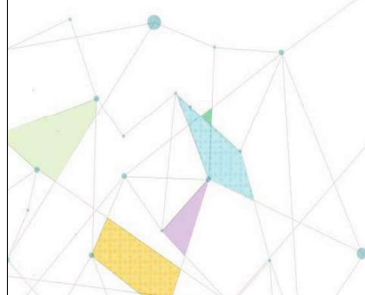




Groundwater Well Drilling & Development

Groundwater

Groundwater Well Drilling & Development



Aims & Objectives

- The aims of the course are to:
 - (1) Understand the process of groundwater development, and be aware of precaution when developing groundwater
 - (2) Understand the history of groundwater development in Korea, and understand that groundwater development is carried out according to the development of the country
- The objectives are that trainees will understand:
 - (1) Groundwater development procedure
 - (2) Groundwater development history

Contents

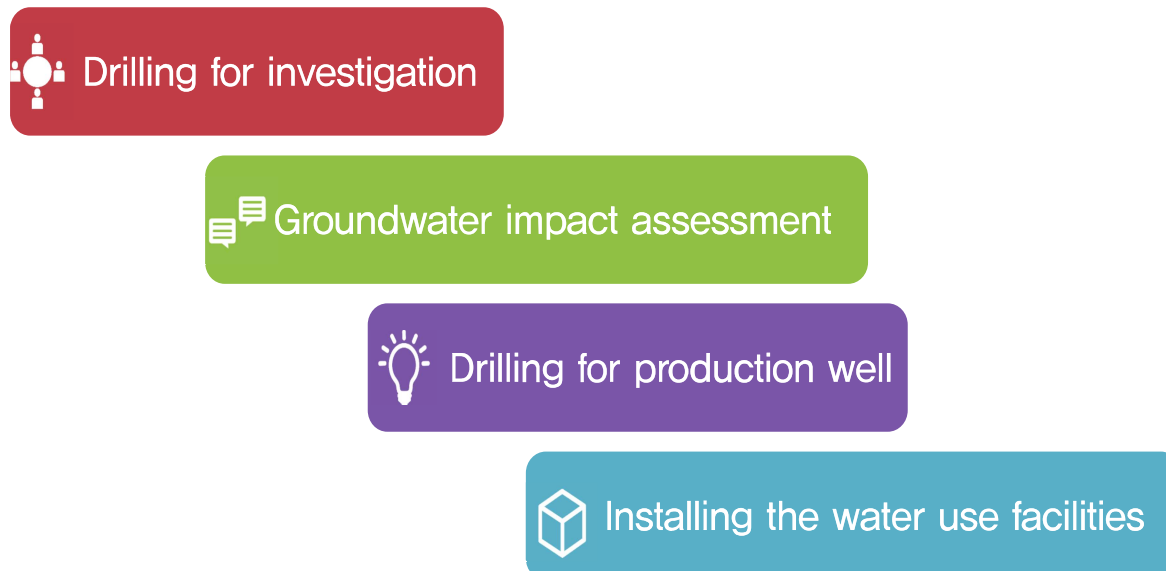
1. Groundwater Development
2. History of groundwater development

1. Groundwater development

- 1.1 Groundwater development procedure
- 1.2 Groundwater well drilling
- 1.3 Large scale radial collector well
- 1.4 Well development

