



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

October 3, 2016

This report serves as the written testimony summarizing the work conducted by the Commission on Water Resource Management (CWRM) in establishing, implementing, and monitoring measurable interim instream flow standards (IIFS) for the four hydrologic units comprising Nā Wai ‘Ehā, Central Maui: Waikapū, Wailuku, Waiehu, and Waihee. This is in response to the Petition to Amend the Interim Instream Flow Standards in Nā Wai ‘Ehā (Petition) by EarthJustice on behalf of Hui o Nā Wai ‘Ehā and the Maui Tomorrow Foundation. The Commission on Water Resource Management (Commission) initiated contested case hearings (CCH) in 2006 to address water use permit applications with Dr. Lawrence Miike, who was on the Commission at the time, as Hearings Officer. Following the unsuccessful mediation of the waste complaint portion of the Petition, the CCH began in December 2007 and concluded in March 2008. In April 2009, the Hearings Officer submitted his proposed Findings of Fact (FOF), Conclusions of Law (COL), and Decision and Order (D&O), and in June 2010, the Commission issued its FOF, COL, and D&O, amending the IIFS to Waihee and Waiehu streams, while retaining the existing values for Wailuku and Waikapū streams. Following this decision, the Commission contracted with the United States Geological Survey (USGS) to establish monitoring locations and develop rating curves to support CWRM in the implementation of these 2010 IIFS values. At the same time, the decision to not amend the IIFS values for Wailuku and Waikapū streams was appealed up to the Hawai‘i Supreme Court, which ruled that the Commission must consider ecosystem services, habitat for native biota, and traditional and customary practices in establishing IIFS values. Before a second CCH was held, the parties agreed on a mediated settlement of additional IIFS values for Wailuku and Waikapū streams in April 2014, which were then recommended by the Hearings Office and approved by the Commission. Following this decision, CWRM staff began to implement a monitoring program on the Wailuku and Waikapū streams in fall 2014. Thus some IIFS values in Nā Wai ‘Ehā were established in 2010 and some in 2014, which results in the discrepancy in periods of record among the monitoring stations.

Overview of Results

The implementation of a monitoring program to collect data concerning the maintenance of IIFS values is dependent on the same principles as maintaining a series of gaging stations to monitor natural stream flow. Reliable data is dependent on an appropriate reach with an established control and an updated rating curve coupled with dependable equipment. Unfortunately, many reaches below diversions in Nā Wai ‘Ehā are not suitable for monitoring stream flow without substantial alteration. Further, after monitoring stations were established and measurements were made to generate a rating curve by the USGS, a lack of CWRM staff limited the maintenance of these gaging efforts from 2011 to 2014. In some instances, the reach may have changed or the control shifted, resulting in a change in the rating curve. In 2014, CWRM staff began to update the rating curve for each monitoring station, which has improved the reliability of data gathered. For each hydrologic unit, a map detailing the location of the IIFS point(s) and the monitoring station is included. The fieldwork that has gone into establishing and maintaining each CWRM monitoring station is detailed followed by the current rating curve. A graphical representation of

mean daily flows measured since station establishment for each IIFS with a reference station is included for the same period of record. Standard descriptive statistics are provided in the text for the period of record. Table 1 breaks down the estimated natural flow, the estimated or measured regulated flow, and the amount of flow diverted at specific locations throughout Nā Wai 'Ehā. Estimated regulated flows are based on Oki et al. 2010 and measured regulated flows are based on CWRM monitoring stations. Flows diverted are based on mean monthly reported values by the diversion operator.

This report was prepared by Dr. Ayrton M. Strauch, Hydrologic Program Manager for CWRM's Stream Protection and Management Branch. Should you have any questions, please contact Ayrton Strauch by email at ayron.m.strauch@hawaii.gov

WAIKAPŪ HYDROLOGIC UNIT

Fieldwork Timeline- Site 6-86: Waikapū at 600 ft

8/2014	Staff plate installation
9/3/2014	CWRM staff measured flow
9/4/2014	CWRM staff measured flow
9/24/2014	CWRM staff measured flow
10/6/2014	CWRM staff measured flow
10/13/2014	CWRM staff measured flow
10/14/2014	CWRM staff measured flow
10/23/2014	CWRM staff measured flow
11/20/2014	WWC moved boulder in channel
	CWRM installed pressure transducer
	CWRM staff measured flow
12/3/2014	CWRM staff measured flow
12/15/2014	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
12/16/2014	CWRM staff measured flow
2/11/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
3/23/2015	WWC modified channel
	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
3/24/2015	CWRM staff measured flow
5/5/2015	New staff plate installation
5/19/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
6/18/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
8/18/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
10/14/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
12/16/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
1/22/2016	CWRM staff measured flow

	CWRM staff downloaded pressure transducer
4/8/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
6/7/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
9/8/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer

Fieldwork Timeline- Site 6-88: Waikapū at 915 ft

9/3/2014	CWRM staff measured flow
12/3/2014	CWRM staff measured flow
12/15/2014	CWRM staff measured flow
2/11/2015	CWRM staff measured flow
3/23/2015	CWRM staff measured flow
3/24/2015	CWRM staff measured flow
5/19/2015	CWRM staff measured flow
6/18/2015	CWRM staff measured flow
6/7/2016	CWRM staff measured flow

IIFS Monitoring Summary

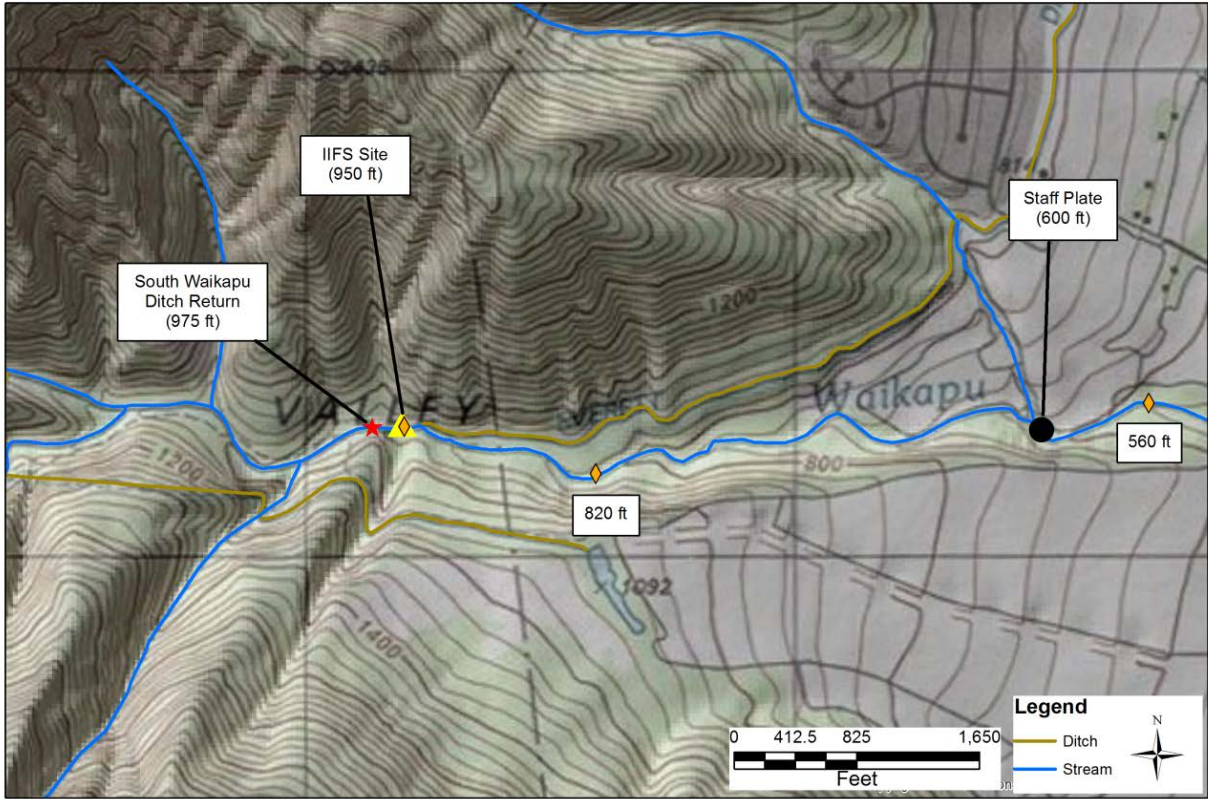
The mediated amended IIFS location is at an elevation of 950 ft, below the return of water from the South Waikapū Ditch to Waikapū Stream and above the Everett Ditch intake at 920 ft. Due to the slope and composition of the stream, this reach is not suitable for monitoring or measuring. A location at 915 ft is used for measuring stream flow as the channel cross-section is more suitable, and a monitoring station (staff plate) has been installed on Waikapū Stream at an elevation of 880 ft. The Everett Ditch intake has been sealed by steel plates, although a small amount of water enters the ditch at this location and returned to the stream at the first control point immediately below the 880 ft elevation location. For ease of access and monitoring, a second location was established at an elevation of 600 ft (CWRM ID 6-86) such that the ditch managers may directly read flow values on a daily basis. The IIFS value at station 6-86 is assumed to be 2.9 mgd.

