



Water and Energy Wasted During Residential Shower Events: Findings from a Pilot Field Study of Hot Water Distribution Systems

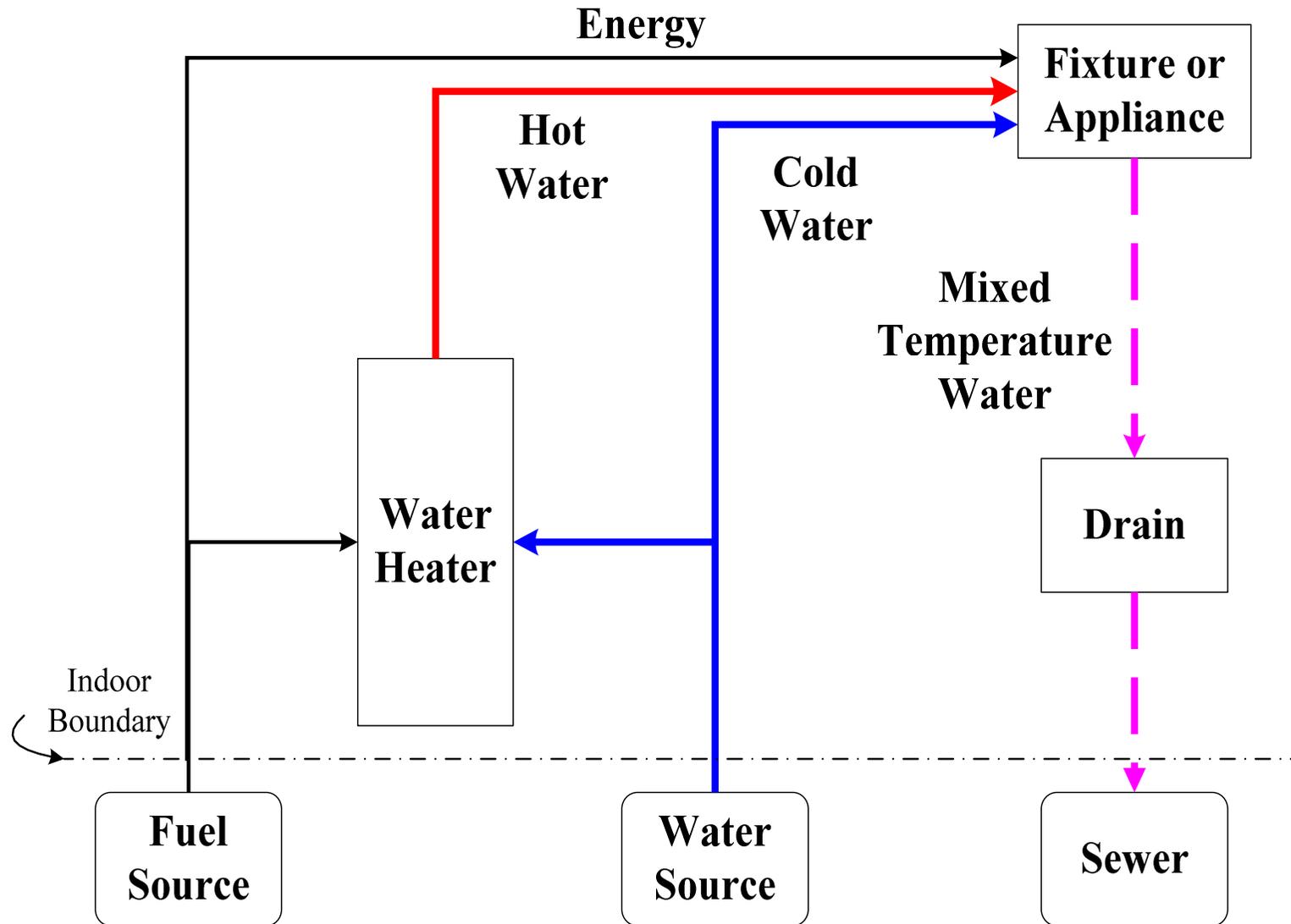
