

Water Use and Savings on Large Dairy Farms

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Thanks

- Vander Made Dairy
- Cliff Vandermark
- Vmark LLC



Overview

- Past research
- Monitoring project
- Water usage
- Management information and recommendation
- Summary
- Questions and Answers.

How much water is used?

- Cow consumption
 - 35 - 40 gallons/cow-day?
 - 3 – 5 pounds/pound of milk? (50 gal/80#)
- Cleaning (No flushing)
 - 17 gallons/cow-day?
- Total consumption + cleaning
 - 40 – 50 gallons/cow-day?

Cow consumption

- Drinking water
- Water in feed
- Plus cleaning our waterers

Why a concern?

- Costs
 - Pumping water
 - Manure storage volume
 - Land application costs
- Water availability
- Neighbor concerns

Costs

- 1 gpm at \$0.01 per gallon
 - \$14.40 per day
 - \$100.80 per week
 - \$432.00 per month
 - \$5,356.00 per year.

Storage Volume

- 1 gpm
 - 1,440 gallons per day
 - 10,080 gallons per week
 - 43,200 gallons per month
 - 525,600 gallons per year

Monitoring project

- Dairy in Defiance County
- 540 expanded to 1,000 cows
- Typical 6 row free stall barn with milking center
- 3X milking, 6 hours per milking
- August 1, 2004 to December 31, 2006
- Total mixed ration feeding program
- Earthen manure storages

Dairy milking center

- Herringbone parlor
- Holding area
- Milk Room
- Utility Room
- Storage Room
- Office
- Break Room
- Restrooms



Water related items

- No washing of teats
- Hose down parlor after milking
- Well water plate heat exchanger with holding tank
- Water softener
- Compressor heat recovery into hot water
- Cow drinking water from storage tank with well water makeup
- CIP of milking equipment and bulk tank

Understanding water flows

- Main source
- Cold water lines
- Hot water lines
- Key monitoring points



Meter locations

- 1 — Parlor Water: used for cleaning parlor floors, walls, and milking equipment
- 2 — Cow Drinking Water: directly consumed
- 3 — Well Water: pumped from the well
- 4 — Soft Water: used in commercial operations

Meter locations, cont.

- 5 — Hot water: used in commercial operations
- 6 — Hot water, Cleaning in Place (CIP)
- 7 — Cold Water, CIP
- 8 — All CIP Water
- 9 — Plate Cooler Water

Meter locations, cont.

- 10 — Cold Water, Bulk Tank
- 11 — Hot Water, Bulk Tank
- 12 — Cold Water, Domestic
- 13 — Hot Water, Domestic

Metering equipment

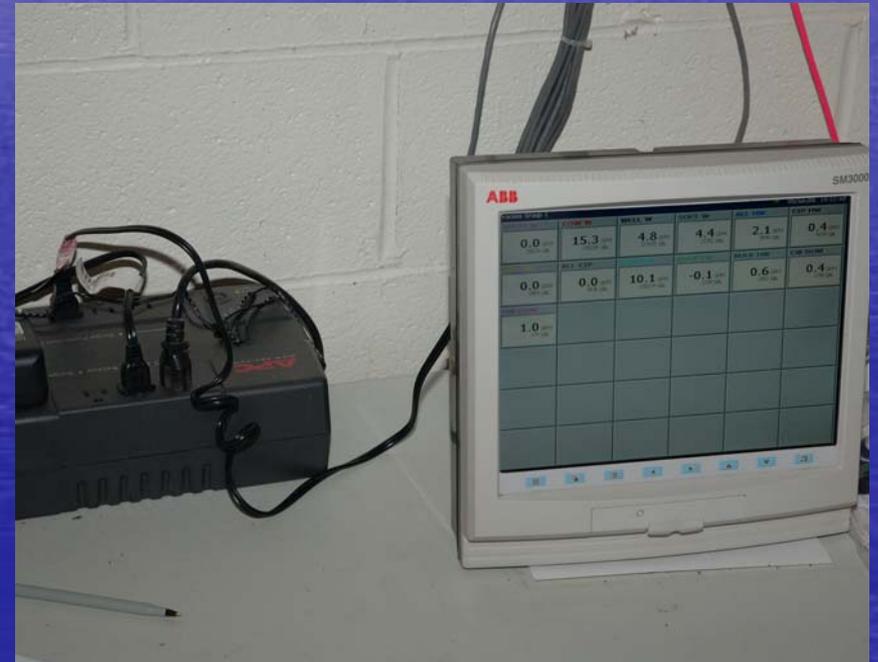
- GF+ Signet Model 2536 Paddlewheel Rotor-X Flow Sensor
- GF+ Signet Model 8550 ProcessPro™ Flow Transmitter
- ABB SM3000 Multipoint Videographic Recorder

