Ministry of Agriculture, Livestock and Irrigation
Irrigation and Water Utilization Management Department

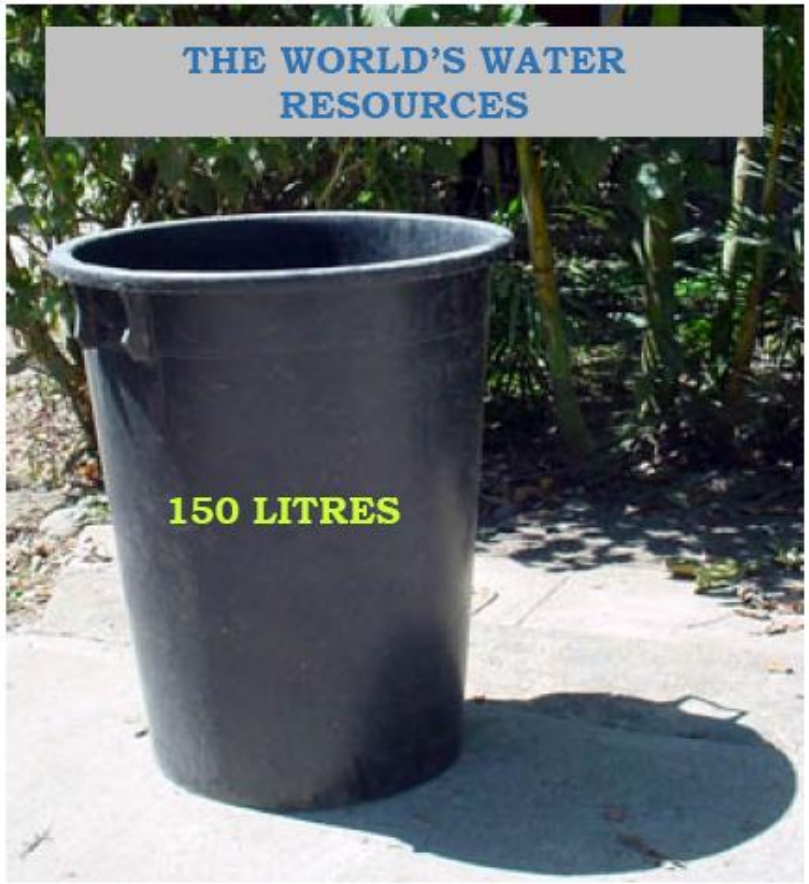
Pilot Project of Groundwater Monitoring in Myanmar

Thant Zin
Assistant Hydrogeologist
Groundwater Division

March, 2017

Nay Pyi Taw

The importance of groundwater



Imagine:

All the water on the planet =

150 litre container

BUT JUST 4 LITRES ARE FRESH !!

The remaining 146 litres are SEAWATER

Source: Prof Ken Howard, Osaka Cut, 2003

The importance of groundwater

Out of these 4 litres:

3 litres are frozen (earth's ice caps, permafrost regions)

... leaving one lonely litre of freshwater

... and 99% the lonely litre of freshwater is GROUNDWATER !!

It is essential that we protect and manage groundwater resources effectively!

Source: Prof Ken Howard, Osaka Cut, 2003

The importance of groundwater

UNESCO estimated people living in water stressed situation:

- **0.5 billion in 2000**
- **2.8 billion in 2025**
- **4.0 billion in 2050**

Community well in Gujarat, India (2003): water table declining 3 m/yr

Groundwater will help meet the growing demand for water supplies under growing global population and the uncertain effects of climate variability and change.

Land Subsidence in Iran due to Groundwater overexploitation

جمهوری اسلامی ایران
وزارت نیرو

As a result of groundwater level fall, subsidence phenomenon has happened in many plains and sinkholes have been established in these plains.

Land Subsidence in Iran due to Groundwater overexploitation

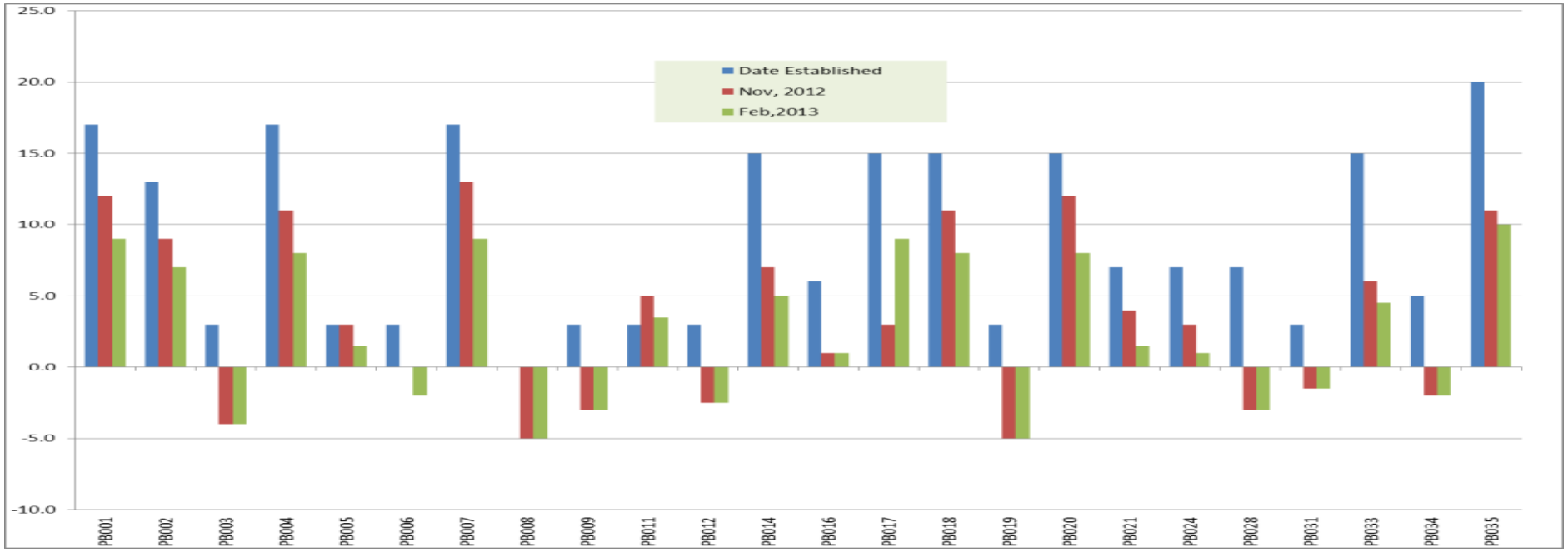
Land Subsidence in USA due to Groundwater overexploitation

large increases in land under irrigation has led to

- **groundwater depletion in regions with primarily groundwater-fed irrigation**
- **groundwater accumulation as a result of recharge from return flows from surface-water fed irrigation**
- **Land subsidence**