1.1 Groundwater development procedure

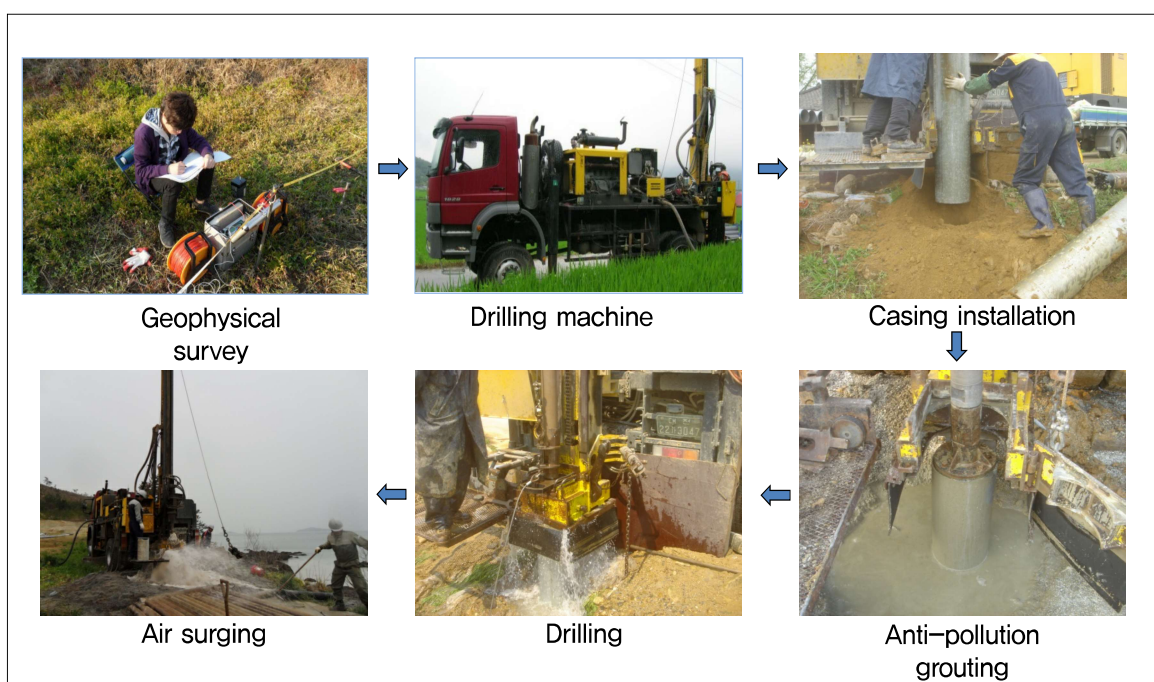
◆ Groundwater development procedure



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1.1 Groundwater development procedure

◆ Drilling for investigation

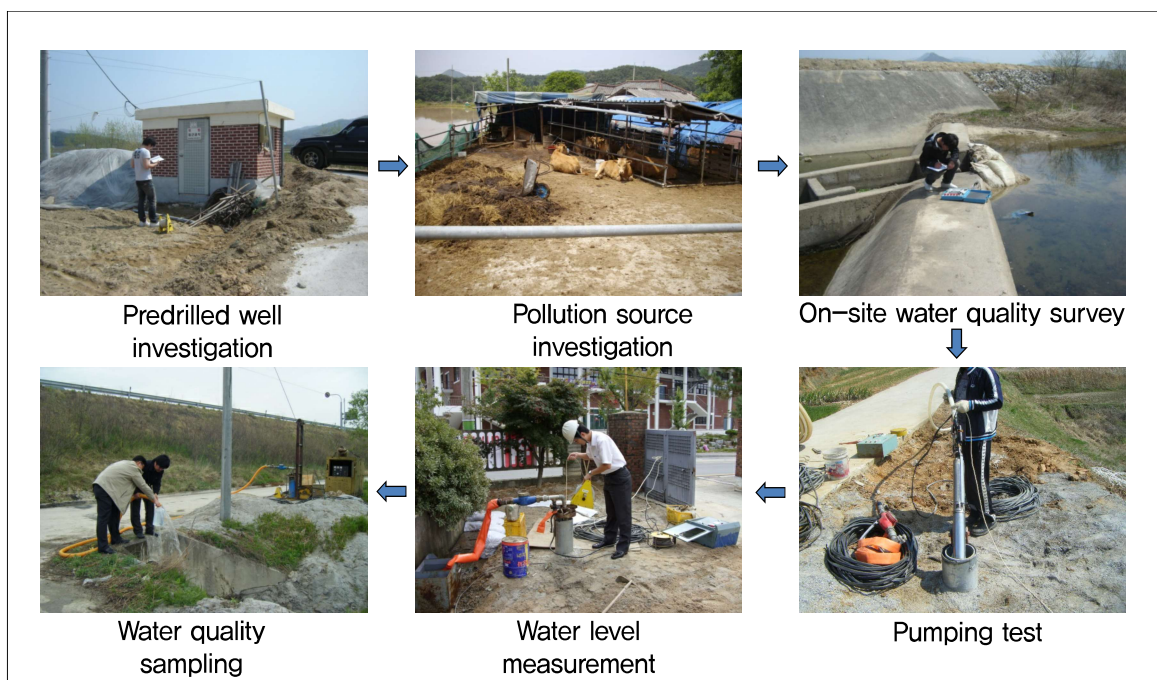


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Source) Korea Rural Community Corporation