Jim Lutz

October 18, 2011

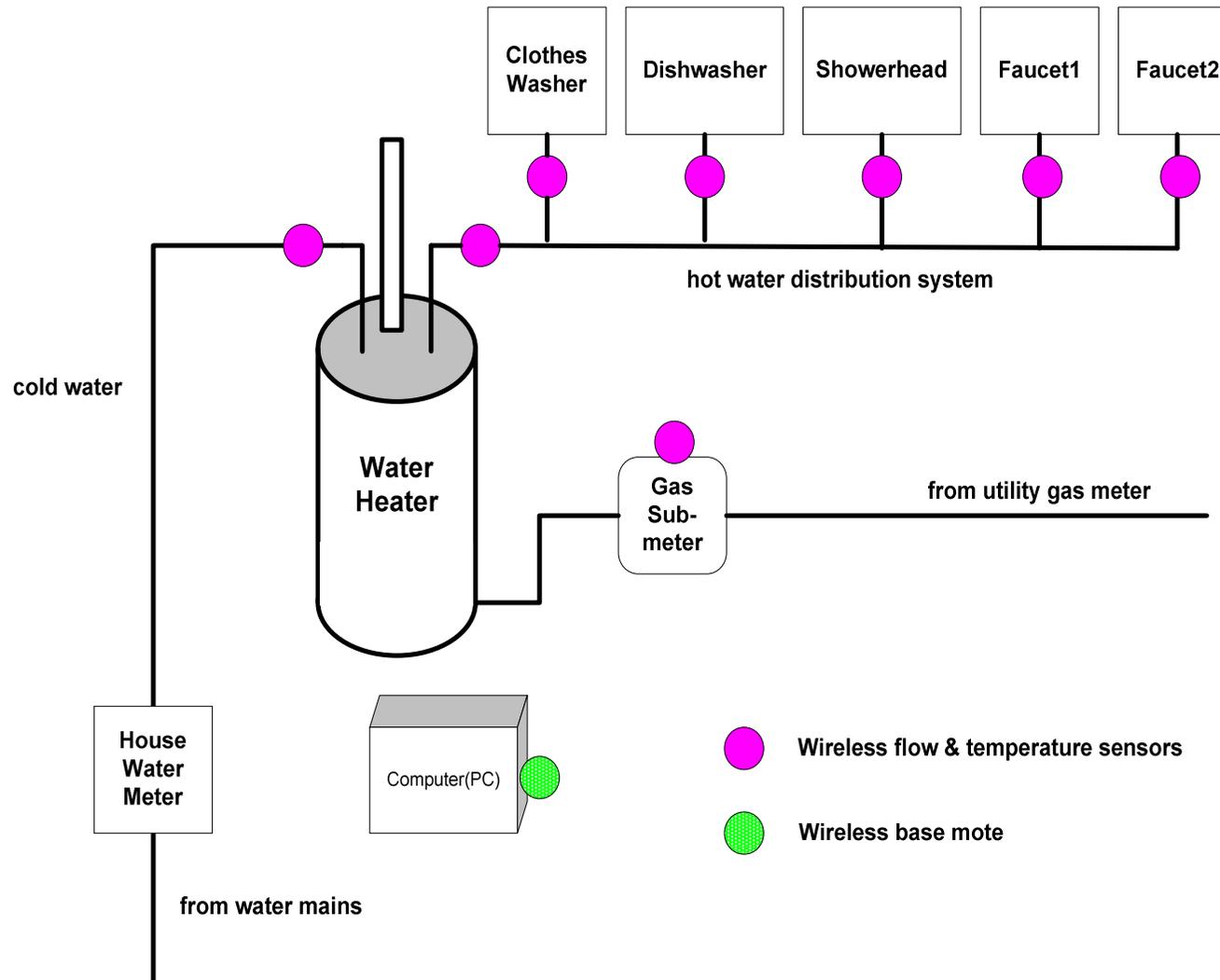
jdlutz@lbl.gov

funding for this work from the California Department of Water Resources

