GOVERNMENT OF BERMUDA

Department of Statistics

Bermuda Fresh Water

Our People and the Environment.

Overview of Bermuda

As of May 20, 2016

POPULATION

63,779

Population Density : 3,084/m ile²

Sex: 52% Female

Race: 52% Black

Median Age: 44 Years Old

HOUSING

28,192

Private Dwelling Units : 97%

Group Dwelling Units : 3%

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LAND USE

20.7 miles²

Total Area (Acres) : 13,268.7

Residential : 44.9%

Open Space: 33.3%

Paget Parish : 758.1
(residential acreage)


Town of St George
St George
Hamilton
Smiths
Devonshire
Pembroke
City of Hamilton
Paget
Warwick
Sandys
Southampton
DigitalGlobe, GeoEye, Earthstar Geographics | Govt of Bermuda, Dept of Planning
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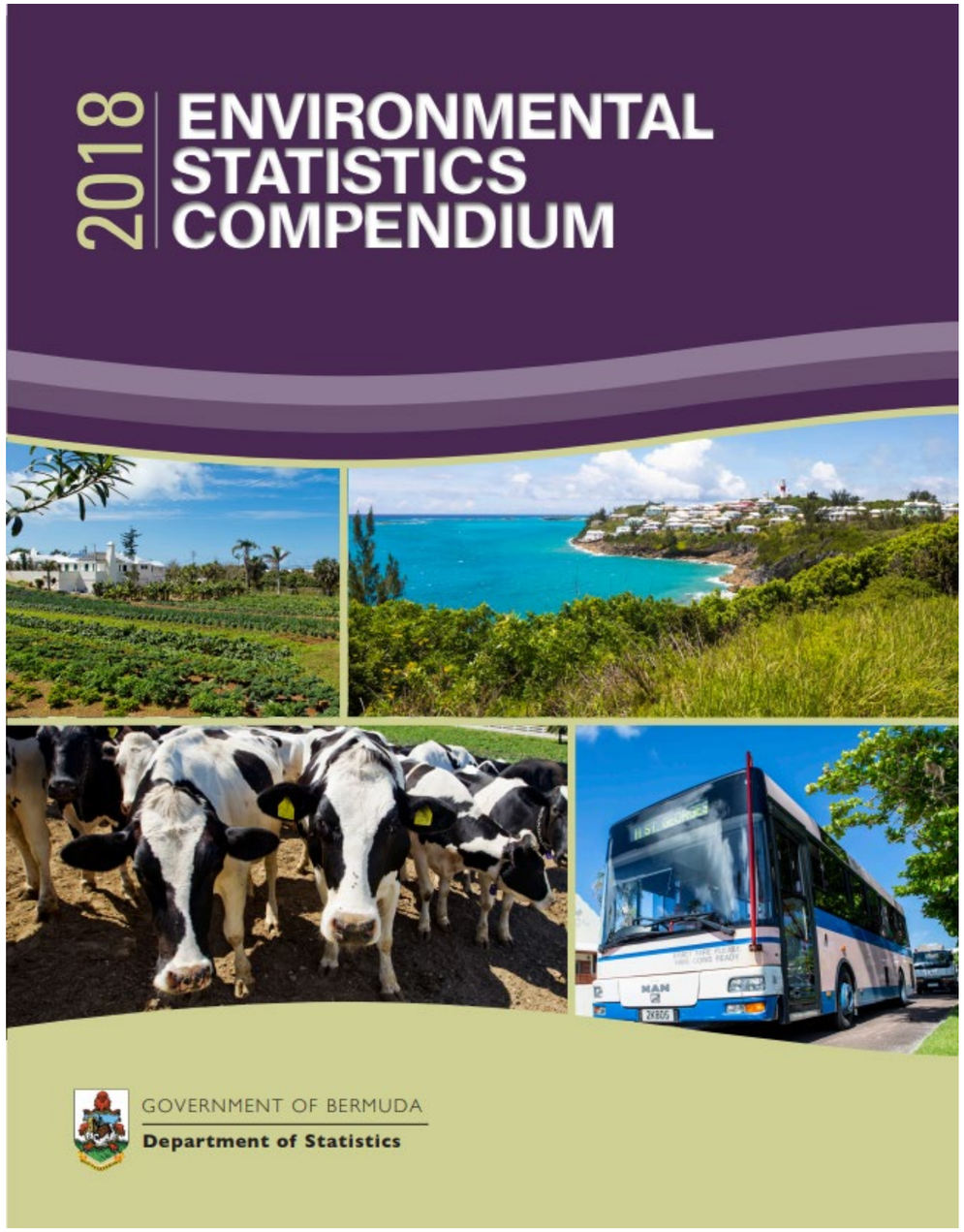

ENVIRONMENTAL STATISTICS COMPENDIUM

Collation of existing data sourced from the activities of both government and non-governmental entities that are involved in monitoring, controlling or promoting awareness about issues affecting Bermuda's environment .