This iconic photo from the 1970s documents land subsidence from groundwater withdrawal in California's San Joaquin Valley. The markers indicate the approximate altitude of land in 1925 and 1955. Photo: USGS

Water Level and Yield changes in Pyawbwe-Phayangazu GW Irrigation Area



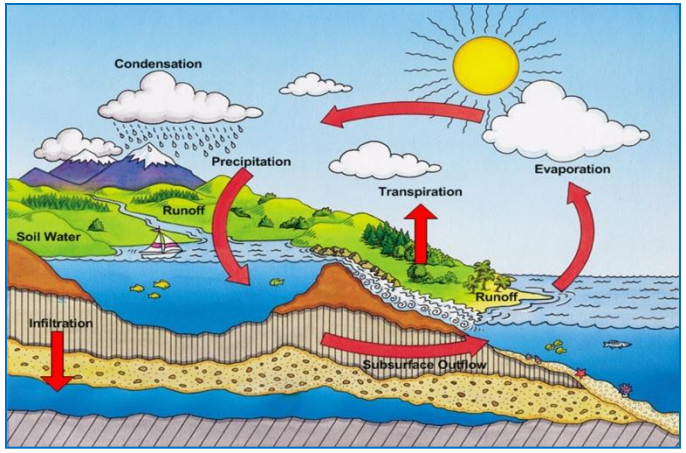
- Initially, 75 over flowing wells out of 100 tube-wells drilled in 2011.
- Only 23 wells are overflowing in 2014.
- Yield is also decreasing.

  - Initial Yield of flowing wells ranges from 1500 to 7500 gph and pumping wells ranges from 2500 to 10000 gph.

  - In 2014, Yield of flowing wells observed that 500 gph to 3000 gph and pumping wells ranges from 2500 gph to 7500 gph.

INTRODUCTION

- GW is limited resource
- Estimation of GW Balance is essential for sustainable development of resource
- Weak in systematic groundwater management practice
- GW Extraction works are rapidly increasing in accord with recent nation need



Objectives

- **Data Support**
- **Water level fluctuation**
- **WQ Changes**
- **Overexploitation of GW**
- **GW Monitoring Network**


Climate Change (Drought)
Population Growth
Weak in legal enforcement
MAJOR CONTROLLING FACTORS OF INCREASING GROUNDWATER EXTRACTION
Food sufficiency
Development of Industrialization
Extension of Agricultural Land


Africa


Thailand


Inle Lake


Inle Lake

PLAN OF WORKS RELATED TO GW MONITORING

Priority

- Heavy GW extracted areas
- Coastal areas

Facilities

- Drilling of monitoring wells
- Installation of monitoring devices
- Regular data collection and database

Location of stations

- Spatial extent of GW basin and aquifer distribution

Investigations

- Geological survey, GP survey , Aquifer testing in necessary areas
- Laboratory analysis for water samples in high risk areas

Capacity building

- In-country and oversea trainings for GW engineering subjects

SITE SELECTION

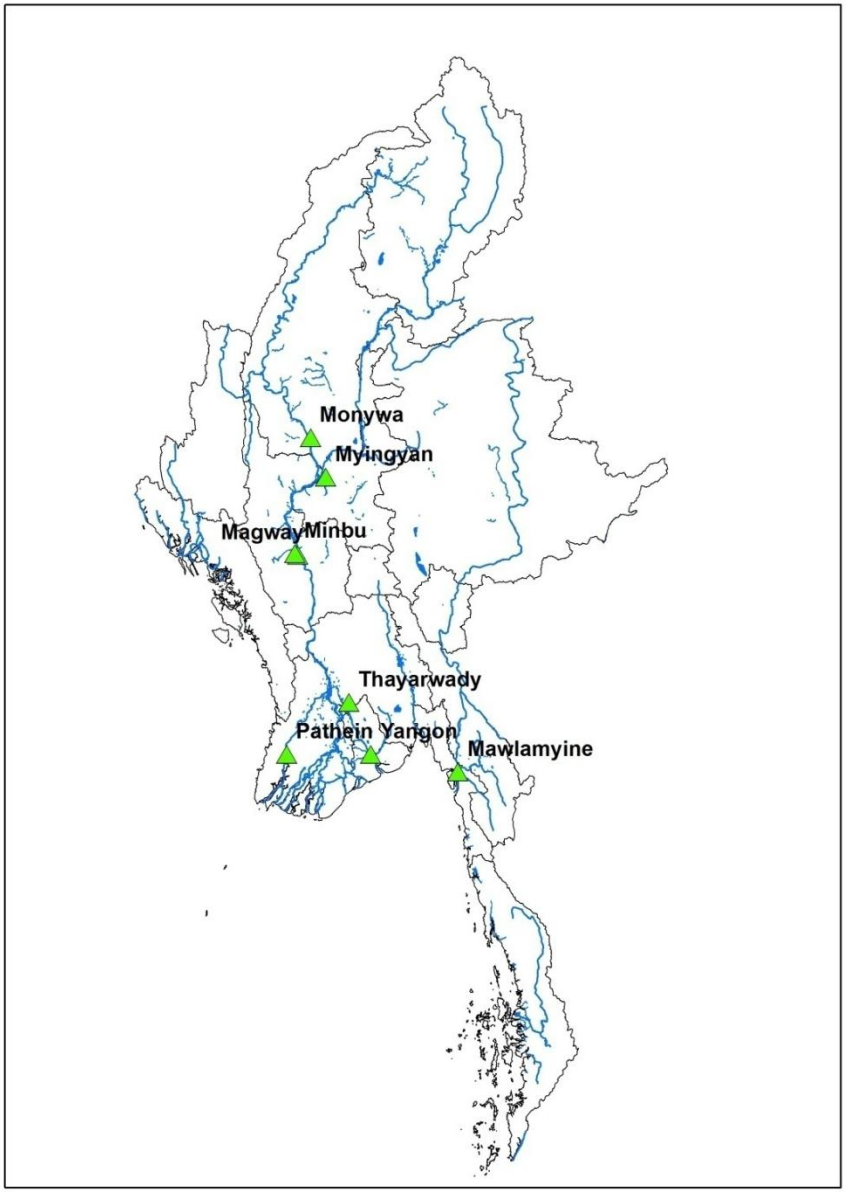
- Dimension of GW Basin
- Stratigraphy and spatial distribution of major aquifers
- Depth to aquifer of monitoring well
- Potential saline water intrusion areas

