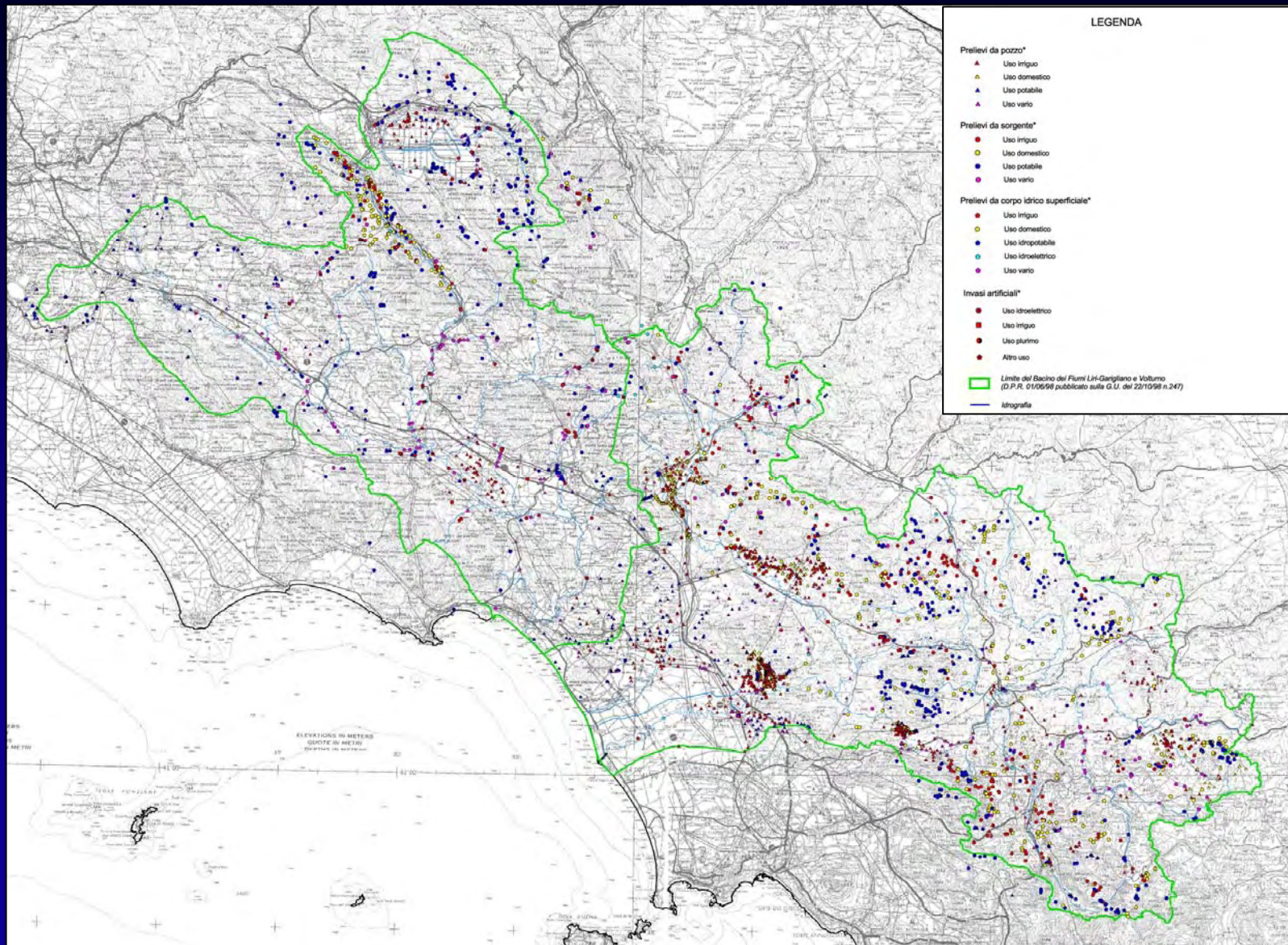


**Industrial water**

# MAIN WATER EXPLOITATION POINTS

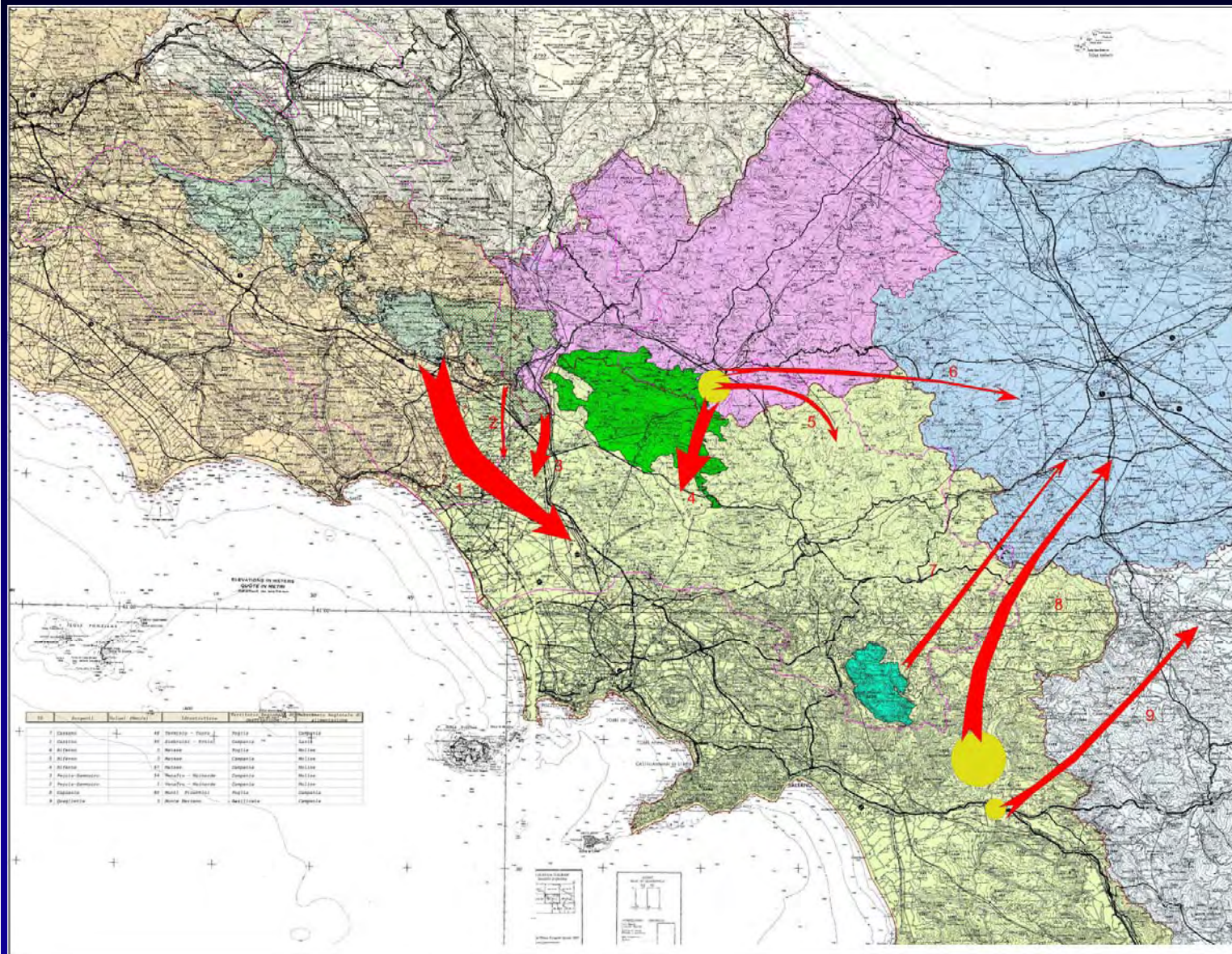


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# MAIN INTERREGIONAL WATER RESOURCES TRANSFERS



## LEGENDA

### Idrostrutture

- Monti del Matese
- Monti Simbruni - Ernici
- Monti delle Mairarde - Venafro
- Monti del Terminio - Tuoro

### Regioni

- Abruzzo
- Basilicata
- Campania
- Lazio
- Molise
- Puglia



Trasferimenti

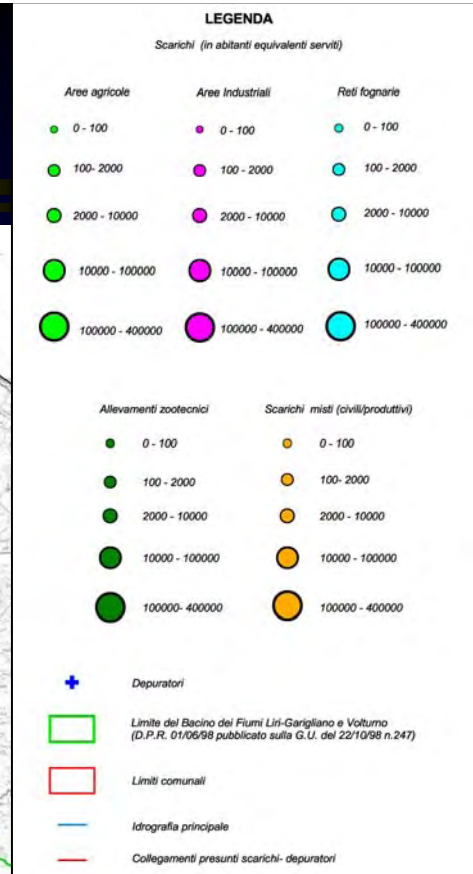
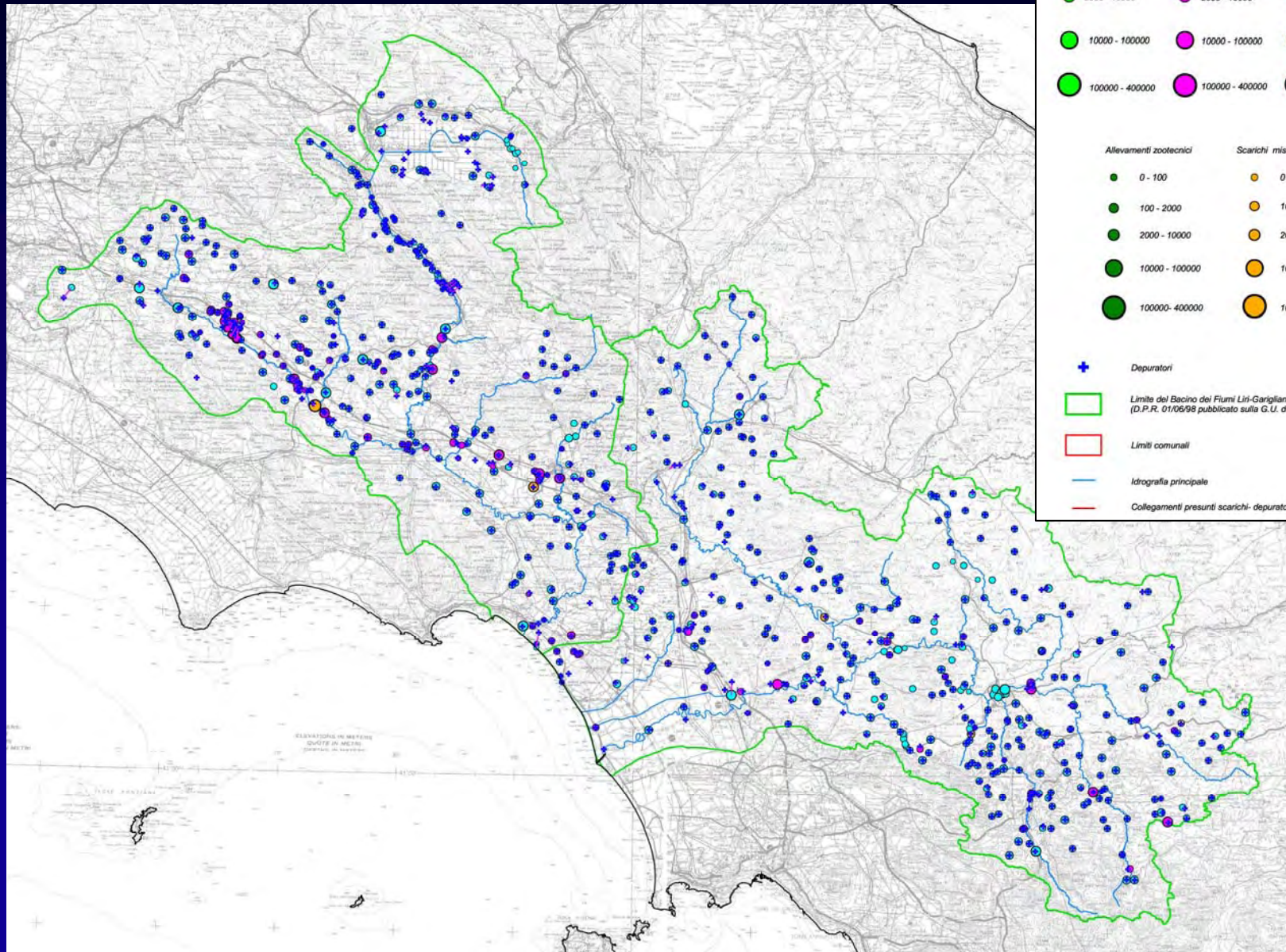


Prelievi oggetto di trasferimento fuori bacino

— Limite del Bacino Liri-Garigliano e Volturno

N. ID	Acquedotto	Località (Monte)	Localizzazione	Provincia	Regione	Provincia	Regione
1	Castello	48. Montecelio - Tiburtina	Puglia	Castellana Grotte	Lazio		
2	Castello	49. Montecelio - Tiburtina	Campania	Castellana Grotte	Lazio		
3	Al Forno	50. Nola	Puglia	Castellana Grotte	Molise		
4	Al Forno	51. Nola	Campania	Castellana Grotte	Molise		
5	Al Forno	52. Nola	Campania	Castellana Grotte	Molise		
6	Al Forno	53. Nola	Campania	Castellana Grotte	Molise		
7	Al Forno	54. Nola	Campania	Castellana Grotte	Molise		
8	Al Forno	55. Nola	Campania	Castellana Grotte	Molise		
9	Al Forno	56. Nola	Campania	Castellana Grotte	Molise		
10	Al Forno	57. Nola	Campania	Castellana Grotte	Molise		
11	Al Forno	58. Nola	Campania	Castellana Grotte	Molise		
12	Al Forno	59. Nola	Campania	Castellana Grotte	Molise		
13	Al Forno	60. Nola	Campania	Castellana Grotte	Molise		
14	Al Forno	61. Nola	Campania	Castellana Grotte	Molise		
15	Al Forno	62. Nola	Campania	Castellana Grotte	Molise		
16	Al Forno	63. Nola	Campania	Castellana Grotte	Molise		
17	Al Forno	64. Nola	Campania	Castellana Grotte	Molise		
18	Al Forno	65. Nola	Campania	Castellana Grotte	Molise		
19	Al Forno	66. Nola	Campania	Castellana Grotte	Molise		
20	Al Forno	67. Nola	Campania	Castellana Grotte	Molise		
21	Al Forno	68. Nola	Campania	Castellana Grotte	Molise		
22	Al Forno	69. Nola	Campania	Castellana Grotte	Molise		
23	Al Forno	70. Nola	Campania	Castellana Grotte	Molise		
24	Al Forno	71. Nola	Campania	Castellana Grotte	Molise		
25	Al Forno	72. Nola	Campania	Castellana Grotte	Molise		
26	Al Forno	73. Nola	Campania	Castellana Grotte	Molise		
27	Al Forno	74. Nola	Campania	Castellana Grotte	Molise		
28	Al Forno	75. Nola	Campania	Castellana Grotte	Molise		
29	Al Forno	76. Nola	Campania	Castellana Grotte	Molise		
30	Al Forno	77. Nola	Campania	Castellana Grotte	Molise		
31	Al Forno	78. Nola	Campania	Castellana Grotte	Molise		
32	Al Forno	79. Nola	Campania	Castellana Grotte	Molise		
33	Al Forno	80. Nola	Campania	Castellana Grotte	Molise		
34	Al Forno	81. Nola	Campania	Castellana Grotte	Molise		
35	Al Forno	82. Nola	Campania	Castellana Grotte	Molise		
36	Al Forno	83. Nola	Campania	Castellana Grotte	Molise		
37	Al Forno	84. Nola	Campania	Castellana Grotte	Molise		
38	Al Forno	85. Nola	Campania	Castellana Grotte	Molise		
39	Al Forno	86. Nola	Campania	Castellana Grotte	Molise		
40	Al Forno	87. Nola	Campania	Castellana Grotte	Molise		
41	Al Forno	88. Nola	Campania	Castellana Grotte	Molise		
42	Al Forno	89. Nola	Campania	Castellana Grotte	Molise		
43	Al Forno	90. Nola	Campania	Castellana Grotte	Molise		
44	Al Forno	91. Nola	Campania	Castellana Grotte	Molise		
45	Al Forno	92. Nola	Campania	Castellana Grotte	Molise		
46	Al Forno	93. Nola	Campania	Castellana Grotte	Molise		
47	Al Forno	94. Nola	Campania	Castellana Grotte	Molise		
48	Al Forno	95. Nola	Campania	Castellana Grotte	Molise		
49	Al Forno	96. Nola	Campania	Castellana Grotte	Molise		
50	Al Forno	97. Nola	Campania	Castellana Grotte	Molise		
51	Al Forno	98. Nola	Campania	Castellana Grotte	Molise		
52	Al Forno	99. Nola	Campania	Castellana Grotte	Molise		
53	Al Forno	100. Nola	Campania	Castellana Grotte	Molise		

