

From: Milligan, Ronald [<mailto:rmilligan@usbr.gov>]

Sent: Tuesday, April 14, 2015 3:51 PM

To: Rea, Maria@NOAA

Cc: Grober, Les@Waterboards; Fry, Susan@USBR; Howard, Tom; Riddle, Diane@Waterboards; Wilcox, Carl@Wildlife; Garwin.Yip@noaa.gov; Castleberry, Dan@fws

Subject: Re: Invitation: Review Sac River Modeling - Afternoon meeting prep @ Wed Apr 15, 2015 10am - 11:30am (rmilligan@usbr.gov)

All –

In preparation to our discussions tomorrow, please find attached temperature model output, and companion operations forecast, that is our best attempt to merge the temperature target of 56 degrees at the near Clear Creek gage, modified SRSCs diversion schedules (especially in April and May), and maintain stable operations down to the Delta. I have included a tabular comparison of this operation with the scenario created last month. This data output is based on the following:

- DWR April 90% exceedance runoff projections,
- DWR April 90% exceedance basin depletion projections (high estimate),
- The latest projected NWS projected meteorological data,
- Current lake temperature profiles at Shasta and Whiskeytown, but a March profile at Trinity,
- A Dry-Year Trinity Restoration Program flow volume,
- Substantial use of Trinity River diversions,
- Delta outflow objectives consistent with our most recent TUCP.

Rather than present a number of competing runs, this single run is a hybrid of what we were discussing last week and seems to meet the temperature performance objectives, although the releases at Keswick are slightly higher. This configuration does accomplish the following:

- Meets the 56 degree target a Clear Creek (real-time adjustments will further enhance performance),
- Delays the full use of the side gate operation until well into October,
- Preserves over 300 taf of cold water past the end of September,
- Allows for a SRSC diversion schedule with consideration for fallowing and GW substitution,
- Re-operates transfer volumes to the fall to benefit fall-run Chinook,
- Allows for opportunity to improve summer pumping if summer deletions are closer to 2014 levels,

Shoot me any questions you may have and I will talk with you tomorrow.

Ron

**April 2015 90% Exceedance Outlook
With SRSC Coordinated Diversions**

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

| | | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
|--------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| Trinity | | 1191 | 1179 | 1012 | 877 | 754 | 629 | 539 | 508 | 476 | 460 | | |
| | Elev. | 2274 | 2256 | 2241 | 2225 | 2206 | 2192 | 2186 | 2180 | 2177 | 2179 | 2185 | 2197 |
| Whiskeytown | | 205 | 238 | 238 | 238 | 238 | 230 | 206 | 206 | 206 | | | |
| | Elev. | 1209 | 1209 | 1209 | 1209 | 1209 | 1207 | 1199 | 1199 | 1199 | 1199 | 1199 | 1199 |
| Shasta | | 2689 | 2621 | 2325 | 2023 | 1661 | 1341 | 1164 | 1083 | 1093 | 1118 | | |
| | Elev. | 990 | 975 | 959 | 936 | 914 | 900 | 893 | 894 | 896 | 906 | 921 | 943 |
| Folsom | | 572 | 596 | 553 | 429 | 293 | 267 | 238 | 225 | 219 | 222 | | |
| | Elev. | 428 | 423 | 407 | 386 | 381 | 375 | 373 | 371 | 372 | 375 | 385 | 405 |
| New Melones | | 553 | 478 | 388 | 294 | 207 | 124 | 64 | 50 | 58 | 65 | | |
| | Elev. | 853 | 832 | 806 | 778 | 743 | 708 | 697 | 703 | 709 | 711 | 716 | 720 |
| San Luis | | 395 | 393 | 321 | 226 | 110 | 28 | 135 | 301 | 380 | 535 | | |
| | Elev. | 476 | 457 | 429 | 385 | 346 | 358 | 388 | 416 | 451 | 481 | 476 | 464 |
| Total | | 5506 | 4836 | 4087 | 3263 | 2627 | 2371 | 2373 | 2431 | 2607 | | | |