Pilot GW Monitoring Stations in Myanmar (in progress)

St. No	Region/State	District	Monitoring well location	Well Diameter x Depth (ft)	Geological Formation
1	Sagaing	Monywa	Groundwater Ring (3)	∅ 2'' x 100'	Irrawaddy formation
2	Mandalay	Myingyan	IWRUM District Office compound	∅ 4'' x 200'	Irrawaddy Formation
3	Mandalay	Kyaukse	IWRUM District Office compound	∅ 4'' x 200'	Alluvium
4	Magway	-	IWRUM Regional Office compound	∅ 4'' x 240'	Irrawaddy Formation
5	Magway	Minbu	IWRUM District Office compound	∅ 4'' x 200'	Irrawaddy Formation
6	Bago	Tharyarwaddy	IWRUM District Office compound	∅ 2'' x 148'	Alluvium
7	Yangon	-	IWRUM Regional Office compound	∅ 4'' x 480'	Irrawaddy Formation
8	Ayeyarwaddy	Pathein	IWRUM Regional Office compound	∅ 4'' x 200'	Alluvium
9	Mon	Mawlamyine	IWRUM District Office compound	∅ 4'' x 200'	Equivalent to Irrawaddy Formation

Now in progress

Pilot Implementing GW Monitoring Stations



Completed Protection Facility

Yangon

Myingyan

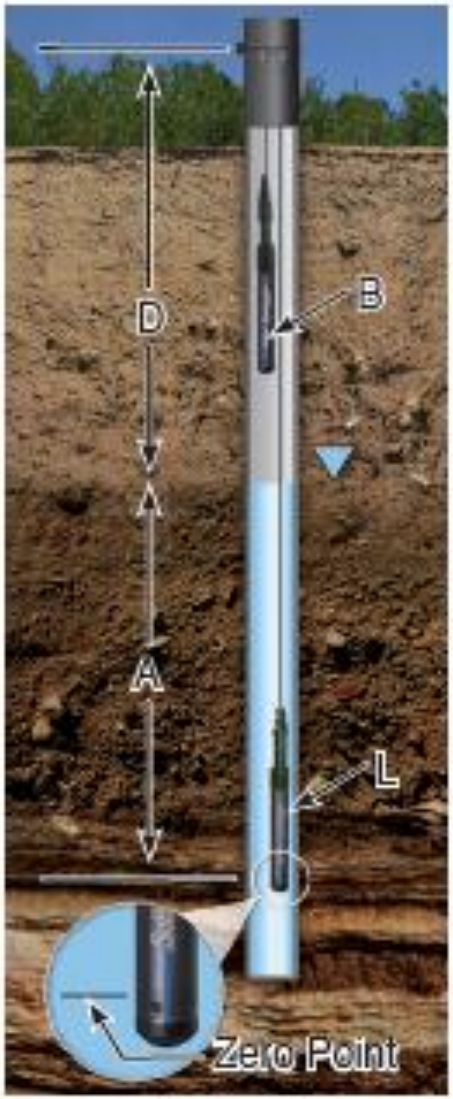
Kyaukse

Monywa

Solinst

LTC Levelogger Junior Technical Specifications	
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	30, 100 ft. (10, 30 m)
Accuracy	± 0.1% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1°C
Resolution:	0.1°C
Temp Compensation Range:	10°C to 40°C
Conductivity Sensor:	4-Electrode Platinum
Full Range:	0 to 80,000 µS/cm
Calibrated Range:	500 to 50,000 µS/cm
Accuracy:	± 2% of reading or 20 µS/cm
Resolution:	1 µS
Normalization:	Specific Conductance normalized to 25°C for full range
User Calibration Points:	1413, 5000, 12,880 µS
Battery Life:	5 years (based on 1 reading/ 5 minutes)
Clock Accuracy:	± 1 minute / year
Operating Temperature:	-20°C to 80°C
Memory:	Non-volatile EEPROM, FRAM back-up, Slate mode only
Maximum Readings:	16,000
Communication Speed:	9600 bps
Com Interface:	Optical Infrared: USB, RS-232, SDI-12
Size:	7/8" x 7.5" (22 mm x 190 mm)
Weight:	200 g (7.05 oz.)
Wetted Materials:	Hastelloy, Delrin®, Viton®, 316L Stainless Steel, Platinum
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	5 seconds to 99 hours
Altitude Input:	-980 to 16,400 ft. (-300 to 5,000 m)
Barometric Compensation:	High accuracy, air-only, Barologger

Downloaded Monitoring Data Form



$A = L - B$

Figure 1-1
Levelogger Measurement Fundamentals

linst Levelogger Software

atalogger Utilities Configuration Help

gger Settings | Data Control | Real Time View | Data Wizard | Conductivity Cal | Leveloader

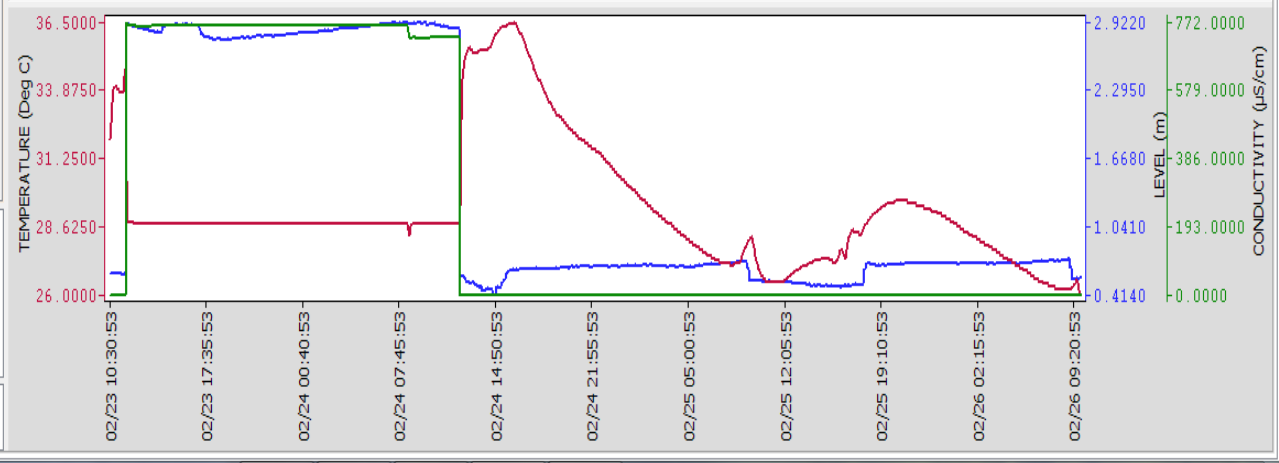
Com Por USB Serial Port (COM11) Solinst Levelogger Model 3001

