Outline of the Aichi Irrigation Project
Start of the Aichi Irrigation Project

Local Situation
- Aichi Prefecture’s Chita Peninsula lacks water
- Major successive droughts in 1944 and 1947
- Strong local movements for irrigation canals

National Policy
- Acute postwar food shortages
- Trend for emphasis on land development
Aichi Prefecture’s Chita Peninsula Lacks Water

- No large rivers
- Ensuring agricultural water with storage reservoirs
- Ensuring domestic water with beach wells

Scooping up groundwater

Housewives carrying water from beach wells
Strong Local Movements for Irrigation Canals

A passionate explanation meeting to bring about irrigation canals in Aichi
History of Aichi Irrigation

1945-1954
- Managing Body: Min of Ag. & Forestry
  - July 1949
  - Project Implementation: Direct Investigation
  - Sept. 1955 to Sept. 1961

1955-1964
- Aichi Irrigation Project
  - October 1955
  - Aichi Irrigation Public Corporation
  - May 1962
  - Merged, October 1968

1965-1974
- Water Resources Development Public Corporation
- Management tasks, from FY 1961

1974-1984
- Change in water demand and new demands
  - Sharp increase in municipal water demand due to high economic growth
  - Large changes in agricultural water use styles due to reorganizing of farmland and promotion of field development

1985-1988
- Responding with management facilities
  - Responses when maintenance, inspections, repairs get difficult
  - Responses to aging and deterioration of irrigation facilities

1989-1997
- From October 2003

1998-
- Japan Water Agency

Management Tasks (Water distribution management, facilities management, assets management)

FY 1981 to FY 2004
- Aichi Irrigation Phase II Project
- Western Nagano Earthquake
  - Sept. 14, 1984
- FY 1995 to FY 2006

Makio Dam Silting Measures
Outline of Aichi Irrigation Project (Phase I)

- First large scale general development projects in Japan (agricultural water, water supply water, industrial water, power generation) centering on agricultural development
- Water source facilities (Makio Dam), Main canal (length, 112 km), Lateral canal (length, 1,012 km), and others, for unified implementation
- Water supplied to: Kani County, Gifu Prefecture; Owari Eastern Hills, Aichi Prefecture; Chita Peninsula area
- Built between 1955 and 1961
- Implemented with formation of Aichi Irrigation Public Corporation
Characteristics of Phase I Project

1. Brought in foreign capital (World Bank loans)
2. Establishment of Aichi Irrigation Public Corporation
3. Active cooperation of related organizations
4. Unified implementation (from dams to terminal waterways, canals, and power generation facilities)
5. Technical cooperation from U.S. consultants
6. Totally mechanized implementation
7. Project completed in the short time of five years

★ Results rapidly apparent
★ Later major contributions to civil engineering techniques

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 1955</td>
<td>Aichi Irrigation Public Corporation established</td>
</tr>
<tr>
<td>Aug. 1957</td>
<td>World Bank loan contracts and government guarantee contracts signed</td>
</tr>
<tr>
<td>Nov. 1957</td>
<td>Work starts</td>
</tr>
<tr>
<td>Sept. 1961</td>
<td>Construction work completed/Water starts flowing</td>
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</tbody>
</table>
Construction Work (Makio Dam)

Night rush work

December 1, 1958: Main body begins construction
May 28, 1961: Makio Dam completed
Construction Work (Open canals)

Casting thin lining concrete
Outline of the Aichi Irrigation Phase II Project
Waterway Areas Being More And More Developed

Kasugai City Kozoji New Town

Kozoji
Sharp Increase in Municipal Water Demands due to High Economic Growth

Intake pattern (plan)

1963

Agricultural Water

Municipal Water

1981

Agricultural Water

Municipal Water

Cannot cut off water
Loss of Durability and Carrying Capability through Aging

State of silting within waterways

State of inverted subsidence

State of leaking and cracks in waterways
Development into Phase II

- Changes in water demand and new demands
  - Sharp increase in municipal water demands due to high economic growth
  - Large changes in agricultural water use styles due to reorganizing of farmland and promotion of field development

- A wealth of management facilities
  - Responses to aging and deterioration of irrigation facilities
  - Responses when maintenance, inspections, repairs get difficult
Work Plan for Phase II
Reconstruction of Main Canal Facilities, etc.

