

Transfer of European Approach of Groundwater Monitoring to China

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Contents of presentation

- EU WFD groundwater monitoring
- China groundwater information centre
- Methodology
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- Beijing Plain case
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EU Water Framework Directive Objectives

- Achievement of good status of water resources
- Promotion of sustainable use of water resources
- Improvement of aquatic environment
- Reduction of groundwater pollution
- Mitigation of the effects of floods and droughts

EU WFD Time Framework

Action	Time	References
River Basin Districts	2003	Article 3 and 24
Characterisation (pressure, impacts, water use, protection areas)	2004	Article 5 and 6, Annex II and III)
Monitoring network operational	2006	Article 8, Annex V
Programme of measures River Basin Management Plan	2009	Article 11 and 13, Annex III
Implementation of water price policies	2010	Article 9
Programme of measures operational	2012	Article 11
Environmental objectives	2015	Article 4

EU WFD Groundwater Objectives

- Prevent deterioration in the status of all groundwater bodies
- Prevent or limit the input of pollutants into groundwater
- Protect, enhance and restore all bodies of groundwater
- Reverse significant and sustained upward trend in pollutant concentration
- Achieve the objectives for Protected Areas

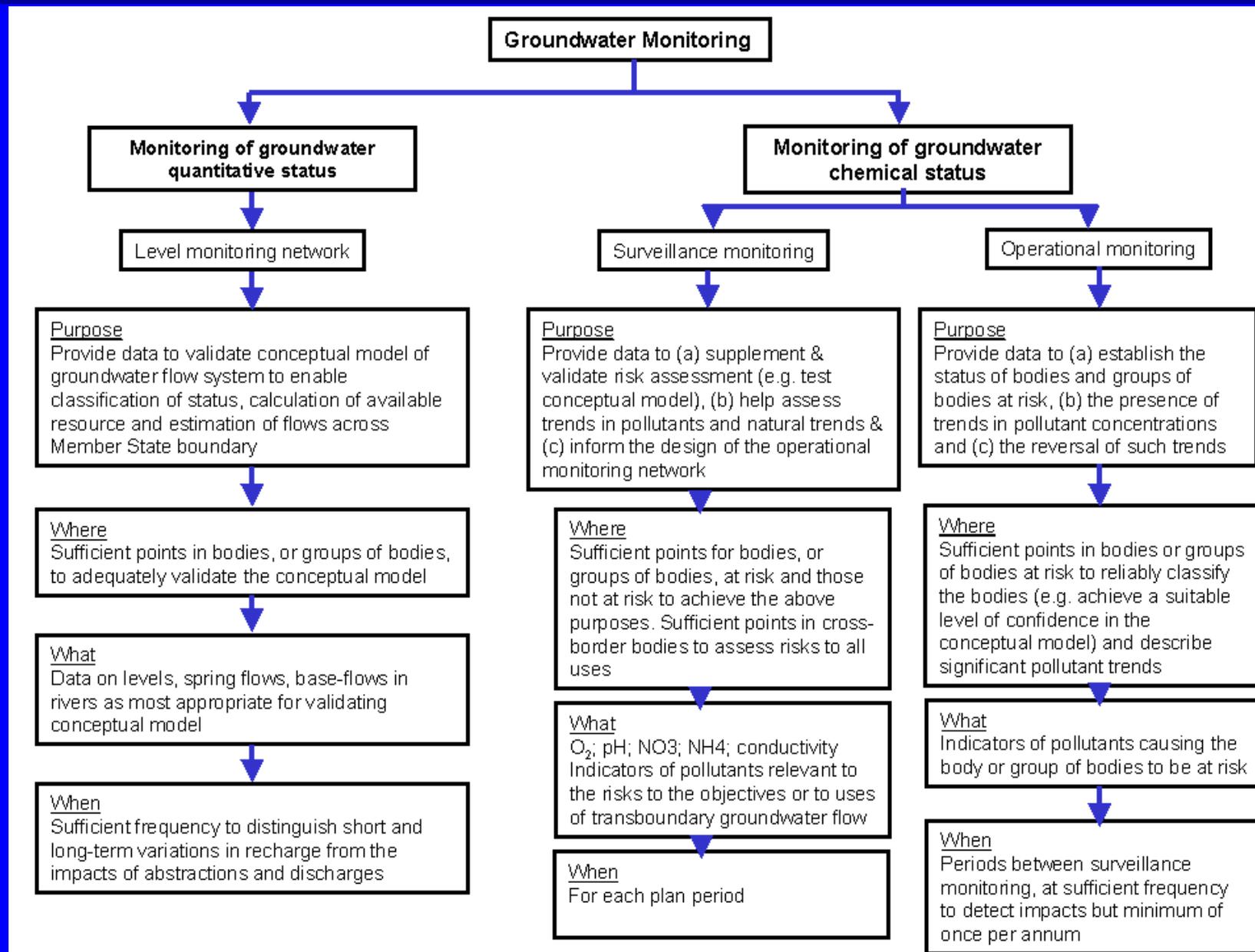
EU WFD Groundwater Monitoring Objectives

- Reliable assessment of quantitative status
- Estimation of the direction and rate of cross boundary groundwater flow
- Validation of impact assessment procedure
- Assessment of long-term trends
- Reliable assessment of qualitative status
- Detection of significant and sustained upward trends in pollutant concentrations
- Assessment of the reversal of such trends

Schedule of EU Groundwater Monitoring

WFD requirements	Monitoring activities	Time	Period
Characterisation of water bodies		2 yrs	2002 – 2004
Define information need	Define monitoring strategy	0.5 yrs	2004 – 2005
Design and installation	Network design, install new wells, modify old wells	2 yrs	2005 – 2006
Performing monitoring	Monitoring and data collection	1 yr	2006 – 2007
Assess groundwater status	Interpretation and presentation of monitoring results	0.5 yr	2008
Draft RBMPs	Monitoring plan	2 yrs	2005 – 2009
Implement measures	Monitoring effects	3 yrs	2009 – 2012
First monitoring cycle	Monitoring effects	7 yrs	2008 – 2015

Classification of Groundwater Monitoring



Groundwater Quantitative Status

- Good groundwater quantitative status:
 - Available groundwater resources $>$ long-term annual average abstraction
 - No negative impacts on surface water and terrestrial ecosystems
 - No saltwater intrusion
- Information from monitoring (water level, flow) should be able to assess quantitative status together with estimate of recharge and conceptual model
- No specific method is proposed how to determine number of monitoring wells and frequency

Chemical Status and Pollutant Trend

- Concentrations of pollutants:
 - do not exhibit effects of intrusions
 - do not exceed quality standards
 - will not result in failure to achieve environmental objectives
- Groundwater quality monitoring should
 - provide information in classifying the chemical status of groundwater bodies
 - detection of any significant upward trend in pollutant concentrations
- Two types of monitoring distinguished
 - *surveillance monitoring*
 - *operational monitoring*