786__2016_02_26 | 1071786__2016_02_26

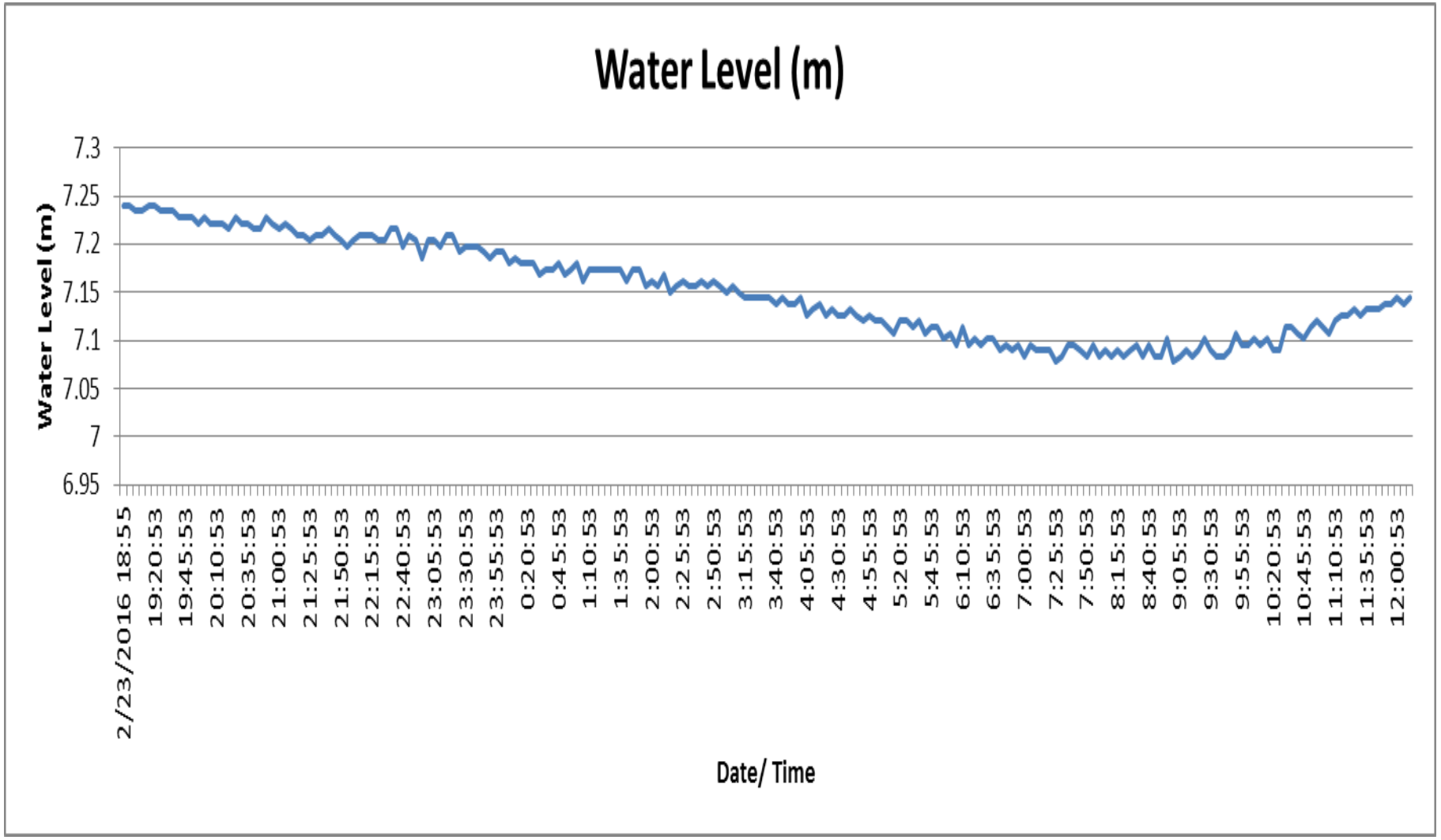
Combined Pl

ngitude
N/A
VEL
Unit
m
Offset
0 m
Altitude
0 m
Density
1.00 kg/L
EMPERATURE
Unit
Deg C
ONDUCTIVITY
Unit
µS/cm