Following the installation of a staff plate for reading stream stage (height) at the monitoring location (6-86), field measurements were made to establish a rating curve in order to convert stream stage to discharge (Figure 2A). A pressure transducer with an internal data logger was then installed to measure and record stream stage on hourly intervals. Following a large flow event in April 2015, the control point shifted in the stream, forcing the relocation of the monitoring station 10 feet upstream and the development of a new rating curve (Figure 2B). This new curve was used from May 2015 to present.

Hourly stage data were converted to mean daily discharge (Figure 3). Mean and median discharge values for the period of monitoring (November 20, 2014 to September 8, 2016) were 5.61 mgd and 4.17 mgd,

respectively, with a standard deviation of 4.41 mgd. The upper quartile (75th Percentile) and lower quartile (25th Percentile) discharges were 6.18 mgd and 2.85 mgd, respectively.

Nine seepage runs between the 915 ft and 600 ft elevation stations were conducted between December 2014 and June 2016. Discharge was also measured in the Everett Ditch to estimate the small amount of water by-passing the measuring station before returning to the stream. Of these nine seepage runs, five occurred during variable flow conditions and were not included. For the other four measurements, three exhibited a small gain in flow between the upper station and the lower station, while one exhibited a small loss. The mean change in flow between stations for these four measurements was 0.28 mgd and represented 3.9% of flow at the upper station.



Prepared by the Department of Land and Natural Resources
Commission on Water Resources Management
UTM Zone 4, NAD 1983

Figure 1. Waikapū Stream with various elevations and monitoring locations related to the amended interim instream flow standard (IIFS).

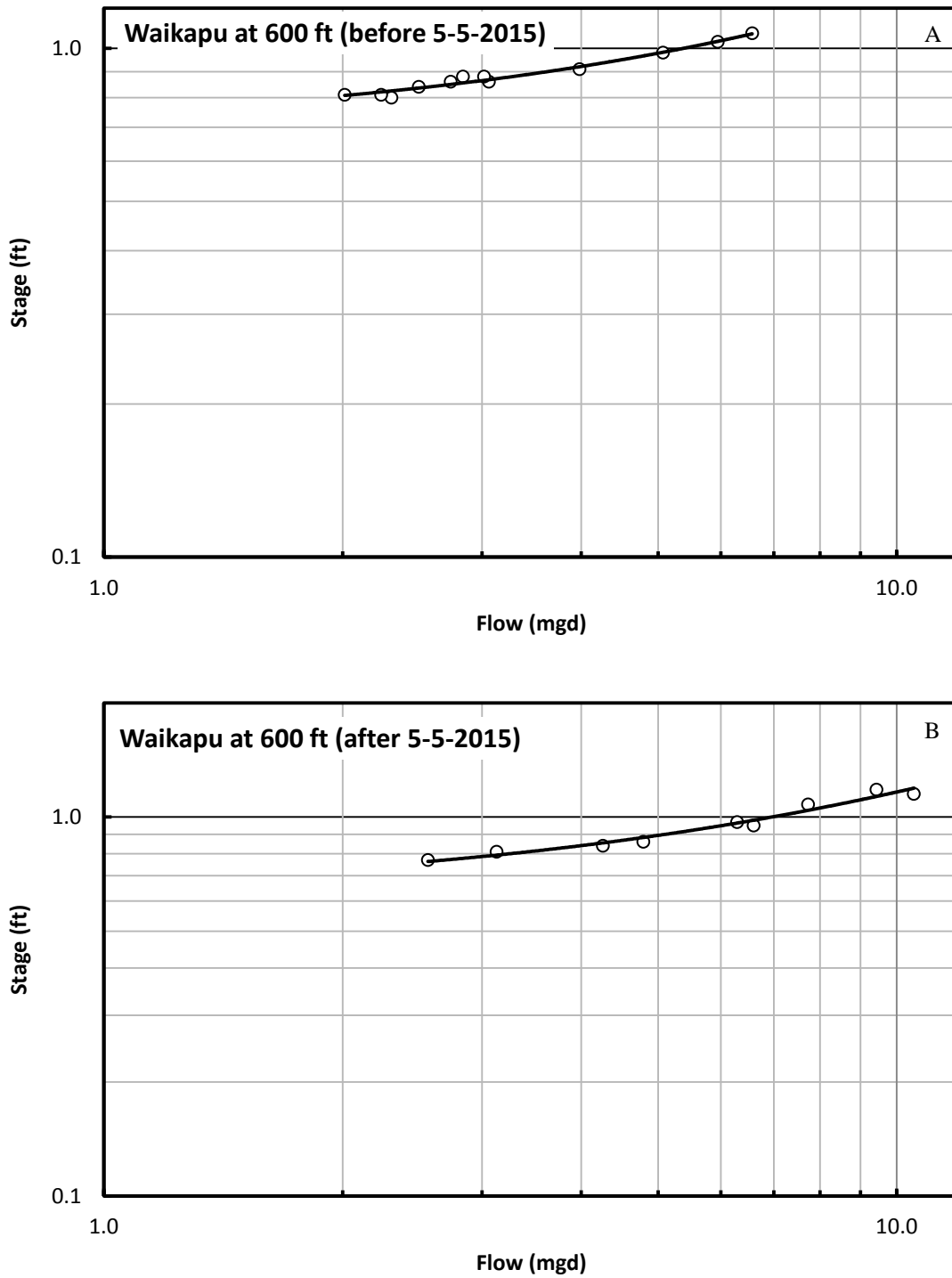


Figure 2. Stream discharge (millions of gallons per day, mgd) on Waikapū Stream at an elevation of 600ft (CWRM ID 6-86) relative to stream stage (ft) (A) before the high flow event and (B) after the high flow event and the staff plate was moved to a location with a better control.

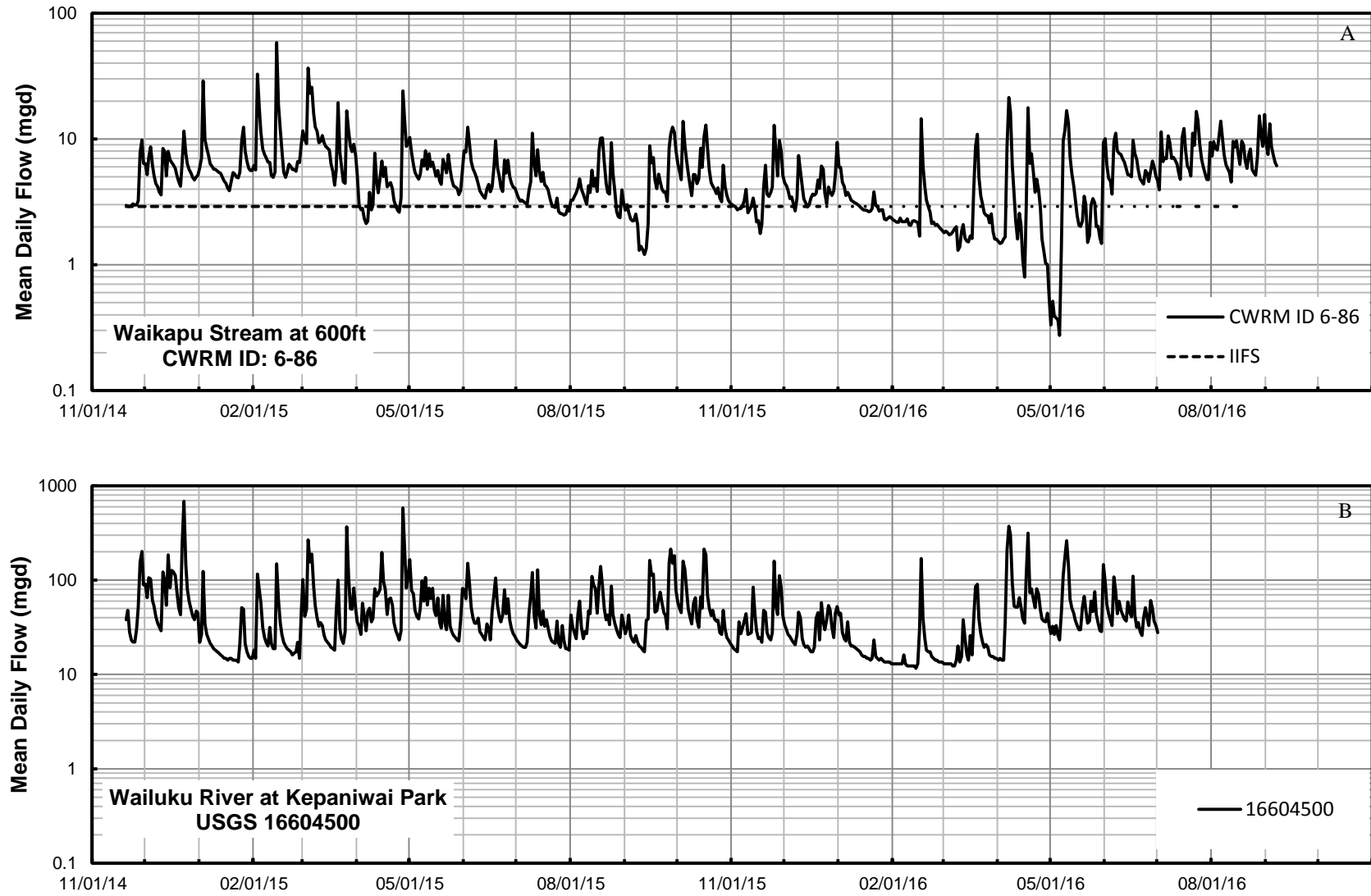


Figure 3. Mean daily flow (million gallons per day, mgd) for (A) Waikapū Stream at 600 ft (CWRM ID 6-86) with the amended instream flow standard (IIFS) and (B) Wailuku River at Kepaniwai Park (USGS station 16604500) for reference.

WAILUKU HYDROLOGIC UNIT

Fieldwork Timeline- Site 6-85: Wailuku River at Kepaniwai Park

8/2014	Staff plate installation
9/3/2014	CWRM staff measured flow
9/4/2014	CWRM staff measured flow
9/24/2014	CWRM staff measured flow
9/25/2014	CWRM staff measured flow
10/6/2014	CWRM staff measured flow
10/13/2014	CWRM staff measured flow
10/14/2014	CWRM staff measured flow
10/23/2014	CWRM staff measured flow
11/20/2014	CWRM installed pressure transducer CWRM staff measured flow
12/15/2014	CWRM staff measured flow CWRM staff downloaded pressure transducer
2/11/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
3/23/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
5/19/2015	CWRM staff downloaded pressure transducer
6/18/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
8/18/2015	CWRM staff downloaded pressure transducer
12/16/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
1/22/2016	CWRM staff downloaded pressure transducer
4/7/2016	CWRM staff measured flow
6/7/2016	CWRM staff measured flow CWRM staff downloaded pressure transducer
9/8/2016	CWRM staff measured flow CWRM staff downloaded pressure transducer

Fieldwork Timeline- Site 6-109: Wailuku River at Waiehu Beach Rd

5/19/2015	CWRM staff measured flow
6/19/2015	CWRM staff measured flow
12/18/2015	CWRM staff measured flow
1/22/2016	CWRM staff measured flow
3/1/2016	CWRM staff measured flow
9/8/2016	CWRM staff measured flow

IIFS Monitoring Summary

The mediated amended IIFS location is immediately below the return of water from the 'Īao -Waikapū and 'Īao -Maniania ditches to Wailuku Stream at Kepaniwai Park (Figure 4). Due to the slope and composition of the stream, this reach is not suitable for monitoring or measuring. A location approximately 750 ft downstream at Kepaniwai Park is used for monitoring discharge. Further downstream, the stream channel is amendable to measuring flow underneath the bridge. Following the installation of a staff plate for reading stream stage (height) at the monitoring location, field measurements were made to establish a rating curve to convert stream stage to discharge (Figure 5). A pressure transducer with an internal data logger was then installed to measure and record stream stage on hourly intervals. The IIFS at Kepaniwai Park is dependent on the flow of water in Wailuku River upstream of the Iao-Waikapu/Maniania Ditch Diversion: If the flow is greater than 15 mgd, then the IIFS is 10 mgd; if the flow drops below 15 mgd for three consecutive days, the greater of one-third (1/3) of the flow or 3.9 mgd may be diverted and the IIFS is the resulting difference. If the flow drops below 10 mgd, then 3.4 mgd may be diverted until the flow returns to at least 10 mgd.

Hourly stage data were converted to mean daily discharge (Figure 6). Mean and median discharge values for the period of monitoring (November 20, 2014 to September 8, 2016) 45.90 mgd are 29.53 mgd, respectively, with a standard deviation of 56.80 mgd. The upper quartile (75th Percentile) and lower quartile (25th Percentile) discharges are 52.72 mgd and 13.72 mgd, respectively. Discharge was reduced below the IIFS in February and March 2015 for maintenance on the downstream Spreckels Ditch intake by Hawaiian Commercial & Sugar.

An IIFS site at the mouth of the stream was established as 5 mgd based on the approximately 5.6 mgd loss in stream flow between Kepaniwai Park and the stream mouth. This permits HC&S to divert water during higher flows, but not during low flows. Due to upstream channel conditions and the Army Corps of Engineers jurisdictional control over channelized stream segments, it is not possible to continuously monitor the IIFS at the mouth. However, if the IIFS is being met at Kepaniwai Park, it is assumed to be met at the mouth. This has been verified by field measurements.