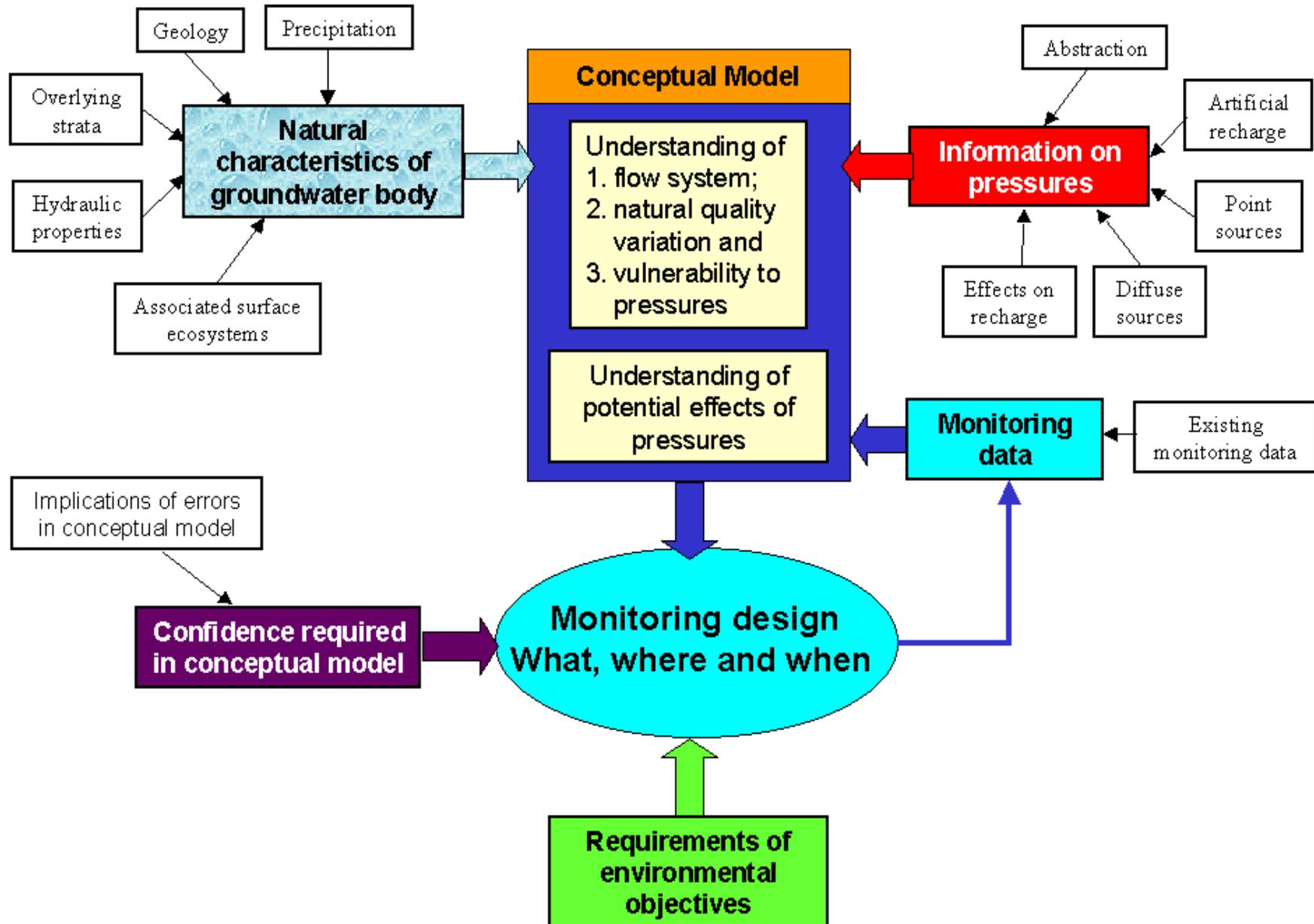
Objectives of Surveillance Monitoring

- Supplement and validate the assessments of risks of failing to achieve:
 - good groundwater status;
 - Protected Area objectives;
 - the trend reversal objective
- Contribute to the assessment of significant long-term trends (natural and artificial)
- No specific method is proposed how to determine number of samples and sampling frequency

Objectives of Operational Monitoring

- Only in groundwater bodies (or groups) identified as being “at risk” following risk assessment and surveillance monitoring
- To classify bodies at risk as poor or good status with appropriate level of confidence
- To establish the presence of significant upward trends in pollutant concentrations
- No specific method is proposed how to determine number of samples and sampling frequency

Conceptual Framework Monitoring Network Design



Guiding Documents

- European Union Water Framework Directive: Common Implementation Strategy, 2001, Statistical aspects of the identification of groundwater pollution trends, and aggregation of monitoring results.
- European Union Water Framework Directive: Common Implementation Strategy, 2003, Guidance on Monitoring for the Water Framework Directive, Final Version, Working Group 2.7.
- European Union Water Framework Directive: Common Implementation Strategy, 2004, Technical report on groundwater monitoring.
- <http://forum.europa.eu.int/Public/irc/env/wfd/library>

China Groundwater Information Centre

- Project period: 2003 - 2008
- DGIS Oret/Miliev Programme (35%)
- Ministry of Land and Resources (65%)
- China Institute for Geo-Environmental Monitoring (CIGEM)
- Geo-Environmental Monitoring Stations of Beijing, Shandong and Xinjiang, China
- TNO-NITG, UNESCO-IHE, Van Essen Instruments, The Netherlands

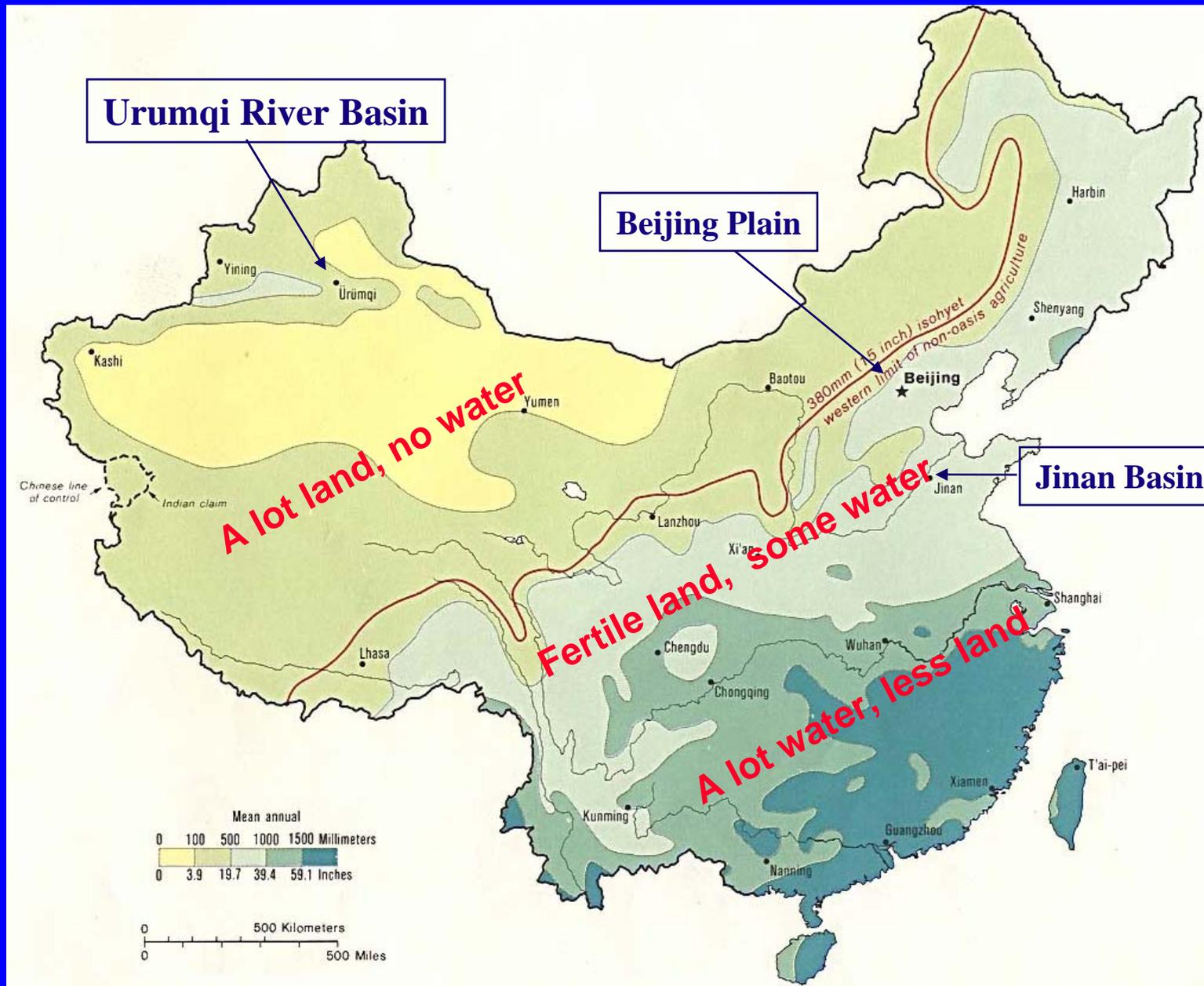
China Groundwater Information Centre

- To establish and strengthen the capacity of the China Groundwater Information Centre
- To increase the efficiency and effectiveness of groundwater monitoring, data processing and analysis, information dissemination
- To train a large number of specialists for groundwater information management
- To raise awareness of public and decision-makers for groundwater resources protection