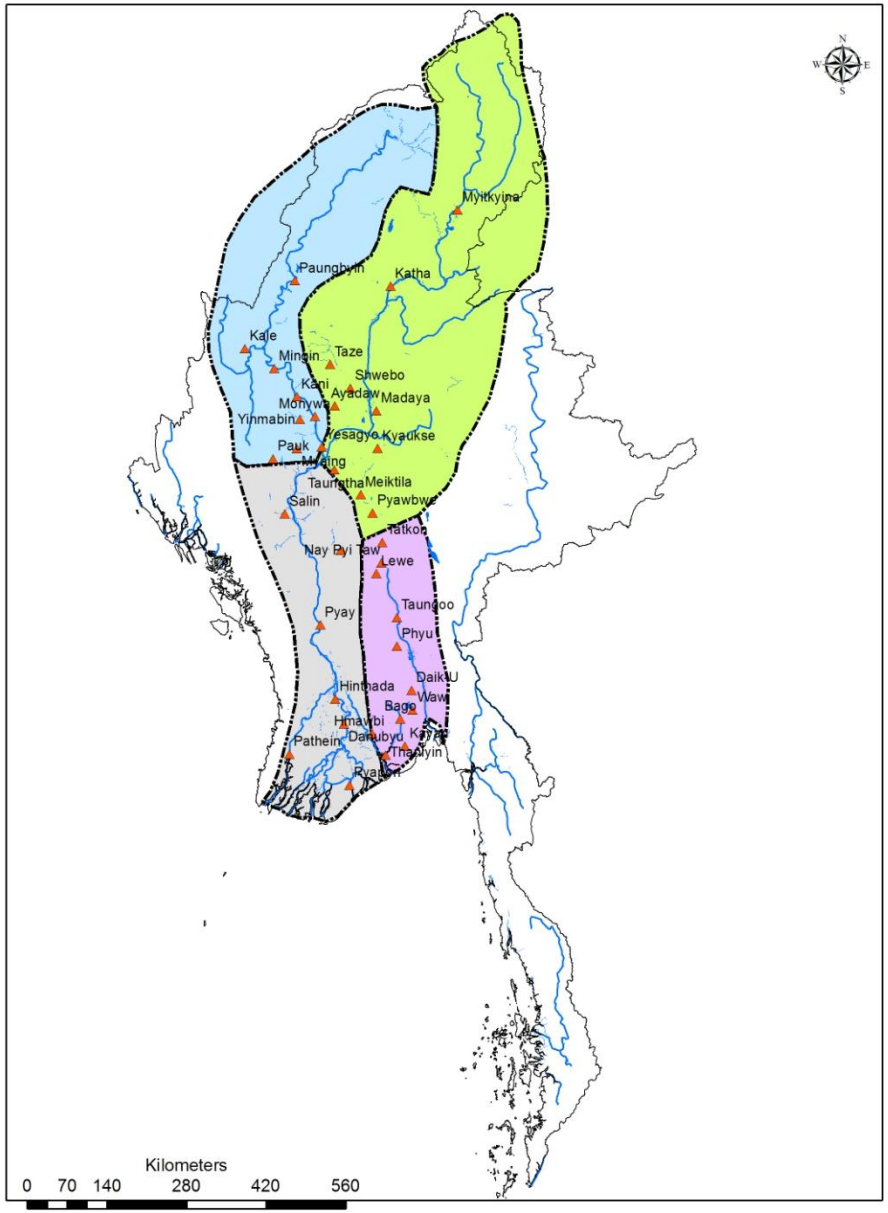
	Date	Time	LEVEL (m)	TEMPERATURE (Deg C)	CONDUCTIVITY (µS/cm)
15	2/23/2016	11:40:53.0 AM	0.600	34.70	0.0
16	2/23/2016	11:45:53.0 AM	2.922	30.40	772.0
17	2/23/2016	11:50:53.0 AM	2.892	28.90	765.0
18	2/23/2016	11:55:53.0 AM	2.910	28.80	763.0
19	2/23/2016	12:00:53.0 PM	2.892	28.80	762.0
20	2/23/2016	12:05:53.0 PM	2.892	28.80	761.0
21	2/23/2016	12:10:53.0 PM	2.886	28.80	761.0
22	2/23/2016	12:15:53.0 PM	2.880	28.80	760.0



Desktop 11:13 AM 2/26/2016

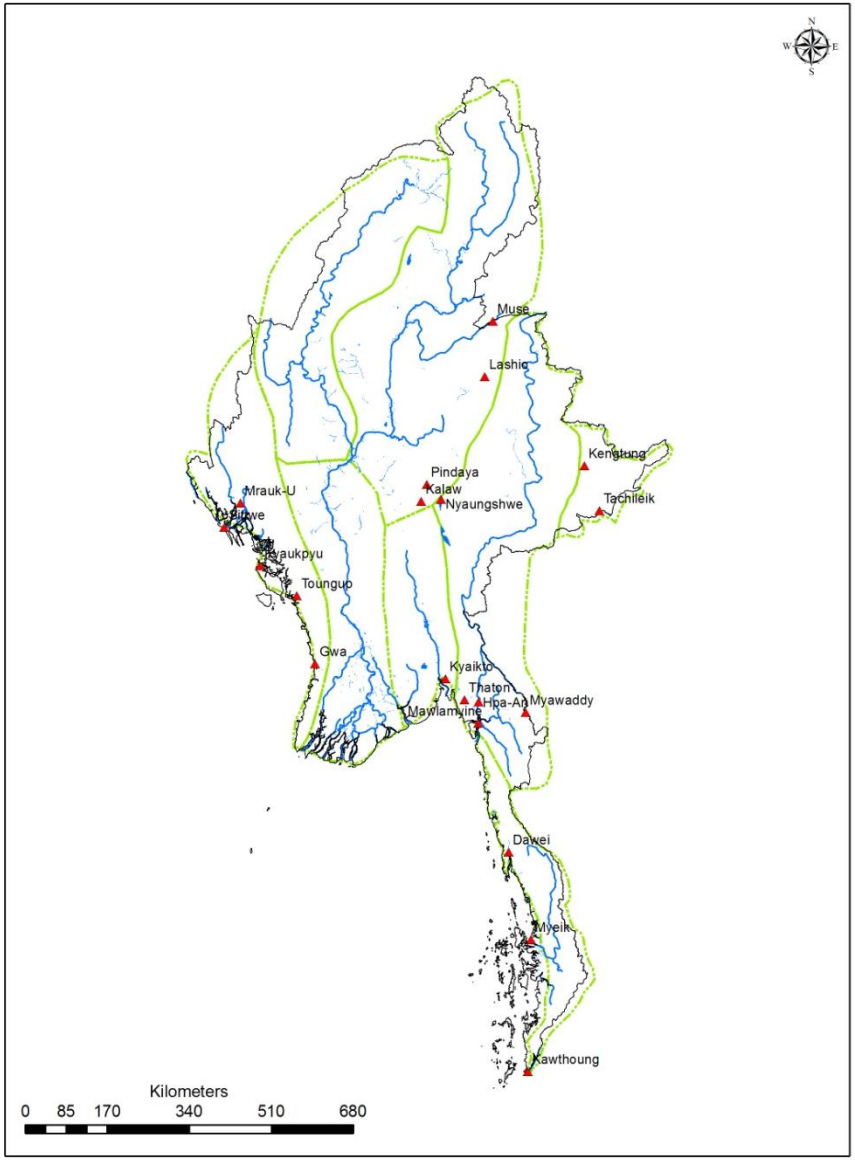

Water Level (m)
Water Level (m)
7.3
7.25
7.2
7.15
7.1
7.05
7
6.95
2/23/2016 18:55
19:20:53
19:45:53
20:10:53
20:35:53
21:00:53
21:25:53
21:50:53
22:15:53
22:40:53
23:05:53
23:30:53
23:55:53
0:20:53
0:45:53
1:10:53
1:35:53
2:00:53
2:25:53
2:50:53
3:15:53
3:40:53
4:05:53
4:30:53
4:55:53
5:20:53
5:45:53
6:10:53
6:35:53
7:00:53
7:25:53
7:50:53
8:15:53
8:40:53
9:05:53
9:30:53
9:55:53
10:20:53
10:45:53
11:10:53
11:35:53
12:00:53
Date/ Time