Use for this project does not imply endorsement of this equipment over others that give the same performance.

Water meters



Water meter monitoring



ABB

SM3000 Videographic Recorder - SM3000

Recording Channels

[Home](#) Auto-Refresh

| Channel | Long Tag | Short Tag | Value | Alarms | Primary Sample Rate | Secondary Sample Rate | Recording Status |
|---------|-------------------|-----------|----------|--------|---------------------|-----------------------|------------------|
| 1.1 | Analogue Input A1 | WASH W | -0.0 GPM | | 3.0 s | 1.0 s | Primary |
| 1.2 | Analogue Input A2 | COW W | 11.8 GPM | | 3.0 s | 1.0 s | Primary |
| 1.3 | Analogue Input A3 | WELL W | 9.2 GPM | | 3.0 s | 1.0 s | Primary |
| 1.4 | Analogue Input A4 | SOFT W | 0.7 GPM | | 3.0 s | 1.0 s | Primary |
| 1.5 | Analogue Input A5 | ALL HW | 1.3 GPM | | 3.0 s | 1.0 s | Primary |
| 1.6 | Analogue Input A6 | CIP HW | 0.5 GPM | | 3.0 s | 1.0 s | Primary |
| 1.7 | Analogue Input B1 | CIP CW | 0.0 GPM | | 3.0 s | 1.0 s | Primary |
| 1.8 | Analogue Input B2 | ALL CIP | 0.0 GPM | | 3.0 s | 1.0 s | Primary |
| 1.9 | Analogue Input B3 | PLATE W | 19.5 GPM | | 3.0 s | 1.0 s | Primary |
| 1.10 | Analogue Input B4 | BULK CW | -0.1 GPM | | 3.0 s | 1.0 s | Primary |
| 1.11 | Analogue Input B5 | BULK HW | 0.6 GPM | | 3.0 s | 1.0 s | Primary |
| 1.12 | Analogue Input C1 | CW DOM | 0.5 GPM | | 3.0 s | 1.0 s | Primary |
| 2.1 | Analogue Input C2 | HW DOM | 1.4 GPM | | 10.0 s | 1.0 s | Primary |

ABB

SM3000 Videographic Recorder - SM3000

Totalizers

[Home](#) Auto-Refresh

| Totalizers | Tag | Batch | Secure | Units | Preset | Predet | Status |
|------------|------------------|----------|----------|-------|--------|-------------|--------|
| 1.1A | Total Flow 1.1A | 91376.0 | 91376.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.2A | Total Flow 1.2A | 402884.0 | 402884.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.3A | Total Flow 1.3A | 632211.0 | 632211.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.4A | Total Flow 1.4A | 63770.0 | 63770.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.5A | Total Flow 1.5A | 21402.0 | 21402.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.6A | Total Flow 1.6A | 12431.0 | 12431.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.7A | Total Flow 1.7A | 10777.0 | 10777.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.8A | Total Flow 1.8A | 24233.0 | 24233.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.9A | Total Flow 1.9A | 384444.0 | 384444.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.10A | Total Flow 1.10A | 3998.0 | 3998.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.11A | Total Flow 1.11A | 4680.0 | 4680.0 | GAL | 0.0 | 100000000.0 | Go |
| 1.12A | Total Flow 1.12A | 3362.0 | 3362.0 | GAL | 0.0 | 100000000.0 | Go |
| 2.1A | Total Flow 2.1A | 499.0 | 499.0 | GAL | 0.0 | 100000000.0 | Go |

ABB
SM3000 Videographic Recorder - SM3000

Totaliser Log

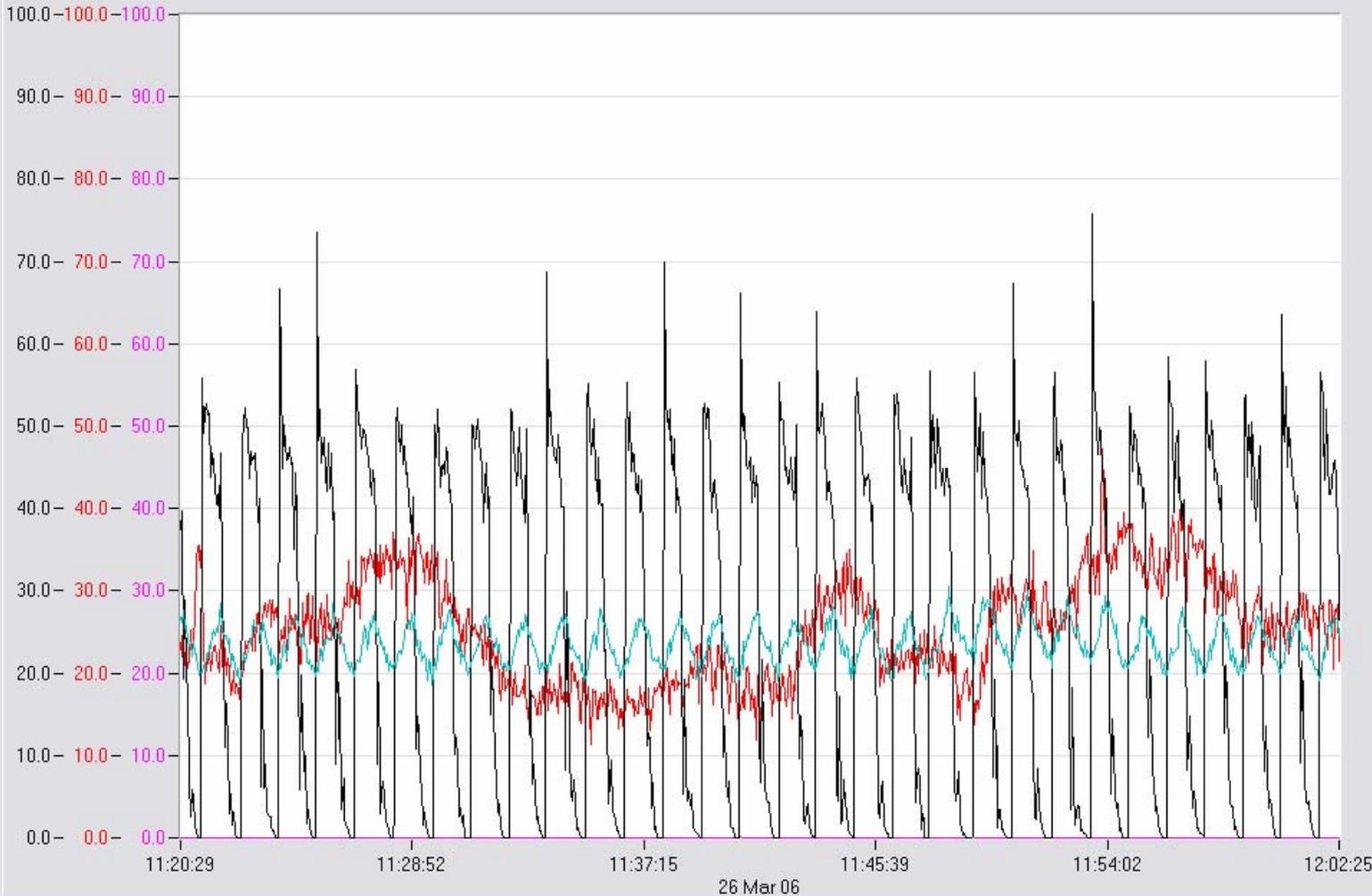
[Home](#)

| Date Time | Event | Tag | Source Tag | Value | Statistics |
|----------------------|-------|--------------------|--------------------------------|----------------------|--|
| 20/02/06 08:00:00 | Timed | Total Flow 1.8A | Analogue Input B2 (ALL CIP) | 24121 (24121) GAL | 33.1 max 12/02/06 12:20:58, -1.2 min 05/02/06 16:57:49, 1.0 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.7A | Analogue Input B1 (CIP CW) | 10700 (10700) GAL | 19.8 max 16/02/06 19:28:37, -2.4 min 18/02/06 20:17:27, 0.4 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.6A | Analogue Input A6 (CIP HW) | 12359 (12359) GAL | 28.2 max 19/02/06 03:46:16, -2.2 min 10/02/06 04:54:23, 1.0 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.5A | Analogue Input A5 (ALL HW) | 21237 (21237) GAL | 33.0 max 07/02/06 03:09:19, -1.2 min 11/02/06 04:38:12, 2.1 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.4A | Analogue Input A4 (SOFT W) | 63080 (63080) GAL | 37.4 max 06/02/06 23:57:58, -2.7 min 11/02/06 20:00:06, 2.4 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.3A | Analogue Input A3 (WELL W) | 626519 (626519) GAL | 85.0 max 15/02/06 22:33:53, -2.9 min 06/02/06 18:42:46, 23.7 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.2A | Analogue Input A2 (COW W) | 401091 (401091) GAL | 100.0 max 03/02/06 21:03:45, -2.7 min 19/02/06 06:55:42, 15.0 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 1.1A | Analogue Input A1 (WASH W) | 89807 (89807) GAL | 74.2 max 13/02/06 20:01:14, -2.9 min 11/02/06 18:36:44, 3.4 avg |
| 20/02/06 08:00:00 | Timed | Total Flow 2.1A | Analogue Input C2 (HW DOM) | 494 (494) GAL | 5.2 max 04/02/06 16:31:56, 1.1 min 05/02/06 23:26:16, 1.2 avg |
| 20/02/06 | | Total Flow | Analogue Input C1 (CW) | | 7.1 max 11/02/06 08:52:07, 0.2 min 04/02/06 14:50:44 |

SM3000(N_29736_7_1) Process Group 1 #1 - Data Integrity Verified Successfully



17:59:54
27 Mar 06



| | |
|----------------|-------------------------------------|
| WASH W | <input checked="" type="checkbox"/> |
| 0.0 | GPM |
| COW W | <input checked="" type="checkbox"/> |
| 19.8 | GPM |
| WELL W | <input checked="" type="checkbox"/> |
| 40.4 | GPM |
| SOFT W | <input type="checkbox"/> |
| 0.0 | GPM |
| ALL HW | <input type="checkbox"/> |
| 1.5 | GPM |
| CIP HW | <input type="checkbox"/> |
| 0.5 | GPM |
| CIP CW | <input type="checkbox"/> |
| 0.0 | GPM |
| ALL CIP | <input type="checkbox"/> |
| 0.0 | GPM |
| PLATE W | <input checked="" type="checkbox"/> |
| 20.6 | GPM |
| BULK CW | <input type="checkbox"/> |
| -0.1 | GPM |
| BULK HW | <input type="checkbox"/> |
| 0.7 | GPM |
| CW DOM | <input type="checkbox"/> |
| 0.6 | GPM |