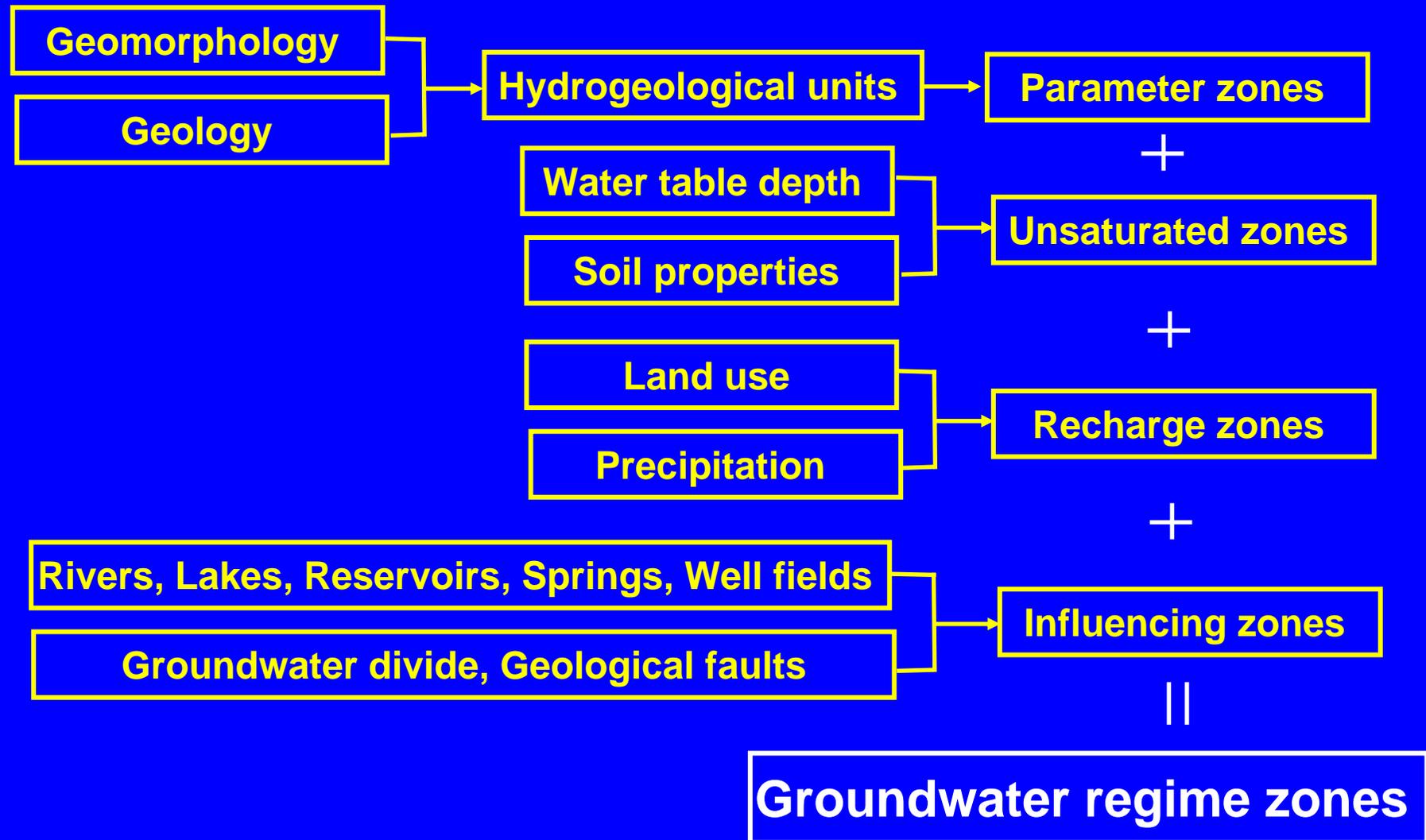
China Groundwater Information Centre

- To optimise groundwater monitoring networks with automatic recorders
- To develop a China Groundwater Information System based on ArcGIS
- To develop regional groundwater models for supporting decision-making in groundwater resources management
- To implement 3 pilot studies: Urumqi River Basin, Beijing Plain, and Jinan Karstic Spring Catchment

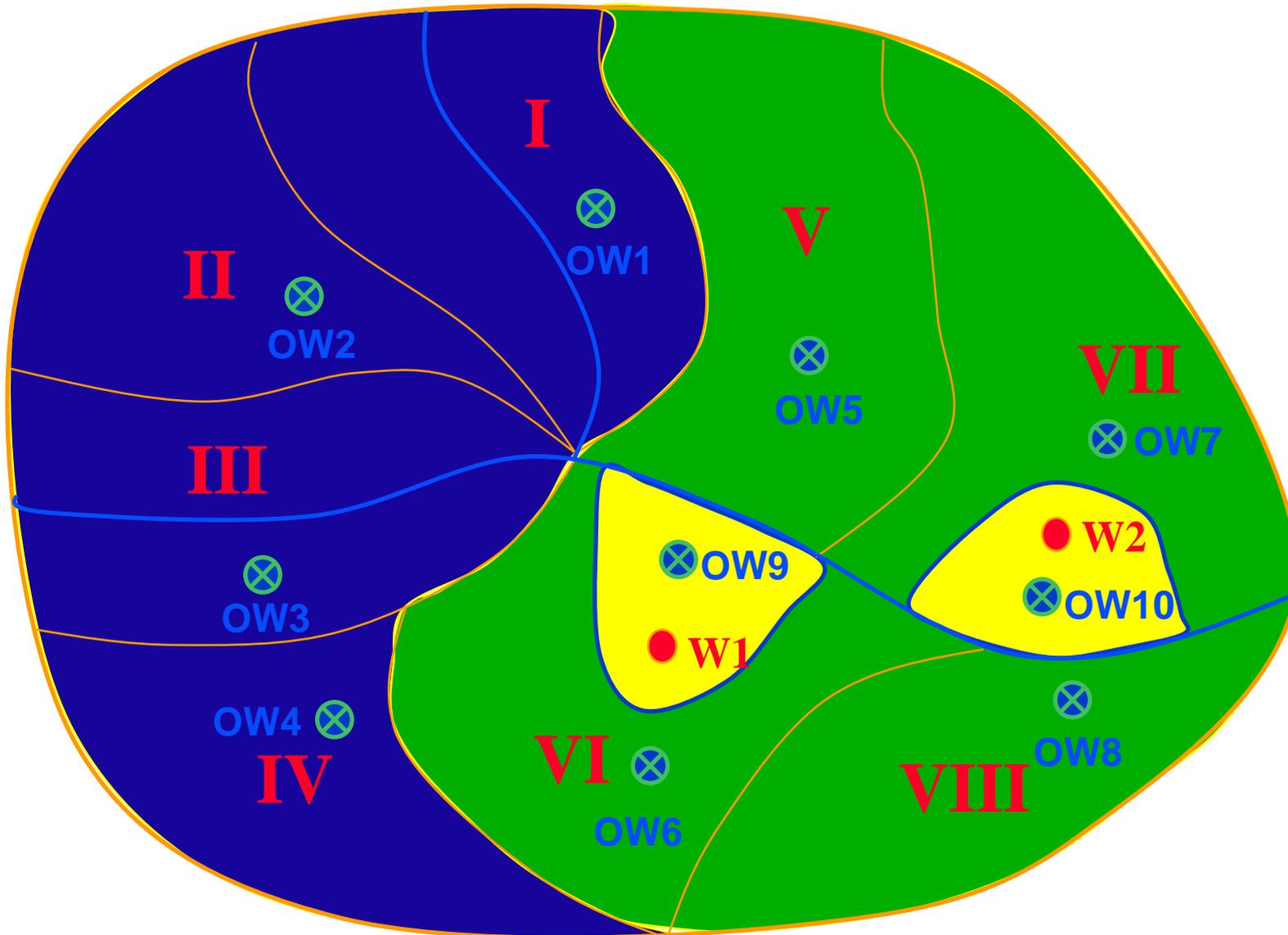
China Groundwater Information Centre



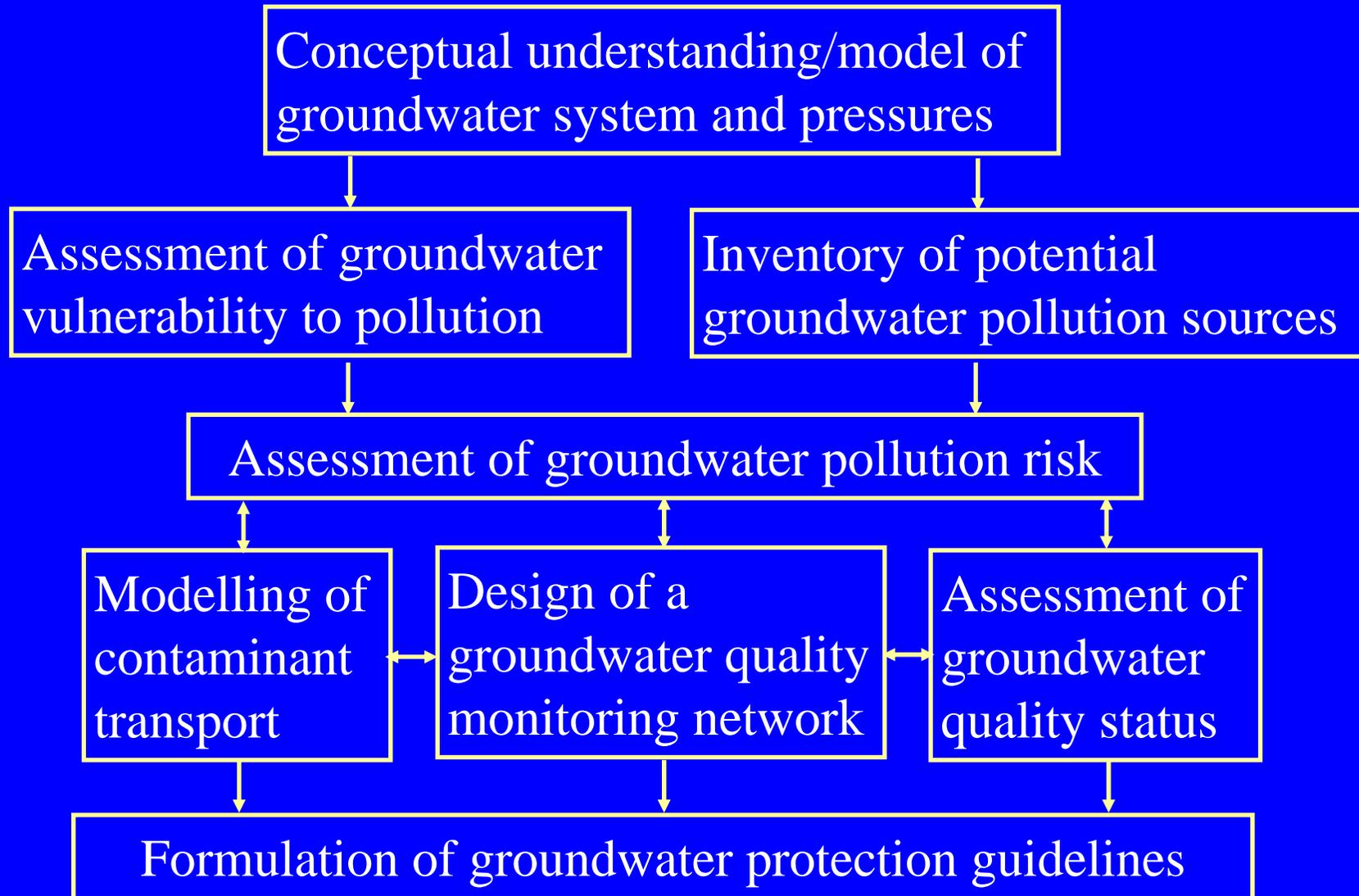
Groundwater Level Monitoring



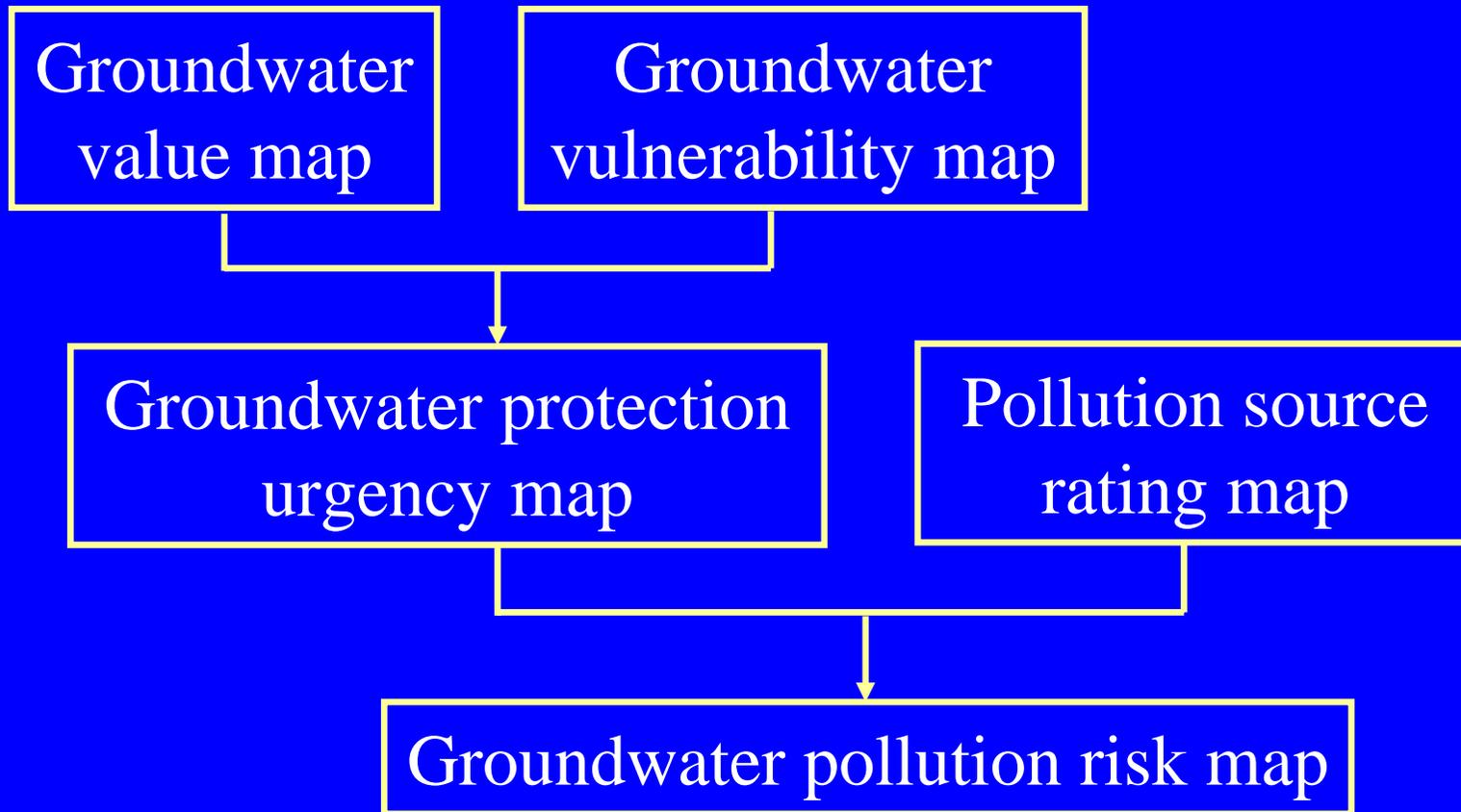
Groundwater Regime Zone Map



Groundwater Quality Monitoring



Groundwater Pollution Risk Map



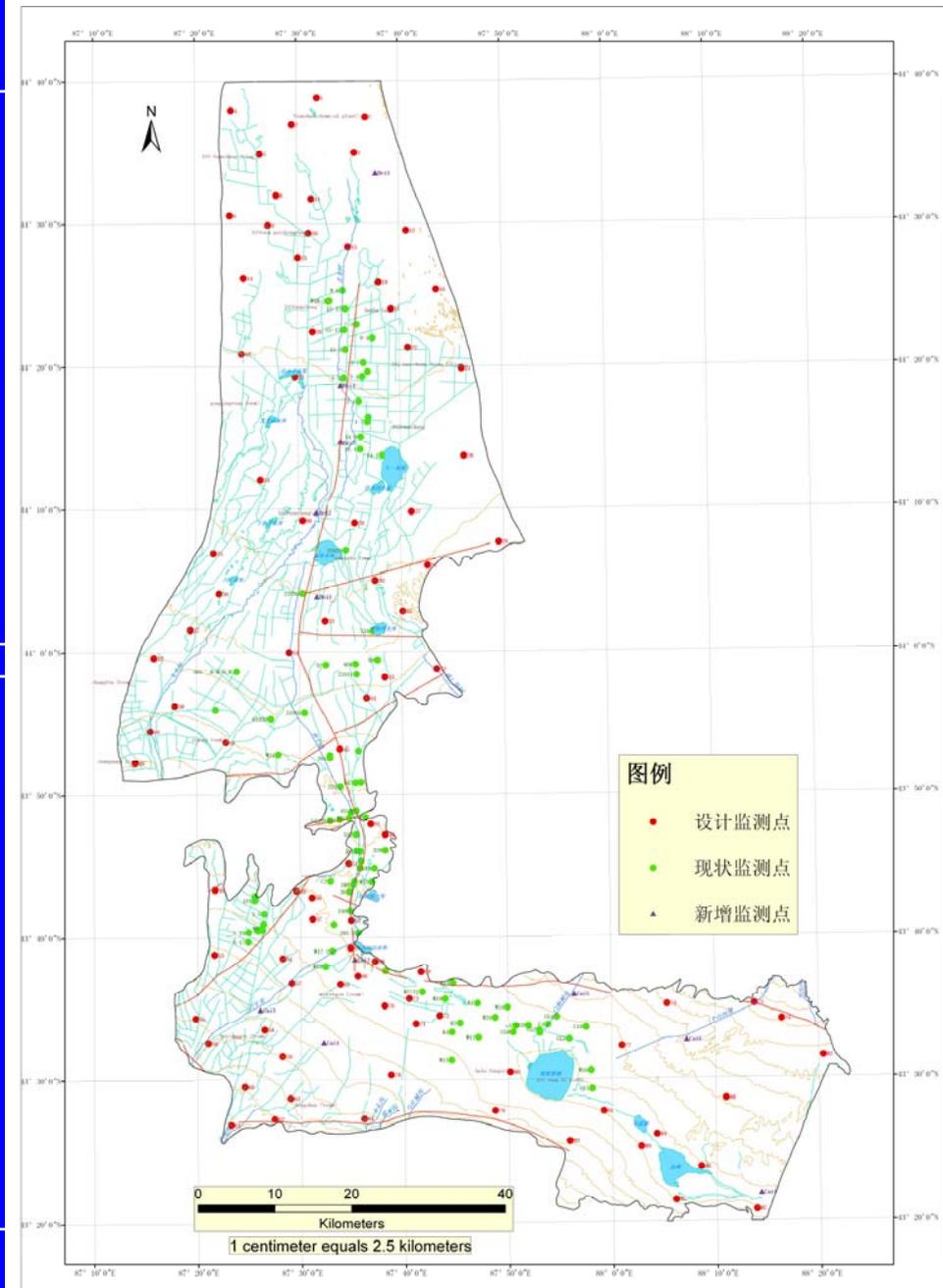
Urumqi River Basin

Regional Groundwater Level Monitoring Network

- 91 new observation wells
- Chaiwopu Basin 42
- River Valley 4
- River Plain 45

- Surface-groundwater interaction
- Spring discharges
- Shallow water table
- Groundwater irrigation
- Groundwater depletion