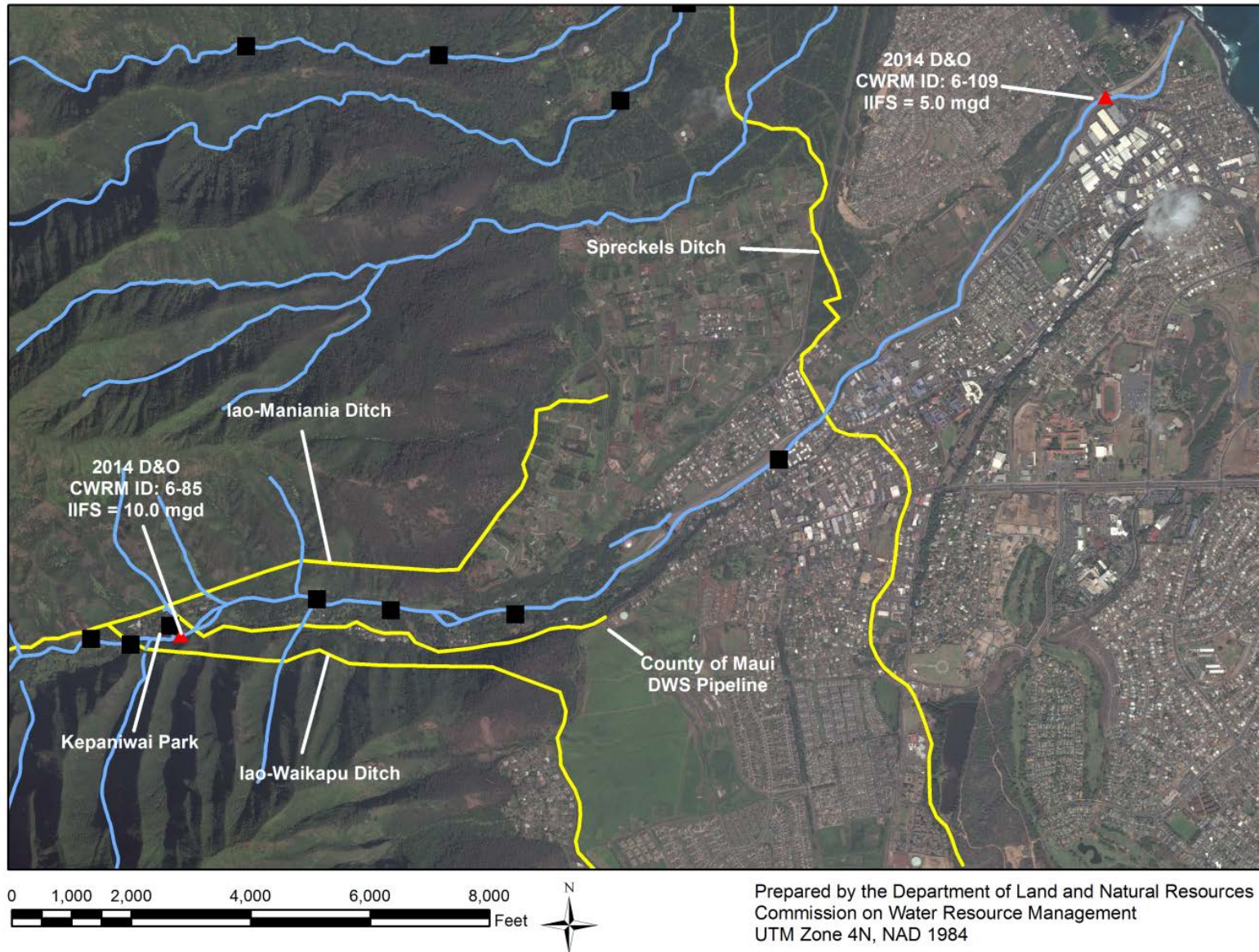


Figure 4. Wailuku River with diversions, ditches and amended interim instream flow standard (IIFS) monitoring locations based on the 2014 D&O.

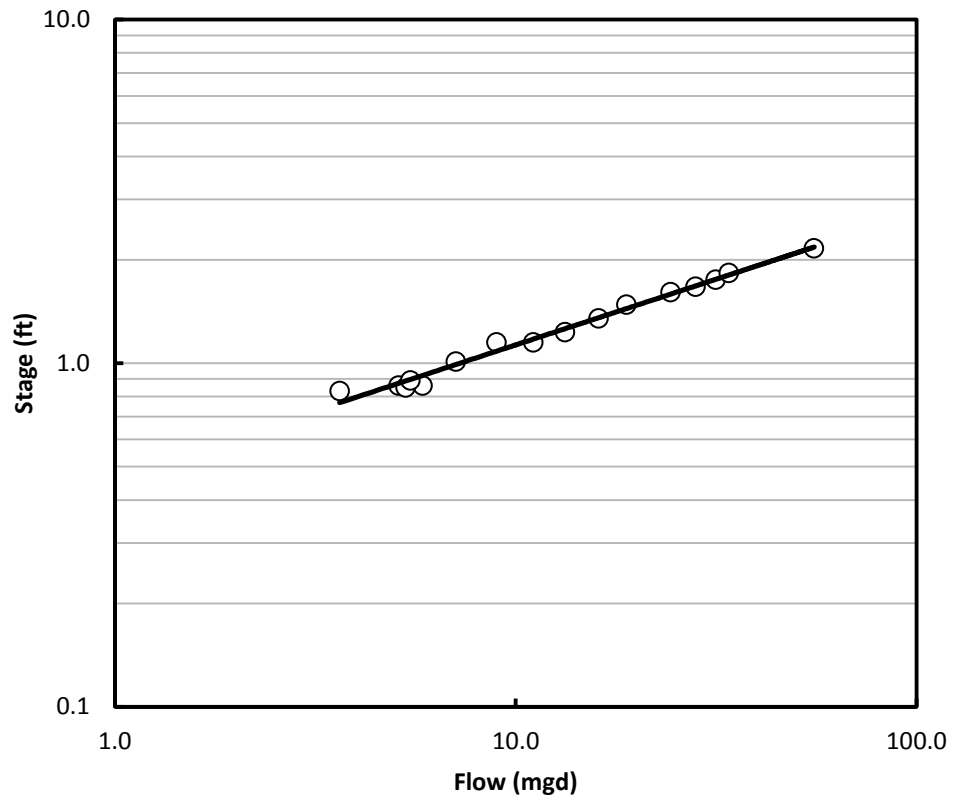


Figure 5. Stream discharge (millions of gallons per day, mgd) on Wailuku River at Kepaniwai Park (CWRM ID 6-85) relative to stream stage (ft).