1.1 Groundwater development procedure

◆ Groundwater impact assessment

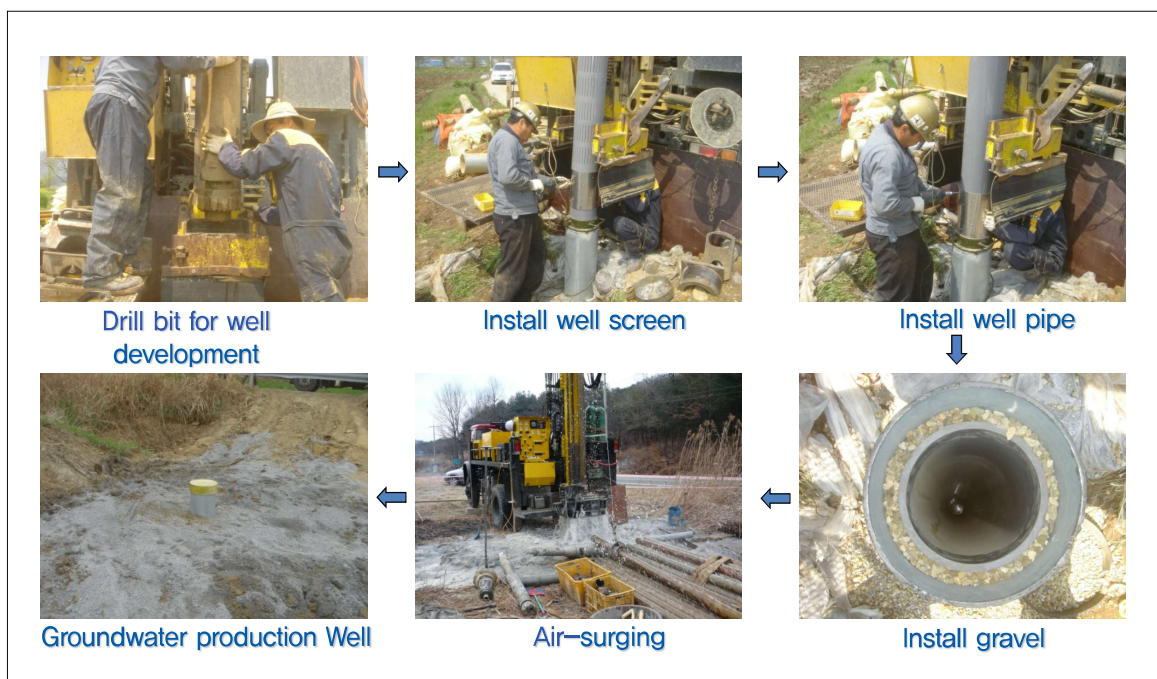


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Source) Korea Rural Community Corporation

1.1 Groundwater development procedure

◆ Drilling for production well



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Source) Korea Rural Community Corporation

1.1 Groundwater development procedure

◆ Installing the water use facilities



Submersible motor pump



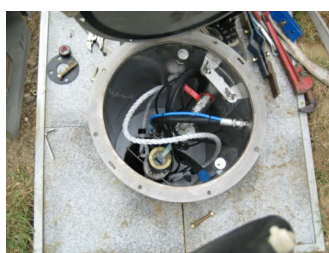
Installing of pipe



Installing submersible pump



Completed well facility



Inside of the well facilities



Installing well protection guide

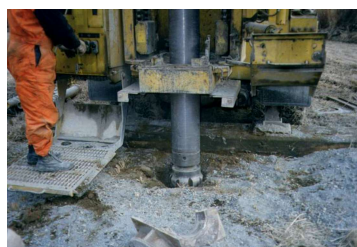
9

Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Drilling well location

- The location of groundwater development should be a location away from the source of pollution or a location where no source of pollution is expected in the future