The Compendium is structured into thirteen [13] sections:

- Population and Housing
- Tourism
- Environmental Health and Weather
- Natural and Environmental Disasters
- Energy, Minerals and Transport
- Agriculture
- Land Use
- Coastal and Marine Resources
- Biodiversity
- Forestry
- Air
- Waste
- Water

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Presentation Outline

TODAY'S DISCUSSION

- ROOF AND TANK SYSTEMS
- HYDROGEOLOGY
    - GROUNDWATER LENSES
    - STATE OF GROUNDWATER QUALITY AND SUPPLY
- WATER USE, WATER RESOURCES AND WATER TREATMENT
- CHALLENGES AND RECOMMENDATIONS

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ARCHITECTURAL HERITAGE

Bermuda has no fresh-water springs, rivers or lakes. As a result, Bermudians have traditionally derived their fresh water using whitewashed rainwater roof catchments and associated storage tanks.

Bermuda's Water Catchment

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Sizing Catchments and Tanks

The Public Health (Water Storage) Regulations, 1951

Prescribed Catchment Area	Prescribed Tank Storage Capacity
Four fifths of the total roof area of the building	100 gallons for every ten square feet of prescribed catchment area

Source: Department of Health, Bermuda

To calculate the required tank size, the building requires water storage of eight imperial gallons for every square foot of the total catchment (roof) area. This legal requirement is based on the scientific rationale that Bermuda's average total rainfall for one year is 55.5 inches distributed relatively evenly across all months, with higher averages for hurricane seasons, due to the torrential rains that these systems have generated .

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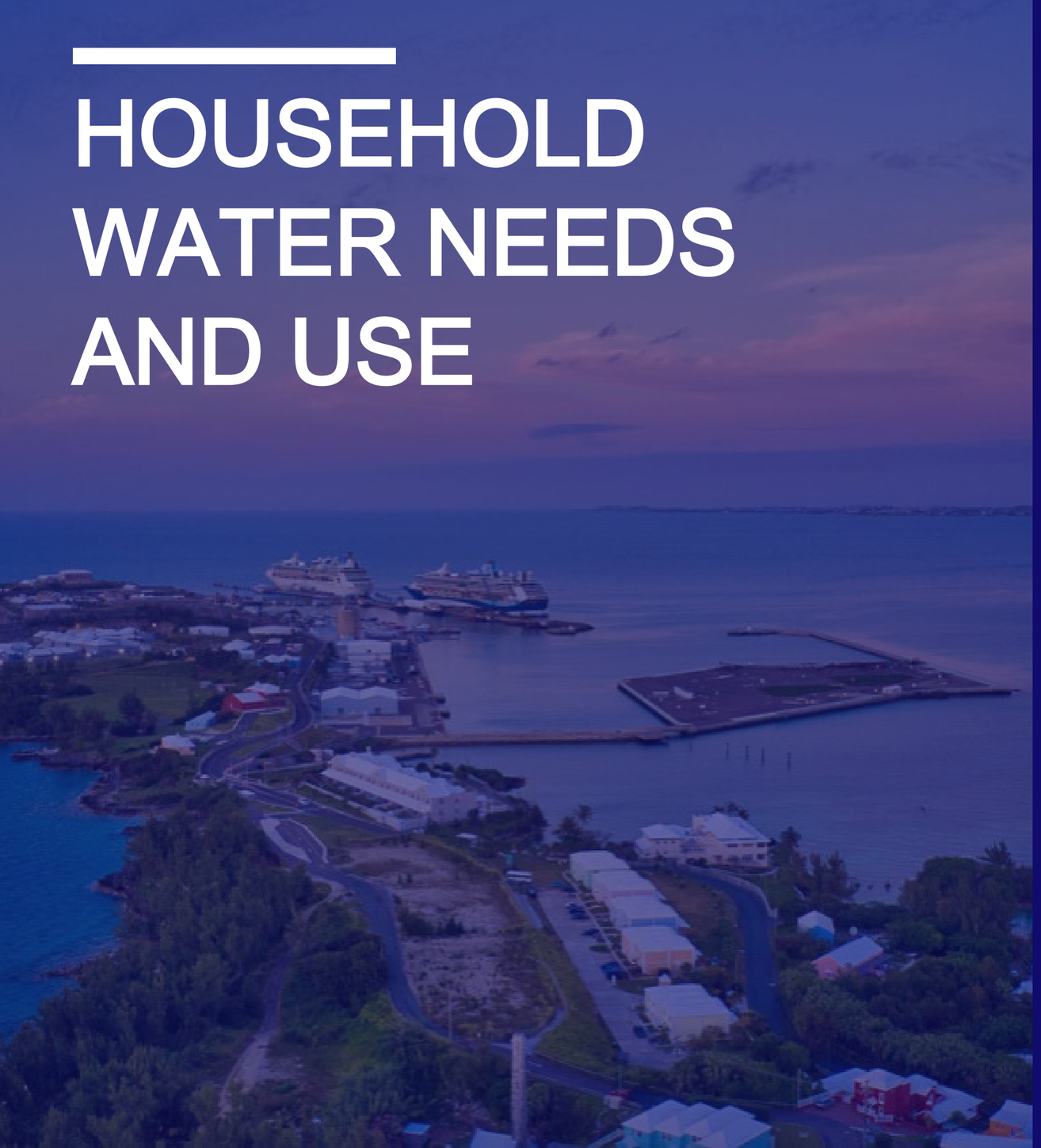
HOUSEHOLD WATER NEEDS AND USE



A 3,000 square foot catchment is estimated to supply 86,580 gallons of water per year. When divided by the number of days in a year, a catchment will only supply 237 gallons of water to use per day.

If the water demand exceeds what is available, the tanks will run dry and supplemental water (for instance from truckers) will have to be obtained .

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Practical Ways to Compensate

(existing structures)

Frugality and modern appliances and fixtures that conserve water.

Install water meters, to monitor consumption, to separate tanks and tank accesses for each dwelling unit or to drill a well to supply flushing water.

Not installing washing machines or dishwashers in every apartment dwelling unit.

Practical Ways to Compensate

(proposed structures)

Reduce proposed occupancy.

Increase the size of the water catchment.

Install a piped water supply service for potable water purposes and a well supply for flushing.

Rainwater Quality & Water Pollution

Rainwater is one of the purest sources of water available and nears distilled water in its purity . Its quality almost always exceeds that of well water . Furthermore, it is subjected to fewer pollutants, such as cesspit recharge and pesticides that may contaminate groundwater . Once rain comes into contact with a roof or catchment surface, the risk of contamination significantly increases .

The Public Health Act, 1949 recognises the potential for contamination and pollution of tank water and empowers authorised officers of the Department of Health to act proactively, rapidly and decisively to remedy situations where the water in a tank appears to be polluted or to be in danger of pollution.

The Department of Health officers may issue an order requiring the tank to be temporarily closed and prohibit the use of its water or they may require the tank be emptied and cleaned or the tank water be chlorinated or otherwise disinfected. Additionally, the Department of Health conducts water analysis services upon request including bacteriological tests of water to detect levels of coliforms conducted.

HYDROGEOLOGY

Our traditional method of water supply continues to provide the vast majority of Bermuda's resident population, however, it was never intended to meet the demand within high occupancy buildings such as hotels. The primary source of the supplementary water continues to be groundwater abstracted from wells. Groundwater exists everywhere in Bermuda at or very close to sea level.

GROUNDWATER LENSES

1972 - 1974

Groundwater hydrology investigations commissioned showed that a total of 1,660 acres of the central parishes were underlain by a substantial fresh water reserve known as Devonshire Lens.

1972 - 1974

Government and commercial water producers abstract groundwater from the Somerset, Port Royal, St. George's and Central lenses.

1975

To ensure overall protection of these resources, the Water Resources Act was passed in 1975.

State of Groundwater Quality and Supply

In February 2000, the Ministry of the Environment commissioned the Bermuda Biological Station for Research (BBSR) to undertake a preliminary survey to look for the presence of pesticide in the groundwaters of Central, St. George's and Port Royal lenses. The areas of focus were those areas of relatively high pesticide application, such as areas underlying golf courses and agricultural land.

The initial results from this study have shown limited contamination of groundwaters .

Water: Use, Resources and Treatment

Use

As there is little manufacturing in Bermuda, the predominant use of water is for domestic purposes and for services related to the tourism industry.