May 2, 2005 use

| Meter | Function | 24 hour gallons |
|-------|-----------------------|-----------------|
| 1 | Parlor cleaning | 4,199 |
| 2 | Cow Drinking | 24,409 |
| 3 | Well | 33,880 |
| 4 | Soft water commercial | 4,200 |

May 2, 2005 use, cont.

| Meter | Function | 24 hour gallons |
|-------|------------------------|-----------------|
| 5 | Hot water – commercial | 1,172 |
| 6 | Hot water – CIP | 837 |
| 7 | Cold water – CIP | 706 |
| 8 | All CIP | 1,595 |

May 2, 2005 use, cont.

| Meter | Function | 24 hour gallons |
|-------|------------------------|-----------------|
| 9 | Plate cooling | 21,675 |
| 10 | Cold water – bulk tank | 156 |
| 11 | Hot water – bulk tank | 145 |
| 12 | Cold water – domestic | 51 |
| 13 | Hot water – domestic | 5 |

Monthly Averages

- Drinking water – based total cows, lactating and non-lactating in the barn
- Waste water – based on total cows, meters 1, 8, 10 and 11
- Total water for the month divided by average number of cows per month

Monthly averages gallons per cow

| Month | 2005 DW | 2006 DW | 2005 WW | 2006 WW |
|-------|------------|------------|------------|------------|
| Jan. | 16.1 | 15.5 | 7.6 | 7.0 |
| Feb. | 17.0 | 23.2 | 7.4 | 6.7 |
| Mar. | 18.7 | 21.1 | 7.0 | 6.5 |
| Apr. | 22.8 | 23.2 | 6.5 | 5.9 |

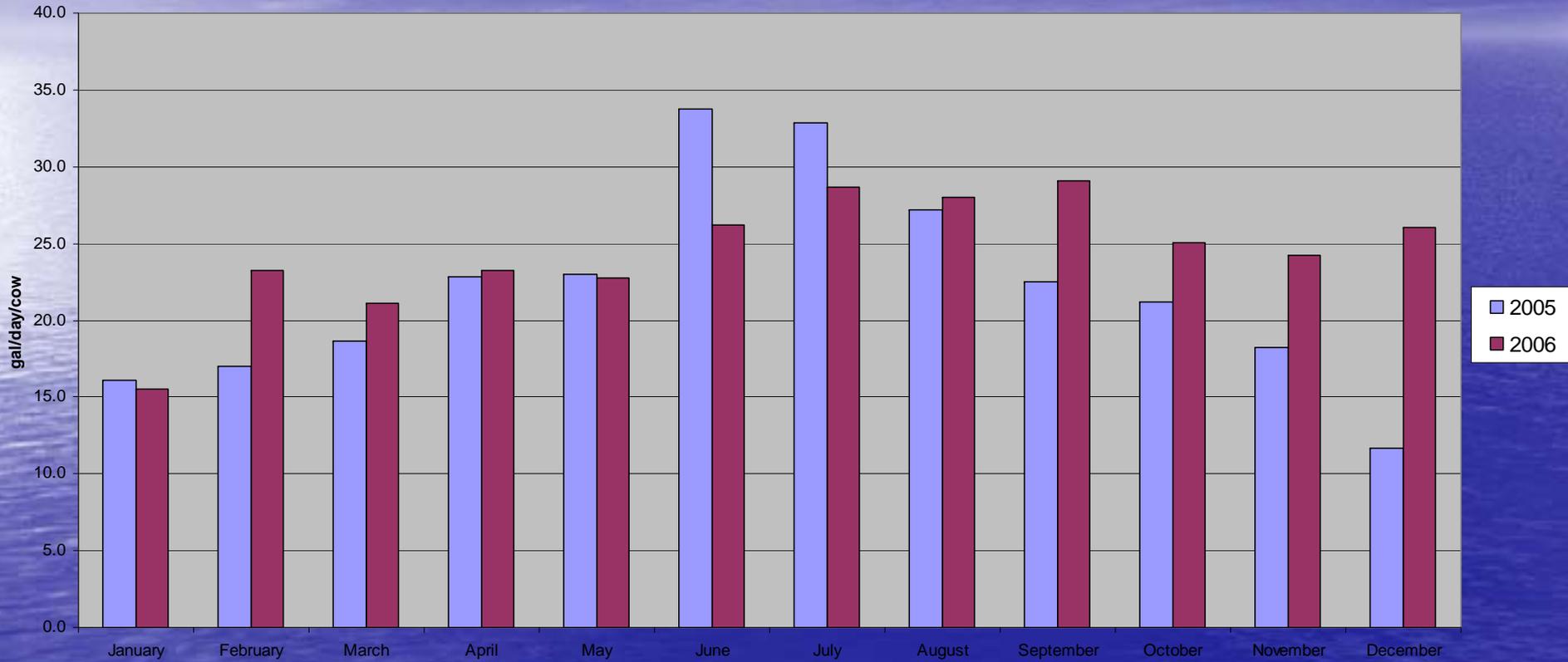
Monthly averages gallons per cow, cont.

| Month | 2005 DW | 2006 DW | 2005 WW | 2006 WW |
|--------|------------|------------|------------|------------|
| May | 23.0 | 22.8 | 6.5 | 5.7 |
| June | 33.8 | 26.2 | 6.3 | 5.8 |
| July | 32.8 | 28.7 | 6.3 | 5.7 |
| August | 27.2 | 28.0 | 5.6 | 5.9 |

Monthly averages gallons per cow, cont.

| Month | 2005 DW | 2006 DW | 2005 WW | 2006 WW |
|---------|------------|------------|------------|------------|
| Sept. | 22.5 | 29.1 | 6.4 | 5.9 |
| Octob. | 21.2 | 25.1 | 6.0 | 6.6 |
| Novem. | 18.2 | 24.2 | 6.5 | 6.3 |
| Decem. | 11.6 | 26 | 6.0 | 6.2 |
| Average | 22.1 | 24.4 | 6.5 | 6.2 |

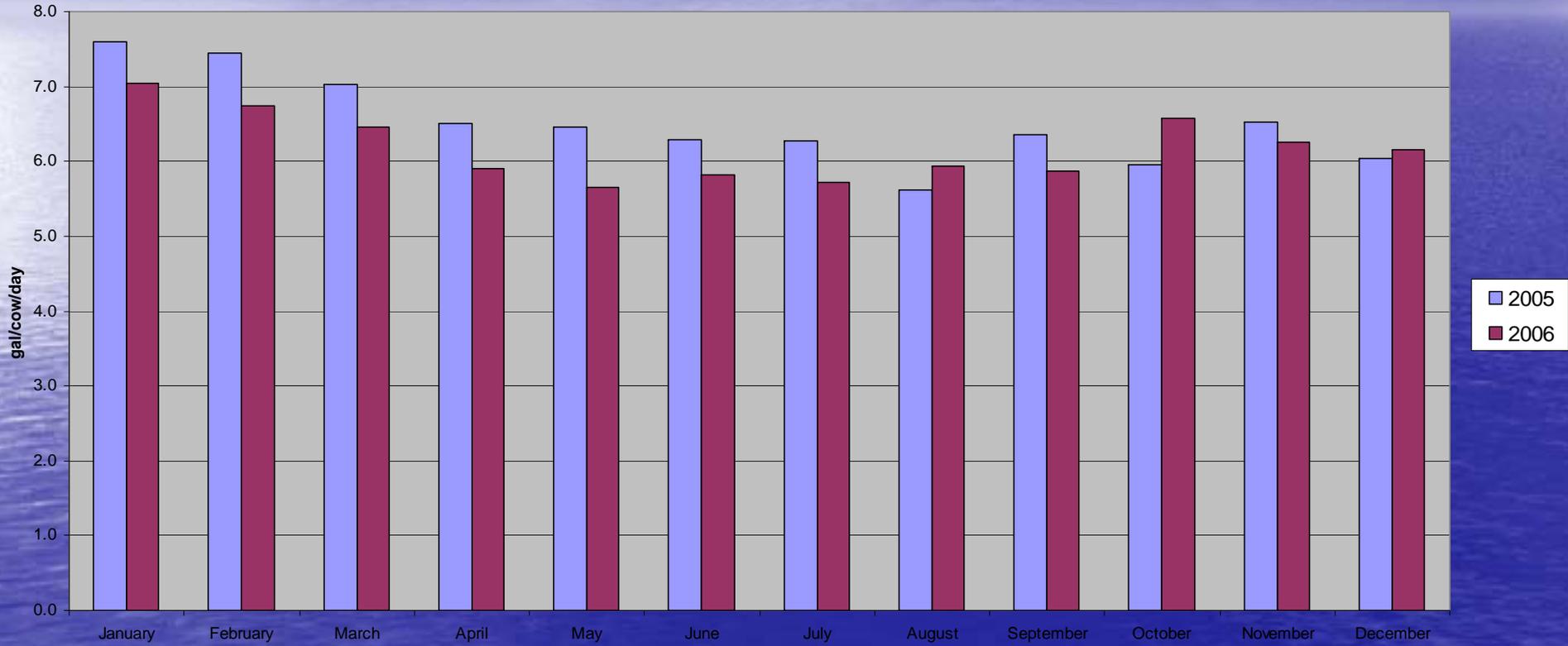
Average Daily Drinking Water Usage



Drinking water gal/cow-day

- Winter average – 18.3
- Spring average – 21.9
- Summer average – 29.4
- Fall average – 23.4
- Overall average – 23.2

Average Daily Waste Water Usage



Waste water use gal./cow-day

- Range: 5.8 – 7.3
- Average: 6.3
- Had increase in cow numbers over the year.

Total water use gal./cow-day

- Winter average – 25.2
- Spring average – 27.8
- Summer average – 33.7
- Fall average – 29.7
- Overall average – 29.6

Yearly use based on average of 888 cows

- Metered farm – 9,600,000 gallons
- Literature low – 12,700,000 gallons (132% of metered)
- Literature high – 16,700,000 gallons (174% of metered)

Why differences?

- Cow water consumption versus drinking water - 6 gpd in feed.
- Peak versus continuous monitoring for a year
- Different climates, e.g. Kansas
- Different milking center equipment

Sprinkler water

| Month Avg. | Gallons Per Day |
|------------|-----------------|
| June | 1,120 |
| July | 1,170 |
| August | 1,213 |

Reducing water use

- Plate cooler
 - From 42 gpm to 21 gpm – 22,680 gal/day, 8 million gallons per year!
- Parlor wash down
 - Scraping alleys instead of washing
 - Training of workers
- Leak detection/ open faucets
 - 6 gpm under concrete floor

Management uses

- Detection of problems
 - CIP cleaning not having adequate volume each time
 - Hot water heater starting to fail
 - No drinking water to cows
 - Periodic short cleaning times on bulk tank

Future plans

- Continue monitoring use and flows
- Activate alarm capabilities that are in the system
 - Lack of flow where and when should be there
 - Flow when there should not be there
 - Excessive change in flow rates

Current thoughts on metering points

- Flows to identify problems or provide management information, examples
 - Total flow
 - Parlor washdown
 - Cow drinking
 - Plate cooler
 - CIP flow
 - Hot water heater

Summary

- Monitoring water at 13 points of large, efficient dairy
- Seasonal variation in water use
- Annual average water use per cow – 29.6 gallons per day
- Water meters are management tool.

Questions?