Groundwater development

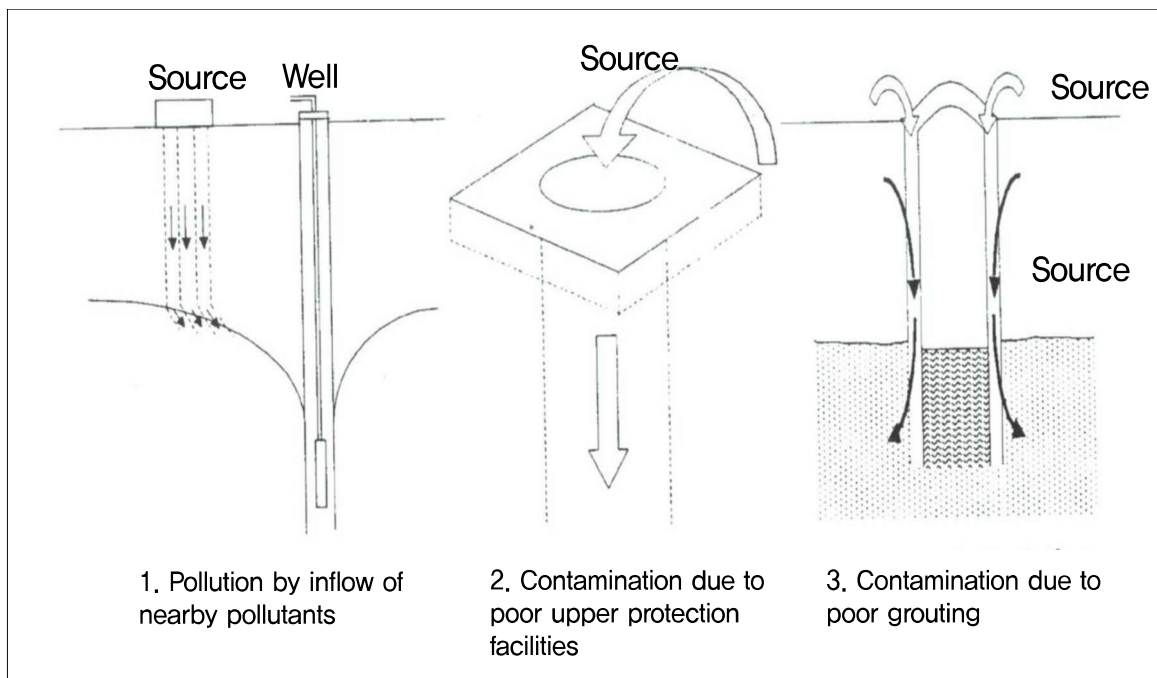
1. Installing the casing
2. Drilling the bedrock
3. Installing the well screen
4. Air-surfing
5. Pumping test

10

Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Case of contamination



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Source) Modified by Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Casing installation

- Casing is installed to prevent collapse of the unconsolidated alluvial layer
- Grouting is made to the depth where the casing is installed to prevent the inflow of surface pollutants through the hollow wall



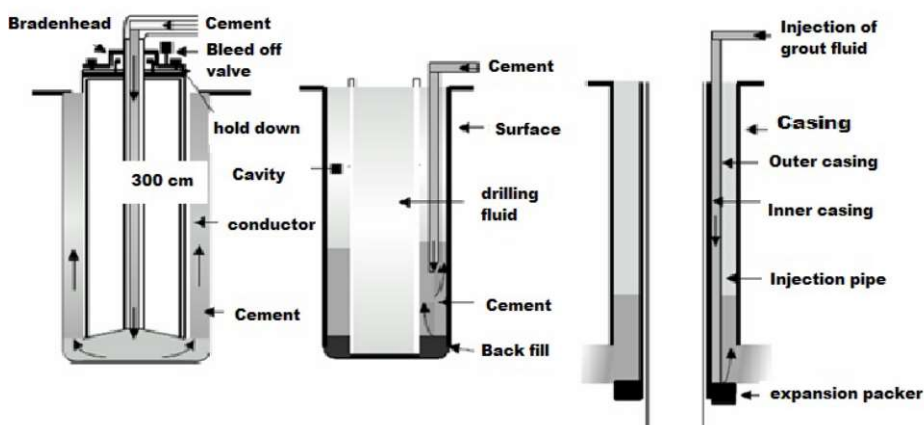
12

Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Grouting method

- Purpose : Prevention of inflow of surface pollutants(up to 1 – 2 m in bedrock)
- Construction method : Bradenhead, Grout pipe, Packer grouting method
- Grouting is effective in the case of groundwater contamination due to nitrate nitrogen in the upper part of the surface



1. Bradenhead method 2. Grout pipe method 3. Packer grouting method

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Source) Modified by Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Installing of well screen

- Air surging is an in-cavity cleaning operation performed using an air compressor to clean the wall of the hole and prevent the sedimentation of slime and mud that has fallen during drilling
- After air-surfing, the well material is installed : filling the space between the hollow wall and the well material with fine gravel of 10 – 20 mm
(※ Gravel filling : partial increase in permeability and suppression of inflow of fine particles → prevent failure of submersible motor pump)