State End of the Month Reservoir Storage (TAF)

| | | | | | | | | | | | | | |
|-----------------------------|-------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|
| Oroville | | 1794 | 1776 | 1638 | 1424 | 1180 | 1001 | 937 | 930 | 830 | 784 | | |
| | Elev. | 761 | 746 | 721 | 690 | 664 | 654 | 653 | 636 | 628 | 649 | 673 | 703 |
| San Luis | | 959 | 846 | 718 | 541 | 300 | 137 | 95 | 131 | 275 | 449 | | |
| Total San Luis (TAF) | | 1354 | 1239 | 1039 | 767 | 410 | 166 | 230 | 432 | 655 | 984 | | |

Monthly River Releases (TAF/cfs)

| | | | | | | | | | | | | | |
|-------------|-----|------|-------|------|------|------|------|------|------|------|------|------|------|
| Trinity | TAF | 32 | 180 | 47 | 28 | 28 | 27 | 23 | 18 | 18 | | | |
| | cfs | 540 | 2,924 | 783 | 450 | 450 | 450 | 373 | 300 | 300 | 300 | 300 | 300 |
| Clear Creek | TAF | 13 | 13 | 9 | 7 | 5 | 9 | 11 | 10 | 11 | | | |
| | cfs | 218 | 216 | 150 | 120 | 85 | 150 | 175 | 175 | 175 | 175 | 175 | 175 |
| Sacramento | TAF | 268 | 461 | 506 | 553 | 523 | 357 | 307 | 238 | 246 | | | |
| | cfs | 4500 | 7500 | 8500 | 9000 | 8500 | 6000 | 5000 | 4000 | 4000 | 3250 | 3250 | 3250 |
| American | TAF | 30 | 92 | 139 | 151 | 49 | 48 | 49 | 48 | 49 | | | |
| | cfs | 500 | 1497 | 2331 | 2462 | 793 | 800 | 804 | 806 | 800 | 801 | 917 | 800 |
| Stanislaus | TAF | 30 | 9 | 9 | 9 | 9 | 9 | 35 | 12 | 13 | | | |
| | cfs | 500 | 150 | 150 | 150 | 150 | 150 | 577 | 200 | 206 | 261 | 309 | 289 |
| Feather | TAF | 48 | 49 | 89 | 154 | 123 | 101 | 55 | 48 | 49 | | | |
| | cfs | 800 | 800 | 1500 | 2500 | 2000 | 1700 | 900 | 800 | 800 | 800 | 800 | 800 |
| WLK | | 3722 | 3716 | 3800 | 3787 | 4340 | 4753 | 4425 | 4107 | 4960 | | | |

Trinity Diversions (TAF)

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Carr PP | 39 | 22 | 97 | 98 | 97 | 62 | 15 | 28 | 19 |
| Spring Crk. PP | 8 | 15 | 90 | 90 | 90 | 60 | 30 | 19 | 12 |

Delta Summary (TAF)

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Tracy | 57 | 31 | 23 | 22 | 20 | 166 | 208 | 97 | 173 |
| USBR Banks | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Contra Costa | 8.7 | 8.7 | 8.7 | 8.0 | 8.3 | 8.7 | 3.5 | 4.3 | 4.7 |
| Total USBR | 65 | 39 | 32 | 30 | 28 | 175 | 212 | 101 | 178 |
| State Export | 33 | 31 | 51 | 30 | 30 | 30 | 74 | 164 | 200 |
| Total Export | 98 | 70 | 83 | 60 | 58 | 205 | 286 | 265 | 378 |
| COA Balance | 0 | 0 | 0 | -20 | -29 | -29 | -29 | -29 | -29 |
| Old/Middle River Std. | | | | | | | | | |
| Old/Middle R. calc. | -1,413 | -1,177 | -1,472 | -1,149 | -1,151 | -3,044 | -3,658 | -3,676 | -4,986 |
| Computed DOI | 4740 | 4002 | 4001 | 2993 | 2993 | 3009 | 2993 | 3496 | 3497 |
| Excess Outflow | 740 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % Export/Inflow | 20% | 15% | 15% | 10% | 11% | 37% | 50% | 51% | 64% |
| % Export/Inflow std. | 35% | 35% | 35% | 65% | 65% | 65% | 65% | 65% | 65% |