中荷合作项目-乌鲁木齐示范区
乌鲁木齐河流域布设的地下水动态监测点分布图



Maintenance of Existing Wells

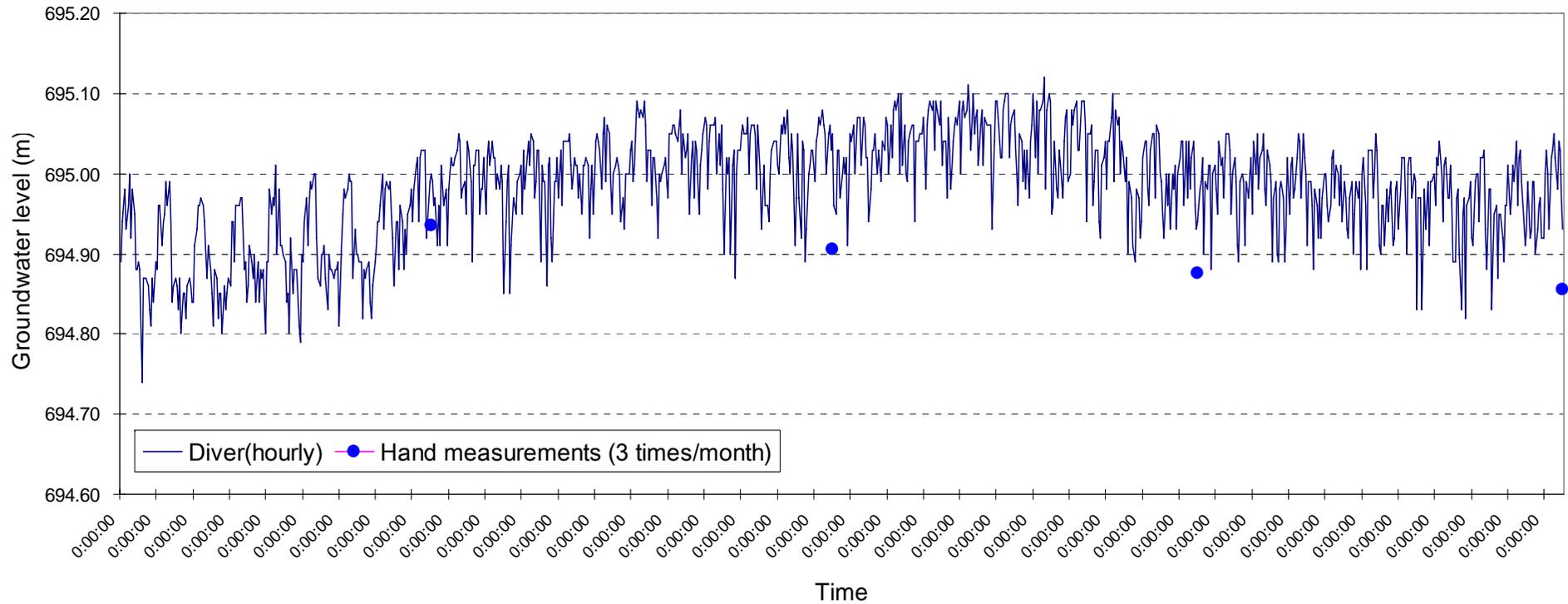


Protection of Monitoring Wells



Installation of Data Loggers

Principle of the Diver measurements

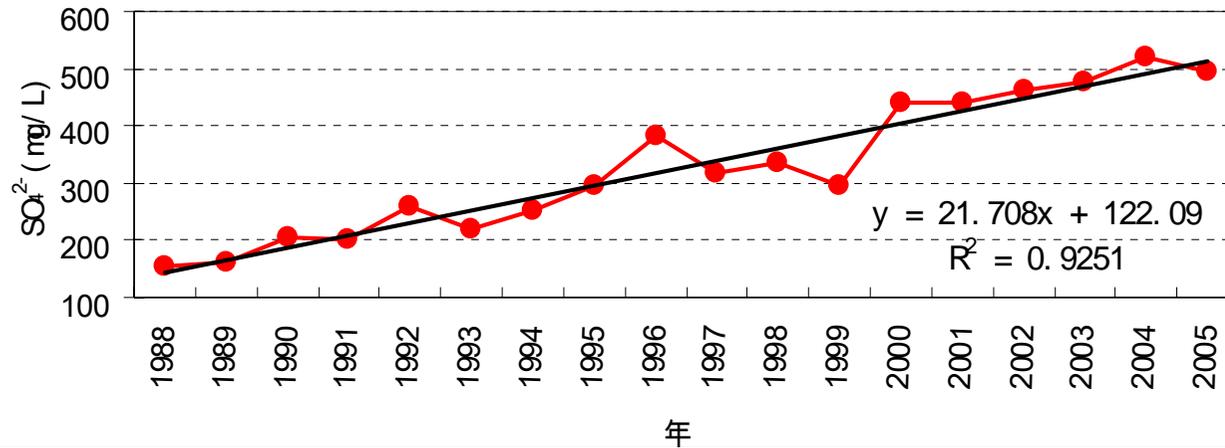


Installation of Divers

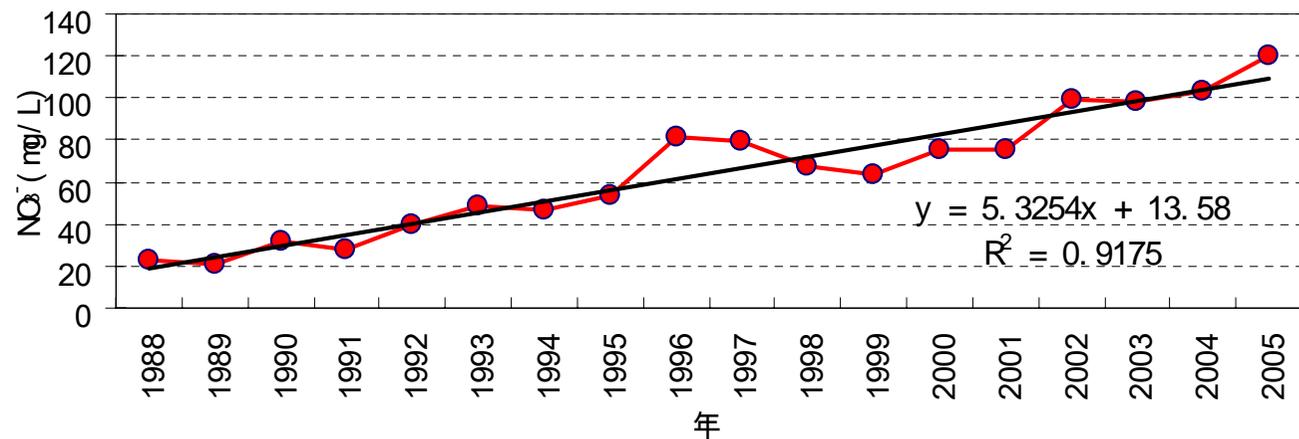


Groundwater Pollution Trends

北部平原米泉404号点 SO_4^{2-} 含量历时曲线



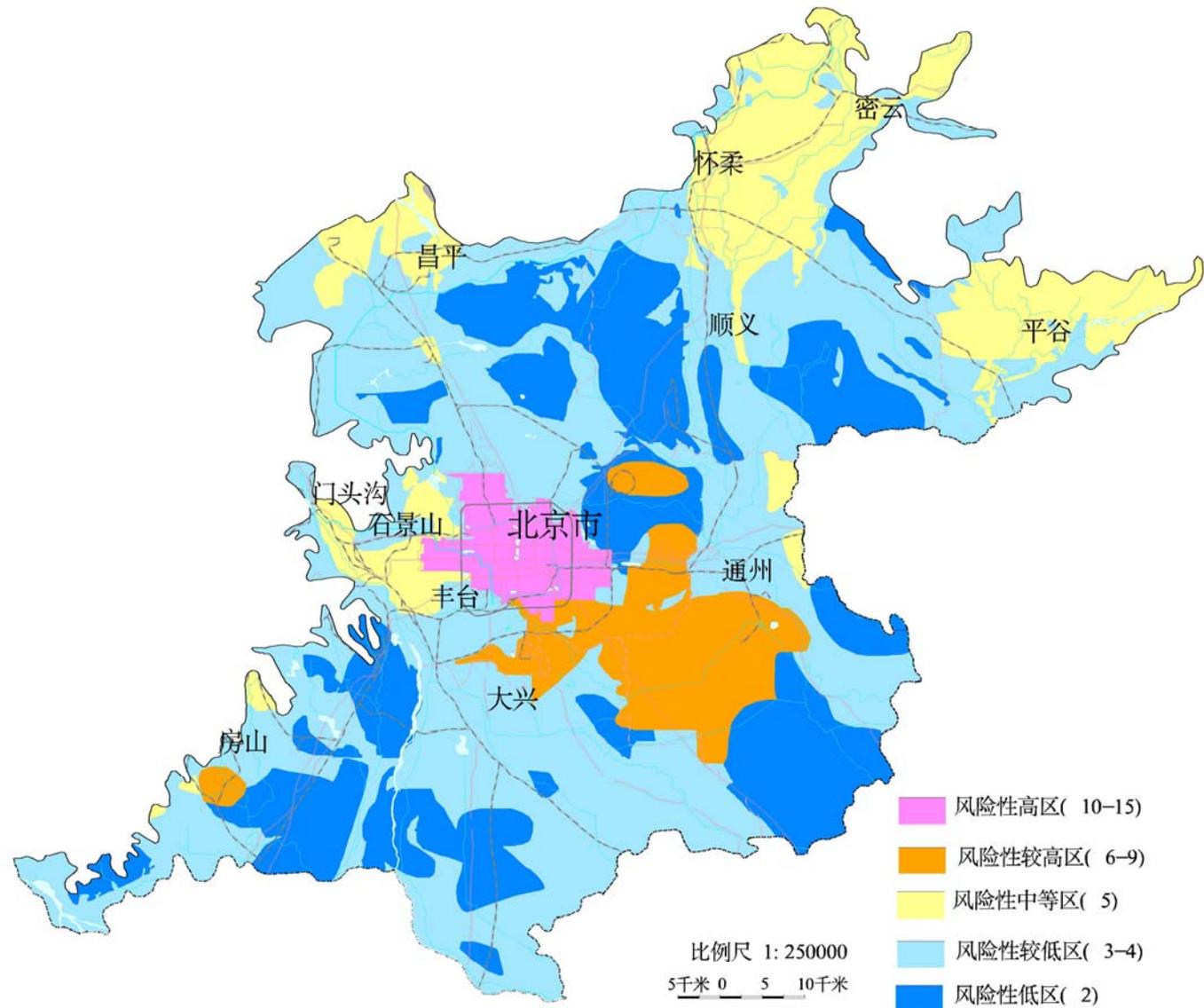
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Groundwater Pollution Risk Beijing Plain