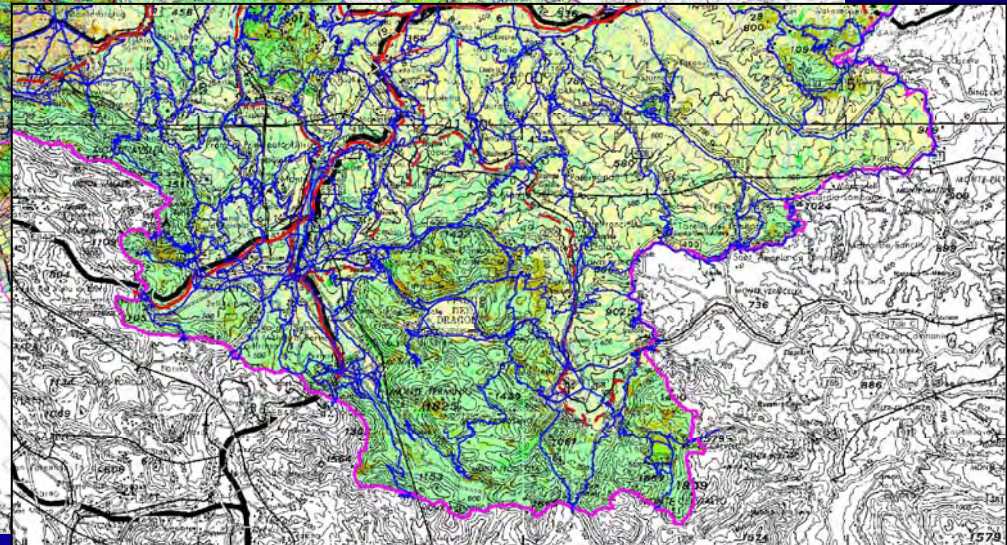
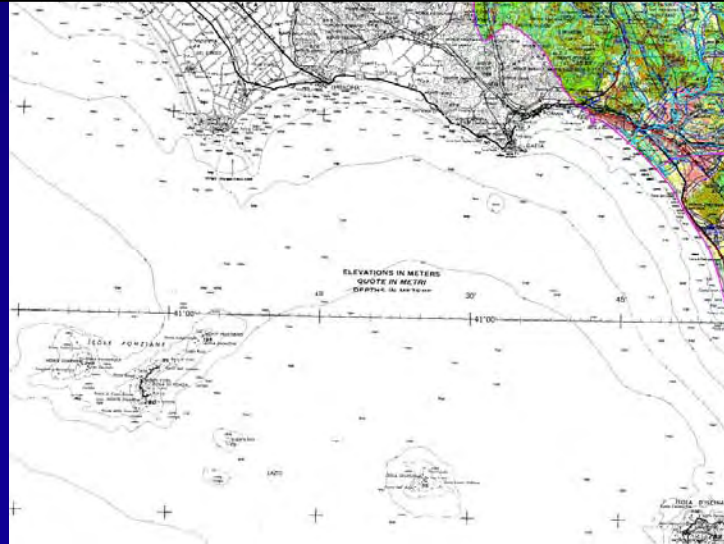
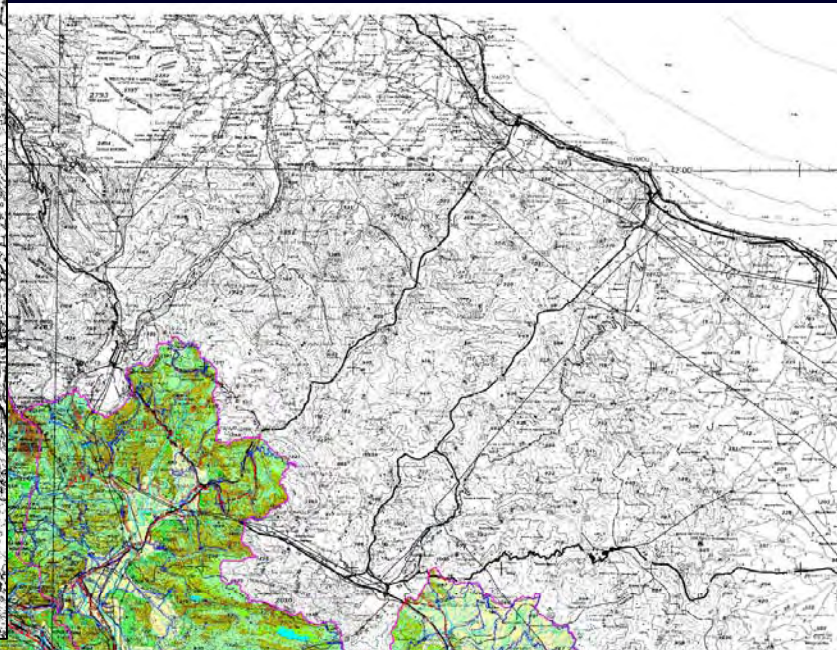
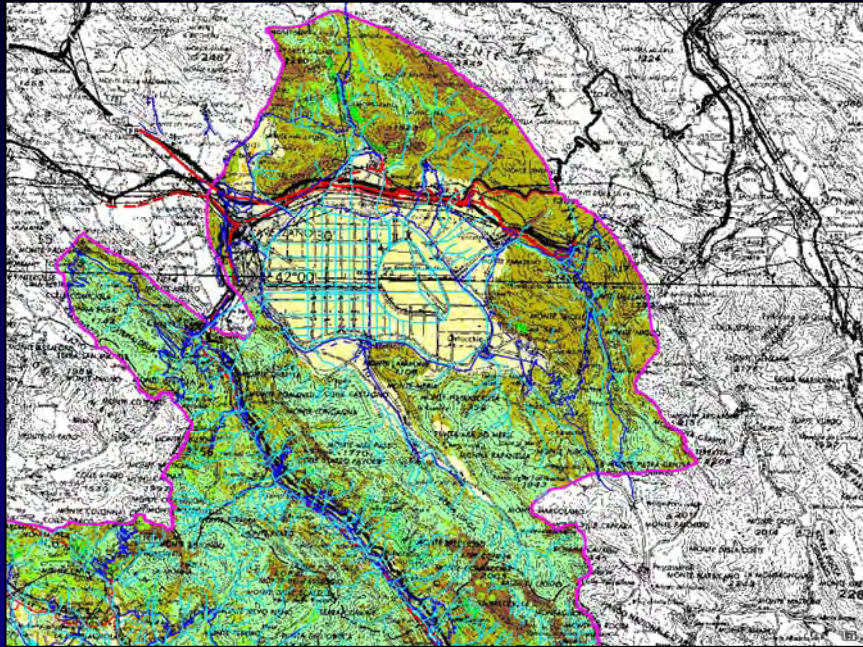
# WASTEWATER DISCHARGE POINTS AND TREATMENT PLANTS



# LAND USE MAP



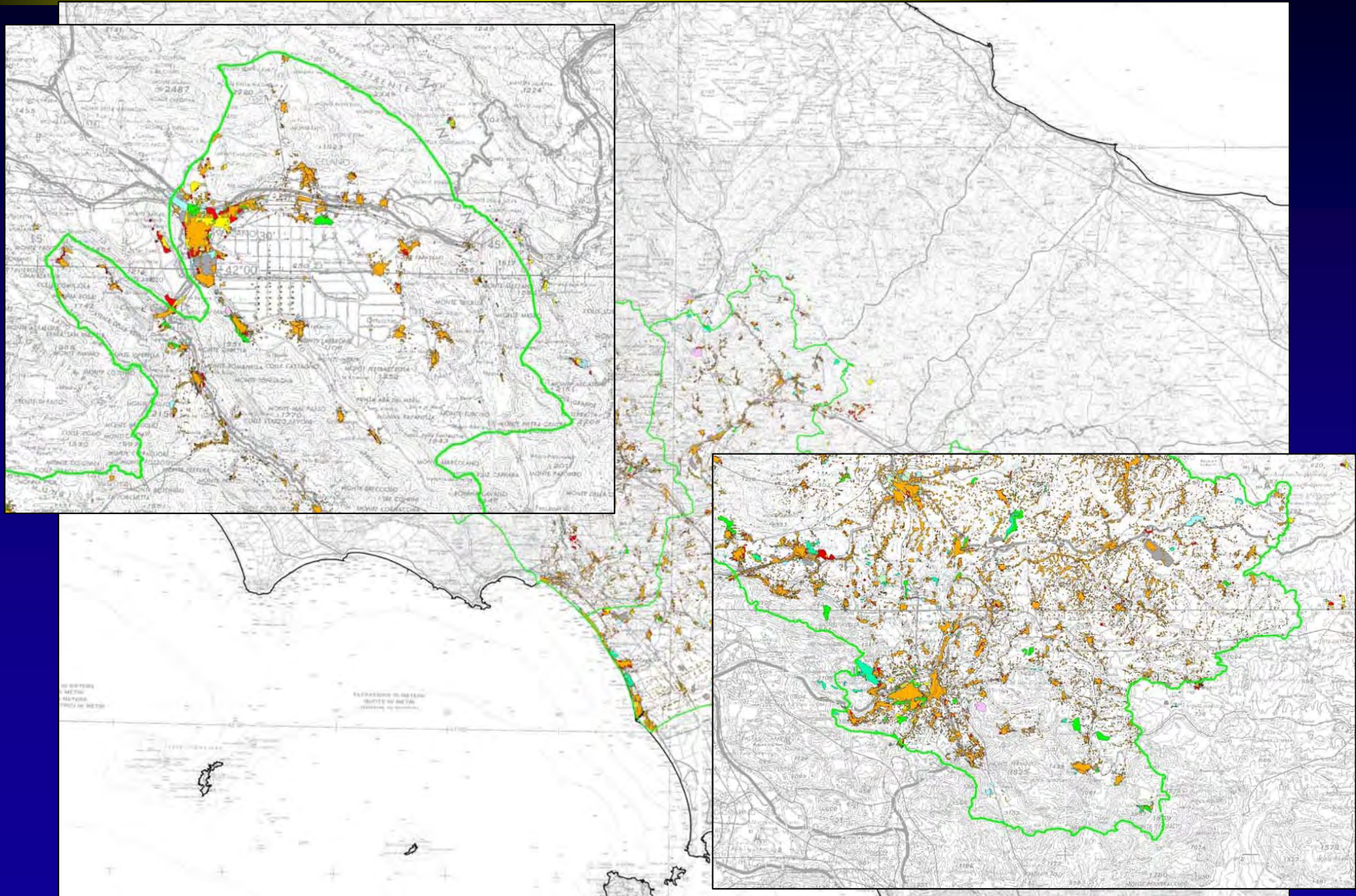
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# URBANIZATION MAP



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# STATUS (IMPACTS)

- water balance
- minimum stream flow (deflusso minimo vitale)
- groundwater and surface water quality

# WATER BALANCE

Water balance is pointed to define a strategy for government of water resources, and to guarantee a sustainable uses.

Aim of water balance is:

- to quantify hydrologic cycle components
- to quantify water exploitation
- to identify new resources
- to provide informations for studies at local scale
- to plan future exploitation based on water demand

Water balance has been computed referring to:

- *natural conditions*: input and output volumes are referred to natural condition without considering resources exploitation.
- *uses*: input and output volumes are computed including resources exploitation, present and future water demand, and minimum streamflow.