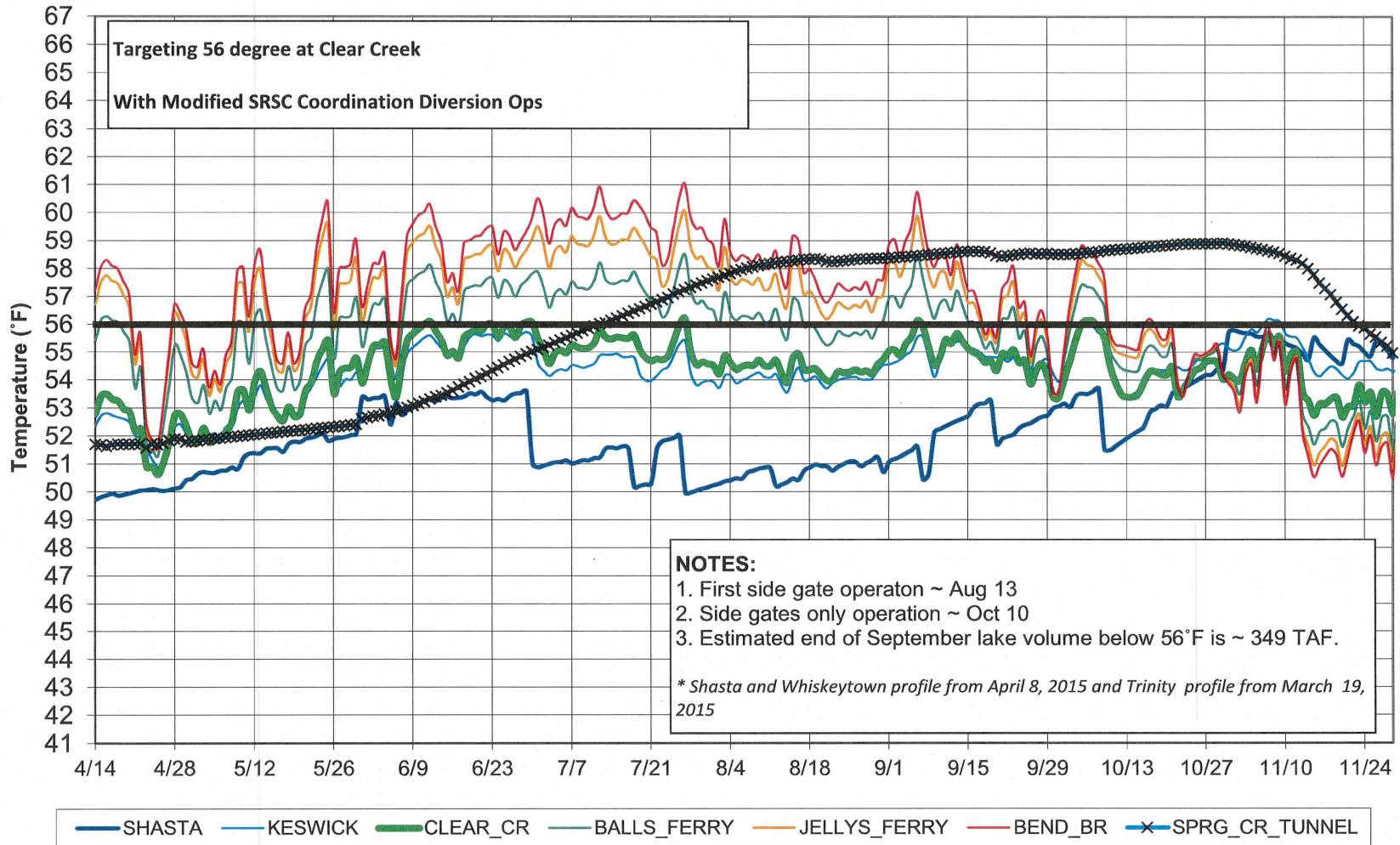
Hydrology

| Water Year Inflow (TAF) | Trinity | Shasta | Folsom | New Melones |
|---------------------------|---------|--------|--------|-------------|
| Year to Date + Forecasted | 887 | 3,452 | 870 | 229 |
| % of mean | 73% | 62% | 32% | 22% |