High pollution risk areas:

- urban area;
- wastewater irrigation area;
- top of alluvial fans

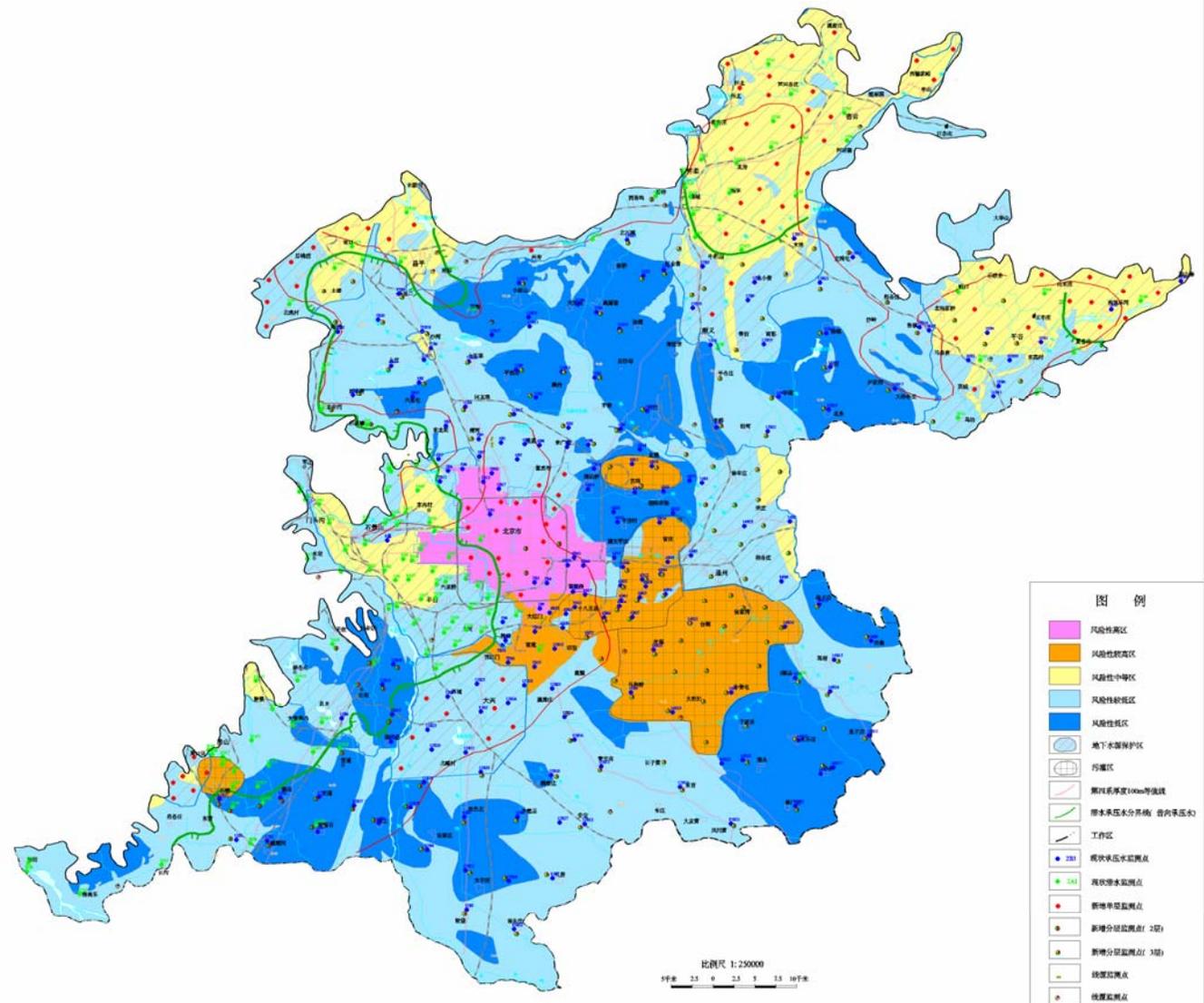


Groundwater Quality Monitoring Beijing Plain

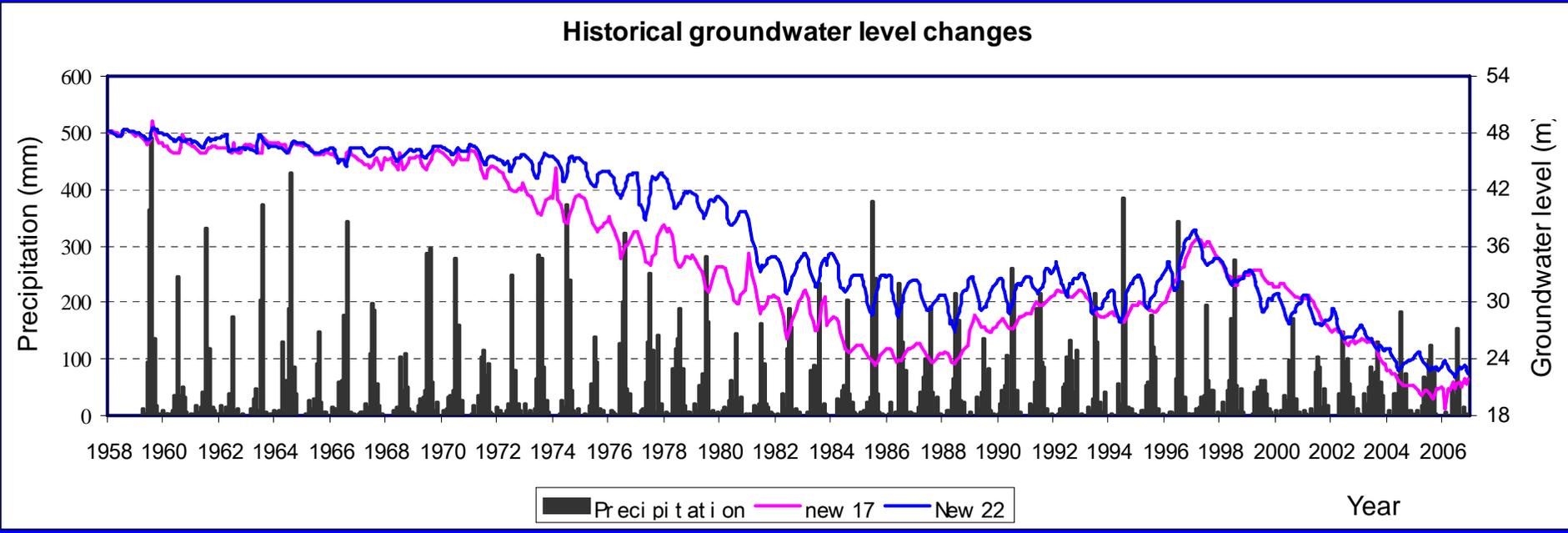
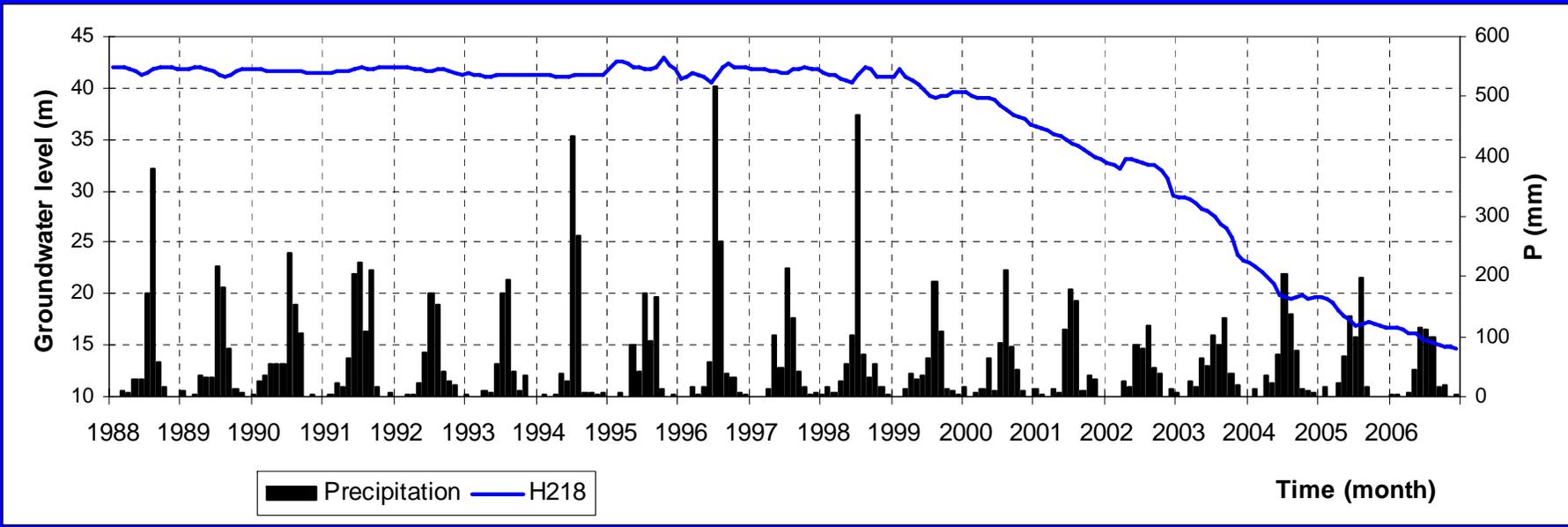
Groundwater quality monitoring

- High pollution risk areas
- Water supply well fields
- Background monitoring
- 538 monitoring sites
- 136 multiple aquifer wells

附图 4 北京市平原区地下水水质监测网设计图

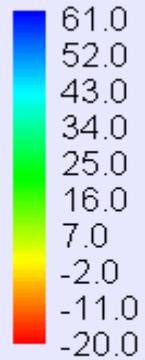


Groundwater level changes in Beijing Plain



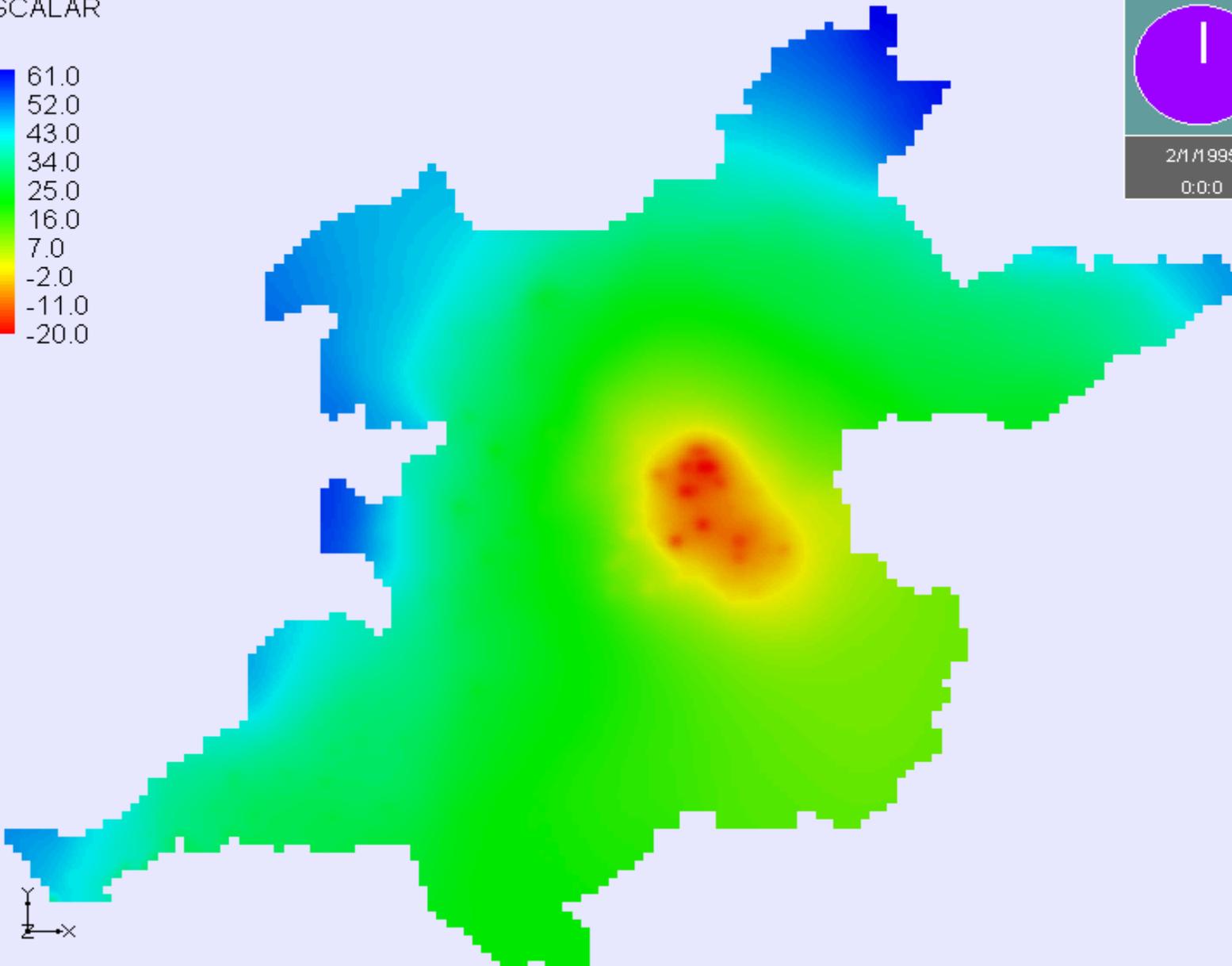
Cone of depression in Beijing Plain

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Concluding Remarks

- Characteristics of European approach on groundwater monitoring:
 - River basin context;
 - Integration of quantity and quality;
 - Cyclic long-term monitoring and assessment;
 - Assessment of status, detection of trend and identification of impacts of pressures.
- Groundwater monitoring in China concentrated mainly on well fields and urban areas – “local problem monitoring”, not yet as “regional process monitoring”. However, impact on groundwater occurs at river basin scale.

Concluding Remarks

- Groundwater regime zone and groundwater pollution risk mapping provides effective tools to design regional groundwater level and quality monitoring networks. They are also helpful for interpreting monitoring results.
- The challenge for implementing national groundwater monitoring in China is to establish a national coordinating body to coordinate monitoring activities by different ministries and provincial departments. A national standard approach should be developed, all monitored data should be stored in a national database and shared by all ministries and departments.

Acknowledgements

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