# SIMPLIFIED MODEL FOR HYDROLOGIC ACCOUNT



# WATER BALANCE CALCULATING POINTS



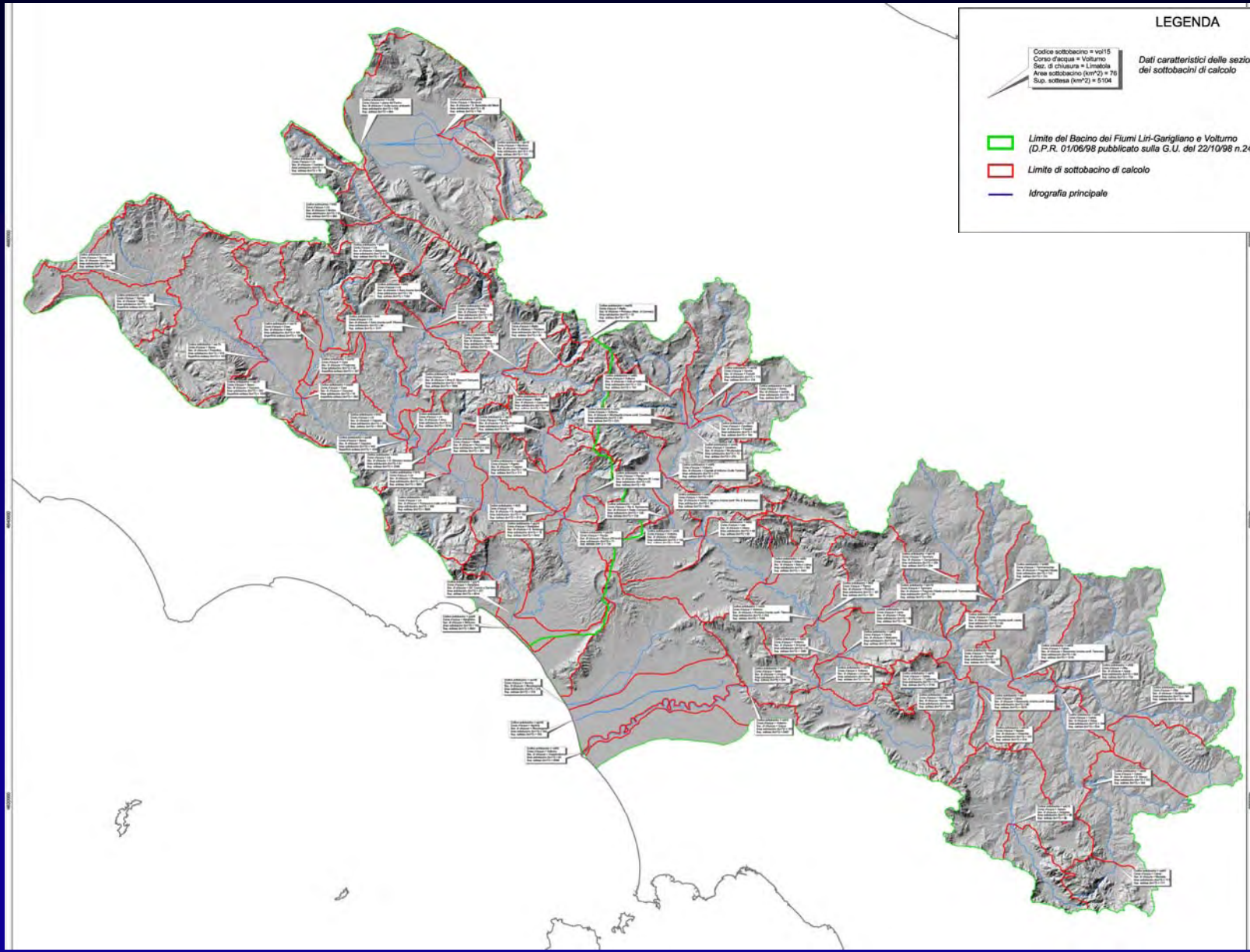
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## LEGENDA

Codice sottobacino e vol15  
Cassa d'acqua = Volturno  
Sez. di chiusura = Limatola  
Area sottobacino (km<sup>2</sup>) = 76  
Sup. sottesa (km<sup>2</sup>) = 5104

Dati caratteristici delle sezioni di chiusura  
dei sottobacini di calcolo

- Limite del Bacino dei Fiumi Liri-Garigliano e Volturno  
(D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)
- Limite di sottobacino di calcolo
- Idrografia principale





# MINIMUM STREAM FLOW (Deflusso Minimo Vitale)

Minimum Stream Flow for biological life (*Deflusso Minimo Vitale*) is the flow value to guarantee preservation of river ecosystem.

Fondamental parameters:

- natural: hydrology, hydrogeology, river ecosystem
- human: river geometry modification, pollutant loads.

There are many methods to compute DMV. Usually they are based on hydrologic and environmental variables.

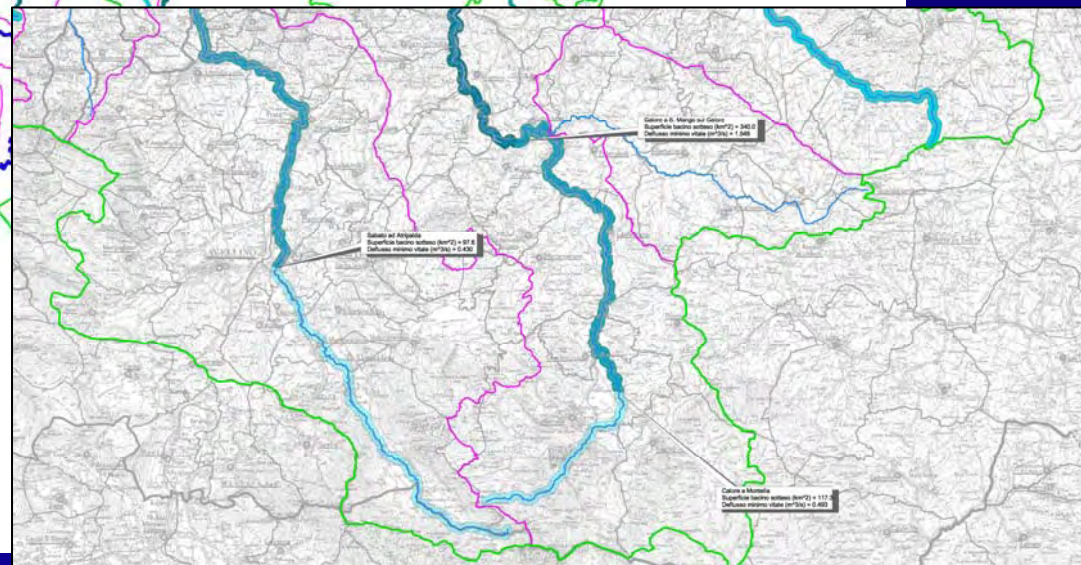
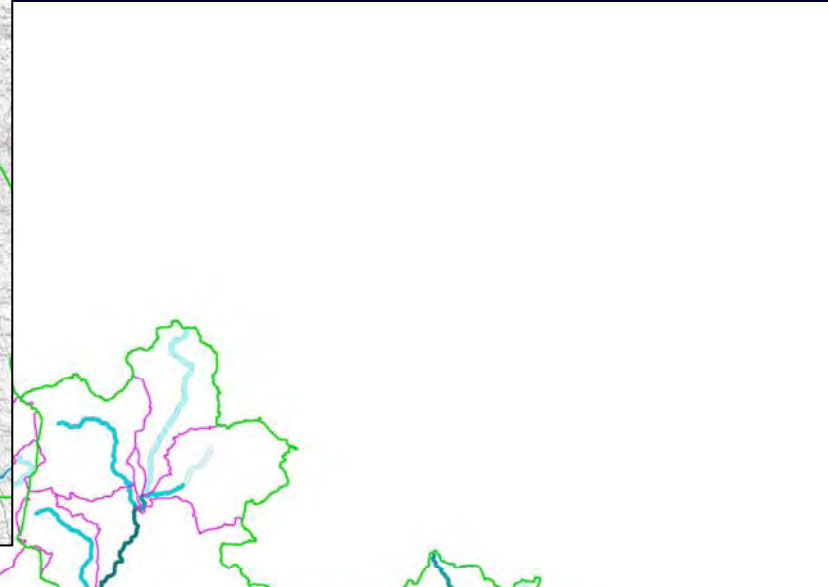
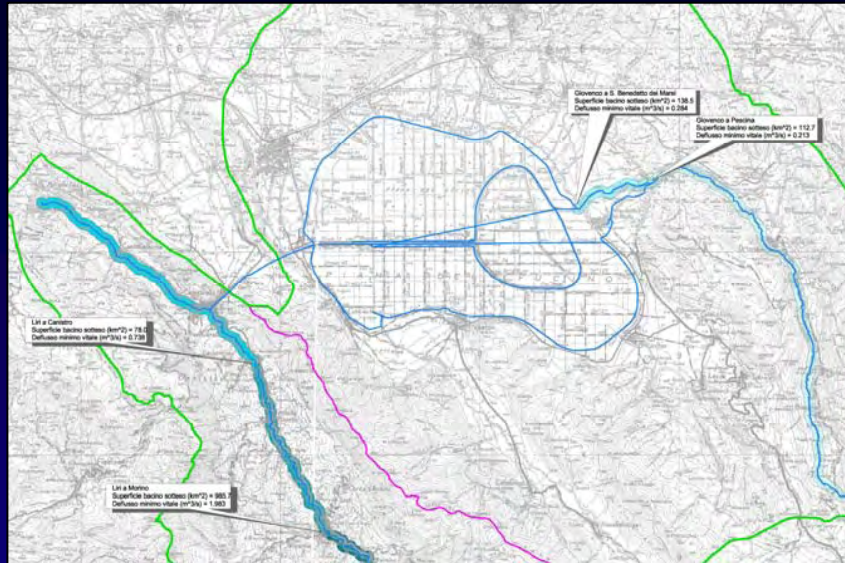
*Basin Authority* used:

- *hydrological-environmental method*, computes DMV using geomorphologic and hydrologic parameters coupled with environmental factor
- *experimental method of microhabitat*, computes DMV using environmental conditions fit for water life.