Received 4/15/15 PM

Provisional

Sacramento River Modeled Temperature 2015 April 90%-Exceedance Outlook



Scenario Differences

March 2015

| | 6 b (1) Reclamation | 6 b (2) Salmonid Plan | 6 b (3) "Temp Optimal" (SWCB Scenario) |
|-----------|------------------------|--------------------------|--|
| | Keswick (cfs) | Keswick (cfs) | Keswick (cfs) |
| April | 5600 | 3250 | 3250 |
| May | 7589 | 5000 | 6000 |
| June | 8549 | 8000 | 8500 |
| July | 9234 | 8000 | 9000 |
| August | 7593 | 8000 | 8500 |
| September | 5000 | 6000 | 6000 |
| October | 4061 | 5500 | 5500 |
| November | 3389 | 5000 | 3389 |
| December | 3250 | 5000 | 3250 |

| 6 b (4) 53 deg target at Shasta Reclamation |
|--|
| Keswick (cfs) |
| 5600 |
| 7589 |
| 8549 |
| 9234 |
| 7593 |
| 5000 |
| 4061 |
| 3389 * |
| 3250 |

April 2015 90% Exceedance Outlook

| | April 90% Temp Forecast With SRSC Coordinated Diversions |
|-----------|---|
| | Keswick (cfs) |
| April | 4500 |
| May | 7500 |
| June | 8500 |
| July | 9000 |
| August | 8500 |
| September | 6000 |
| October | 5000 |
| November | 4000 |
| December | 4000 |

| | 6 b (1) Reclamation | 6 b (2) Salmonid Plan | 6 b (3) "Temp Optimal" (SWCB Scenario) |
|-----------|------------------------|--------------------------|--|
| | Wilkins Slough | Wilkins Slough | Wilkins Slough |
| April | 3800 | 453 | 453 |
| May | 3800 | 1211 | 2211 |
| June | 3800 | 3141 | 3641 |
| July | 3800 | 2206 | 3206 |
| August | 3800 | 3987 | 4487 |
| September | 3800 | 5050 | 5050 |
| October | 3500 | 4939 | 4939 |
| November | 3500 | 5110 | 3500 |
| December | 3500 | 5988 | 4238 |

| 6 b (4) 53 deg target at Shasta Reclamation |
|--|
| Wilkins Slough |
| 3800 |
| 3800 |
| 3800 |
| 3800 |
| 3800 |
| 3800 |
| 3500 |
| 3500 |
| 3500 |
| 3500 |

| | April 90% Temp Forecast With SRSC Coordinated Diversions |
|-----------|---|
| | Wilkins Slough |
| April | 3722 |
| May | 3716 |
| June | 3800 |
| July | 3787 |
| August | 4340 |
| September | 4753 |
| October | 4425 |
| November | 4107 |
| December | 4960 |

| | | | |
|-------------------|---------|--------|--------|
| EO Sep Storage | 1204 | 1558 | 1377 |
| EOS vol below 56 | 199 | 399 | 256 |
| 1st side gate ops | July 26 | Aug 18 | Aug 10 |
| Side gate ops | Sep 11 | Oct 22 | Sep 17 |

| |
|--------|
| 1204 |
| 305 |
| Aug 23 |
| Oct 20 |

| | |
|-------------------|--------|
| EO Sep Storage | 1164 |
| EOS vol below 56 | 386 |
| 1st side gate ops | Aug 23 |
| Side gate ops | Oct 20 |

* Corrected value- previous submittal contained a typo.