Planned Groundwater Monitoring Stations in Central Basin



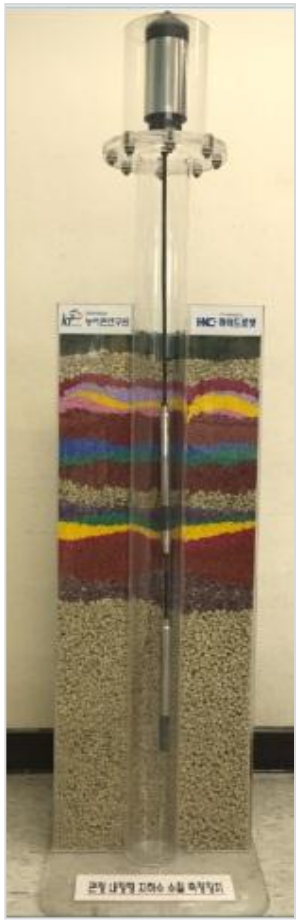
State/Region	Geological formation	No of station
Sagaing	Recent Alluvium, Irrawaddy formation	18
Magway	Recent Alluvium, Irrawaddy formation, Pegu group	9
Mandalay	Recent Alluvium, Irrawaddy formation	12
Bago	Recent Alluvium, Irrawaddy formation	9
Yangon	Recent Alluvium, Irrawaddy formation	5
Ayeyarwaddy	Recent Alluvium, Irrawaddy formation	5
Total		**58**

Planned Groundwater Monitoring Stations in Remote Area



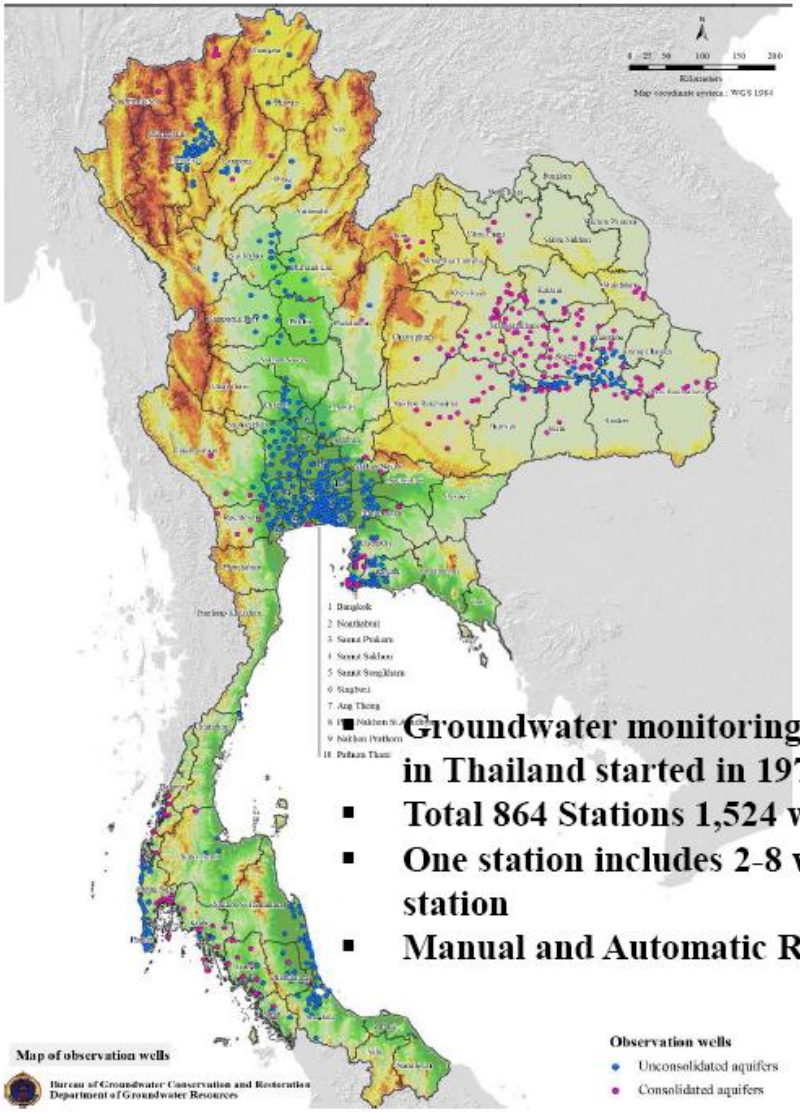
State/Region	Geological formation	No of station
Kayin	Alluvium, Irrawaddy formation	2
Tanintharyi	Upper Paleozoic	3
Mon	Alluvium	3
Rakhine	Alluvium, Pegu group, Eocene	7
Shan	Alluvium, Kalaw Red Bed, Plateau Limestone	7
Total		**22**

Remote Access Facilitated GW Monitoring Station (Future Plan)



THAILAND

Situation of GW Monitoring System and Database



- Groundwater monitoring network in Thailand started in 1977
- Total 864 Stations 1,524 wells
- One station includes 2-8 wells per station
- Manual and Automatic Recorder

