enwave
ENERGY CORPORATION

Washington Energy Summit 2011

Powering Cities of the Future
Deep Lake Water Cooling

District Energy System

- District energy (heating or cooling) involves the large scale distribution of thermal energy through a pipeline distribution system connecting centralized plants to multiple buildings
- Enwave's district energy system in Toronto is comprised of a:
  - District Heating System
  - Steam Distribution Network
  - District Cooling System
  - Chilled Water Distribution Network

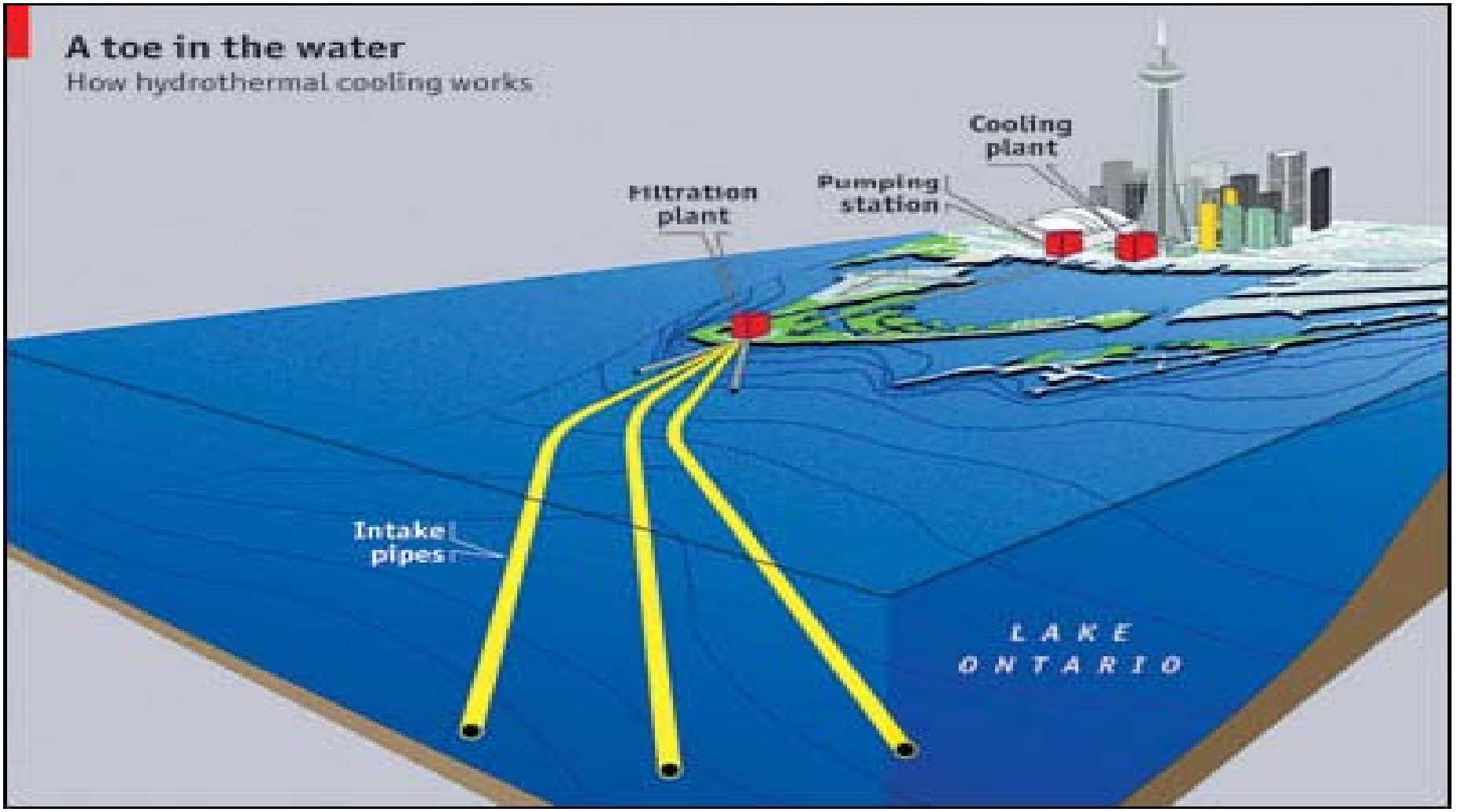
District Heating System

- **3 Steam Plants**:
  - Walton Street: commissioned in 1972, it provides base load energy of 875,000 pounds of steam per hour (pph)
  - Pearl Street: commissioned in 1964, it provides peaking plant energy during heating season of 800,000 pph
  - Queen's Park: re-commissioned in 1995, it provides peaking plant energy during heating season of 210,000 pph
- **Energy Source:** natural gas (fuel oil for back-up)