April 2015 - 90% Exceedance Outlook with SRSC Coordination Diversions

| Inflows | | | | | | | |
|---------------------|---------------|-------------------|---------------|--------|-------------|----------|-----|
| | Trinity | Whiskeytown | Shasta | Folsom | New Melones | Oroville | |
| Oct | 10 | 9 | 2 | 200 | 50 | 25 | 80 |
| Nov | 11 | 14 | 2 | 230 | 50 | 20 | 80 |
| Dec | 12 | 22 | 4 | 260 | 60 | 20 | 100 |
| Jan | 1 | 33 | 8 | 320 | 70 | 20 | 170 |
| Feb | 2 | 55 | 12 | 380 | 110 | 25 | 200 |
| Mar | 3 | 88 | 20 | 520 | 180 | 45 | 280 |
| Apr | 4 | 63 | 16 | 200 | 66 | 12 | 44 |
| May | 5 | 39 | 8 | 160 | 65 | 11 | 38 |
| Jun | 6 | 14 | 4 | 125 | 36 | 2 | 9 |
| Jul | 7 | 8 | 2 | 115 | 38 | 0 | 45 |
| Aug | 8 | 4 | 1 | 123 | 44 | 0 | 67 |
| Sep | 9 | 3 | 1 | 128 | 36 | 0 | 88 |
| Modified Normal/Dry | | | | | | | |
| River Releases | | | | | | | |
| | Trinity (cfs) | Clear Creek (cfs) | Goodwin (cfs) | | | | |
| Oct | 10 | 373 | 175 | 577 | | | |
| Nov | 11 | 300 | 175 | 200 | | | |
| Dec | 12 | 300 | 175 | 206 | | | |
| Jan | 1 | 300 | 175 | 261 | | | |
| Feb | 2 | 300 | 175 | 309 | | | |
| Mar | 3 | 300 | 175 | 280 | | | |
| Apr | 4 | 540 | 218 | 500 | | | |
| May | 5 | 2924 | 216 | 150 | | | |
| Jun | 6 | 783 | 150 | 150 | | | |
| Jul | 7 | 450 | 120 | 150 | | | |
| Aug | 8 | 450 | 85 | 150 | | | |
| Sep | 9 | 450 | 150 | 150 | | | |
| Uodate | | | | | | | |

| Hydrology | | | | | | | | | | | | | | | |
|-----------|-----------------------|----------------------------|----------------------|-------------------------|--------------------------------|-------------------------|--------------------|-------------------|-----------------------|-----------------------------|---------------------|----------------|-----------------|----------------|--|
| | Wilkin's Target (cfs) | Kes-Wilkin's Acc/Dep (cfs) | SJR Above Stan (TAF) | Sac Gross Acc/Dep (TAF) | Freeport Treatment Plant (TAF) | East Side Streams (cfs) | Misc. Creeks (TAF) | Yolo Bypass (TAF) | Transfer Inflow (TAF) | Delta Consumptive Use (TAF) | Delta Outflow (TAF) | X-Channel Gate | Feather Minimum | Feather Target | |
| Oct | 10 | 3500 | -750 | 34 | 40 | 13.3 | 210 | 29 | 0 | 0 | -118 | 184 | 0 | 0 | |
| Nov | 11 | 3500 | -68 | 34 | 90 | 14 | 260 | 19 | 0 | 0 | -55 | 208 | 0 | 0 | |
| Dec | 12 | 3500 | 785 | 33 | 160 | 13.2 | 160 | 11.1 | 0 | 0 | -2 | 215 | 1 | 0 | |
| Jan | 1 | 4000 | 2456 | 36 | 300 | 13.8 | 98 | 0.8 | 0 | 0 | 56 | 369 | 1 | 0 | |
| Feb | 2 | 0 | 1969 | 39 | 240 | 12 | 810 | 0.9 | 0 | 0 | 37 | 633 | 1 | 0 | |
| