Ke Kahuwai Pono

"The trustee who oversees the rightful sharing of water."

CWRM O'ahu Deep Monitoring Well Briefing

Commission On Water Resource Management Meeting

Honolulu, O'ahu, Hawai'i

August 18, 2020

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O‘ahu Deep Monitoring Well Briefing

Briefing Outline

- Deep Monitoring Well (DMW) purpose
- Number and Location of DMWs currently monitored by CWRM in the Pearl Harbor Aquifer
- Data collection and how the data is used

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- Deep monitor wells penetrate the freshwater basal aquifer into the underlying brackish and salt water. DMWs are used to measure the thickness of the freshwater part of the aquifer (freshwater lens) and the freshwater-saltwater transition zone.

- The vertical profile is divided into four parts:
  - the upper fresh water zone (less than 2% sea water)
  - the transition zone (2% to 50% sea water)
  - into the saline zone (greater than 50% sea water)
  - and where encountered, the sea water interface.

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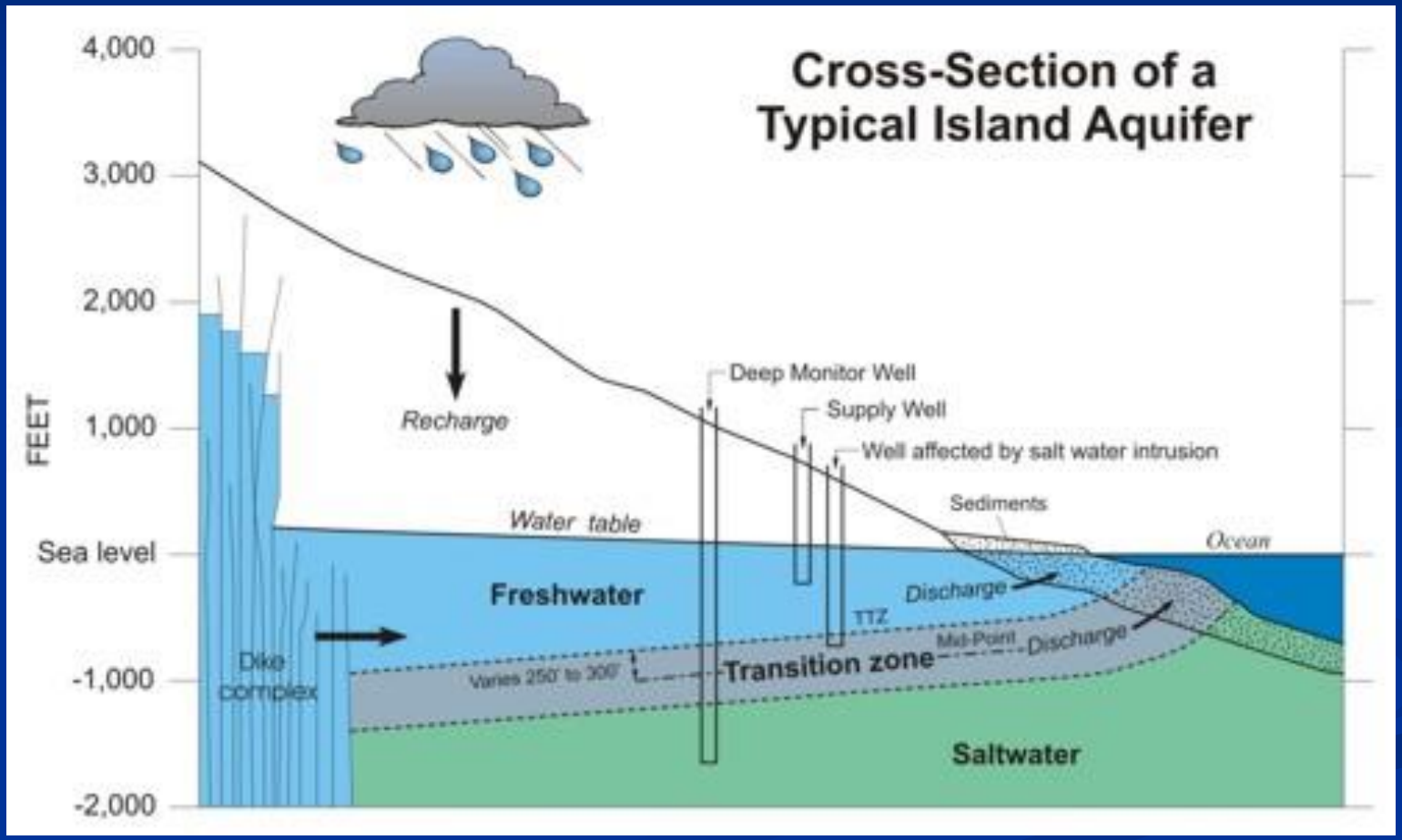

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Number and Location of DMWs currently monitored by CWRM in the Pearl Harbor Aquifer

CWRM currently monitors six (6) DMWs on O‘ahu, all located in the Pearl Harbor aquifer:

1. Waipahu DMW was the earliest of the six DMWs drilled. Originally installed as a municipal supply well in 1926, it was deepened to 1,108 feet in 1980; data collection began in November 1986. This DMW is owned by BWS.
2. Waipio Mauka DMW was installed in 1987.
3. Halawa DMW was installed near the Halawa Correctional Facility in 2000.

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Number and Location of DMWs currently monitored by CWRM in the Pearl Harbor Aquifer

4. Kunia Middle DMW was installed in 2002.
5. Kunia Mauka DMW was installed in 2004.
6. The most recent CWRM DMW, Waimalu DMW, was installed in April 2005.

- The following map shows the locations of the six DMWs.

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Data collection and how the data is used

- Electronic data recorders (or pressure transducers) have been installed in all six DMWs to measure pressure (i.e., water level), and temperature on an hourly schedule.

- During each quarterly visit, the data recorder is retrieved from the well and downloaded to a field laptop for processing. An electronic water level meter is then used to measure the elevation of the water surface in the well.

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Data collection and how the data is used

- An electronic logger that measures conductivity, temperature, and depth (CTD) is then deployed using a winch, to record water quality data throughout the water column.
- The CTD logger collects data at a rate of three data points per second as it is lowered through the water column.
- Upon retrieval of the CTD, the data is downloaded to a field laptop for transfer to the CWRM server, where it is processed and plotted as a profile of conductivity and temperature vs depth.

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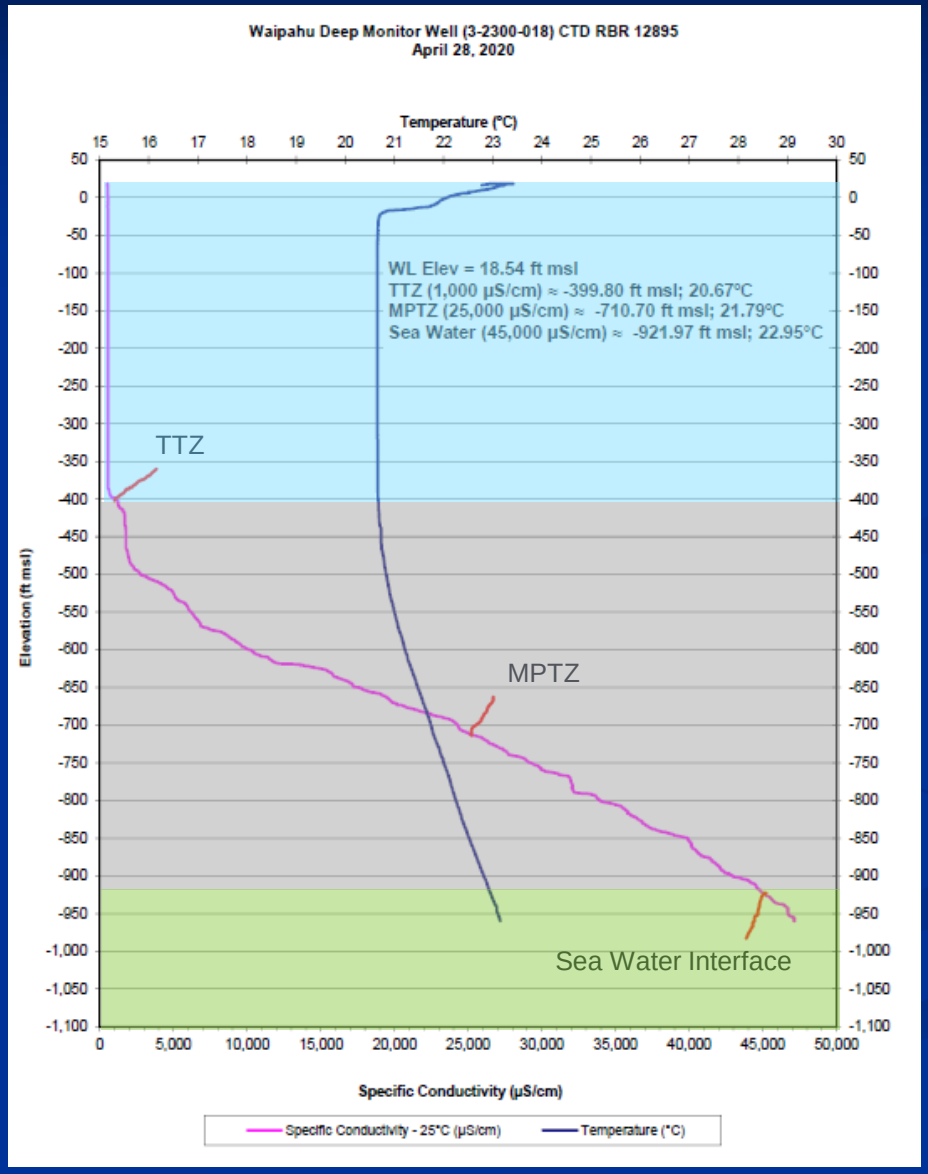
Typical CTD Profile (Waipahu DMW 4-28-2020)



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Data collection and how the data is used

- CWRM plots time-series graphs showing the changes in elevation (relative to mean sea level) for the following data:
- Water level
- Top of transition zone TTZ (2% seawater, or 1,000 µS/cm or 250 mg/l cl^-)
- Midpoint of transition zone MPTZ (50% seawater, or 25,000 µS/cm or 9,500 mg/l cl^-)
- Sea water interface (100% seawater , or 45,000 µS/cm or 19,000 mg/l cl^-)

These time-series plots are posted to our website:
https://dlnr.hawaii.gov/cwrm/groundwater/monitoring/

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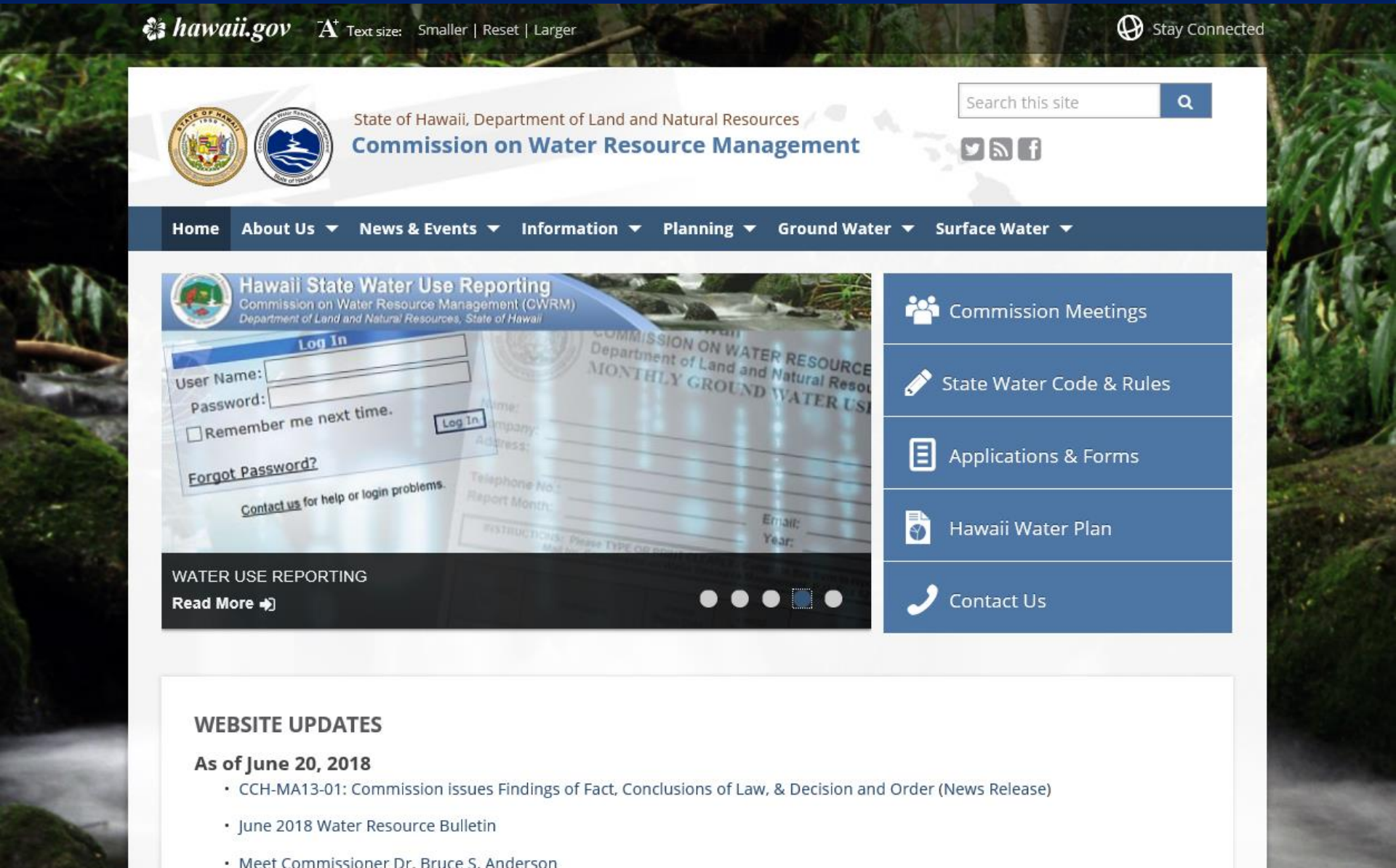

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MONITORING DATA

The Commission on Water Resource Management's Survey Branch is responsible for collecting basic hydrologic data and conducting water availability and sustainable yield analyses statewide. The information presented below highlights some of the Commission's monitoring activities essential to the protection of Hawaii's water resources. The U.S. Geological Survey also collects water level and deep monitor well data through cooperative agreements with CWRM and other government agencies. The Honolulu Board of Water Supply also has a network of water level and deep monitor wells on Oahu.

Deep Monitor Well Data

A deep monitor well penetrates the freshwater basal aquifer into the underlying brackish and salt water. It is used to estimate the thickness of the freshwater part of the aquifer (freshwater lens) and the freshwater-saltwater transition zone. For convenience, the vertical profile is divided into three parts: the upper fresh water zone (less than 2% sea water), the transition zone (2% to 50% sea water), and into the saline zone (greater than 50% sea water). The data are presented as graphs of the changes in elevation (feet, mean sea level) of the top of the transition zone (2% seawater) and the midpoint of the transition zone (50% seawater) over time.

INFORMATION INDEX

- Information
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Symbols:
➽ indicates an external website link
✇ indicates a video link

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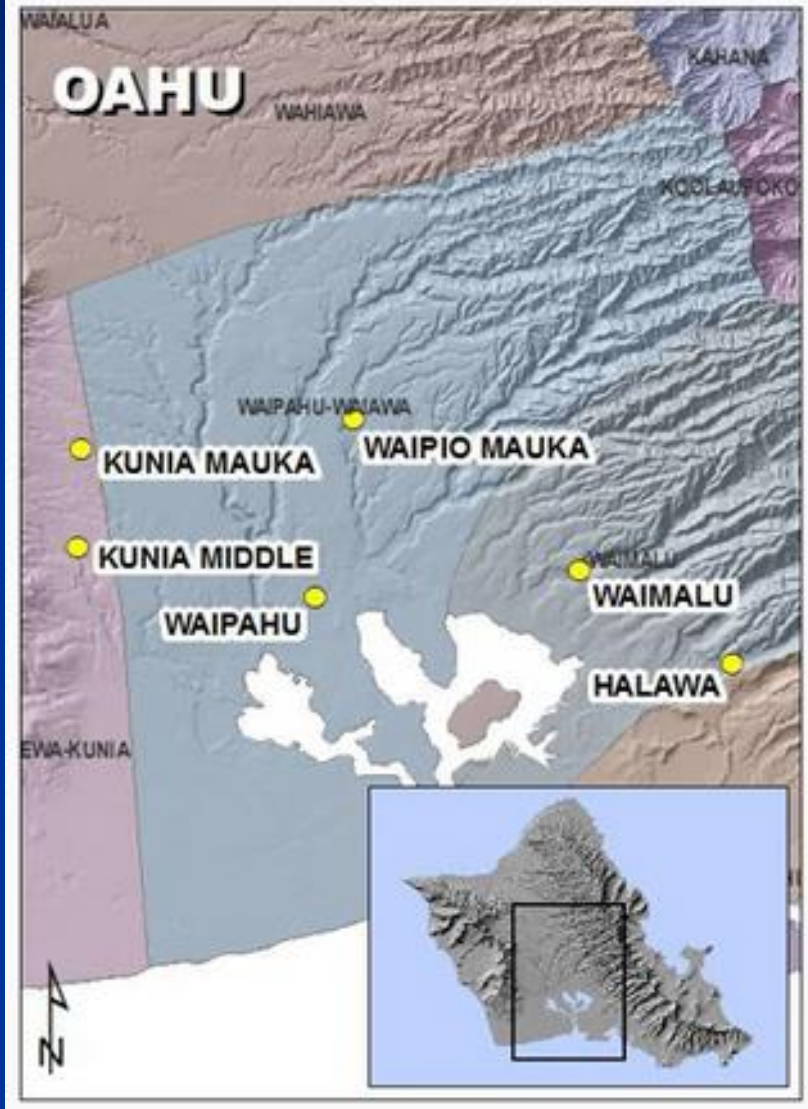

OAHU WELLS

- Halawa
- Kunia Mauka
- Kunia Middle
- Waimalu
- Waipahu
- Waipio Mauka

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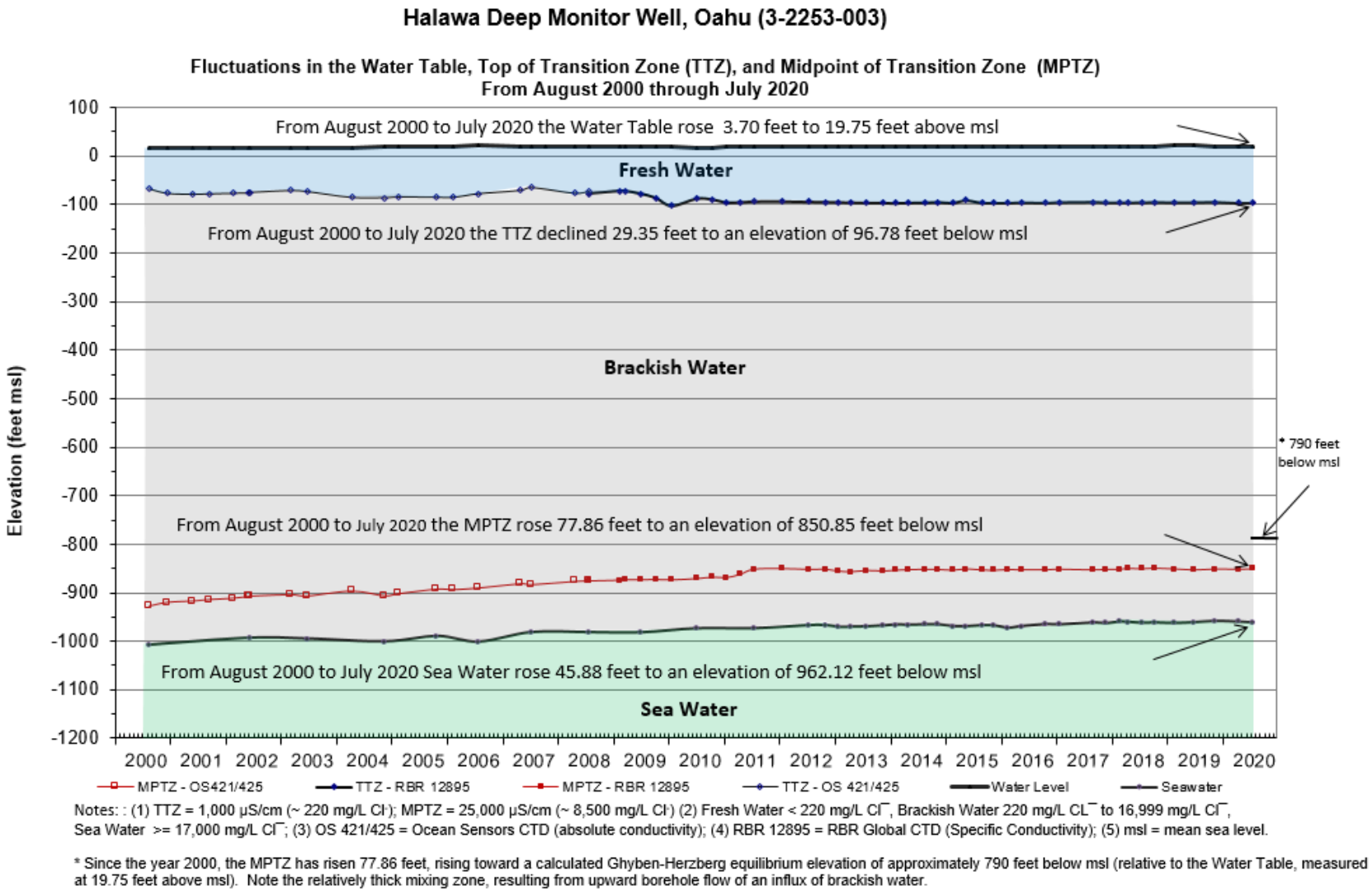

Notes: : (1) TTZ = 1,000 µS/cm (~ 220 mg/L Cl^-); MPTZ = 25,000 µS/cm (~ 8,500 mg/L Cl^-) (2) Fresh Water < 220 mg/L Cl^-, Brackish Water 220 mg/L CL^- to 16,999 mg/L Cl^-, Sea Water >= 17,000 mg/L Cl^-; (3) OS 421/425 = Ocean Sensors CTD (absolute conductivity); (4) RBR 12895 = RBR Global CTD (Specific Conductivity); (5) msl = mean sea level.

* Since the year 2000, the MPTZ has risen 77.86 feet, rising toward a calculated Ghyben-Herzberg equilibrium elevation of approximately 790 feet below msl (relative to the Water Table, measured at 19.75 feet above msl). Note the relatively thick mixing zone, resulting from upward borehole flow of an influx of brackish water.

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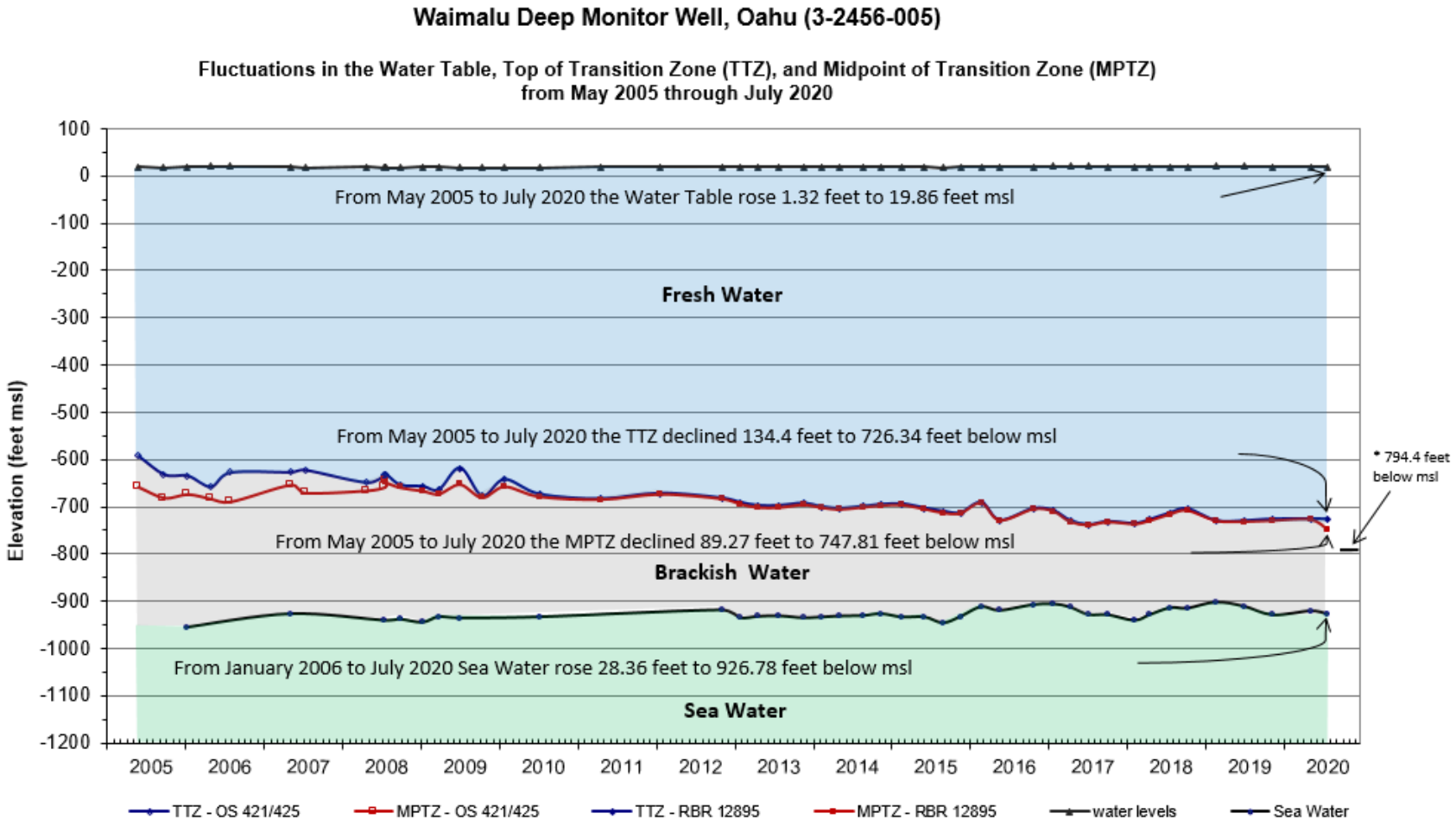

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* Since the year 2005, the MPTZ has declined 89.27 feet toward a calculated Ghyben-Herzberg equilibrium elevation of approximately 788 feet below msl, relative to the Water Table measured at 19.86 feet above msl.

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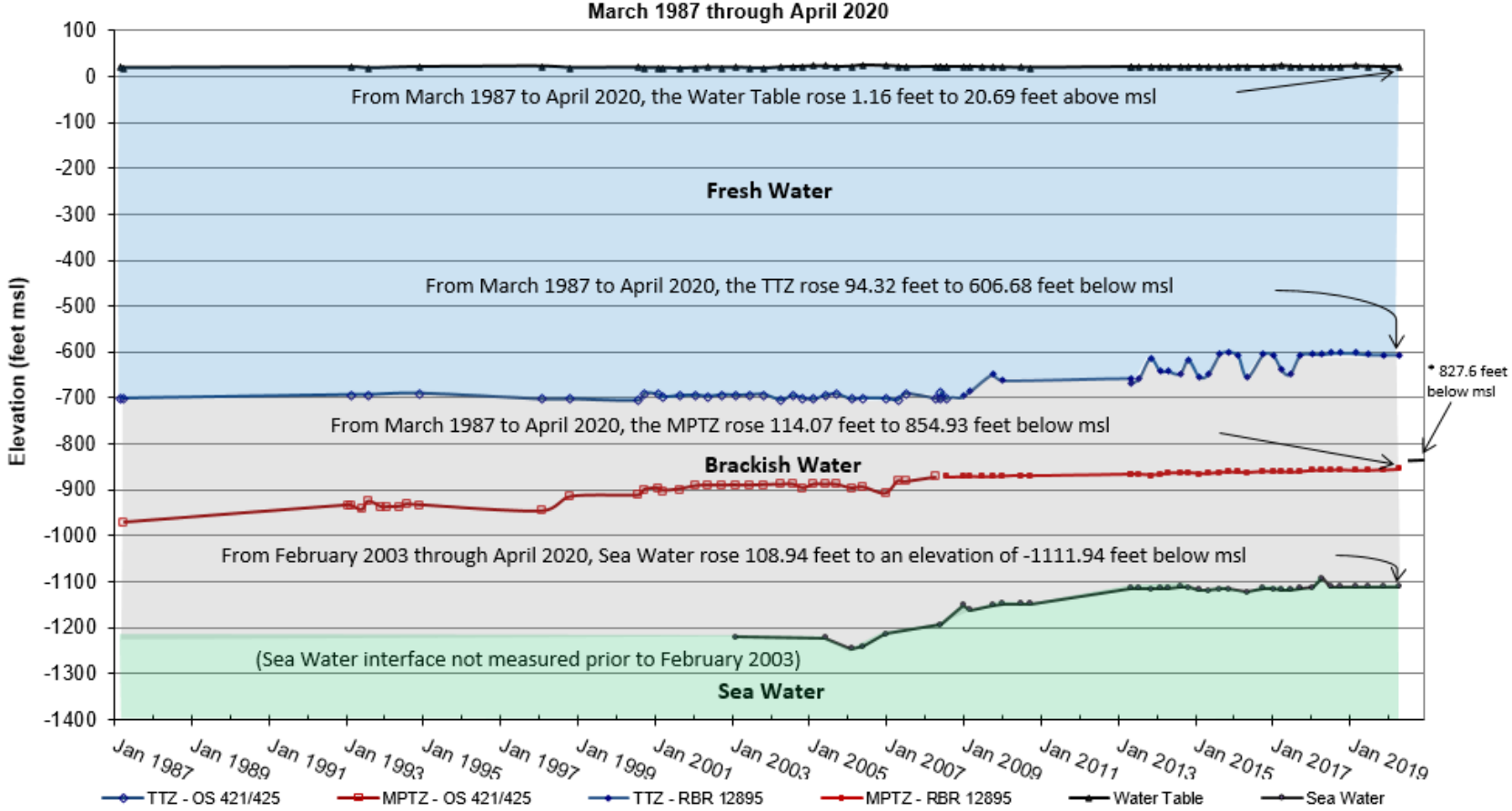

Notes: (1) TTZ = 1,000 µS/cm (~ 220 mg/L Cl⁻); MPTZ = 25,000 µS/cm (~ 8,500 mg/L Cl⁻) (2) Fresh Water < 220 mg/L Cl⁻, Brackish Water 220 mg/L Cl⁻ to 16,999 mg/L Cl⁻, Sea Water >= 17,000 mg/L Cl⁻; (3) OS 421/425 = Ocean Sensors CTD (absolute conductivity); (4) RBR 12895 = RBR Global CTD (Specific Conductivity); (5) msl = mean sea level

* Since the year 1987, the MPTZ has risen 114.07 feet, to below a calculated Ghyben-Herzberg equilibrium elevation of approximately 827.6 feet below msl, relative to the Water Table measured at 20.69 feet above msl.

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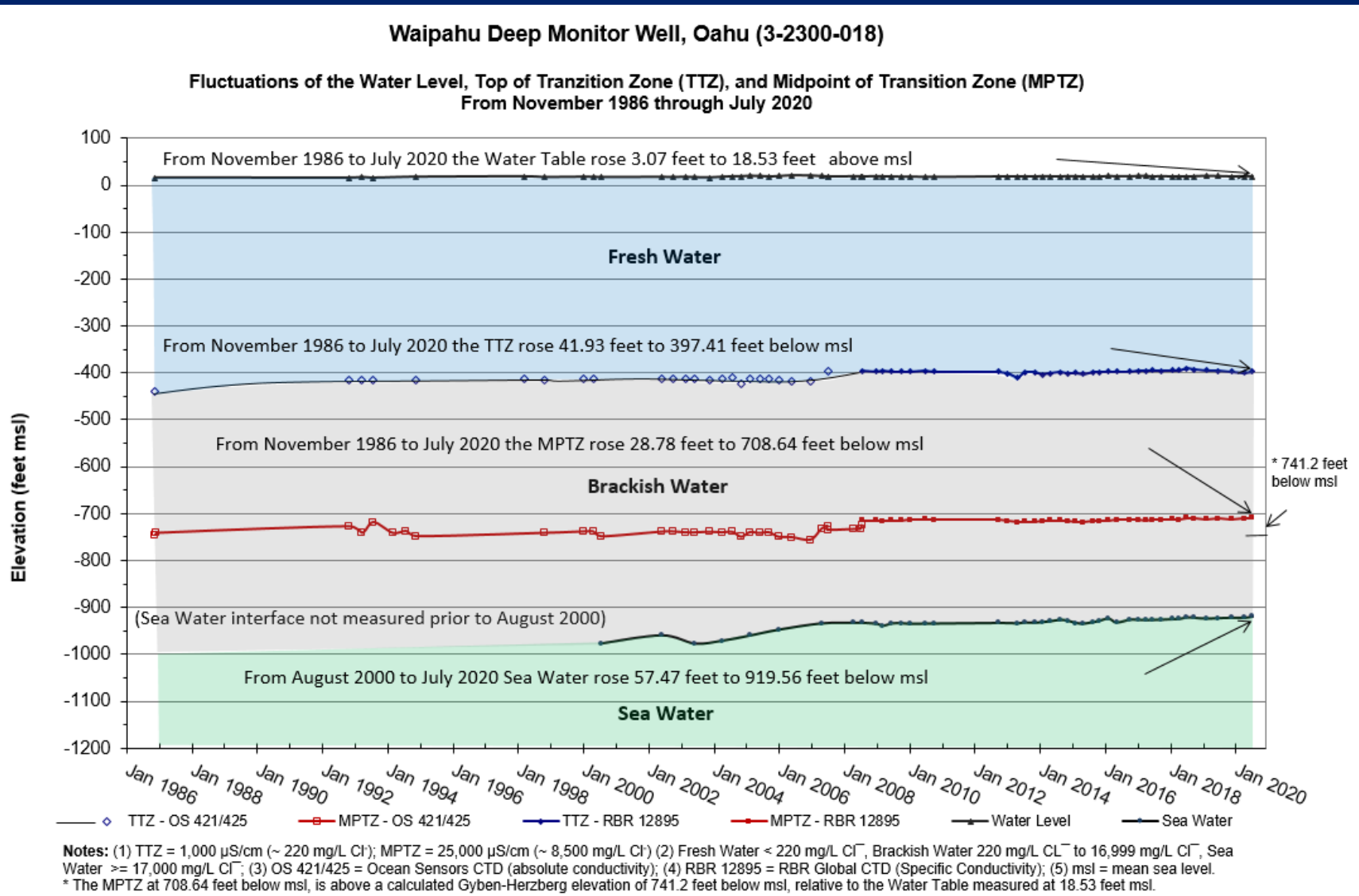

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* The MPTZ at 708.64 feet below msl, is above a calculated Gyben-Herzberg elevation of 741.2 feet below msl, relative to the Water Table measured at 18.53 feet msl.