Steam Distribution Network

- Approximately 2.5 billion pounds of steam were supplied in 2009 to customers through a network of 19.2km of underground steam pipes
- The network serves over 145 buildings in downtown Toronto south of Wellesley Street between John Street and Church Street
- The existing capacity is nearly sold-out

Deep Lake Water Cooling

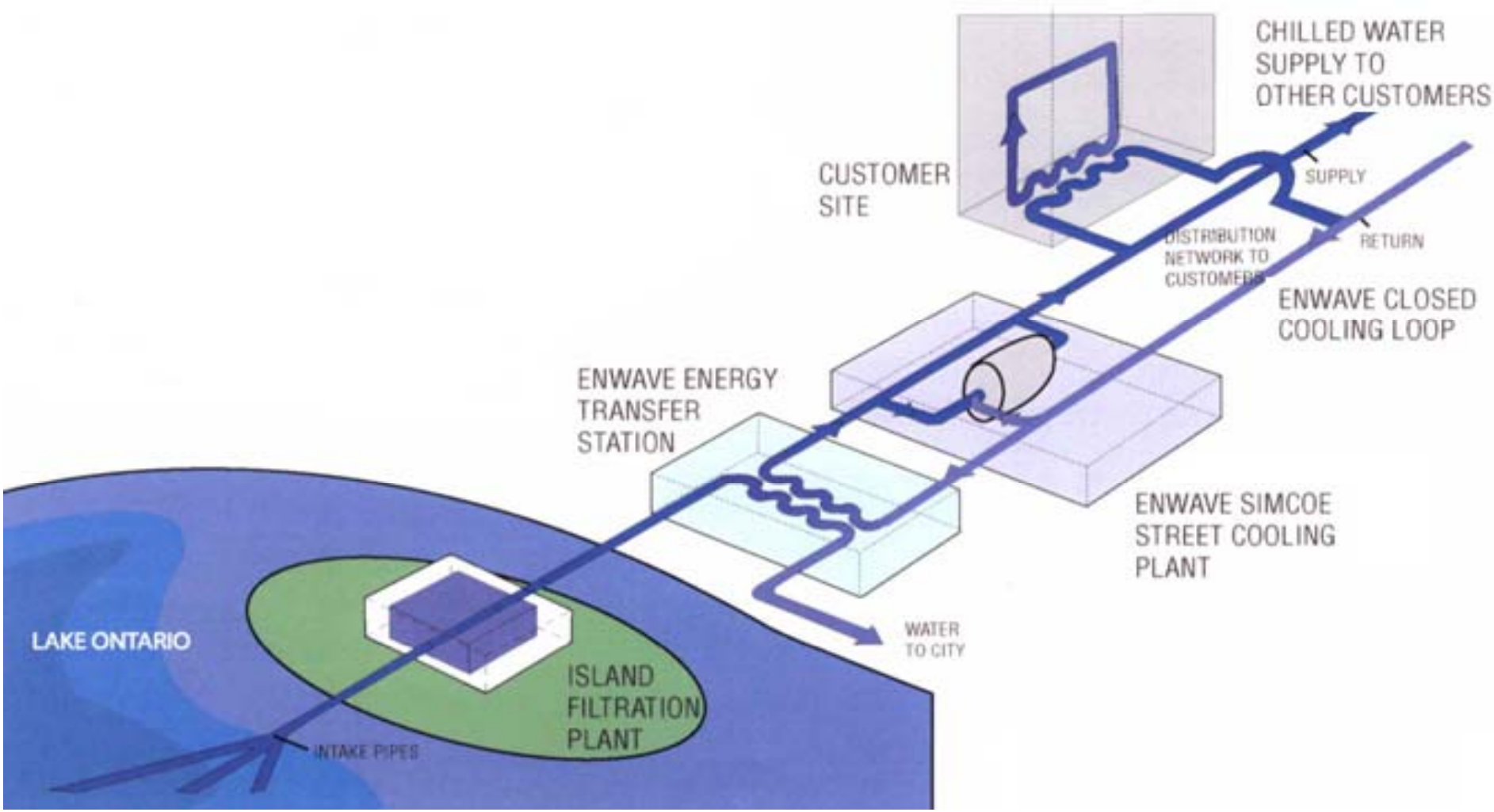


District Cooling System

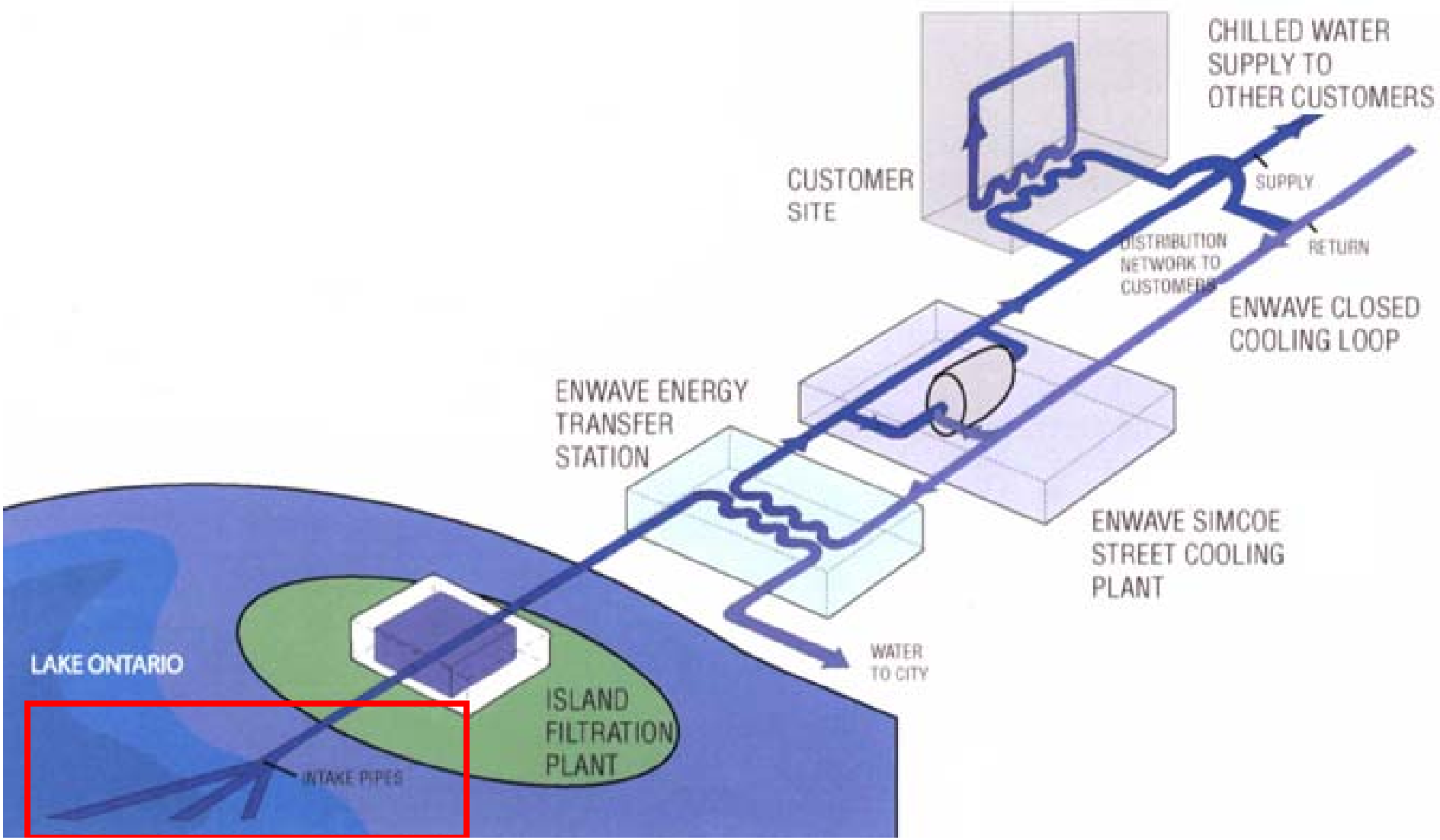
- **Chiller Plant:** commissioned in 1997 and located at the Metro Toronto Convention Centre South Building, it features:
  - Two 4,700 ton steam centrifugal chillers; and
  - Two 2,000 ton electric centrifugal chillers
- **Deep Lake Water Cooling Plant:** commissioned in 2004 and located at the John Street Pumping Station, it features:
  - Three 3 mile long pipes in lake Ontario that bring in to the plant 75,000 tons of cooling capacity; and
  - Heat exchangers facilitate the energy transfer between the cold lake water and Enwave's closed chilled water loop that supplies cold water to customers
  - In building energy transfer stations separate Enwave system and Customer system

SMART ENERGY enwave ENERGY CORPORATION

DLWC Components



Intake Pipes



Intake Pipes/Filtration Plant

- Three concrete encased steel pipes extend 3 miles into Lake Ontario, 280 feet below the surface
- 20 years of marine studies and data had determined that water temperatures at that depth and distance from shore were at a constant temperature of 38° F year round
- New Intake Pipes replaced the need for the City to install expensive carbon filters to protect water quality
- New intakes provided security of supply for City water – deeper and N+1 redundancy
- Water is brought to City's Island Filtration plant, processed and sent to John Street Pumping Station

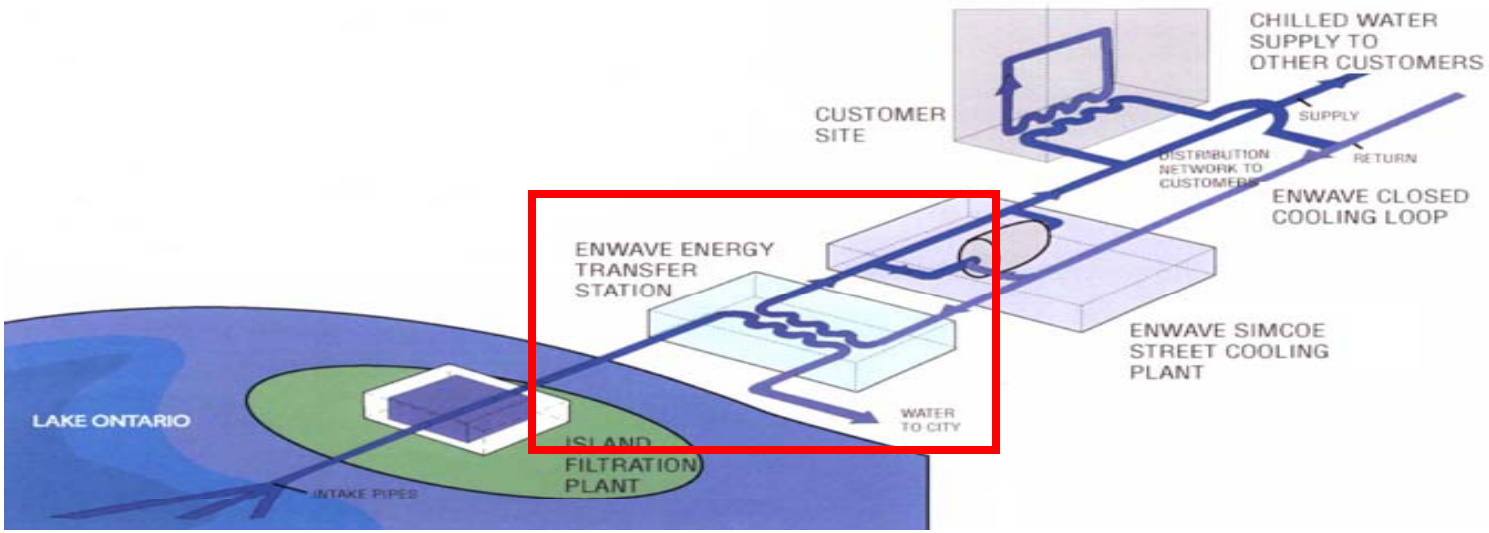
DLWC Components - Intake Pipes

SMART ENERGY
enwave
ENERGY CORPORATION

DLWC Components - Intake Pipes

enwave SMART ENERGY ENERGY CORPORATION

John Street Pumping Station



John Street Pumping Station

John Street Pumping Station

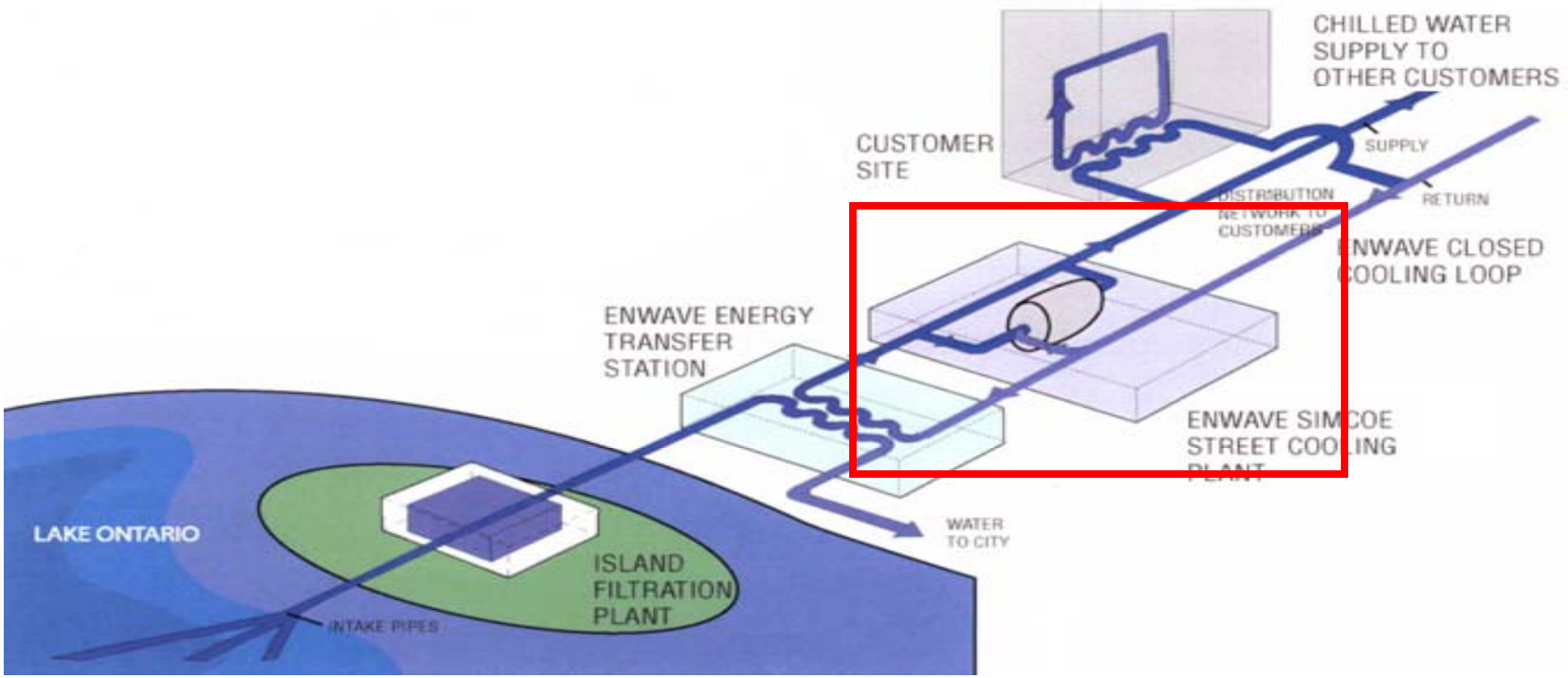
- DLWC provides chilled water to customers through a heat exchange process that occurs at the JSPS which houses Enwave's heat exchangers and the City's potable water pumping infrastructure
- Enwave's closed loop chilled water system and the City's potable water system interface at this location. Water from the two systems never mixes.
- Heat in the 56° F water returned from Enwave's customers is rejected into the cold 38° F filtered lake water through a heat exchange process that occurs across 36 large heat exchangers
- After heat is rejected, City water continues onto the Toronto users at 56° F while Enwave's closed loop water goes to Enwave's Chilled Water Plant at 38° F

JSPS
Heat Exchangers

JSPS – Heat Exchange process

enwave SMART ENERGY ENERGY CORPORATION

Simcoe Street Chilled Water Plant (SSCP)