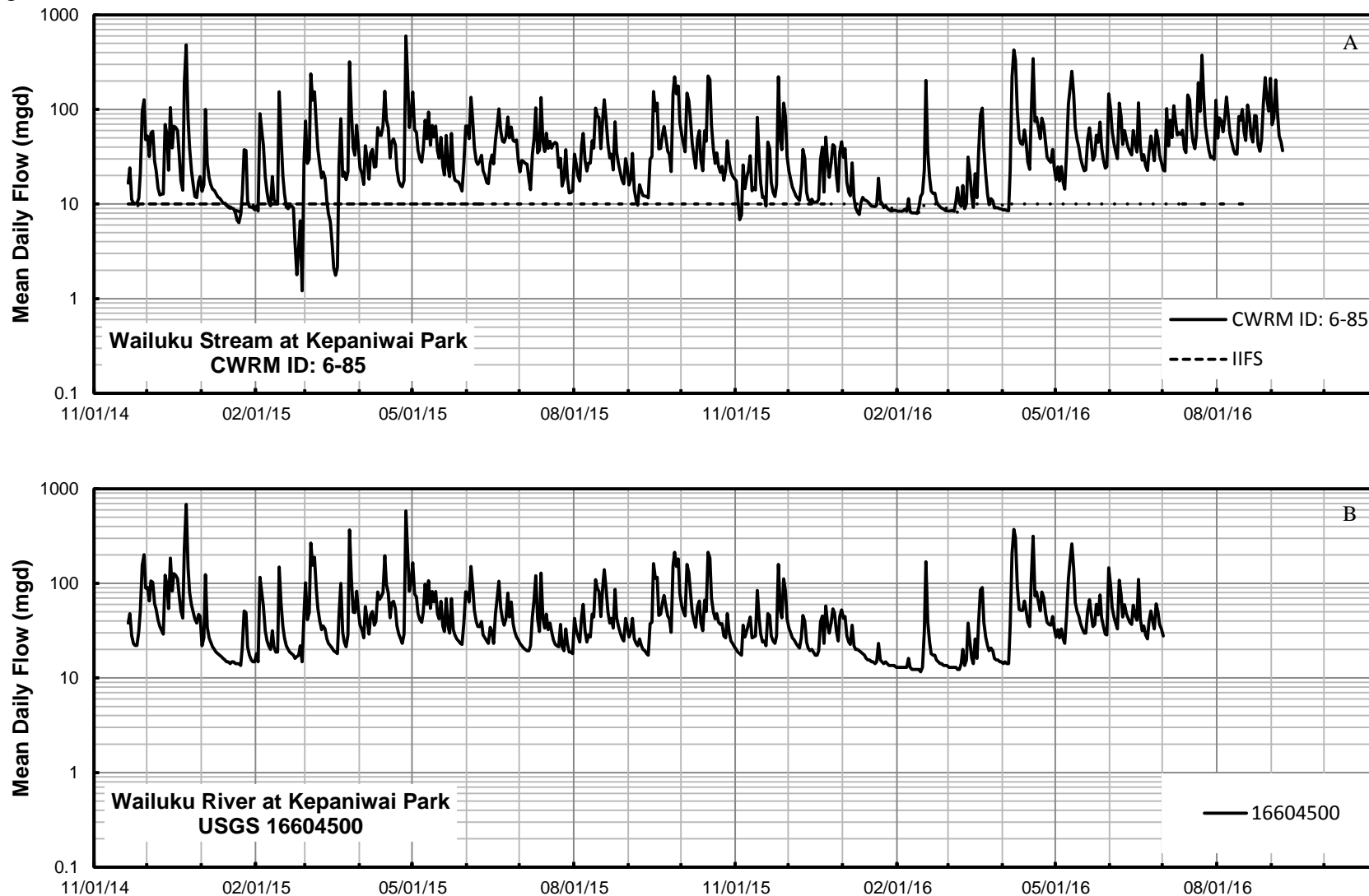


Figure 6. Mean daily flow (million gallons per day, mgd) for (A) Wailuku River at Kepaniwai Park (CWRM ID 6-85) with the amended instream flow standard (IIFS) and (B) Wailuku River at Kepaniwai Park (USGS station 16604500) for reference.

WAIEHU HYDROLOGIC UNIT

Fieldwork Timeline- Site 6-63: Spreckels Ditch Intake at South Waiehu

12/01/2010	CWRM staff installed <i>In-Situ</i> pressure transducer
2/17/2011	CWRM staff downloaded pressure transducer USGS staff measured flow
3/21/2011	USGS staff measured flow CWRM staff downloaded pressure transducer
4/20/2011	USGS staff measured flow
6/15/2011	USGS staff measured flow CWRM staff downloaded pressure transducer
8/11/2011	USGS staff measured flow
9/26/2011	USGS staff measured flow CWRM staff downloaded pressure transducer
12/12/2011	CWRM staff downloaded pressure transducer
3/30/2012	CWRM staff downloaded pressure transducer
6/13/2012	CWRM staff downloaded pressure transducer
9/19/2012	CWRM staff downloaded pressure transducer
3/21/2013	CWRM staff downloaded pressure transducer
9/16/2013	CWRM staff downloaded pressure transducer
9/24/2014	CWRM staff downloaded pressure transducer
12/15/2014	USGS staff measured flow CWRM staff downloaded pressure transducer
3/23/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
6/18/2015	CWRM staff measured flow CWRM staff downloaded pressure transducer
8/18/2015	CWRM staff downloaded pressure transducer CWRM staff installed <i>Onset Hobo</i> pressure transducer
12/16/2015	CWRM staff downloaded pressure transducer
4/8/2016	CWRM staff downloaded pressure transducer
6/7/2016	CWRM staff downloaded pressure transducer
9/8/2016	CWRM staff downloaded pressure transducer

Fieldwork Timeline- Site 6-69: Waiehu Stream blw Confluence

11/29/2011	USGS staff measured flow
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11/30/2011	USGS staff measured flow
12/1/2011	CWRM staff installed <i>In-Situ</i> pressure transducer
1/24/2011	USGS staff measured flow
1/26/2011	USGS staff measured flow
3/21/2011	CWRM staff downloaded pressure transducer
4/12/2011	USGS staff measured flow
6/14/2011	CWRM staff downloaded pressure transducer
9/26/2011	CWRM staff downloaded pressure transducer
12/12/2011	CWRM staff downloaded pressure transducer
3/30/2012	CWRM staff downloaded pressure transducer
6/13/2012	CWRM staff downloaded pressure transducer
9/19/2012	CWRM staff downloaded pressure transducer
3/21/2013	CWRM staff downloaded pressure transducer
9/16/2013	CWRM staff downloaded pressure transducer
9/24/2014	CWRM staff downloaded pressure transducer
12/15/2014	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
2/11/2015	CWRM staff downloaded pressure transducer
3/23/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
5/19/2015	CWRM staff measured flow
6/18/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
8/18/2015	CWRM staff downloaded pressure transducer
	CWRM staff installed <i>Onset Hobo</i> pressure transducer
12/16/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
4/8/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
6/7/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
9/8/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer

IIFS Monitoring Summary

The 2010 D&O established an amended IIFS of 1.6 mgd for North Waiehu Stream below the North Waiehu Ditch Diversion at 870 ft in elevation. This diversion has since been abandoned and the 2014 D&O formally relocated the IIFS to a lower elevation (560 ft) to reflect the abandonment of the Upper North Waiehu Diversion. The new IIFS location will have an IIFS value of 1.0 mgd, reflecting the approximately 0.6 mgd seepage loss in the streambed between these two locations. Additionally, the 2010 D&O established an IIFS of 0.9 mgd immediately below the Spreckels Ditch Diversion on South Waiehu Stream. A location approximately 400 ft downstream of the confluence of the North and South Waiehu branches is used for monitoring discharge in Waiehu. The IIFS at this location is approximated based on the seepage losses between the established IIFS locations and the combined sum of flows (Figure 7). Following the installation of a staff plate for reading stream stage (height) at the monitoring location, field measurements were made to establish a rating curve to convert stream stage to discharge (Figure 8). A pressure transducer with an internal data logger was then installed to measure and record stream stage on hourly intervals.

Hourly stage data were converted to mean daily discharge (Figure 9). Mean and median discharge values for the period of monitoring (March 21, 2011 to September 8, 2016) are 13.76 mgd and 2.58 mgd, respectively, with a standard deviation of 102.25 mgd. The upper quartile (75th Percentile) and lower quartile (25th Percentile) discharges are 5.37 mgd and 1.15 mgd, respectively. The upper limits of the rating curve are not very accurate and skew the mean and standard deviation substantially.