Monitoring well

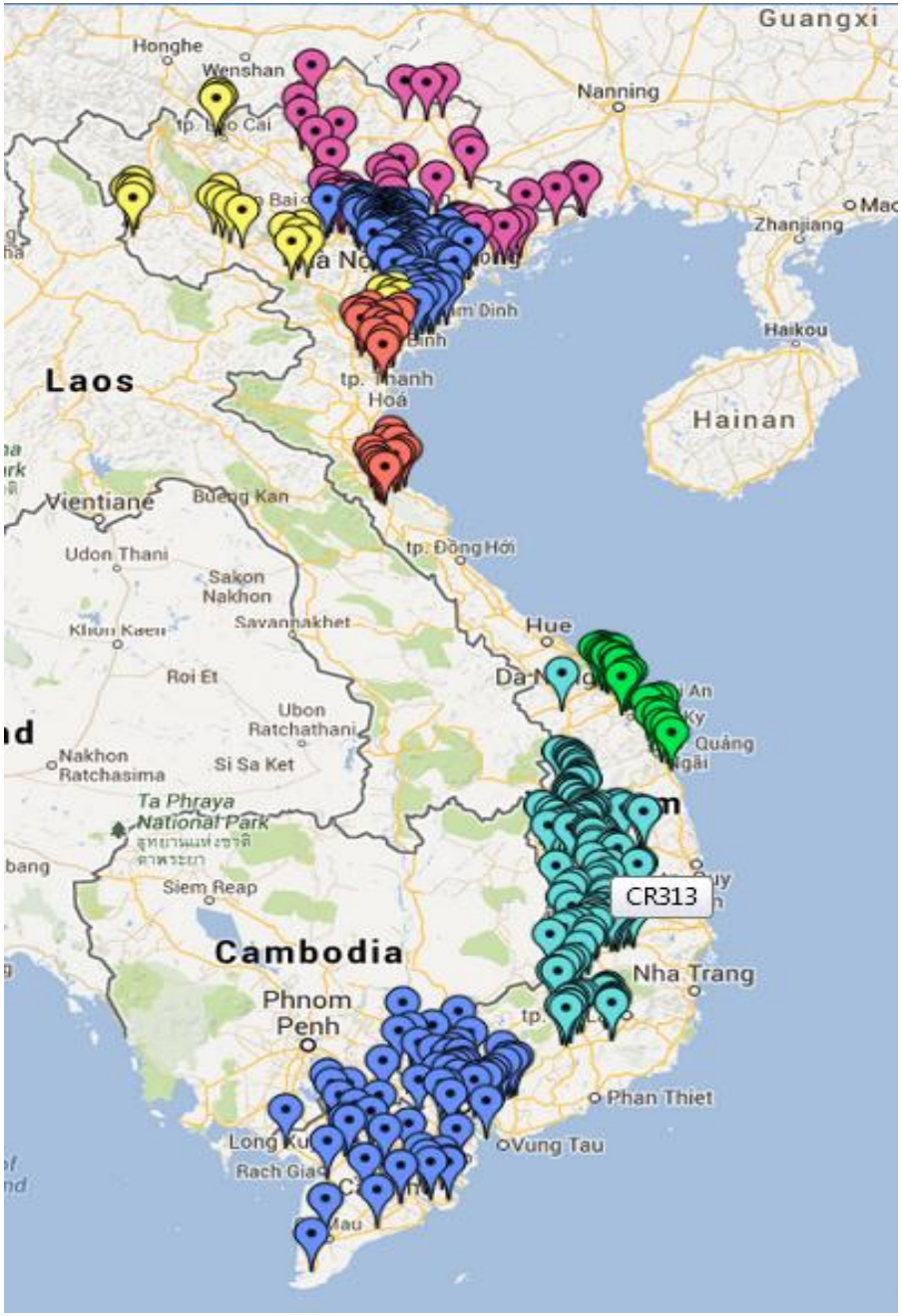
Automatic recorder

THAILAND

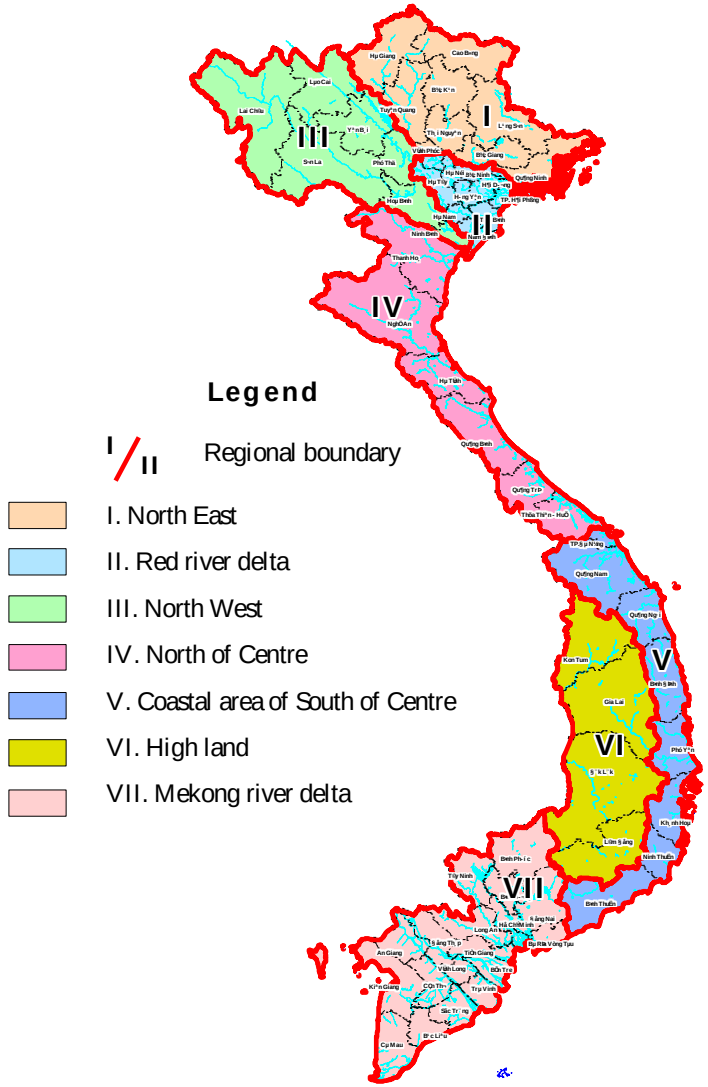
Monitoring Data management

- Data is stored in Pusuthara Database- in Thai language
- People can register to search capture and store data
- Spatial data is available in GIS Format
- ArcGIS online format will be available shortly
- DGR is responsible for the quantity and quality assessment, as well as for the development protection requirements in support of GW management.