# DMV computed with hydrological - environmental method



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**LEGENDA**

**Deflusso Minimo Vitale (m<sup>3</sup>/s)**

0.000 - 0.250
0.250 - 0.500
0.500 - 1.000
1.000 - 2.000
2.000 - 5.000
5.000 - 10.000
10.000 - 20.000

**Dati caratteristici delle sezioni di calcolo**

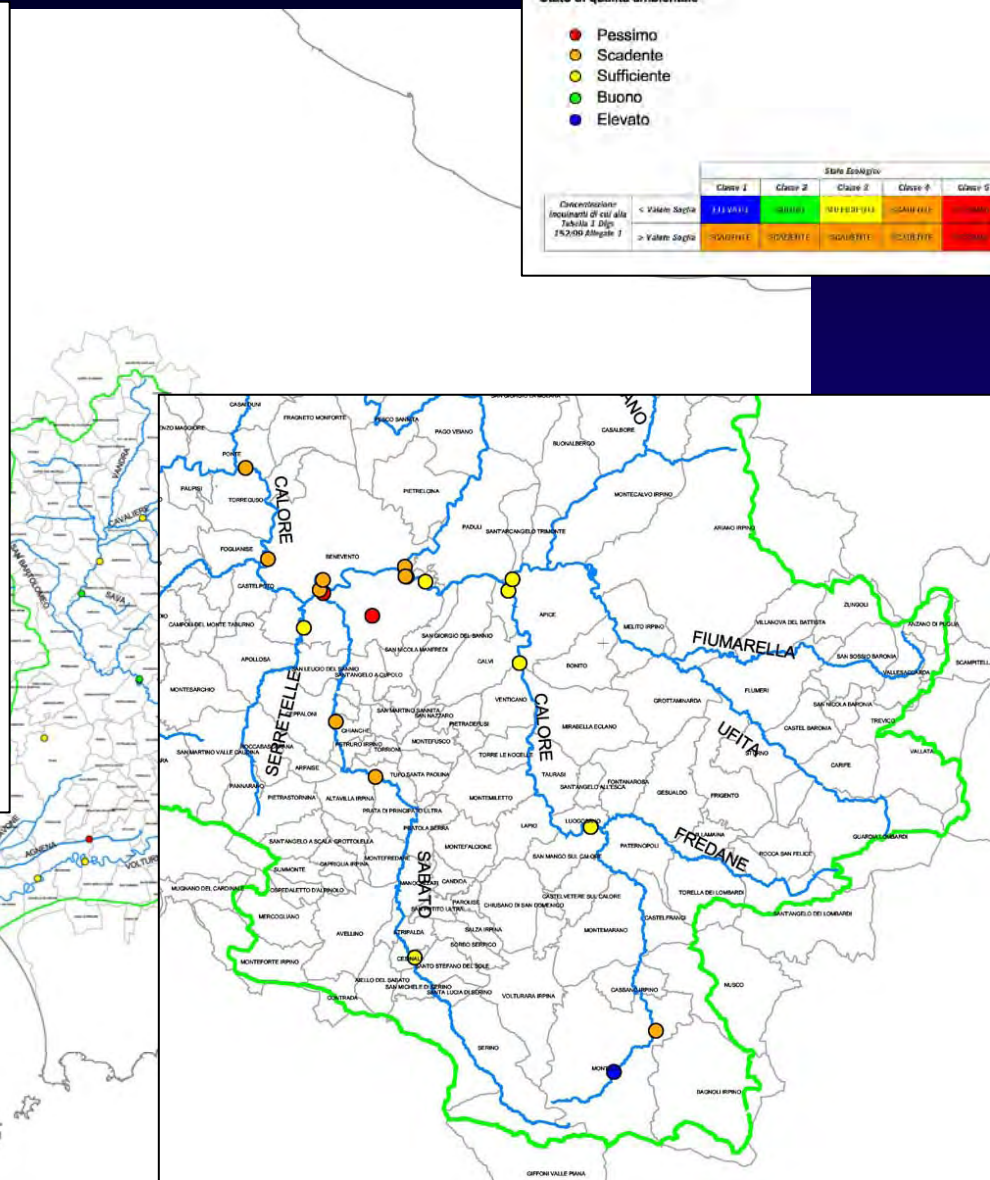
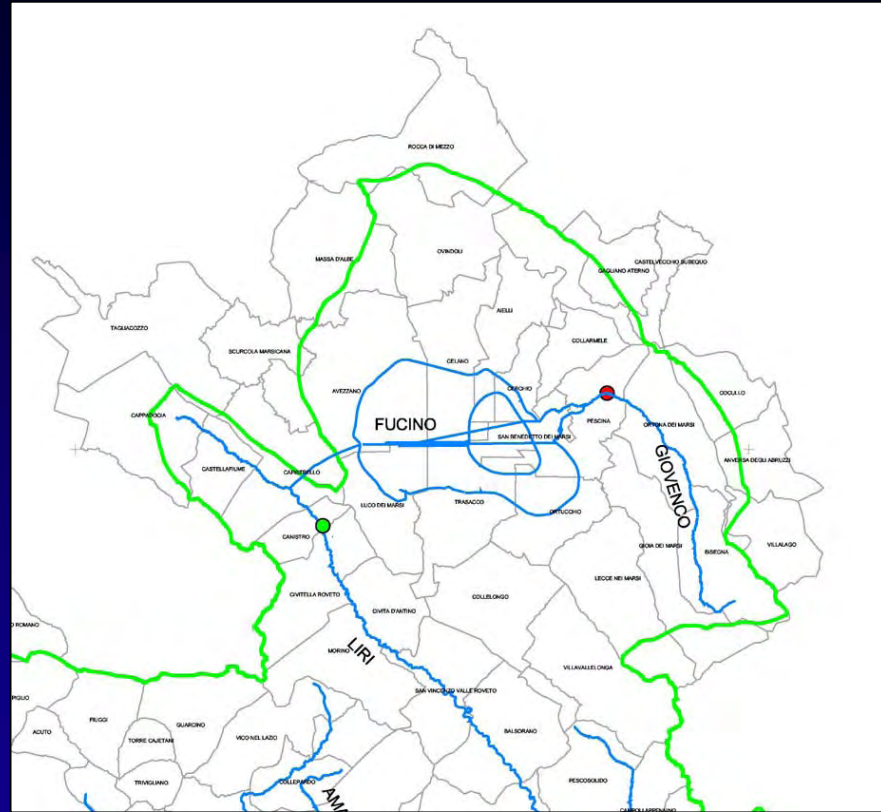
**Limiti Amministrativi**

- Limite del Bacino dei Fiumi Liri-Garigliano e Volturno (D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)
- Limite di sottobacino
- Idrografia principale

# WATER QUALITY



# Surface water quality and environmental level map



**LEGENDA**

- Limite del Bacino dei fiumi Liri-Garigliano e Volturno (D.P.R. 01/08/98 pubblicato sulla G.U. del 22/10/98 n. 247)
- Idrografia principale
- Limiti comunali

**Stato di qualità ambientale**

- Pessimo
- Scadente
- Sufficiente
- Buono
- Elevato

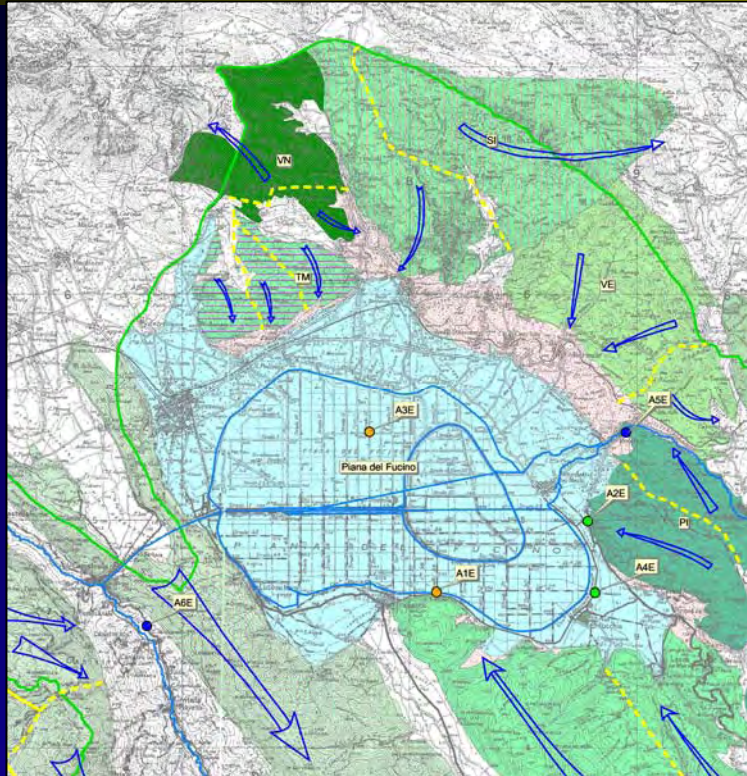
Dimensione/numero di punti di cui alla Tabella 1 D.lgs. 152/99 Allegato 1	Stato Ecologico				
	Classe I	Classe II	Classe III	Classe IV	Classe V
< Valori soglia	Buono	Sufficiente	Scadente	Pessimo	Non class.
> Valori soglia	Scadente	Scadente	Scadente	Scadente	Pessimo