- Doubling of main canals
- Increase of flow capacity
- Modernization of water management facilities
- New terminal balancing reservoir
- Making lateral canals into pipelines

Makio Dam Silting Measures
(FY 1995–FY 2006)

- Silt removal (approx. 5,480,000 m³)
Doubling of Main Canals
(Waterway schematic plan)

Main Canal Schematic Plan

Phase I
- Lateral canal
- Distributor
- Open canal
- Tunnel
- Siphon
- Regulation weir

Phase II
- Lateral canal
- Bypass channel
- Bypass tunnel
- Bypass siphon
- Main route tunnel
- Main route siphon
- Regulation weir
- Doubled waterway

Thin concrete lining in waterway
Doubled flume waterway
Doubling of Main Canals (Standard cross-section)

Shared section

Open canal

Tunnel

Main route (existing)  Bypass (new)
Full flow in bypass tunnel

Siphon

Main route (existing)  Bypass (new)

Agricultural water only section

Covered in concrete blocks

Weep hole
Modernization of Water Management Facilities

**Migration to centralized facilities method**
- From management relying on human interaction to introduction of remote monitoring/control and centralized management
- Reduction of time and labor needed for water management
- Early detection of abnormalities and early determination of abnormal locations

**Placing of water management devices**
- Remote monitoring and control (main intakes, outlet, etc.)
- Remote monitoring (trunk flow volume, trunk water levels, check gate open angles, diverted water amount, device status, etc.)

**Management systems and division of labor**
- Distributed water management
  - From distributed management to centralized management
- Facilities management
  - From four distributed management offices to three (main canals)
Modernization of Water Management Facilities
Remote Monitoring and Control of Principle Facilities

Main intakes, outlet, etc.
Main facilities deemed necessary to respond immediately to water source status, water demand, weather conditions, and other changes where frequent flow regulation operation is required
Facilities where emergency operation is required

- Kaneyama Intake Gate
- Togo Balancing Reservoirs M, B Outlet
- Sakuragane CH Gate, Sori Pond Distributor

Kiso River
Kaneyama Intake Gate
Togo Balancing Reservoir
B Outlet (hydroelectric power generation)
Sakuragane Check Gate
M Outlet Valve
Sori Pond
Mihama Balancing Reservoir
Remote Monitoring of Trunk Flow Volumes

- Early detection of abnormalities and early determination of abnormal locations
- Check of water arrival when flow volume changes or large volumes are introduced
- Highly accurate water distribution implementation (effective use of water resources)
- Supplementation for flow volume change or device change periods

Ultra-sonic flow meter + level gauge  6 locations
- CH gate opening indicator + level gauge  6 locations  *Incl. Sakuragane CH
Remote Monitoring of Trunk Water Levels

- Ensuring appropriate trunk water levels
- Checking water arrival when flow amount changes or floods are introduced (CH lower reaches)
- Early detection of abnormalities and early determination of abnormal locations (locations that need watching)
- Grasping storage volume in main canals (agricultural water use only sections)

- Level gauge installed at caution locations: Detect rising water levels near caution locations
- Level gauge installed at the municipal water distributor: Detect lowering water levels near municipal water distributor
- Level gauge installed at spillways: Detect flow from spillways
Water Level Adjustment Gates (Check Gates) Non-Motive Automation

Phase I
- Main canals: Approx. 112 km
- Agricultural water distributor: 141 locations
- Municipal water distributor: 8 locations

Phase I
- Maintenance of appropriate trunk water levels and distributor water levels during trunk flow volume change
- Of 37 total trunk gates, 18 electric gates are mechanically operated
- Water management to ensure parallel flow with pilot

Phase II
- 14 trunk CH gate locations changed to non-motive automation
1. Goals of construction
   Along with storing and using the unused water that flows down to the terminus of the Aichi irrigation main canal, it is intended to provide a stable supply of agricultural water downstream from the balancing reservoir during periods when the arrival water volume is low. It is also designed to increase the degree of freedom in water management by making the trunk water flow hold its width by using the empty storage capacity of the balancing reservoir.