Resources

The primary source of water is rainwater collected by roof catchments followed by private and public supply wells.

Treatment

Brackish water is treated using the process of reverse osmosis. There have been proposals for the inclusion of a desalination plant.

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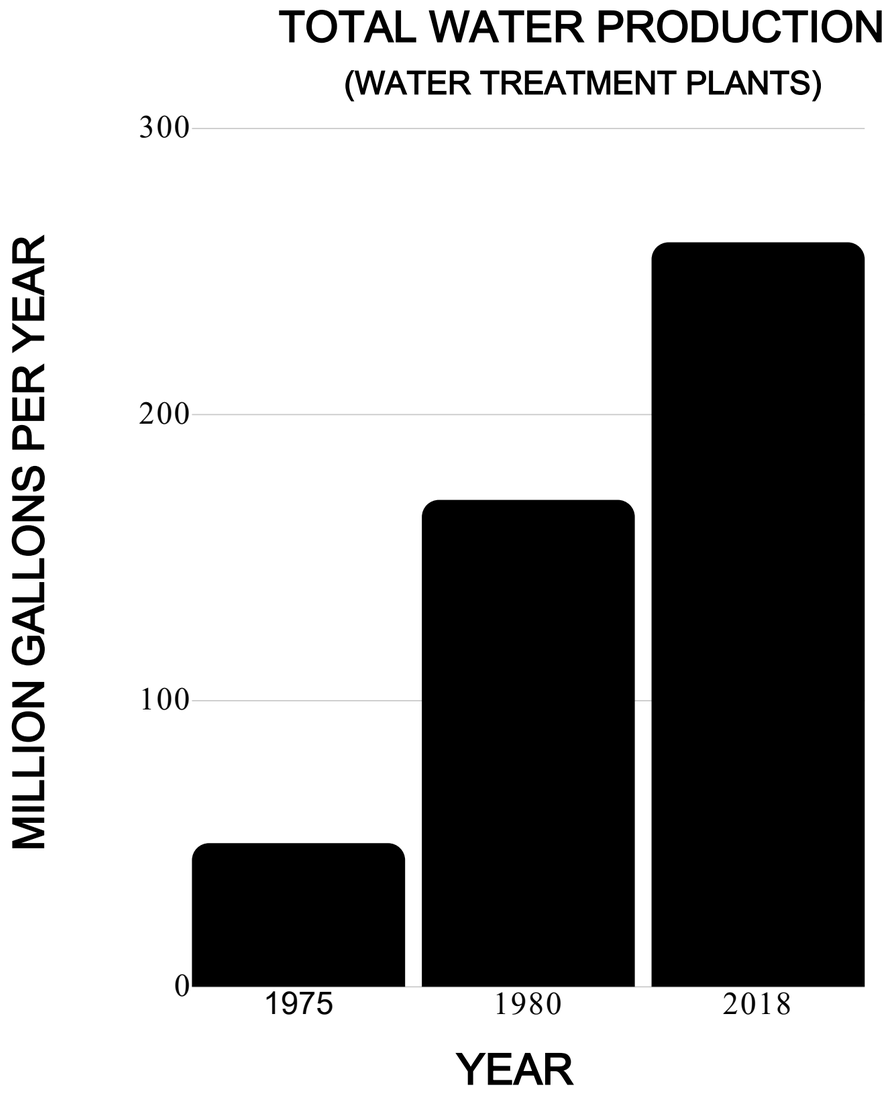
Water Production

(2018)

Bermuda Government
Department of Works and Engineering

- Water produced by four (4) water treatment plants - 260 million imperial gallons/year.
- Total production from Public Works wells - 500 million imperial gallons/year.
- Cost per gallon - $24.00 per 1000 imperial gallons (or $0.024/imperial gallon).
- Total number of customers (metered) active in billing system - 825. Commercial - 74, Residential - 751