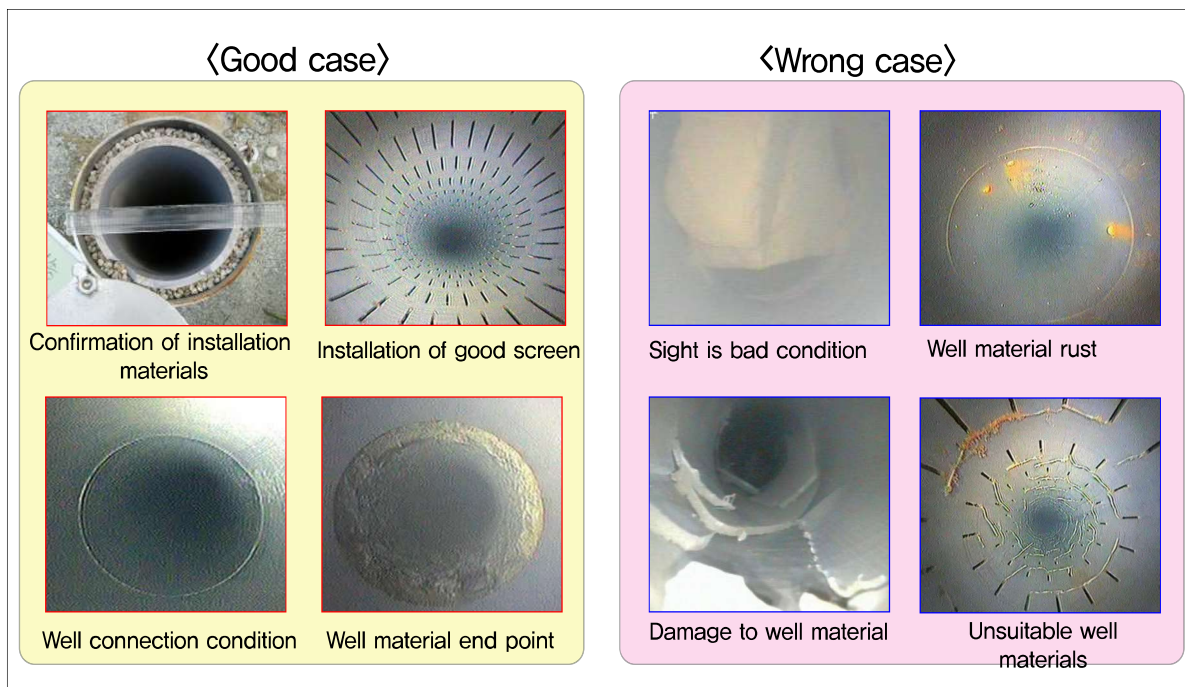


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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Pre-construction inspection



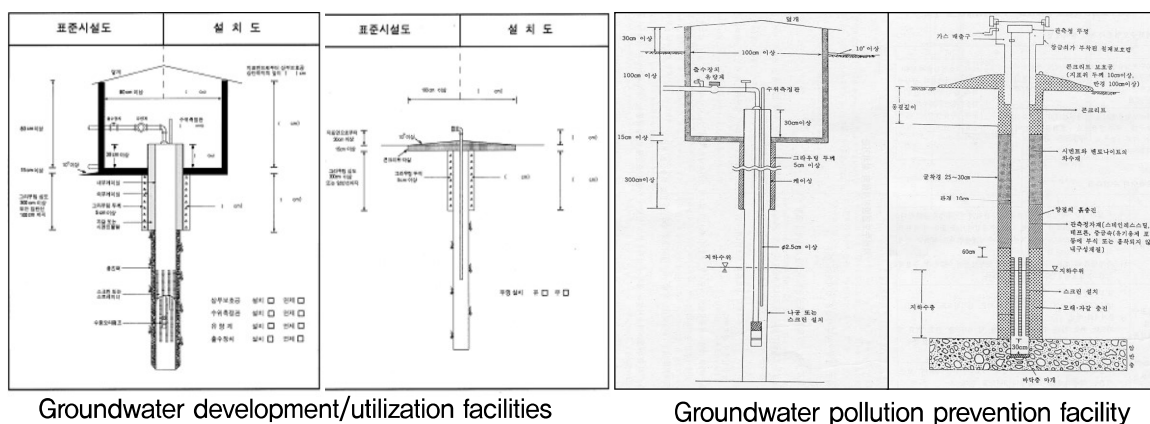
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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Upper well guard installation

- Groundwater well protector : Surface pollutant inflow prevention facility
- Enforcement rules of the Groundwater Act : Chapter 4, Article 8
 - Groundwater development/utilization facilities
- Rules for conservation of groundwater quality : Chapter 2
 - Groundwater pollution prevention facility



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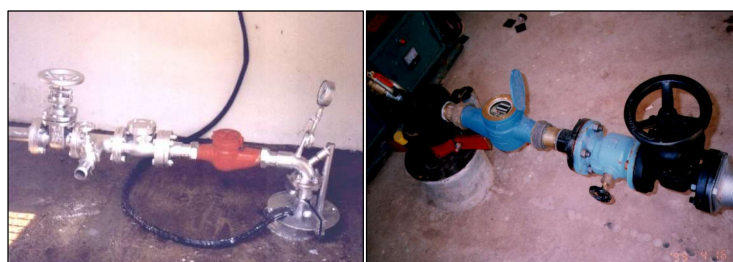
Source) Groundwater Act

1.2 Groundwater well drilling

◆ Well facilities



Groundwater pollution prevention facility



Well pipe and utility facilities

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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Enclosed protection facility

- Enclosed protection facility
 - Installed in protection house or outside the house
- Advantage : Completely block contaminants
 - Easily clean the wells and replace the submersible motors



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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Poor protection facilities

- Poor management and abandoned groundwater wells acts as a pathway for groundwater contamination



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(Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Water quality testing

1) Purpose

- To maintain the water quality within the groundwater law
- Under the Groundwater law, Groundwater users must undergo regular water quality testing.

2) Law

- Groundwater Act : Article 20 (Water quality testing)
- Rules for conservation of groundwater quality : Article 10 (Water quality testing)
- Drinking water management Act : Article 5 (Water quality for drinking water)

3) Water quality testing subject and cycle

- Domestic water : more than 30 tons of pumping rate per day : 3 year
- Industrial water : more than 30 tons of pumping rate per day : 3 year
- Agricultural water : more than 100 tons of pumping rate per day : 3 year

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1.2 Groundwater well drilling

◆ Well facility inspection



Inspection of pipe



Switchboard inspection



Check of well house



Check the water level measuring pipe

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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Well restoration

– Definition

- Restoring the facility or properly backfilling the land to prevent the inflow of pollutants into the facility or land subject to restoration and to not endanger human health and safety

– Abandoned well

- Wells that have failed in use, but are not properly backfilled or buried naturally, and are missing or neglected from the management target, causing concerns about groundwater contamination

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Source) Korea Rural Community Corporation

1.2 Groundwater well drilling

◆ Well restoration procedure



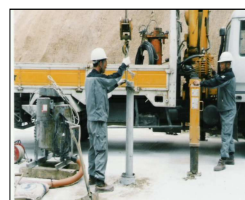
Abandoned well



Backfill material



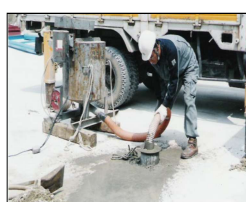
Insert backfill material into well



Casing drawing



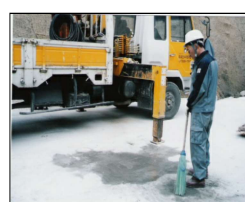
Impervious material injection



Impervious material injection



Backfill processing



Clean up around

23

Source) Korea Rural Community Corporation

1.3 Large scale radial collector well

◆ Install the caisson



Selection of location



Install the sue steel sheet



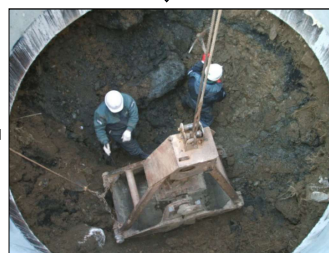
Install the rebar and reinforced concrete



Completion of installation



Install the caisson



Excavation & settlement

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Source) Daju Company, modified by KRC

1.3 Large scale radial collector well

◆ Horizontal drilling for arm



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Source) Daju Company, modified by KRC

1.4 Well development

◆ Well Development for Drilled Wells

- Part of the normal well drilling procedure
- Takes place right after well drilling and before the final disinfection



- Purpose of well development procedures:
 - Maximising the **well yield** after construction
 - Optimising the filter capacity of the gravel pack

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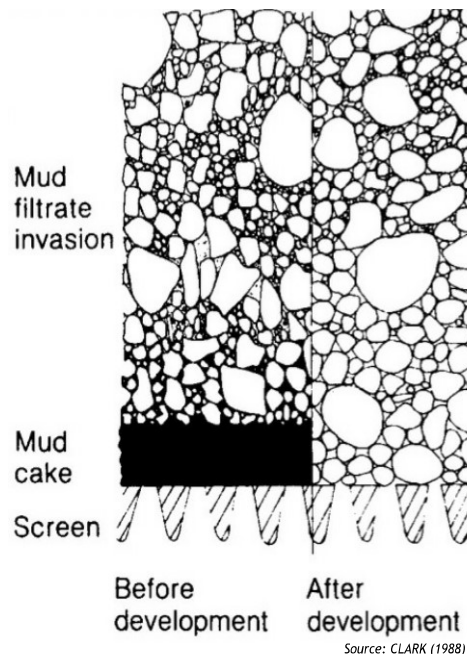
Source: www.ssswm.info

1.4 Well development

◆ Improving the Well Yield right after Construction

- **Well drilling procedures** alter the hydraulic in the vicinity of the well
→ Fines and drilling fluid additives originating from the drilling process remain in the borehole and block the pores of the surrounding aquifer.
- **Well Development techniques** aim to remove these fines (mud cake) and to let consolidate the gravel pack.

Results: - Higher yield
- Less sand intrusion



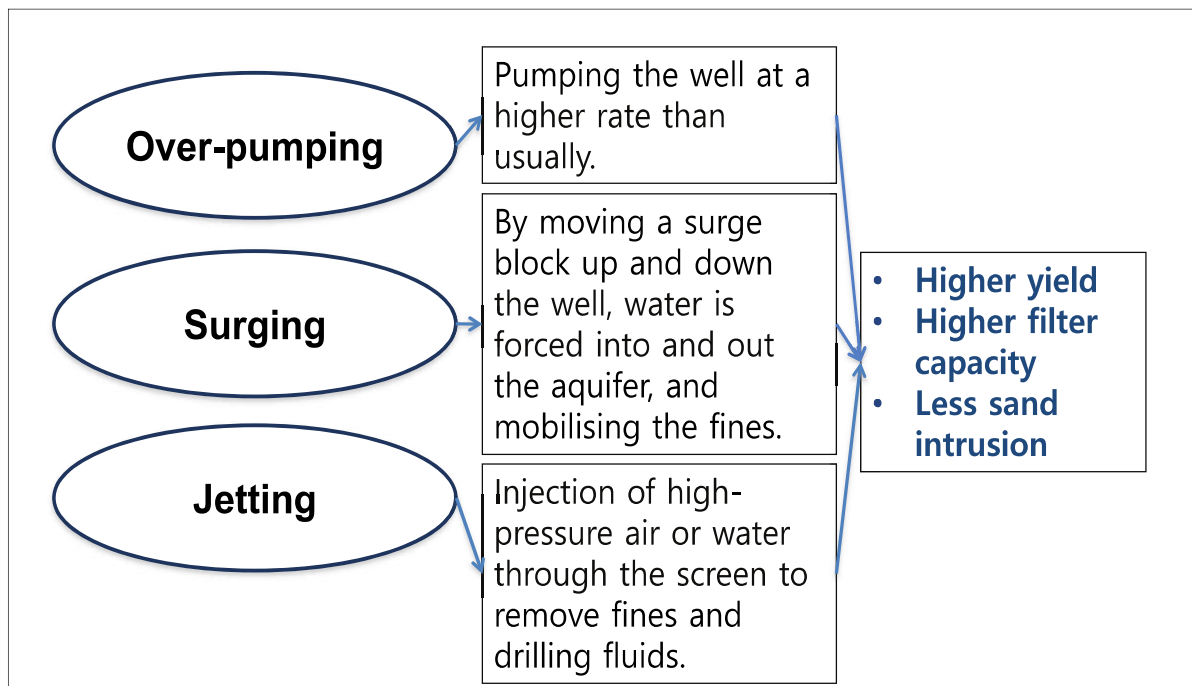
Source: CLARK (1988)

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Source: www.ssswm.info

1.4 Well development

◆ Most Common Well Development Techniques



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Source: www.ssswm.info

2. History of groundwater development

2.1 Groundwater development history of Korea

2.2 Groundwater development in agriculture

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2.1 Groundwater development history of Korea

◆ 1960's ~ 1970's

1960's



Humans dig the ground to develop groundwater

1970's



Development of alluvial layer with depth of 20 m

First groundwater development on Jeju Island

30

Source) Korea Rural Community Corporation

2.1 Groundwater development history of Korea

◆ 1980's ~ 1990's

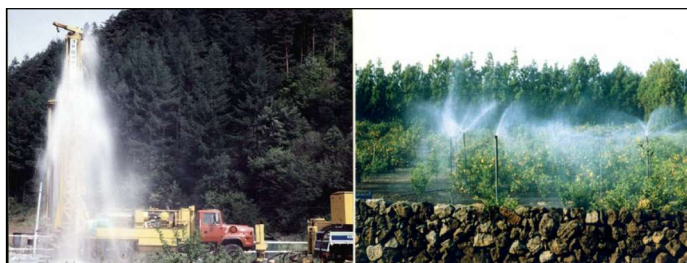
1980's



Develop subsurface dam

Development of rock wells

1990's



Upland water development

Rural domestic water
Hot spring, deep groundwater development

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Source) Korea Rural Community Corporation

2.1 Groundwater development history of Korea

◆ 2000's ~ 2010's

2000's

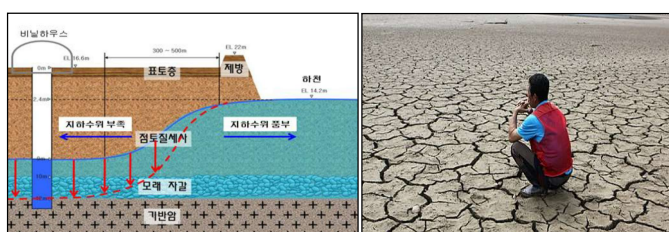


Groundwater conservation
Management

Groundwater contamination

Groundwater observation

2010's



Large-capacity groundwater

Artificial recharge

Smart control of groundwater

Groundwater development
for drought

Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ 1963 ~ 1967 (The begging of groundwater development)



- Feasibility investigation for groundwater by USOM(United States Operation Mission) (1963)
- Develop 3 alluvial wells by Ministry of Agriculture and Forest (1964)
- Development of agricultural water supply plan (for rice field 70,000ha)
- Started well-development project by Korean government (1965–1967)

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(Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ Established groundwater development corporation (1969)



- Newly started groundwater management organization in Ministry of agriculture for big drought in 1967
- Established groundwater development corporation in 1969 by government
 - establish 7 branches in 7 provinces
- ❖ Drought situation at that time
 - 1967 : May~July precipitation 307mm (decrease rice production 8%)
 - 1968 : May~July Precipitation 122mm (decrease rice production 18%)

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(Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ The first successful groundwater development in Jeju island(1970)



- Successfully developed the first deep well for the agricultural water In Jeju island (1970.2~5)
 - located northern part of Jeju island
 - depth of well : 30m, pumping rate : 2,000m³/day
- After success of deep well installation, established groundwater survey and development plan for juju island

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Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ Groundwater development in alluvial aquifer (1971~1980))



- Maintenance of alluvial wells
 - Inspection of groundwater facilities
 - Observational survey of existing public wells
- Groundwater development for drought condition
 - Well development for extreme drought
 - Well development for horticultural complex
 - Well development for emergency water

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Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ Bedrock groundwater development (1981`)



- Started development of bedrock groundwater
 - 1st bedrock groundwater well drilled in 1981
 - well depth : 50m, pumping rate: 500m³/day
- Successfully implanted 8 bedrock groundwater wells
 - After that, bedrock wells are installed instead of alluvial wells
- Deep groundwater development project started 1991
 - well depth : more than 1,000m

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Source) Korea Rural Community Corporation

2.2 Groundwater development in agriculture

◆ Development of underground dams and radial collection wells (1983~)



- Purpose : Large-scale agricultural groundwater development
- Facility : underground dam and radial collection wells
- history
 - 1983: 1st underground dam is installed
 - length of dam : 230m
 - radial collection wells : 4
 - After that, 4 underground dams are installed

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Source) Korea Rural Community Corporation

Thank you very much