2. Balancing reservoir stats
   Stored water volume: Approx. 100,000 m³ (surface area when filled: approx. 2.3 ha)
   Effective water depth: 5 m

Storage of unused water
Responses to lack of arrived water volume

Effective use of water resources
Stable supply
Making Lateral Canals into Pipelines

Phase I
(Open-type waterways) Supply initiated waterway

- Assurance of conveyance, improvement of durability
- Shortens time for water arrival to fields
- Reduces time and labor related to water management and facilities management
- Provides a stable supply to fields
- Effective use of water resources through reducing unused water, non-arriving water volume, and management water
- Reduction of time and labor relating to trunk distributor operation

Upstream priority

Phase II
(Pipe-type waterways) Demand initiated waterway

- E.g.) Water supply taps

Lower areas priority
Makio Dam Silting Measures

The massive amount of silt that flowed into the dam lake as a result of the Western Nagano Earthquake (Sept. 1984) was removed, and the reservoir functions restored.
New Responses with Phase II Project

**Phase I Issues**

- Maintenance inspections in non-suspension water was difficult
- Flow management and distribution management required time and labor
- Early detection of flow status/distribution status and abnormalities was difficult
- Response to agricultural water with its highly variable demands (in particular, the agricultural water only section downstream from the Sakuragane CH)
- Occurrence of unused water at the trunk terminal and response to lack of arrival water amount
- Water management of lateral canals

**Phase II Responses**

- Doubling of main canals
- Non-motive automation of water level regulation gates
- Introduction of remote monitoring and control
- Reinforced use of existing waterways (assurance of storage capacity)
- Addition of downstream water level catchup functions to check gates and storage functions
- New terminal balancing reservoir
- Making lateral canals into pipelines
Main Effects of the Phase II Project

**Responses in Phase II**
- Non-motive automation of water level regulating weirs
- Making lateral canals into pipelines
- Introduction of a remote monitoring and control system
- Increase of conveyance ability
- Doubling of main canals
- New terminal balancing reservoir

**Effects**
- Work efficiency and reduction of labor through unified centralization of management allowed a reduction in the management staff
- Responding to changes in water demand, and contributing greatly to local development
- Made it possible for maintenance inspection by using single-sided flow
- Extending the life of facilities through preventive maintenance measures
- Non-effective outflow suppressed
Unified Centralized Management

Management Depending on Human Interaction

Up to 2002

Centralized Management Method

Distribution Mgmt
Management divided up per branch

Facilities Mgmt
Management divided up per branch

Distribution Mgmt
Centralized management through General Management Office (Local management office backup)

Facilities Mgmt
Divided management per local management office

Inuyama Branch
Kaneyama Control House

Nagakute Branch
Togo Control House

General Office

Distribution plan creation Distribution orders Overall control Etc.

Tokai Branch
Tokai Control House

Taketoyo Branch
Taketoyo Control House

Kiso River

Approx. 34 km

M Approx. 34 km
B Approx. 24 km

General Mgmt Office

Distribution mgmt (All line central mgmt) (Remote operation) (Remote monitoring) Overall control Etc.

Downstream Mgmt Office

General Mgmt Office

Central Mgmt Office

M Approx. 41 km
B Approx. 17 km

M Approx. 34 km
B Approx. 24 km

M Approx. 37 km
B Approx. 2 km

Approx. 31 km

Approx. 34 km

Approx. 31 km

Approx. 20 km

Approx. 27 km

Ise Bay

Mikawa Bay

= Distributed management zones
= Facilities management zones
Annual volume used  FY 2007: Approx. 470,000,000 m³  
(Approx. 376 times the volume of the Nagoya Dome)

The volume is more than triple that of FY 1963

The weight has shifted from agricultural water to municipal water  
(agricultural water 1/5; municipal water 4/5)
Effects of the Project

Agricultural water

Agricultural gross value
FY 2003: Approx. 67 billion yen

Domestic water

Population served by piped water
FY 2005: Approx. 1,130,000

Industrial water

Produced article shipment total
FY 2003: Approx. 3.4 trillion yen

<table>
<thead>
<tr>
<th>Division</th>
<th>Agricultural gross value (millions of yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 1963 (A)</td>
<td>25,566</td>
</tr>
<tr>
<td>FY 2003 (B)</td>
<td>67,013</td>
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<tr>
<td>Ratio (B/A)</td>
<td>2.62</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division</th>
<th>Population served by waterworks (thousands of people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 1963 (A)</td>
<td>195</td>
</tr>
<tr>
<td>FY 2005 (B)</td>
<td>1,130</td>
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<tr>
<td>Ratio (B/A)</td>
<td>5.79</td>
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</tbody>
</table>

* Includes Gifu Pref. Tono area

<table>
<thead>
<tr>
<th>Division</th>
<th>Produced article shipment amount etc. total (hundred billions of yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 1963 (A)</td>
<td>3,259</td>
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<tr>
<td>FY 2003 (B)</td>
<td>34,382</td>
</tr>
<tr>
<td>Ratio (B/A)</td>
<td>10.55</td>
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</tbody>
</table>

* 76 offices
Maintenance Inspections in Non-Suspension Water

Empty water image
Maintenance Inspection

(1) Cleaning inside the waterways, removal of sediment from the waterways
(2) Inspection and maintenance work in the waterways
Maintenance Inspection and Repair Effects

- Facility completion
- Repairs done now
- Followup maintenance
- Assumed life
- Extended life

Time Axis

Facility Function

High

Low
A New Try

Operation of the Togo Power Station

- Power generation using the drop (approx. 14.3m) between the Togo Balancing Reservoir and the Morowa No. 1 Open Canal
- First RPS recognized facility for a water organization
- Power generated contributes to the reduction of load for management costs
Large-Scale Solar Power Generation System in Aichi Pond
Aichi Pond Large-Scale Solar Power Generation System
Part of the "FY 2007 Global Warming Prevention Technology Development Program" (Ministry of the Environment)

● Goal of Technical Development
With the aim of putting the large-scale solar power generation system that uses the surface of water into practical use, the Japan Water Agency is carrying out the following technical developments:

1. Increasing the energy efficiency through cooling the solar cells
2. Reducing the costs of the floats the solar cells are on

Solar cells are generally believed to drop 0.5% in energy production efficiency with every 1 degree rise in temperature, with 25°C being standard.

● Solar Power Generation System (30 kW)
<br>10 kW × 2 units (on water surface)
<br>Air-cooled: Solar cells are cooled by wind on the water surface
Air-cooled + water-cooled: Solar cells are cooled with sprinklers using the pond water
(Water is sprinkled for one minute every ten minutes)

● Effects on Global Warming Prevention
The 30 kW solar power generation system produces the equivalent of enough electricity to run eight typical households for a year (approx. 30,000 kWh).

* The effects of this global warming prevention measure are...
Q: What does this come to when converted into the amount of carbon dioxide prevented?
A: It comes to the equivalent of 21 tons a year (about ten years of output for a typical person in a household)
Q: What does this come to when converted to forest area?
A: It has the same function as approx. 6 ha of forest area

* This technical development is being carried out jointly between the Japan Water Agency and Kureha Engineering Co. Ltd.

● Implementation Period
FY 2007 – FY 2008 (scheduled)  Start of power generation: August 2007
(The facility is scheduled to be enlarged in FY 2008)
Thank you for your attention