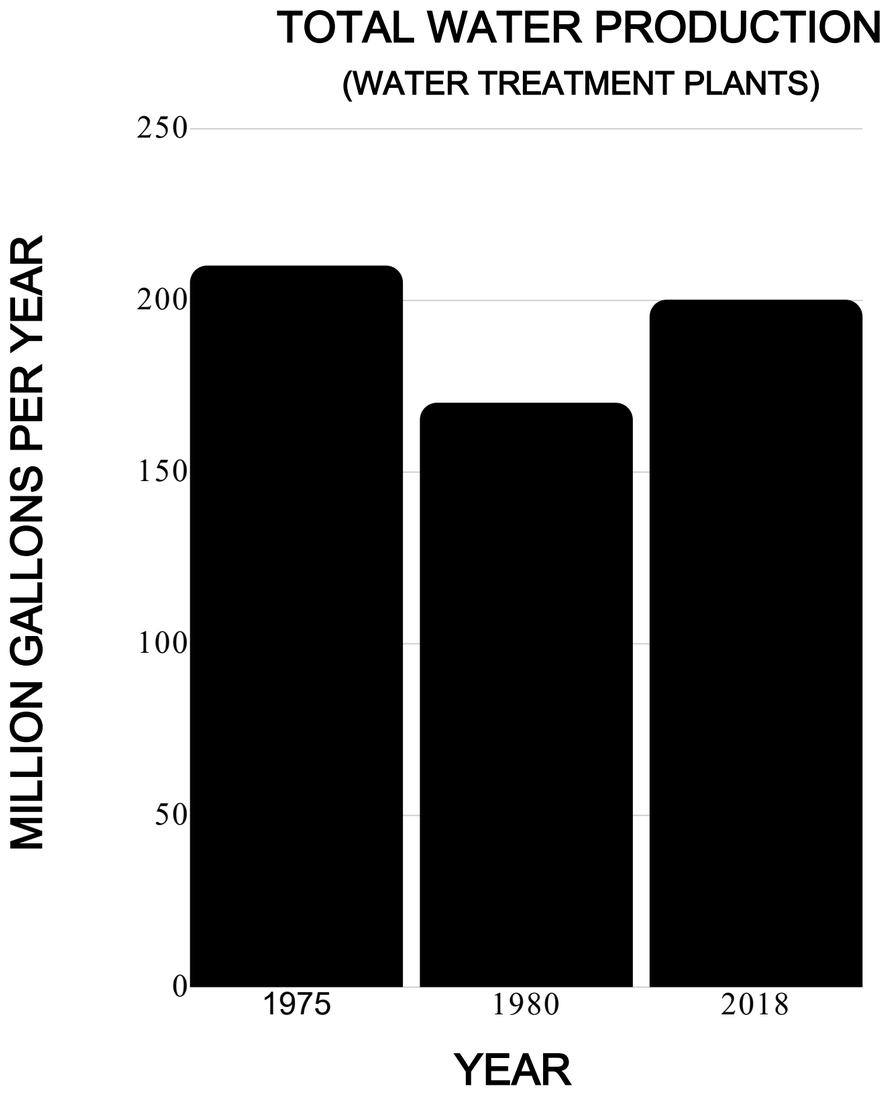


Water Production

(2018)

Bermuda Waterworks Limited
(Watlington Waterworks)

- Total Water Production - 200 million imperial gallons/year.
- Cost per gallon - $35.13 per 1000 imperial gallons (or $0.024/imperial gallon) subject to a 20% discount.
- Total number of customers (metered) active in billing system - 3,000.
- Source of Water - Seawater Reverse Osmosis Plant and a Brackish Water Reverse Osmosis Plant.



CHALLENGES

FOR COLLECTING DATA

Many different sources have critical pieces of information to create the full picture which means getting a comprehensive and well researched position is a timely and bureaucratic process.

WATER SOURCE PROTECTION

Bermuda's groundwater lenses are the most economical sources of supplementary potable water. They should be protected from damage by over-extraction and contamination.

CONSUMPTION CONCERNS

Increased fresh water consumption will require the more costly extraction method of desalinating brackish water and seawater for the government.

MONITORING

The supply and distribution of Bermuda's fresh water resources need to be more extensively monitored and researched.

RECOMMENDATIONS

MAJOR ADVANCES

The limits on abstraction are set under the Water Resouces Act, 1975 and administered by the Ministry of the Environment's Environmental Authority (previously the Water Authority) .

Bermuda's groundwater lenses are protected under the designation of the Water Resources Protection Area (WRPA) Any development proposed within the WRPA is subject to various planning controls to protect the water source .

SEAWATER TREATMENT

Bermuda's largest private water company operates a seawater reverse osmosis plant as they previously reached the limit for groundwater production from their well fields as set by the Environmental Authority .

MODIFYING CONSUMPTION HABITS

More widespread use of seawater for flushin g.
Modified shower heads in hotels / Recycling of waste water at hotels .
Water storage/backup facilities .

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Bermuda Waterworks Limited

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Thank You

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