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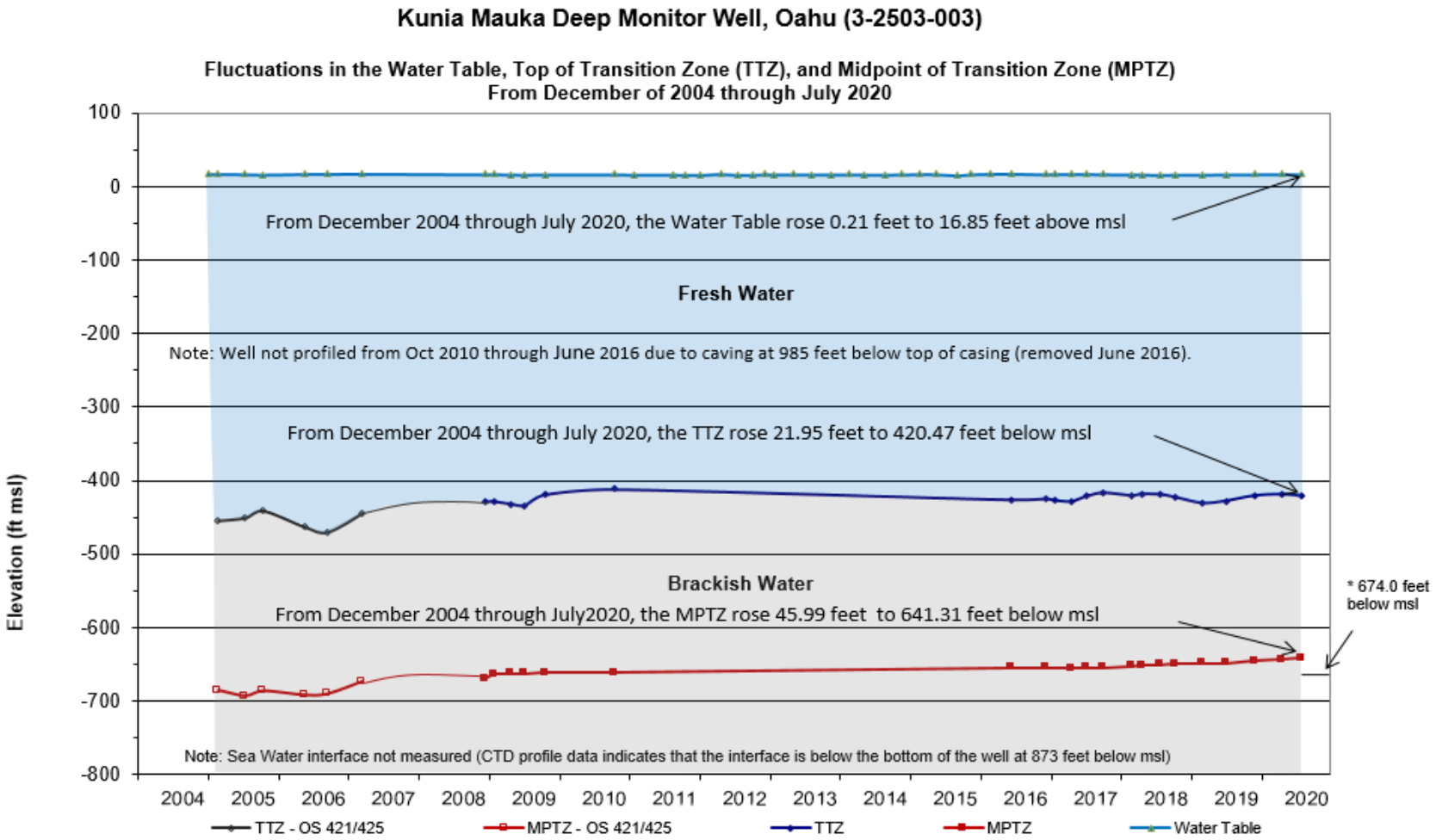

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* Since the year 2004, the MPTZ has risen 46 feet to an elevation of 641.31 feet below msl, where it is above a calculated Ghyben-Herzberg equilibrium elevation of 674 feet below msl, relative to the Water Table measured at 16.85 feet above msl.

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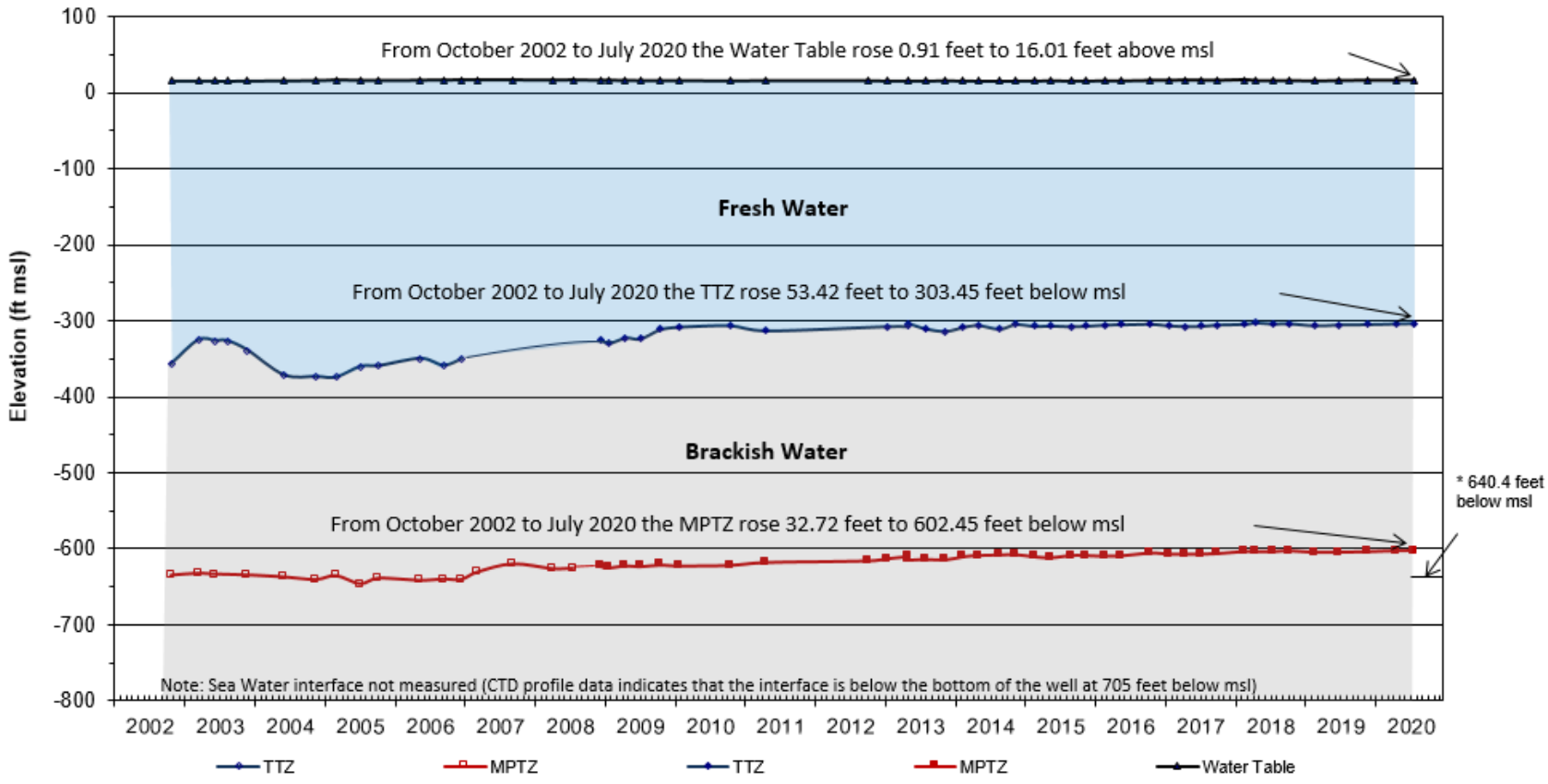

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* Since the year 2002, the MPTZ has risen 32.72 feet to an elevation of 602.45 feet msl, where it is higher than the calculated Ghyben-Herzberg elevation of 640.4 feet below msl, relative to the Water Table measured at 16.01 feet above msl.