enwave SMART ENERGY
ENERGY CORPORATION

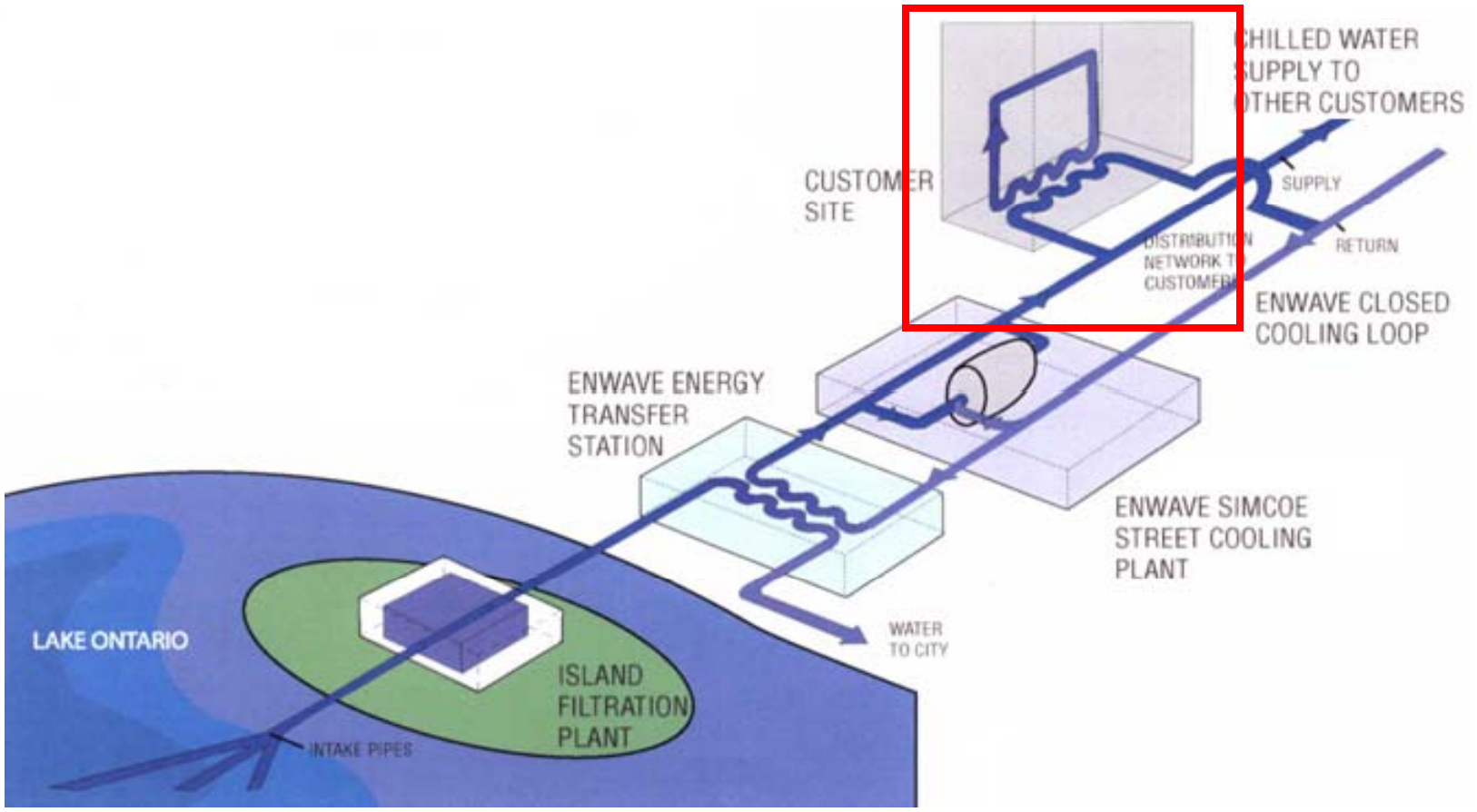
SSCP – Polishing and Back-up Chillers

SMART ENERGY
enwave
ENERGY CORPORATION

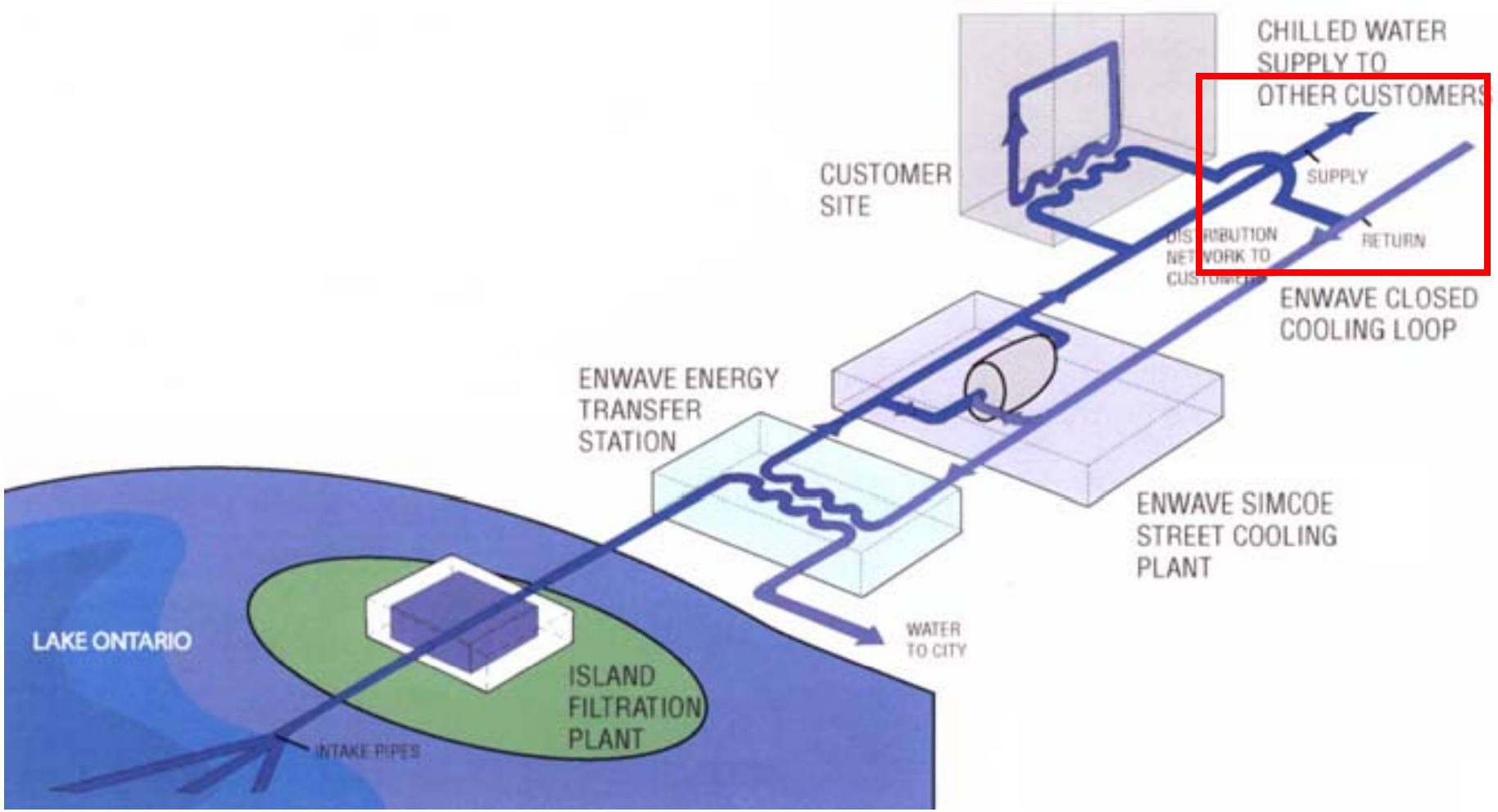
Simcoe Street Chilled Water Plant

- Chillers at the SSCP provide system reliability and additional cooling for peak summers days
- Chiller capacity:
  - Electric Chillers: 4,000TR
  - Steam Chillers: 9,400TR
- 11 MW turbines provide back-up power for the system to ensure reliability
- 24/7 operation by 16 experienced, highly trained full time staff

Customer Sites - Energy Transfer Station



DLWC Distribution Network



Distribution Network

- Almost 18 miles of distribution piping beneath city streets
- 60 feet below the surface at the southern end and 120 feet below the street at the northern-most point
- Serving 64 of Toronto's largest buildings including government, hospitals, commercial and residential customers
- Over 29 million sq. ft connected to the system