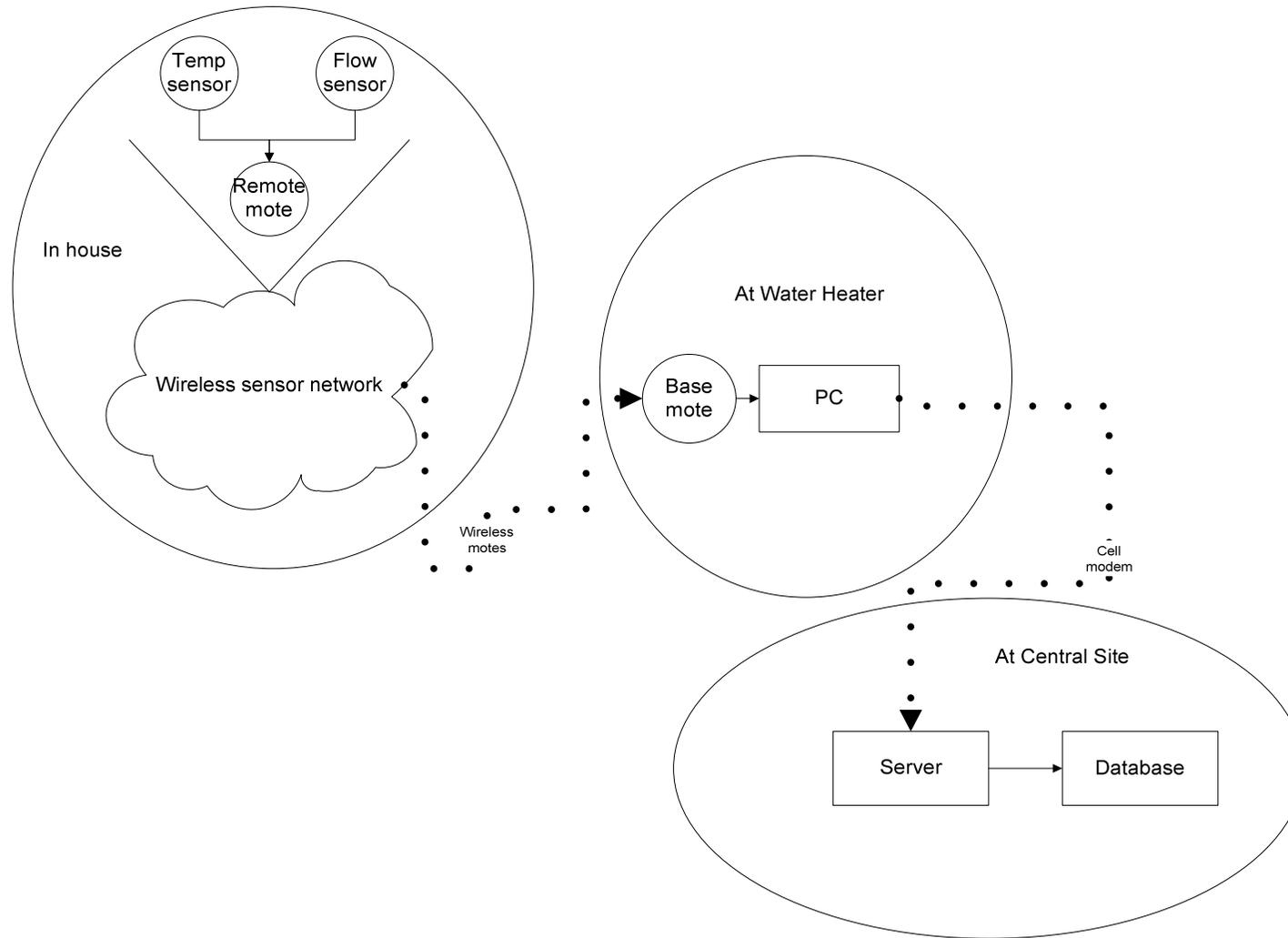
residential hot water distribution system



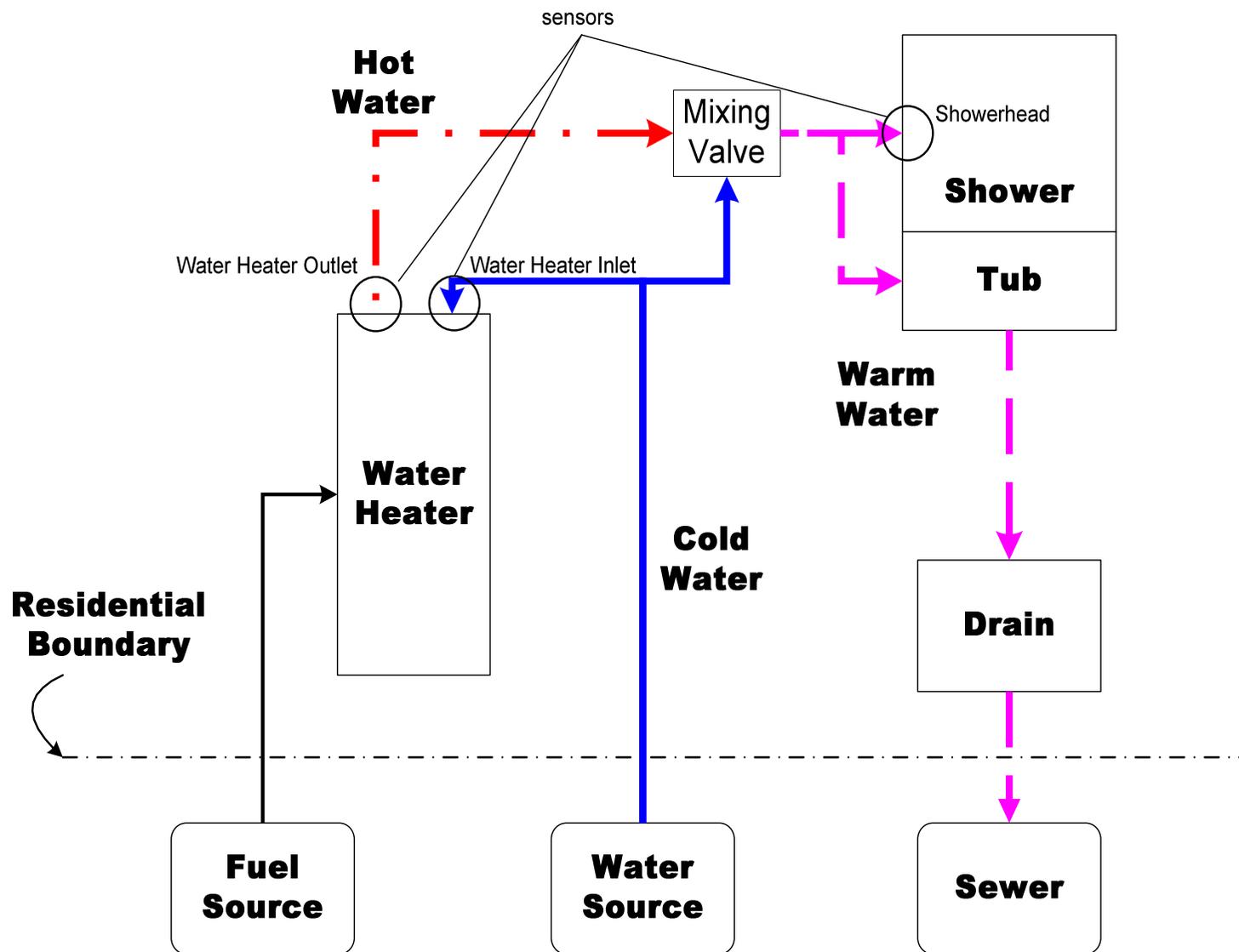
water flow and temperature measurement points



wireless data acquisition system



measurement points for determining shower waste



flow and temperature sensors at showerhead

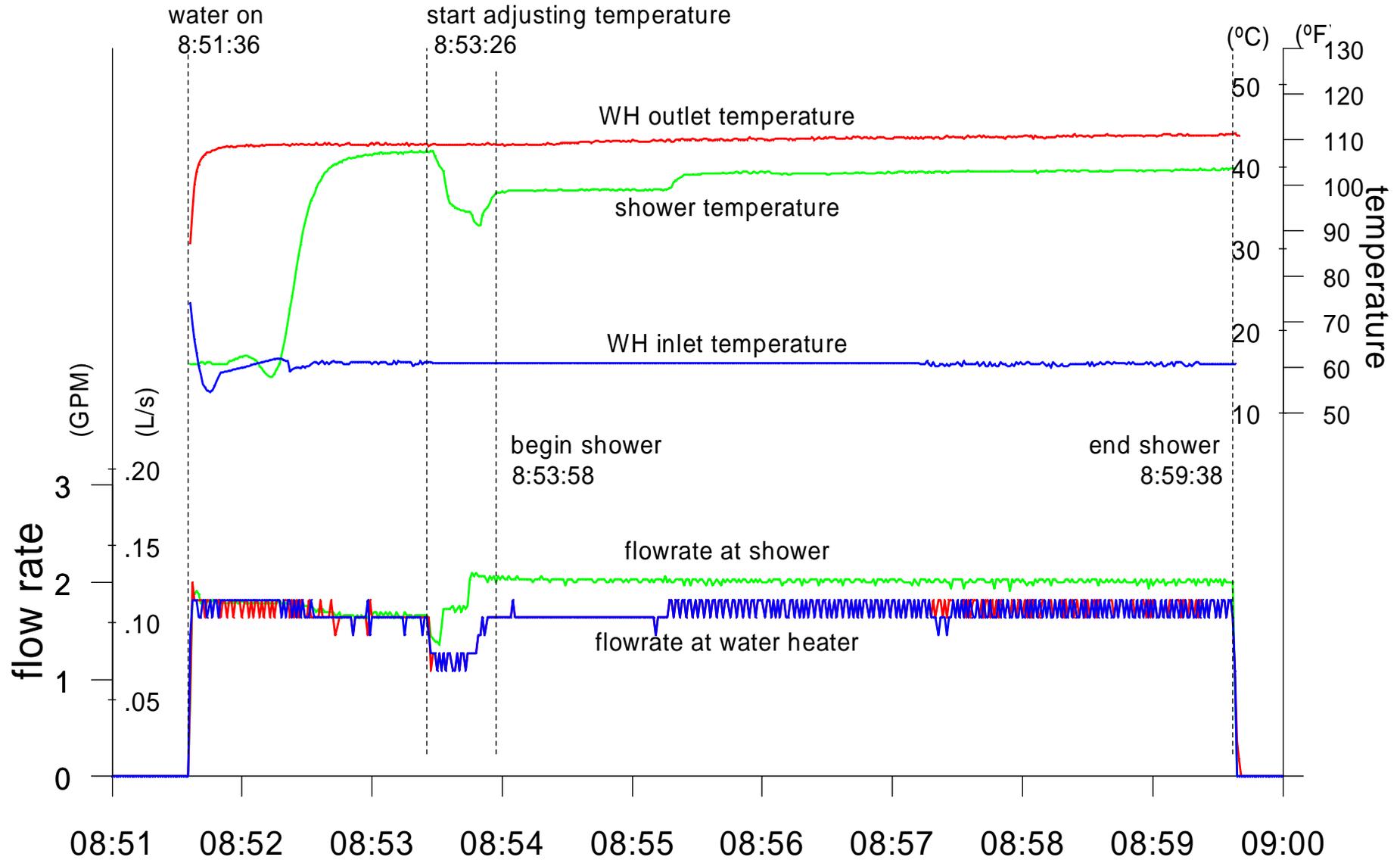


data processing

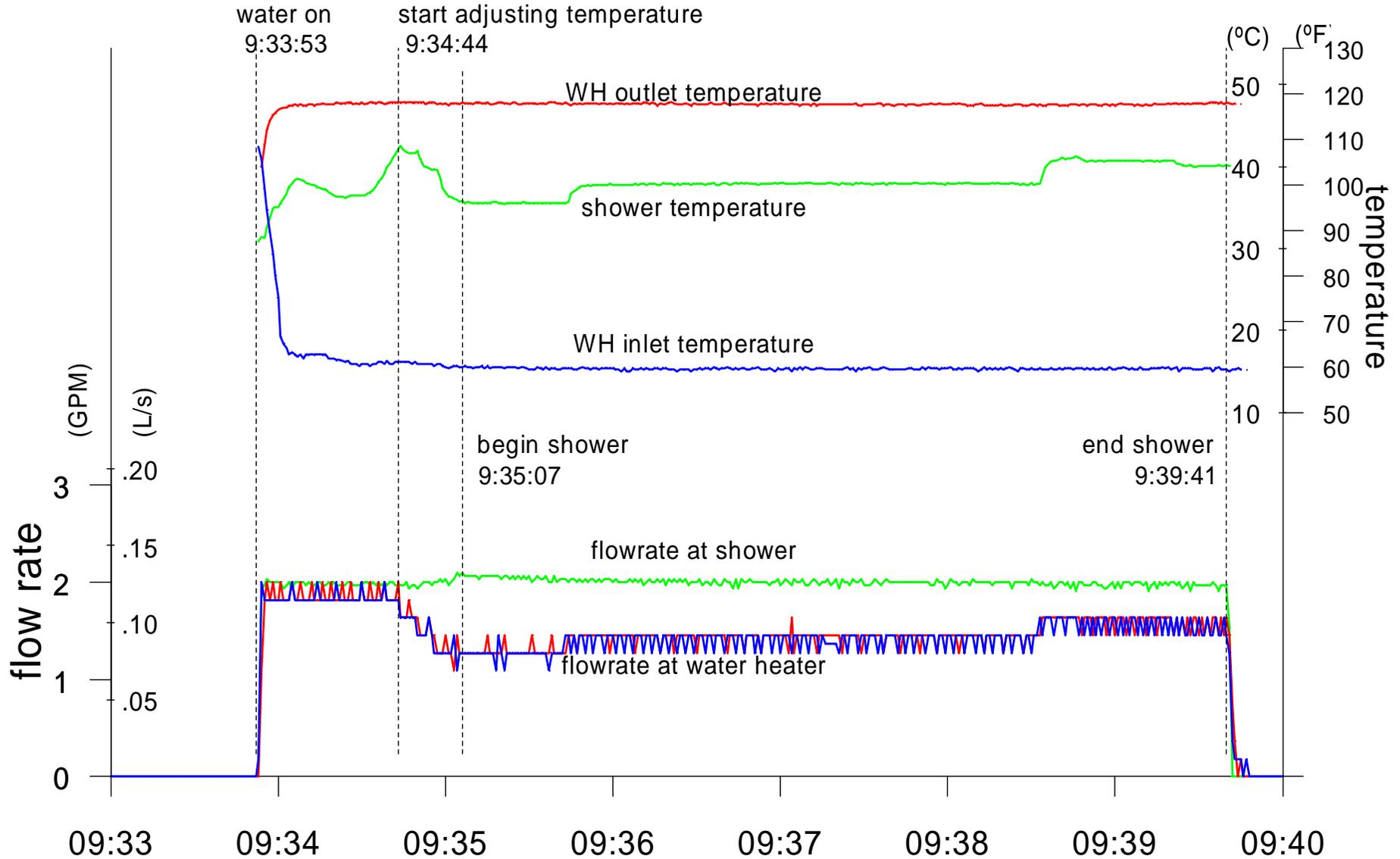


- data from 36 shower events, three households
- developmental nature of the wireless sensor network
- difficulties with various pieces of equipment
- extrapolation and data cleaning
 - linear interpolation for missing data
 - copy water flow from outlet to inlet
 - remove obvious outliers
- able to analyze 5 shower events