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Data collection and how the data is used

In summary, the data collected to date in the six DMWs have measured rising water levels in all six wells, indicating a general thickening of the fresh water aquifer, likely due to reduced pumpage from O‘ahu Sugar closing operations in 1995.

- Halawa DMW +3.70 feet from August 2000 to July 2020
- Waimalu DMW +1.32 feet from May 2005 to July 2020
- Waipahu DMW +3.07 feet from November 1986 to July 2020
- Waipio Mauka DMW +1.11 feet from March 1987 to Aug 2020
- Kunia Mauka DMW +0.21 feet from December 2004 to Aug 2020
- Kunia Middle DMW +0.91 feet from October 2002 to Aug 2020

The top of transition zone (TTZ) borders in the Halawa and Waimalu DMWs show a gentle downward (thickening) trend, as does the MPTZ in Waimalu DMW. The remaining four DMWs show a gentle rise in both TTZ and MPTZ over the history of data collection.

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Data collection and how the data is used

In addition, given the generally remote locations of the DMWs, away from pumping wells, the water level data collected to date in the six DMWs has been evaluated for statistical criteria, to be used as aquifer condition indicators for the proposed Pearl Harbor Water Shortage Plan (PHWSP).

The mean water level was calculated for all six DMWs. Standard Deviations (SD) were then calculated. The -1, -2, and -3 SD have been incorporated into the PHWSP as water shortage triggers.

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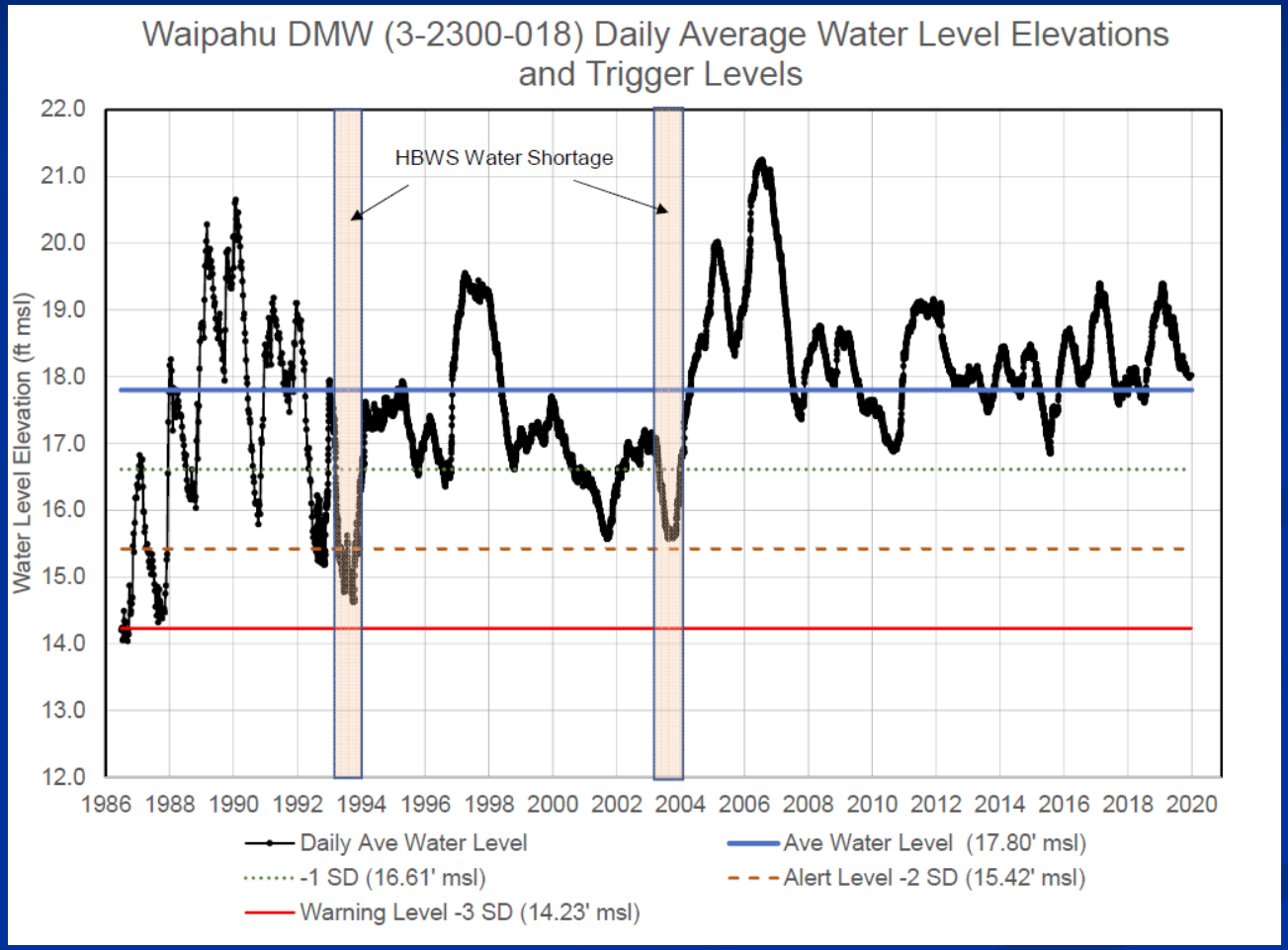
Data collection and how the data is used



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