# WATER QUALITY →

## Groundwater quality map: chemical level

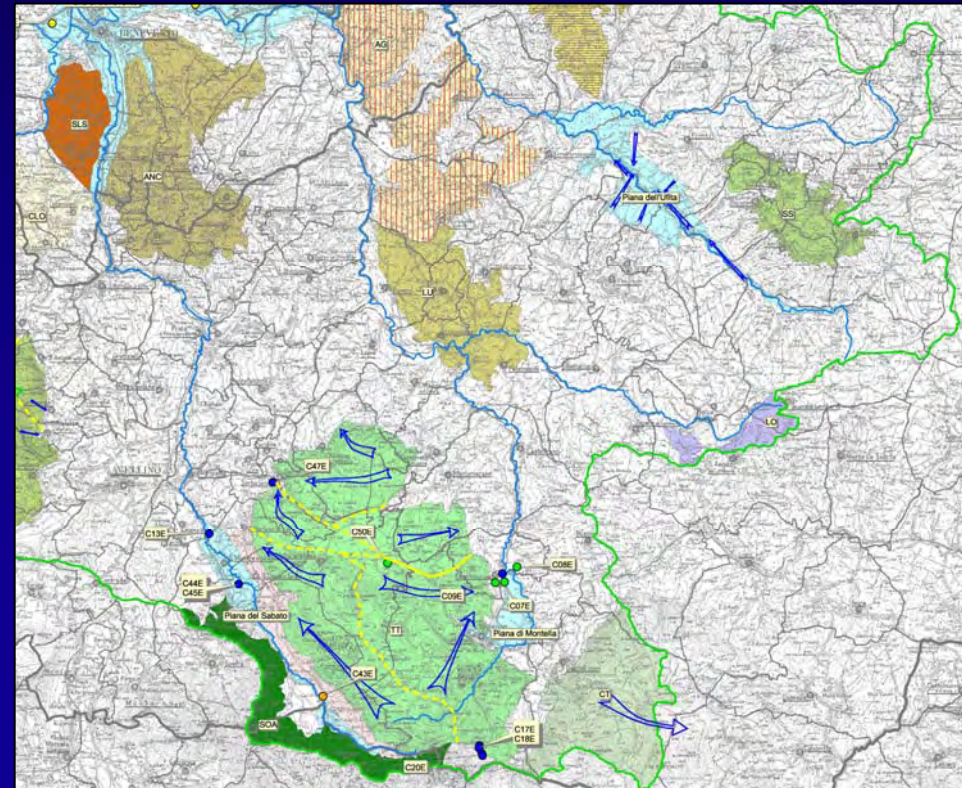


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**Classi chimiche**

○	Classe 0
●	Classe 1
●	Classe 2
●	Classe 3
●	Classe 4
●	Classe variabile



# MONITORING NETWORK → Groundwater



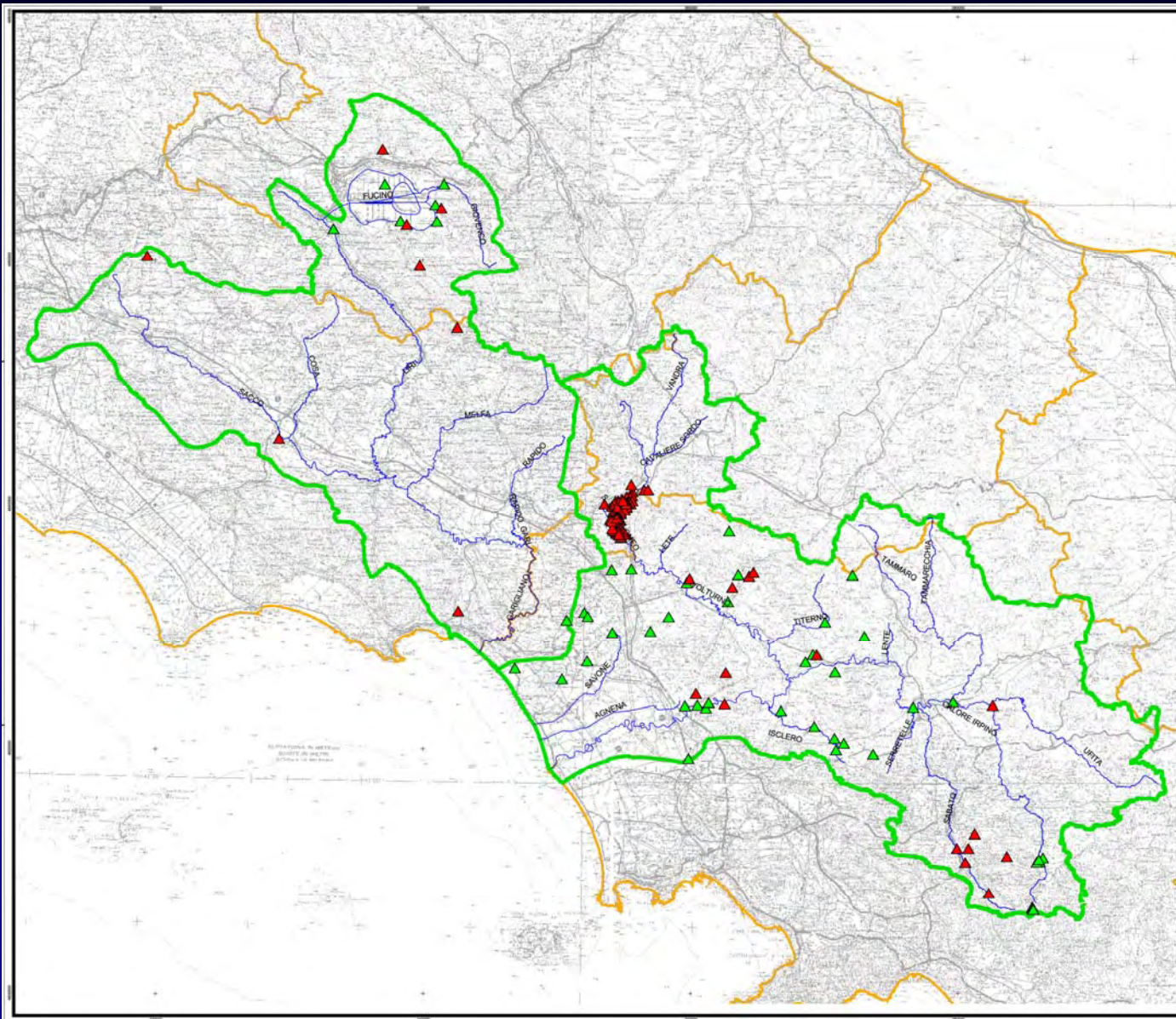
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## LEGENDA

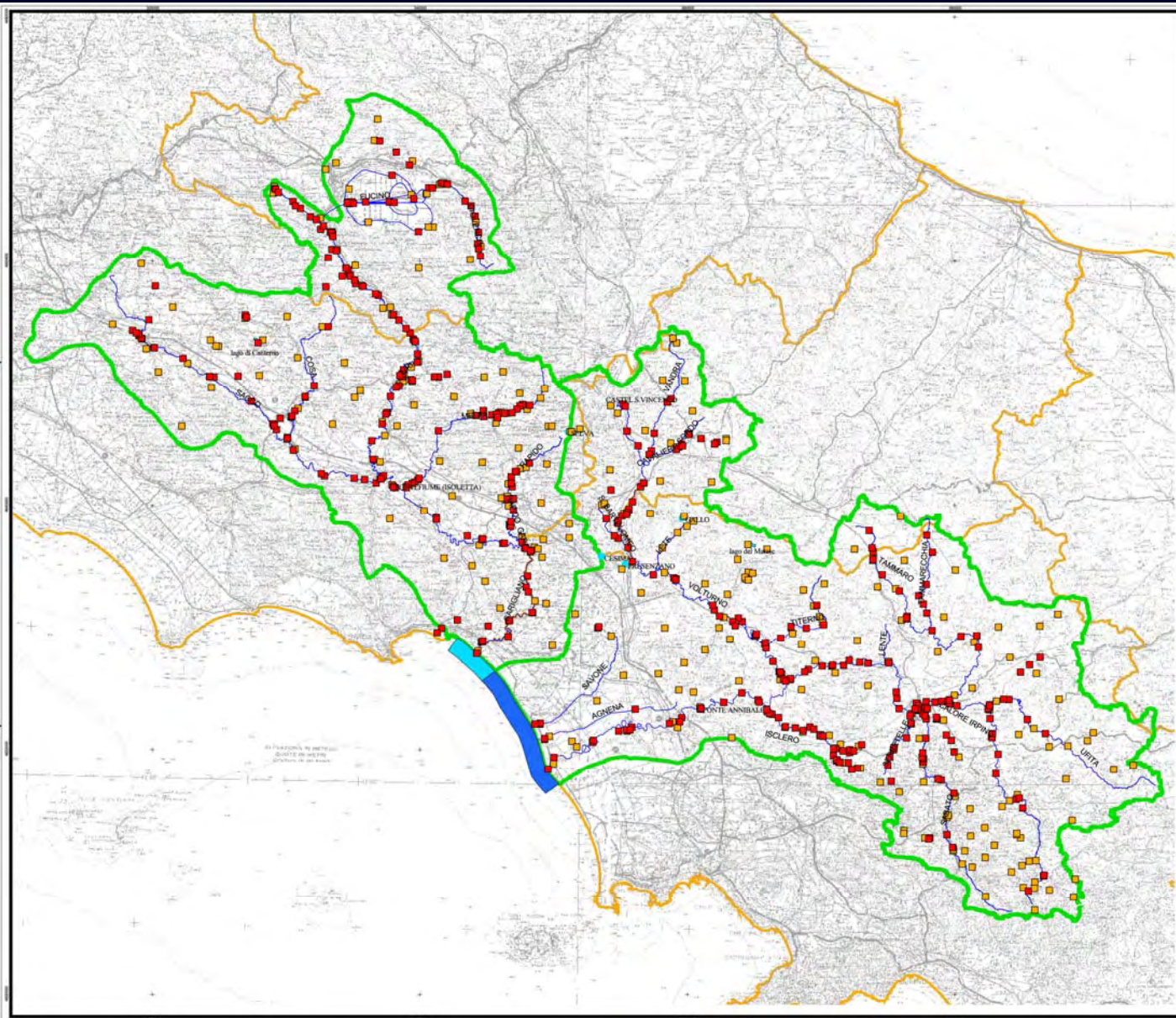
- Idrografia principale
- ▲ Stazioni di monitoraggio quantità
- ▲ Stazioni di monitoraggio qualità