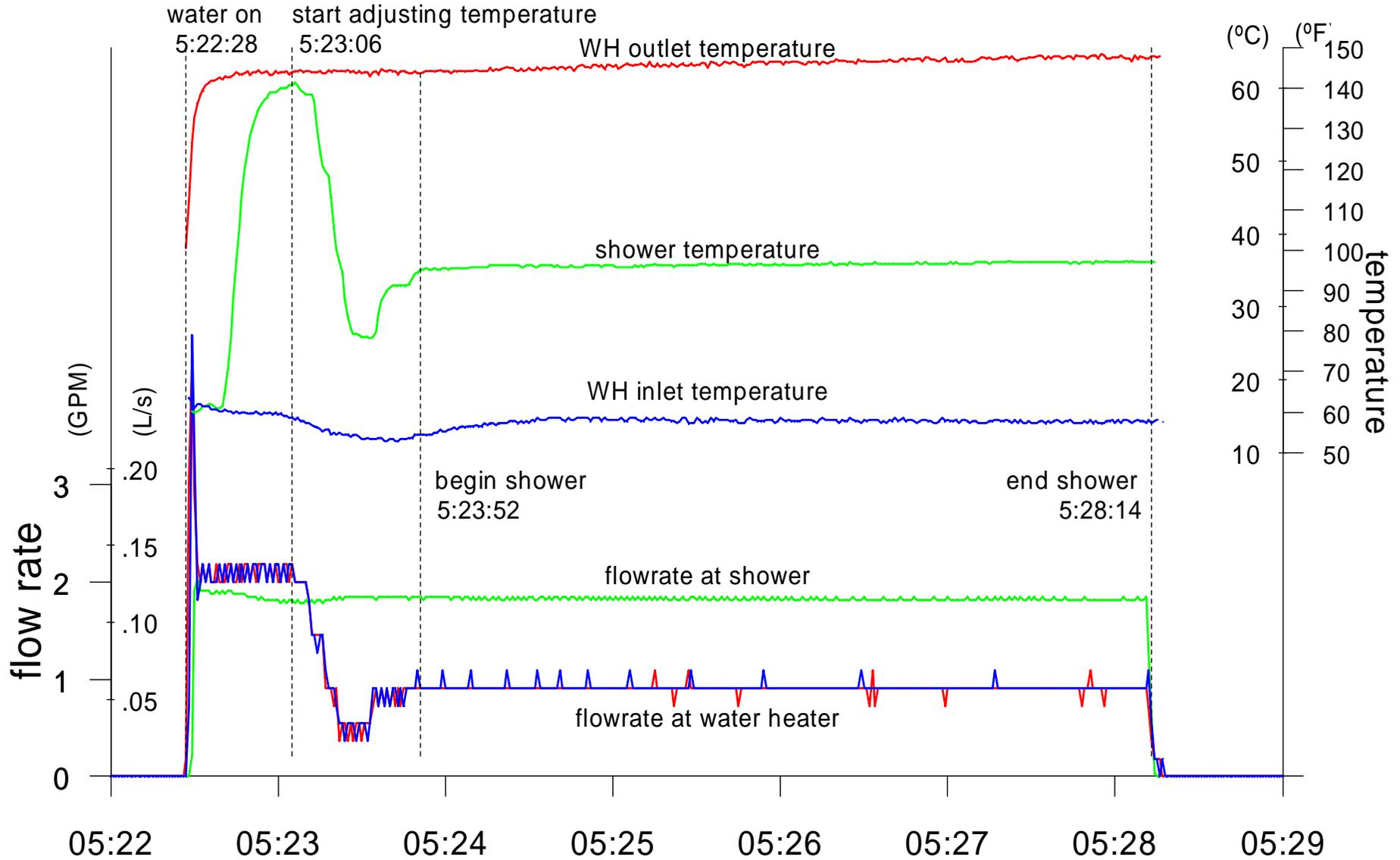
typical shower event



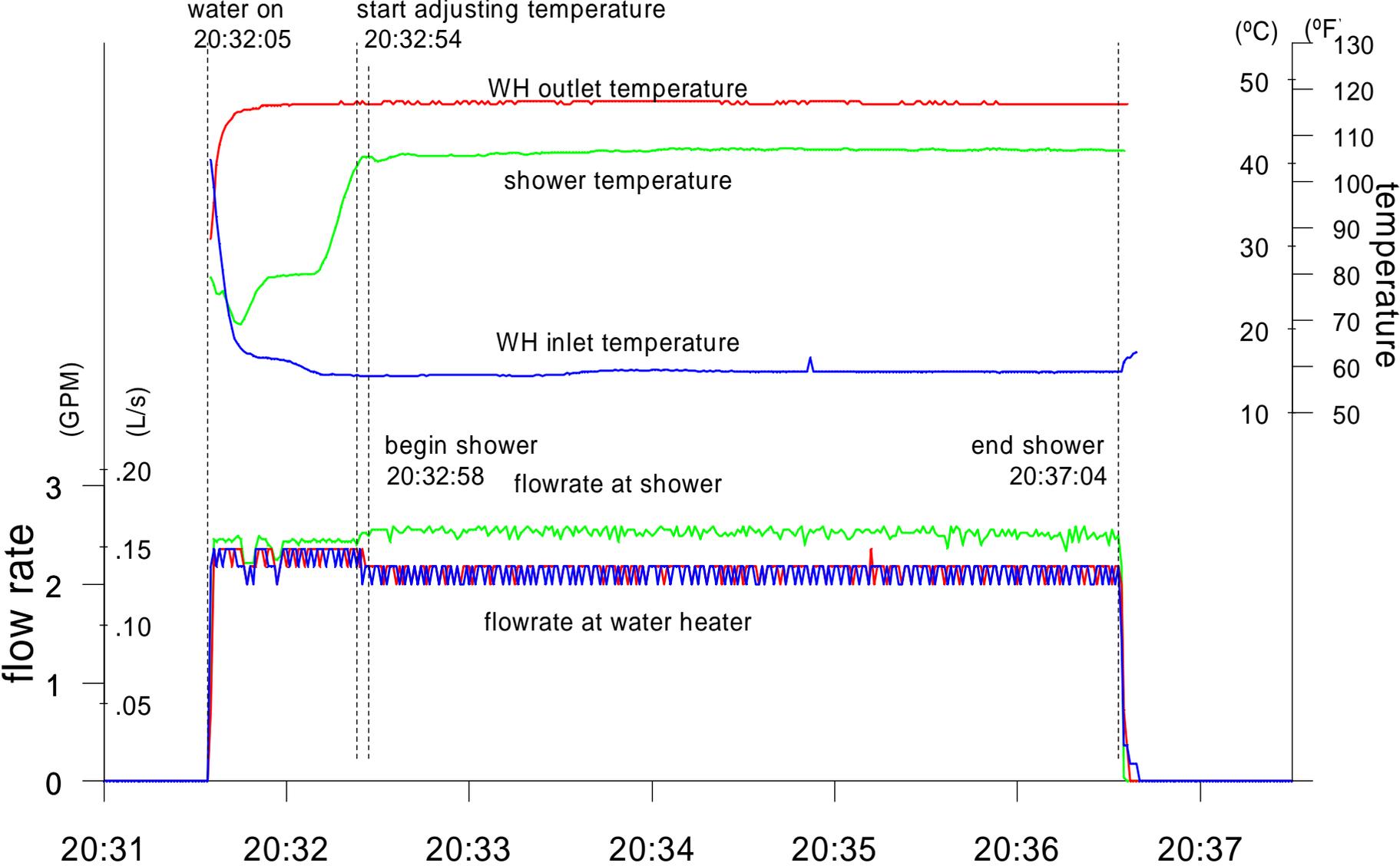
shower event on 2009-03-21



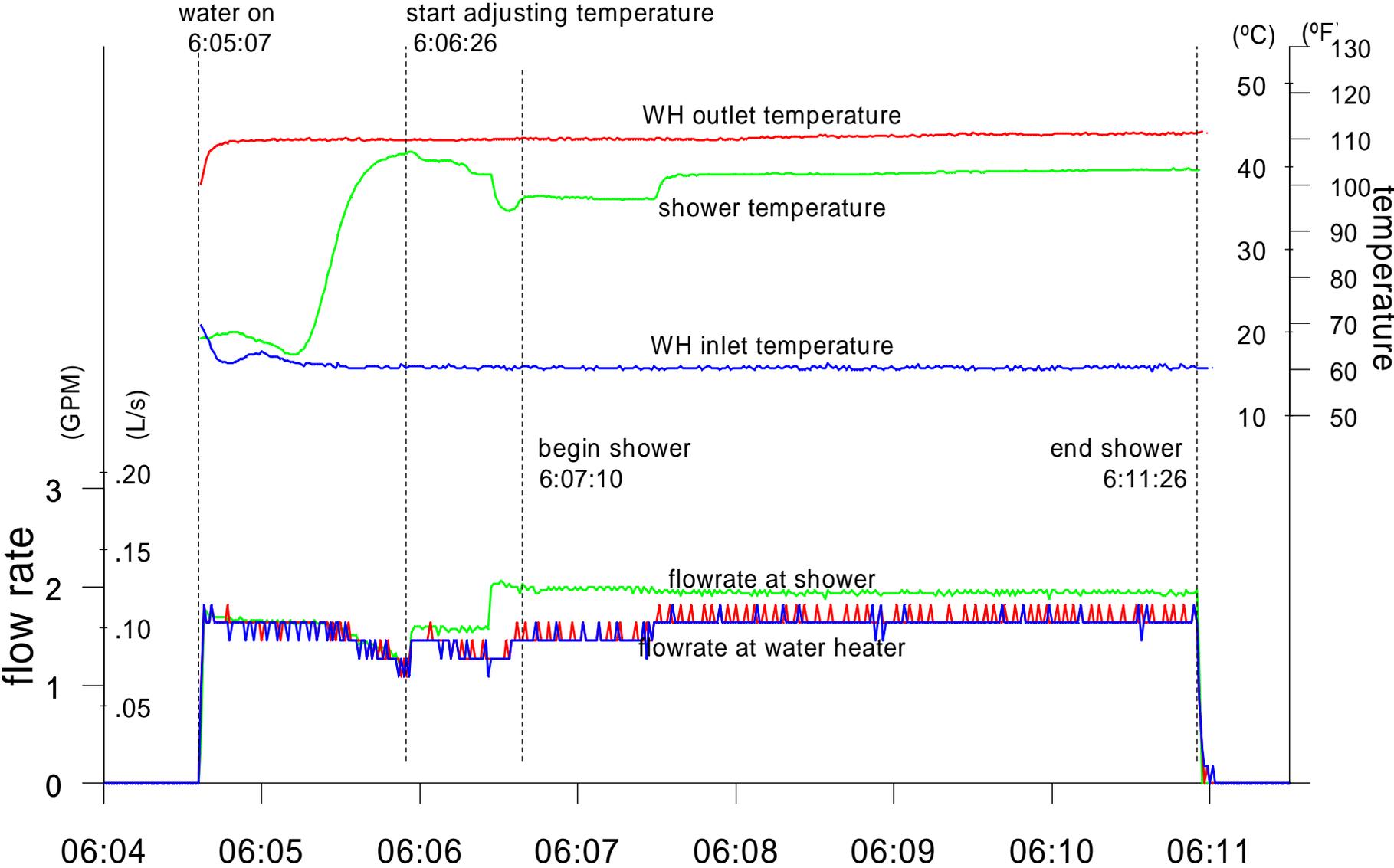
shower event on 2009-02-27



shower event on 2009-01-07



shower event on 2009-03-20



Duration of shower events



Durations of five shower events

Date	Total Duration of Water Flow (minutes)	Duration of Shower (minutes)	Time Wasted (minutes)	% of Time Wasted
1/7/2009	4:59	4:06	0:53	21.5%
2/27/2009	5:46	4:22	1:24	32.1%
3/20/2009	6:19	4:16	2:03	48.0%
3/21/2009	5:48	4:34	1:14	27.0%
3/22/2009	8:02	5:40	2:22	41.8%
average	6:11	4:36	1:35	34.5%

Water use & waste



Water used and wasted during five shower events

Date	Total Water Flow	Water Used for Shower	Water Wasted	% of Water Wasted
1/7/2009	12.5 gal (47.2 L)	10.4 gal (39.4 L)	2.1 gal (7.8 L)	19.9%
2/27/2009	10.5 gal (39.7 L)	8.0 gal (30.2 L)	2.5 gal (9.4 L)	31.2%
3/20/2009	11.6 gal (44.0 L)	8.4 gal (31.7 L)	3.3 gal (12.3 L)	39.0%
3/21/2009	11.6 gal (43.8 L)	9.2 gal (34.7 L)	2.4 gal (9.0 L)	26.0%
3/22/2009	15.5 gal (58.9 L)	11.5 gal (43.4 L)	4.1 gal (15.5 L)	35.7%
average	12.3 gal (46.7 L)	9.5 gal (35.9 L)	2.9 gal (10.8 L)	30.2%

Energy use and waste



Energy used and wasted during five shower events

Date	Total Energy From Water Heater	Energy Used at Shower	Energy Wasted	% of Energy Wasted
1/7/2009	5169 BTU (5.454 MJ)	4114 BTU (4.340 MJ)	1055 BTU (1.113 MJ)	25.7%
2/27/2009	4335 BTU (4.573 MJ)	2554 BTU (2.695 MJ)	1780 BTU (1.878 MJ)	69.7%
3/20/2009	4151 BTU (4.379 MJ)	2847 BTU (3.004 MJ)	1304 BTU (1.375 MJ)	45.8%
3/21/2009	4192 BTU (4.423 MJ)	3122 BTU (3.294 MJ)	1070 BTU (1.128 MJ)	34.3%
3/22/2009	5499 BTU (5.801 MJ)	3902 BTU (4.117 MJ)	1596 BTU (1.684 MJ)	40.9%
average	4669 BTU (4.926 MJ)	3308 BTU (3.490 MJ)	1361 BTU (1.436 MJ)	41.1%

What's next?



- **Current CEC PIER - Reducing Waste in Residential Hot Water Distribution Systems**
 - 6 houses
 - 6 months each
 - better equipment
 - looking for test sites
- **Eventual goal is to revise plumbing codes and practice to minimize energy and water waste of hot water distribution systems.**