Waiehu Stream IIFS current and proposed locations

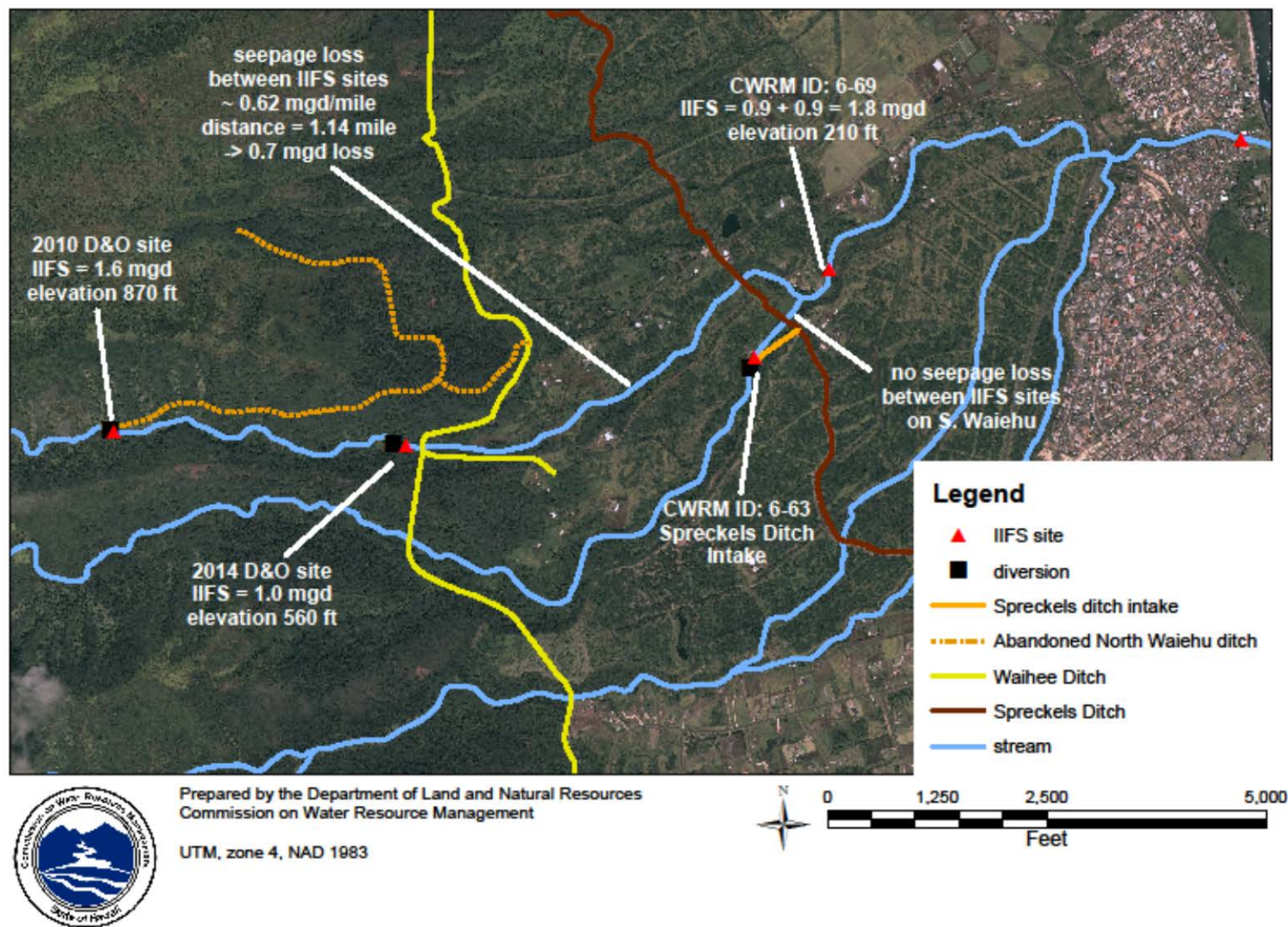


Figure 7. North and South Waiehu streams with IIFS locations and CWRM monitoring locations related to the amended interim instream flow standard (IIFS).

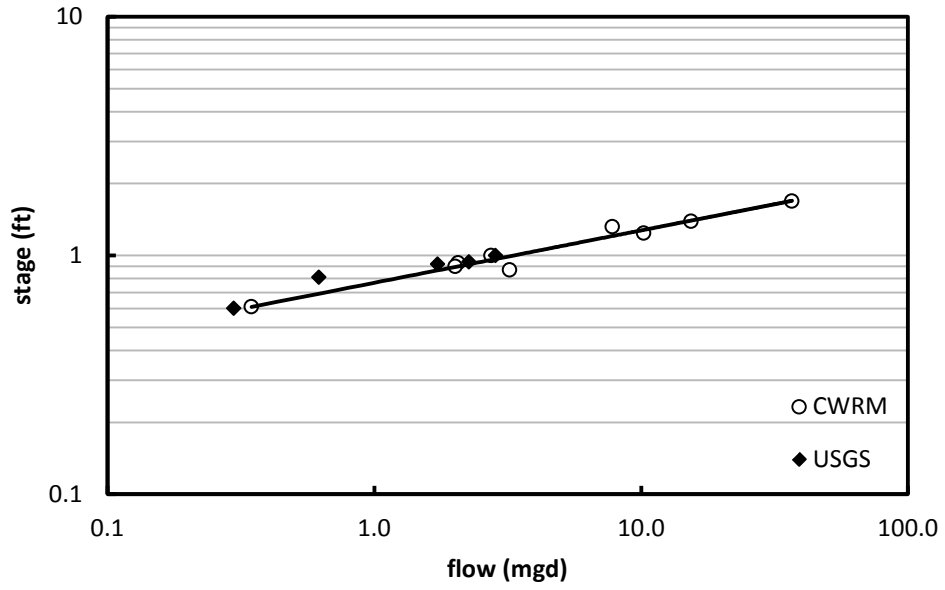


Figure 8. Stream discharge (millions of gallons per day, mgd) on Waiehu Stream below confluence (CWRM ID 6-69) relative to stream stage (ft) measured by CWRM staff or USGS staff.

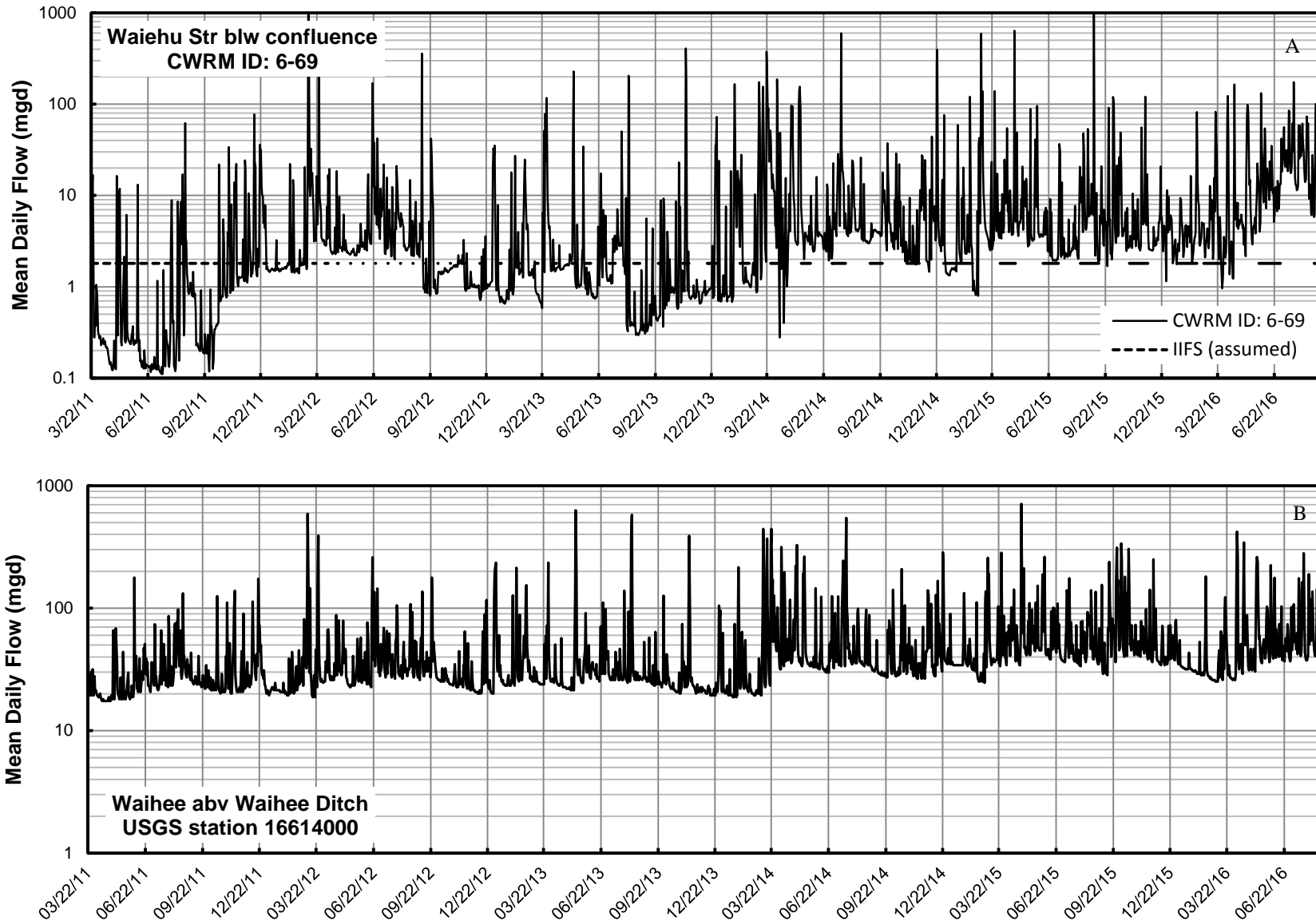


Figure 9. Mean daily flow (million gallons per day, mgd) for (A) Waiehu Stream below the confluence (CWRM ID 6-69) with the amended instream flow standard (IIFS) and (B) Waihee River above Waihee Ditch (USGS station 16614000) for reference.

WAIHEE HYDROLOGIC UNIT

Fieldwork Timeline- Site 6-68: Waihee Stream ds Spreckels Ditch

10/13/2010	USGS staff measured flow
10/14/2010	CWRM staff installed <i>In-Situ Hobo</i> pressure transducer
11/30/2010	USGS staff measured flow
	CWRM staff downloaded pressure transducer
1/24/2011	USGS staff measured flow
4/12/2011	USGS staff measured flow
6/15/2011	CWRM staff downloaded pressure transducer
9/26/2011	CWRM staff downloaded pressure transducer
12/12/2011	CWRM staff downloaded pressure transducer
3/30/2012	CWRM staff downloaded pressure transducer
6/13/2012	CWRM staff downloaded pressure transducer
9/19/2012	CWRM staff downloaded pressure transducer
3/21/2013	CWRM staff downloaded pressure transducer
9/16/2013	CWRM staff downloaded pressure transducer
9/24/2014	CWRM staff downloaded pressure transducer
12/15/2014	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
3/23/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
6/18/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
8/18/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
	CWRM staff installed <i>Onset Hobo</i> pressure transducer
12/16/2015	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
6/7/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer
9/8/2016	CWRM staff measured flow
	CWRM staff downloaded pressure transducer

Fieldwork Timeline- Site 6-71: Waihee Stream nr Kahekili Hwy

10/13/2010	USGS staff measured flow
10/14/2010	USGS staff measured flow

11/30/2010	USGS staff measured flow
10/20/2011	CWRM staff installed <i>In-Situ Hobo</i> pressure transducer
12/12/2011	CWRM staff downloaded pressure transducer
1/24/2011	USGS staff measured flow
4/12/2011	USGS staff measured flow
12/13/2011	USGS staff measured flow
	CWRM staff recovered buried pressure transducer

IIFS Monitoring Summary

The 2010 D&O established an amended IIFS of 10.0 mgd on the Waihee Stream below the Spreckels Ditch Diversion. Due to stream channel conditions, a location approximately 3,000 ft downstream of the diversion return point is used for monitoring discharge in Waihee (Figure 10). Following the installation of a staff plate for reading stream stage (height) at the monitoring location, field measurements were made to establish a rating curve to convert stream stage to discharge (Figure 11). A pressure transducer with an internal data logger was then installed to measure and record stream stage on hourly intervals. An additional IIFS site near the mouth of the stream was established in 2010, but after the burial of the transducer and staff plate in material during a high flow event in 2011, this equipment was removed from the stream channel. In the 2014 D&O, this IIFS was excluded.

Hourly stage data were converted to mean daily discharge (Figure 12). Mean and median discharge values for the period of monitoring (March 21, 2011 to September 8, 2016) are 14.69 mgd and 11.59 mgd, respectively, with a standard deviation of 8.73 mgd. The upper quartile (75th Percentile) and lower quartile (25th Percentile) discharges are 16.05 mgd and 9.89 mgd, respectively. The upper limits of the rating curve are not very accurate and skew the mean and standard deviation heavily.