### Limiti Amministrativi

- Limite regionale
- Limite del Bacino dei Fiumi Liri-Garigliano e Volturno (D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)



# MONITORING NETWORK → Surface water



**LEGENDA**

-  Laghi
-  Invasi
-  Acque marino-costiere bacino Liri-Garigliano
-  Acque marino-costiere bacino Volturno
-  Idrografia principale
-  Stazioni di monitoraggio quantità
-  Stazioni di monitoraggio qualità

Limiti Amministrativi

-  Limite regionale
-  Limite del Bacino dei Fiumi Liri-Garigliano e Volturno (D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)

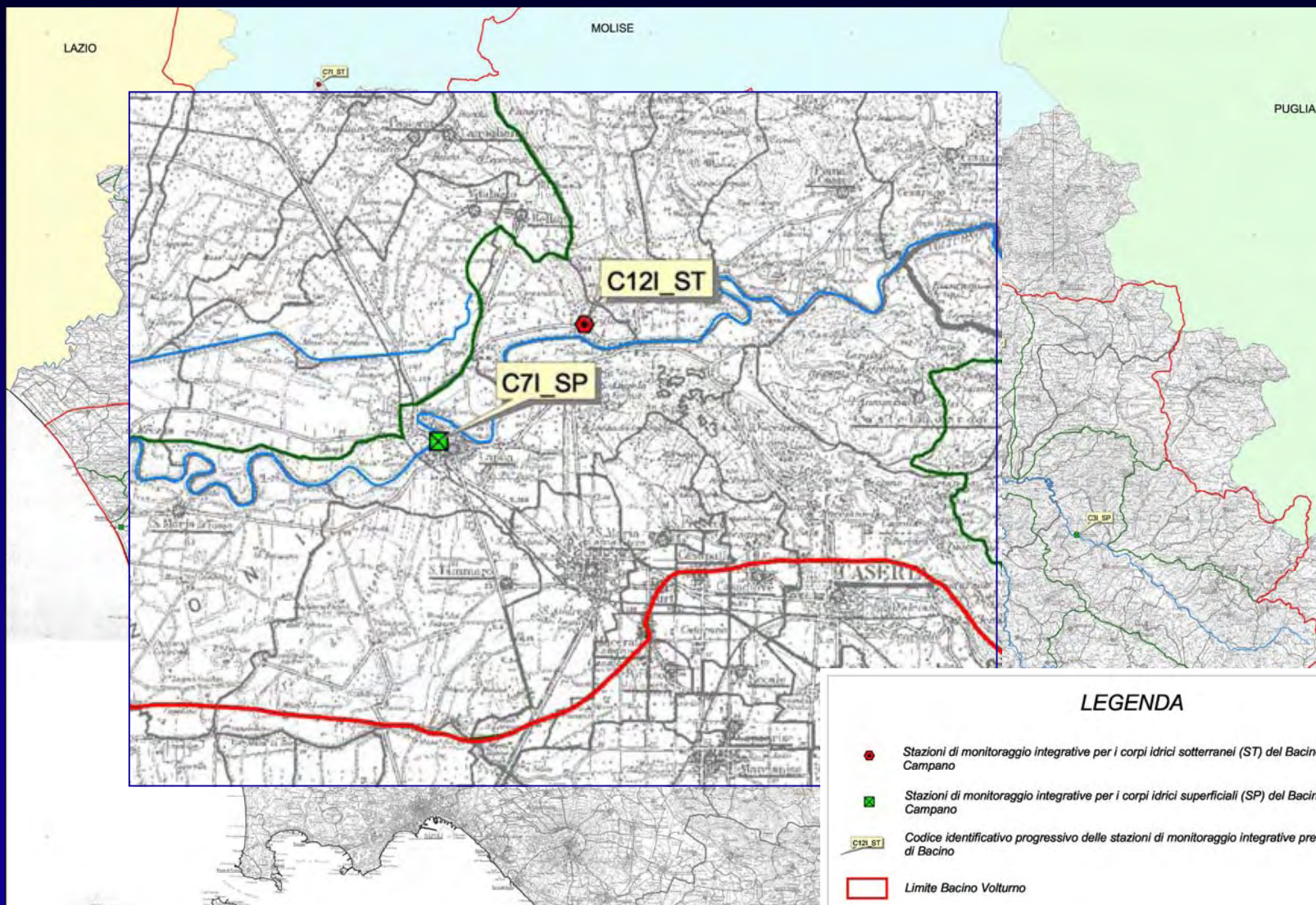
# SPECIFIC PROGRAM FOR WATER RESOURCES MANAGEMENT



*Basin Authority* elaborated two special program focused on water resources management:

- Quality and quantity monitoring network for groundwater and surface water in Volturno basin
- Program for groundwater and surface water resources management in Fucino Plain.

# MONITORING NETWORK LAYOUT DESIGNED FOR VOLTURNO BASIN

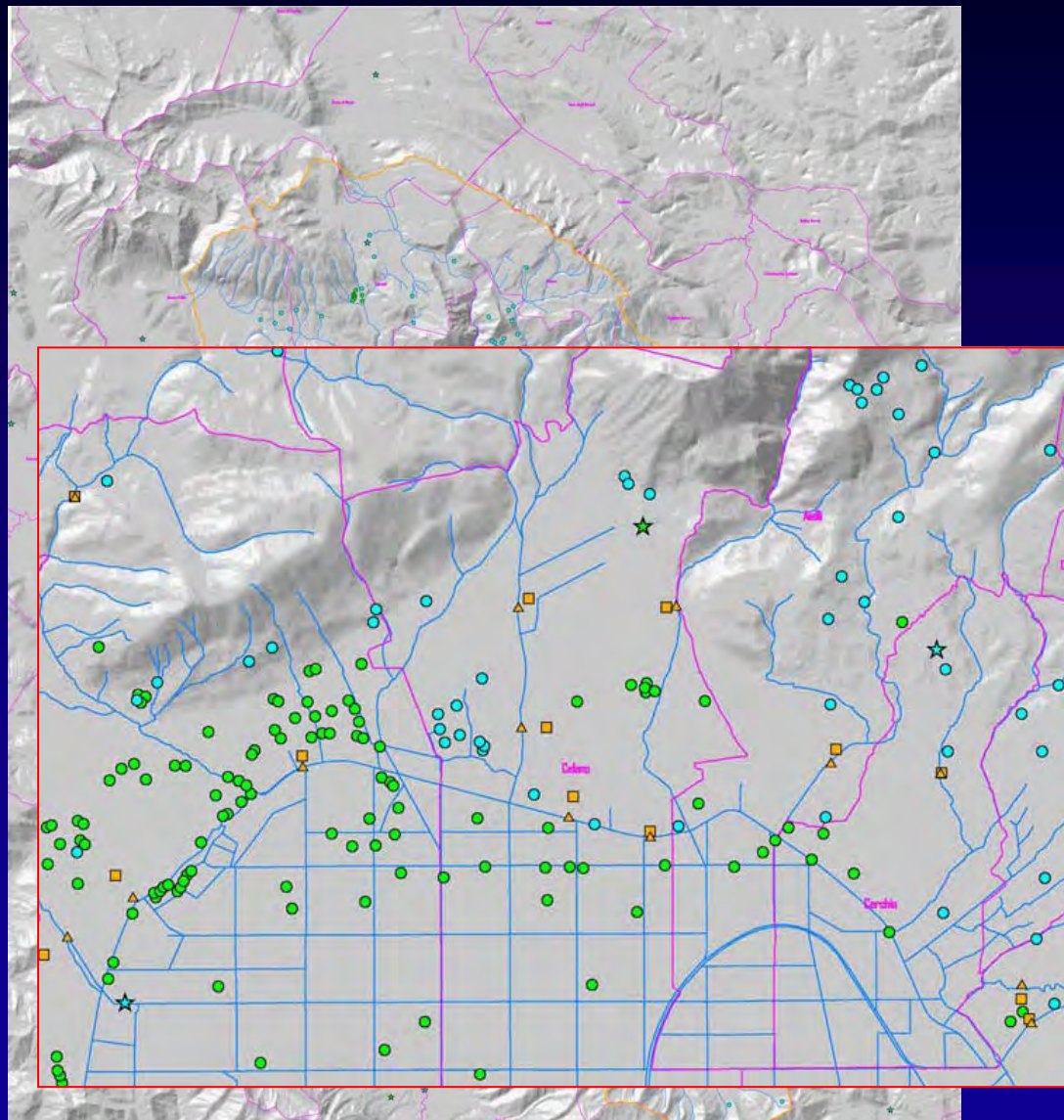


## LEGENDA

- Stazioni di monitoraggio integrative per i corpi idrici sotterranei (ST) del Bacino Volturno - territorio Campano
- Stazioni di monitoraggio integrative per i corpi idrici superficiali (SP) del Bacino Volturno - territorio Campano
- C12I\_ST Codice identificativo progressivo delle stazioni di monitoraggio integrative previste dall'Autorità di Bacino
- ▭ Limite Bacino Volturno
- ▭ Limite di sottobacino



# FUCINO PLAIN: DATA COLLECTION FOR GROUNDWATER AND SURFACE WATER PROTECTION PROGRAM



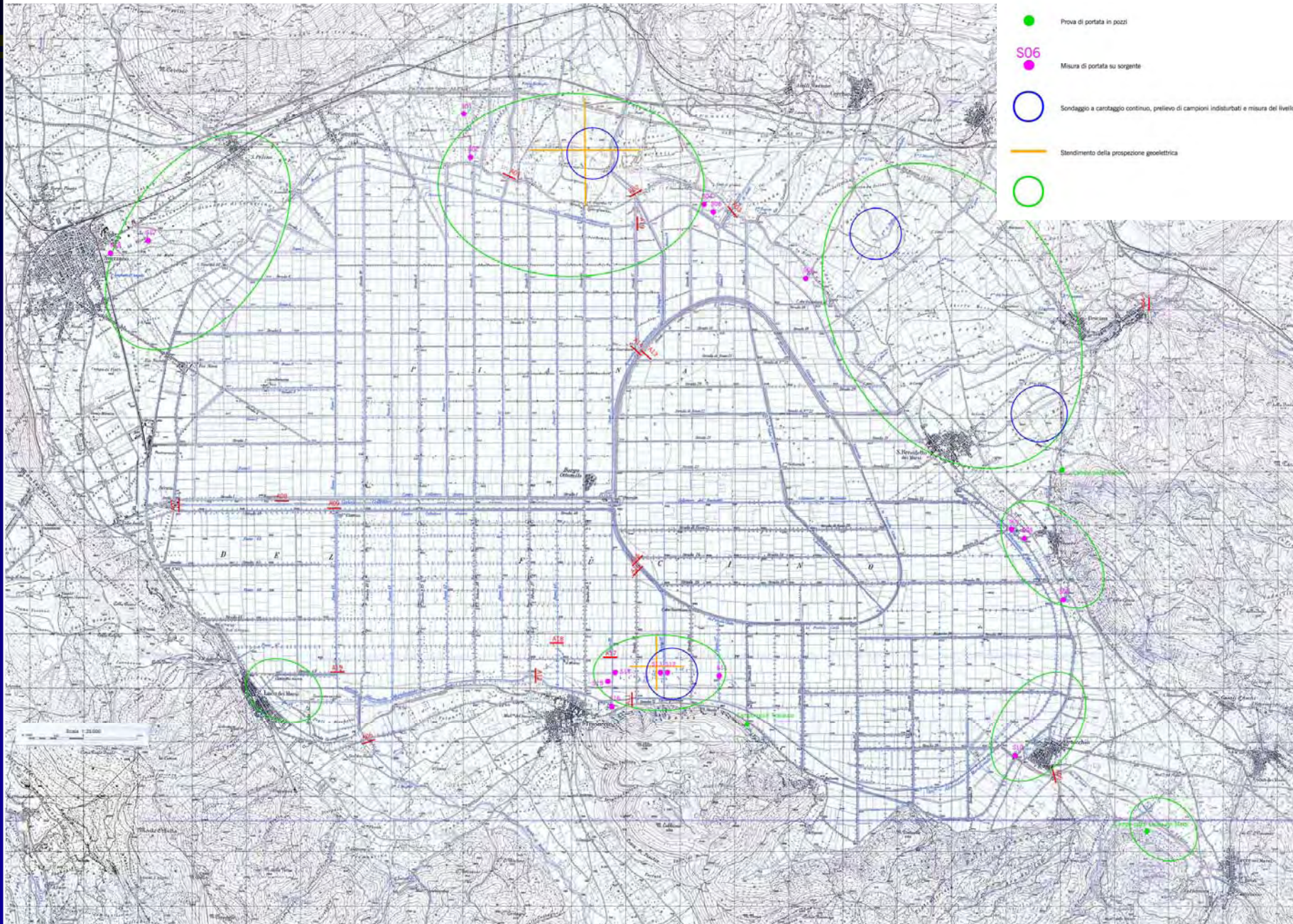
## LEGENDA

-  Scarichi
-  Depuratori
-  Restituzioni
-  Derivazioni
  
-  Sorgenti
-  Pozzi
  
-  Stazioni idrometriche
-  Stazioni pluviometriche e termometriche
-  Stazioni pluviometriche
  
-  Limiti del bacino idrografico del Fucino
-  Confini comunali
-  Idrografia

# FUCINO PLAIN: field investigations

## LEGENDA

- A04**  Misura di portata in alveo
-  Prova di portata in pozzi
- S06**  Misura di portata su sorgente
-  Sondaggio a carotaggio continuo, prelievo di campioni indisturbati e misura del livello piezometrico
-  Stendimento della proiezione geoelettrica
-  



# ACTIVITIES FOR WFD IMPLEMENTATION

Basin Authority is involved in implementation process of WFD, and its technical staff realised report document required in art. 5.

The report provides an analysis of Liri-Garigliano and Volturno basin characteristics, and undertakes an impact review of human activity on the status of waters in accordance with the requirements of art. 5.

Report contains:

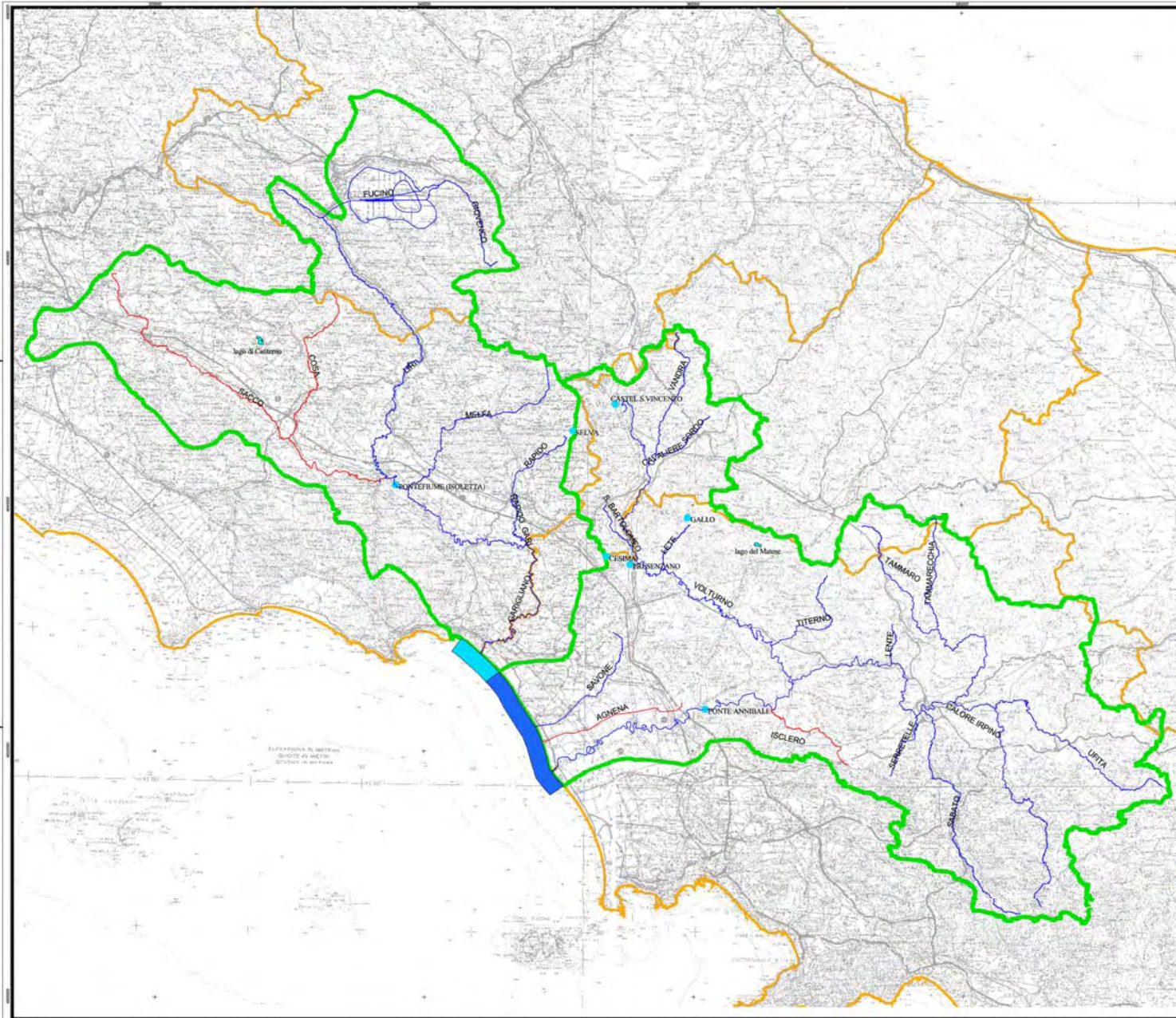
- a characterization of water bodies, including a preliminar individuation of heavily modified water bodies
- a review pressures and impacts and identify sites at risk of not meeting the environmental objective of ‘good status’
- a register of Protected Areas

All informations used to realise report derive from Water Resources Government Plan elaborated by Basin Authority.

# SURFACE WATER BODIES AT RISK MAP



Autorità di Bacino  
Fiumi Liri-Garigliano e Volturno



## LEGENDA

- Laghi
- Invasi
- Acque marino-costiere bacino Liri-Garigliano
- Acque marino-costiere bacino Volturno
- Corpo idrico a rischio
- Corpo idrico non a rischio
- Limiti Amministrativi**
- Limite regionale
- Limite del Bacino dei Fiumi Liri-Garigliano e Volturno (D.P.R. 01/06/98 pubblicato sulla G.U. del 22/10/98 n.247)

# PROTECTED AREAS