Distribution System – Boring Machine

enwave SMART ENERGY ENERGY CORPORATION

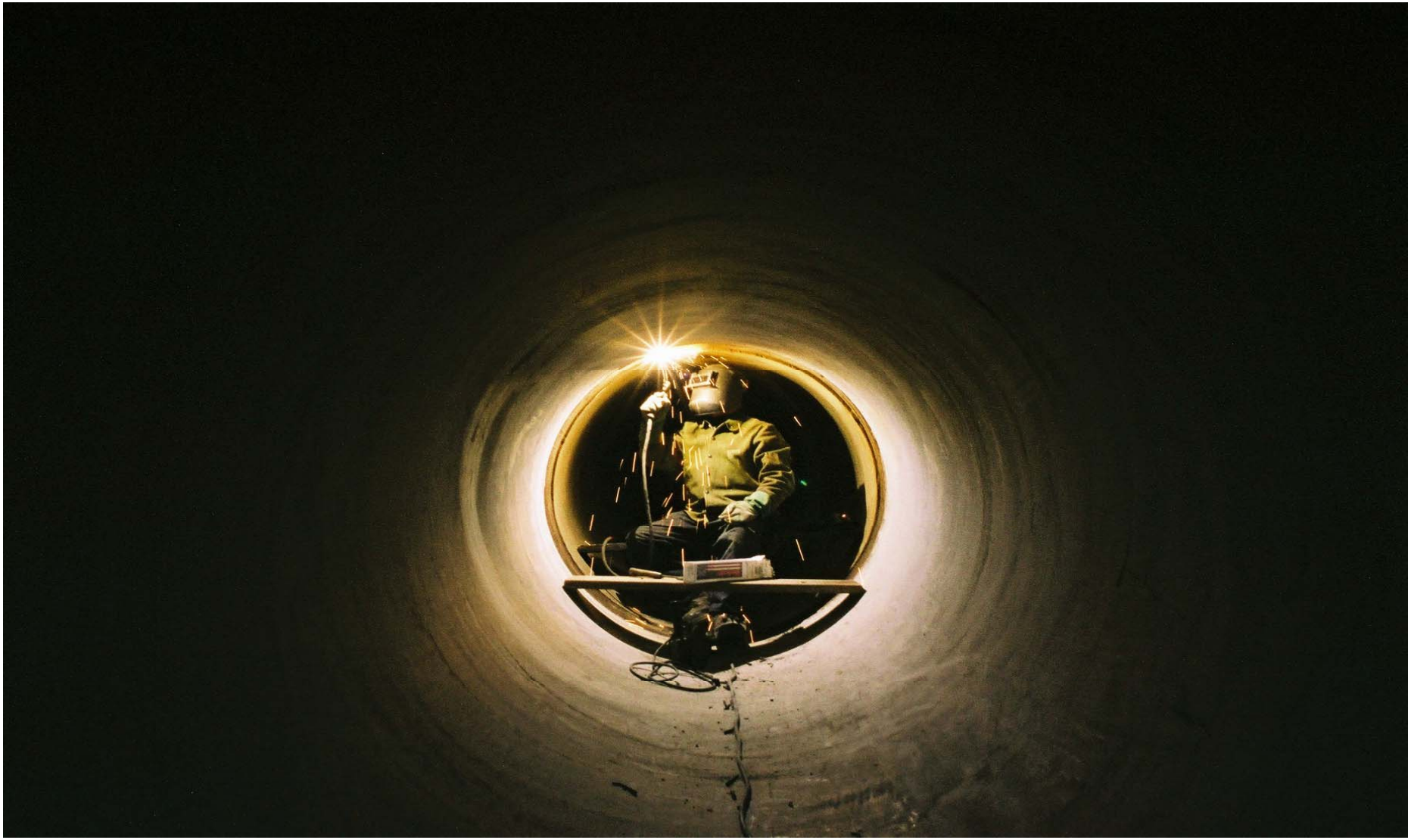
DLWC – Staging Area

SMART ENERGY
enwave
ENERGY CORPORATION

DLWC Distribution Tunnels

enwave SMART ENERGY ENERGY CORPORATION

DLWC Distribution Pipes



DLWC Distribution Tunnels

Customer Contracts

Capacity & Consumption Format

- Capacity Charge ⇨ Fixed Costs
- Consumption Charge ⇨ Variable Costs

No two rate structures are the same

Long Term relationships: (20 Year Contracts)

- Matches Chiller Lifecycle
- Enwave Equipment Amortization

Charges only increase by CPI each year

SMART ENERGY enwave ENERGY CORPORATION

Contracts

Flexible Terms

- Firm Capacity:
  - Entire load is provided by Enwave
- Interruptible:
  - Peak Load provided by customer chillers
  - DLWC provides cooling off peak
- Base Load:
  - Hybrid of Firm and Interruptible

SMART ENERGY enwave ENERGY CORPORATION

Customer Benefits

In House Equipment Maintenance

- Remove Chillers from Service
- No need to switch to Towers for Free Cooling
- New HX need service every 5-7 years

Utilities Savings

- Make-up water for Cooling Towers
- Electrical demand charge for Chiller use
- OPA & City of Toronto Rebates

enwave SMART ENERGY ENERGY CORPORATION

Environmental Benefits

- Electrical use reduced by 90% over chillers
  - City Demand reduced by 61 MW
  - Consumption reduced 85 Million kWh/Yr
  - 173 million kw/th not put in lake from coal plants
  - CO2 Emissions reduced by 79,000 Tonnes/ Year
  - 145 tonnes of Nox reductions
  - 318 tonnes reduction in SOX
  - 714 million litres less water used in cooling towers
- Equivalent of 15,000 vehicles removed form Toronto streets

SMART ENERGY enwave ENERGY CORPORATION