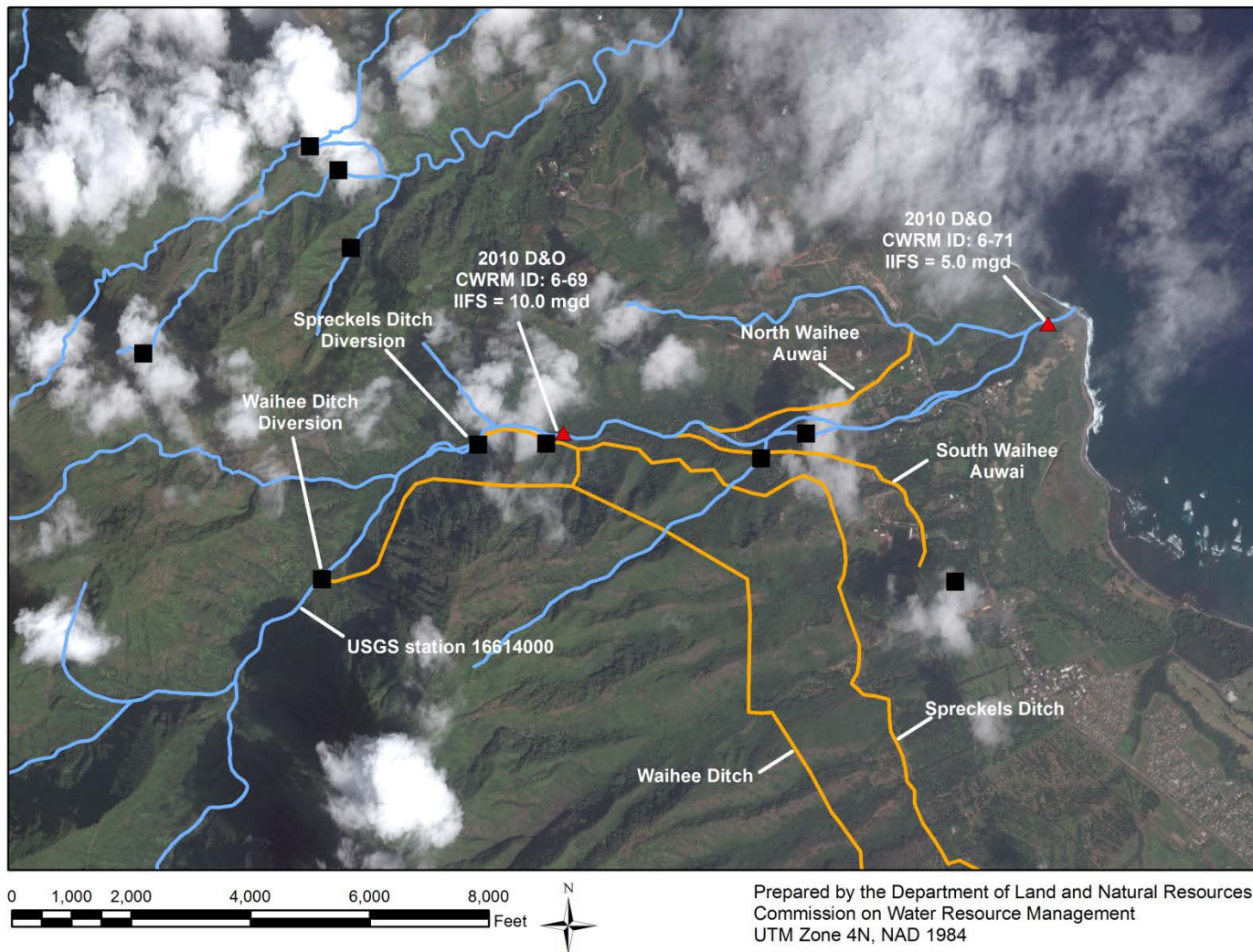


Figure 10. Waihee River with Waihee Ditch and Spreckels Ditch diversions, the North and South Waihee auwai, with CWRM monitoring locations for the 2010 amended interim instream flow standard (IIFS).

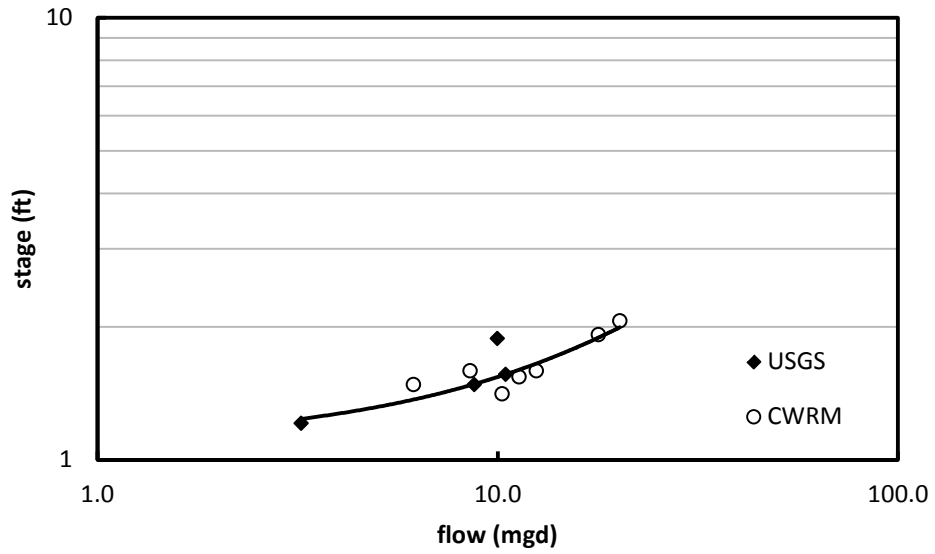


Figure 11. Stream discharge (millions of gallons per day, mgd) on Waihee River below Spreckels Ditch Intake (CWRM ID 6-68) relative to stream stage (ft) measured by CWRM staff or USGS staff.

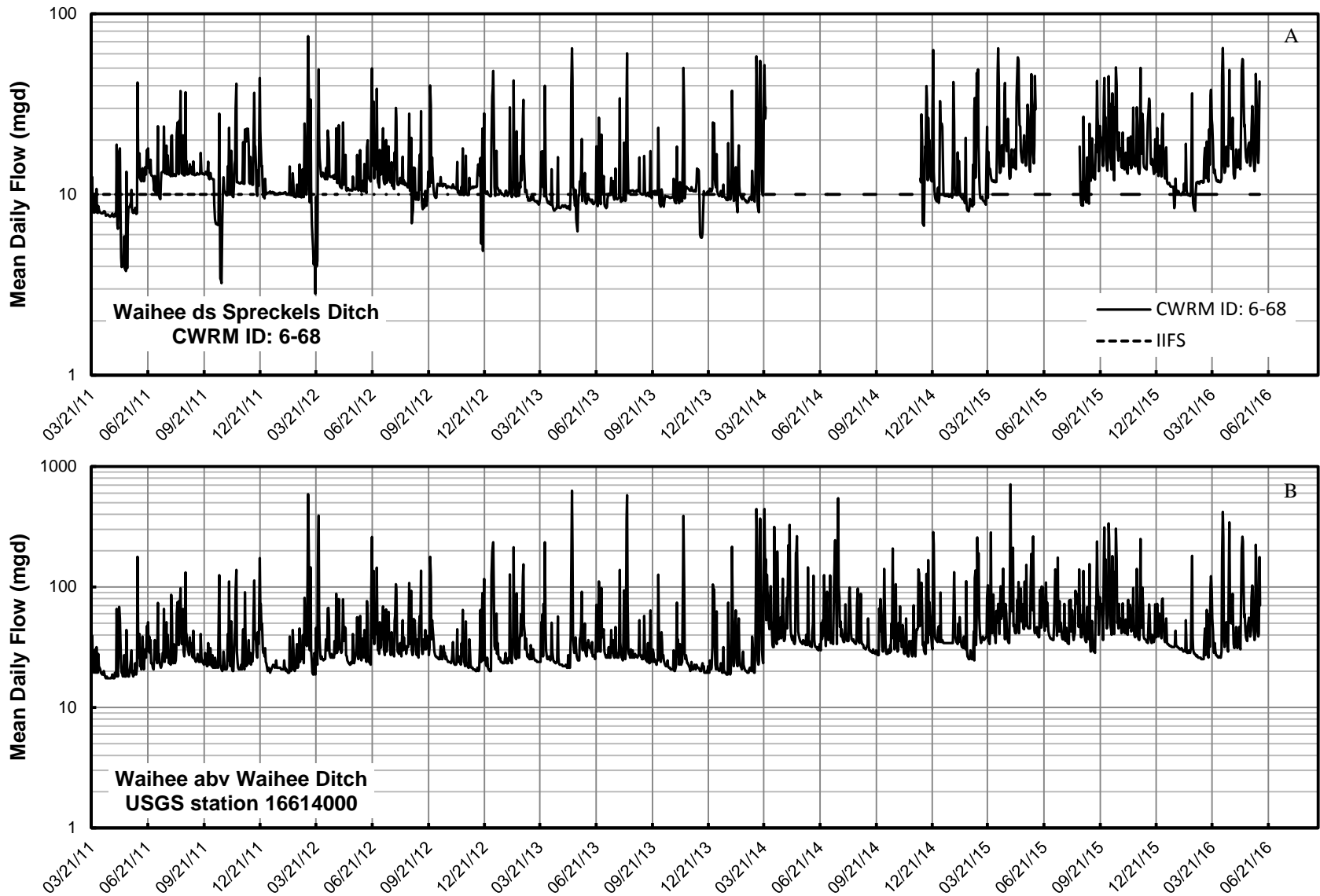


Figure 12. Mean daily flow (million gallons per day, mgd) for (A) Waihee River below Spreckels Ditch Intake (CWRM ID 6-68) with the amended in-stream flow standard (IIFS) and (B) Waihee River above Waihee Ditch (USGS station 16614000) for reference.

COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII

Surface Water Use Permit Applications,) Case No.. CCH-MA15-01
Integration of Appurtenant Rights and)
Amendments to the Interim Instream Flow)
Standards, Na Wai Eha Surface Water)
Management Areas of Waihee, Waiehu, Iao and)
Waikapu Streams, Maui)
_____)

CERTIFICATE OF SERVICE

On October 4, 2016, a copy of the foregoing document was posted on the Commission on Water Resource Management's website and served on the parties that have opted for electronic service.

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