VIETNAM



VN GW region and monitoring network

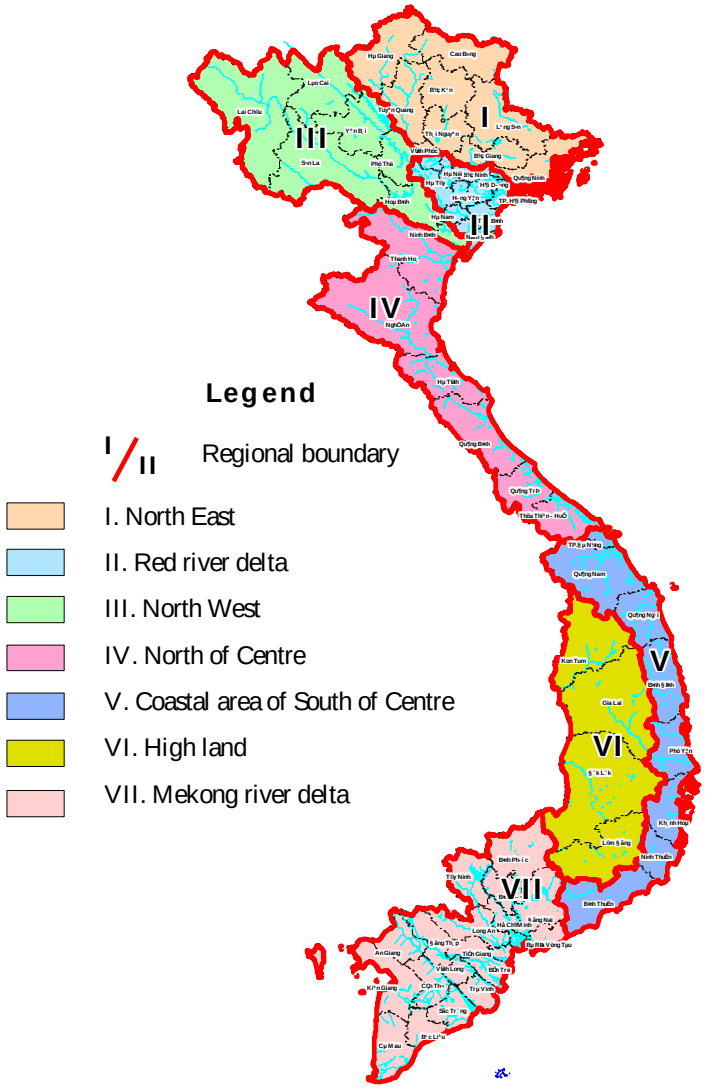


VIETNAM

Vietnam National water resources monitoring network

Total have 731 monitoring wells in 2013 and now some wells completed duty and moved out. In 2014 have 707 monitoring wells are including:

1. Red river delta (BB): 206 wells (built in 1990)
2. North of Centre : 46 wells (Built in 2010)
3. Coastal area of South of Centre: 41 wells (Built in 2010)
4. High land: 212 wells, (Built in 1990)
5. Mekong river delta: 208 wells. (built in 1990)



VIETNAM

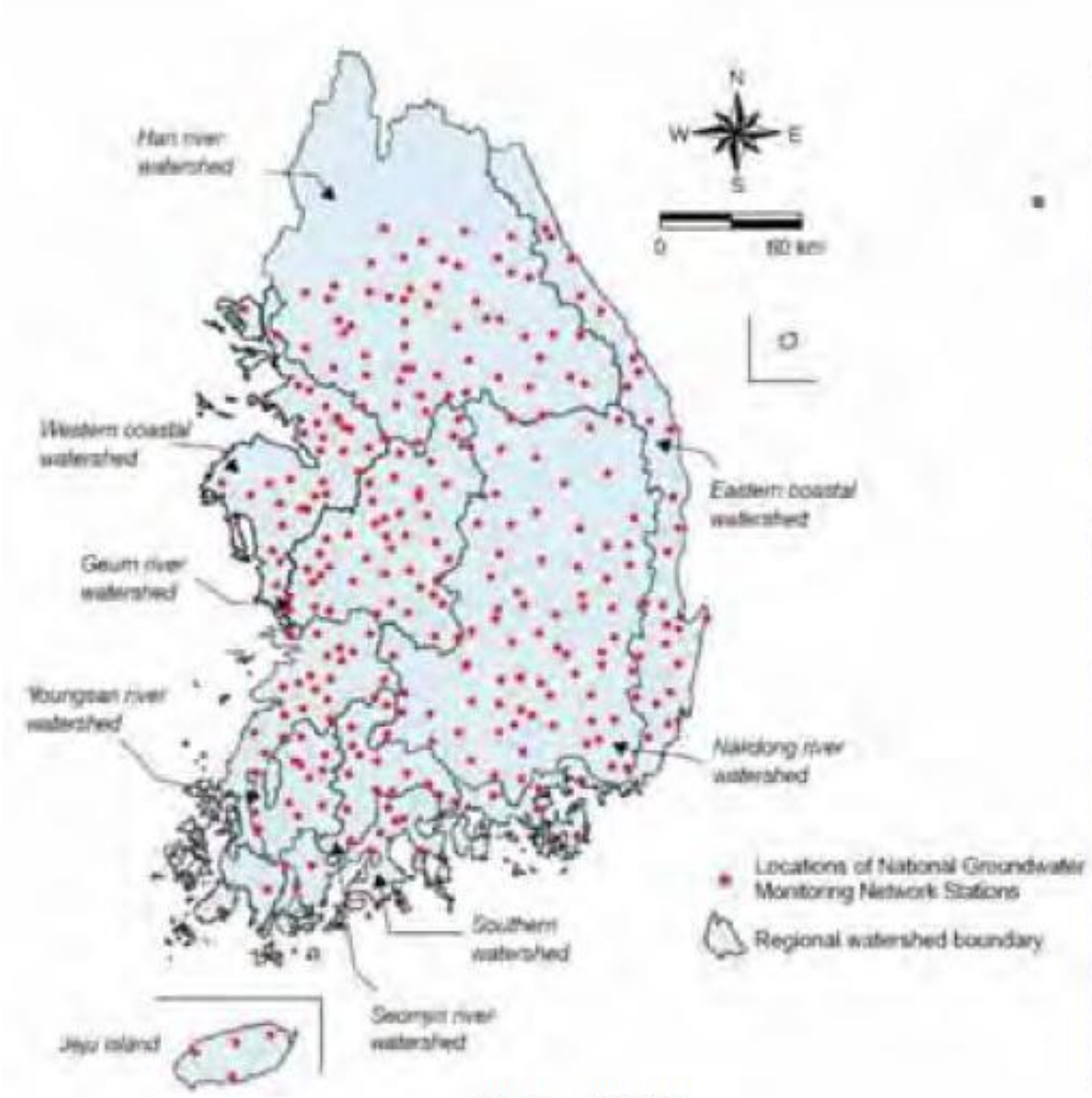

06/03/2010


CÔNG TRÌNH QUAN TRẮC
TÀI NGUYÊN NƯỚC DƯỚI ĐẤT
ĐIỂM QUAN TRẮC
NGHIÊM CẤM XÂM PHẠM
25/11/2010


06/03/2010


06/03/2010

SOUTH KOREA



(Kim, 2012)

SOUTH KOREA

GROUNDWATER MANAGEMENT

❖ Laws and Regulation on Groundwater Management, **Relevant Acts:**

- Groundwater Act (Act no. 13383), Drinking Water Management Act (No. 13164), Rural Development Act (No. 12963-21), Hot Spring Water Act (No. 13401), Special Act on the Establishment of Jeju Special Self-Governing Province (No. 13637)

❖ Legal regulation for groundwater (GW) management in Korea includes the following:

1) Basic survey and regular monitoring of GW level, quality, and usage status,
2) Establishment of national GW management plan in every 5-10 years,
3) Regulation and management of GW utilization facilities considering environmental, social impacts,
4) Declaration of GW protection zone, prevention from GW pollution, management of potential GW pollution sources, and design of GW remediation.

National GW monitoring station

FOR SUSTAINABLE DEVELOPMENT , KEEP ON OUR PRECIOUS GROUNDWATER RESOURCE

THANK YOU
FOR YOUR ATTENTION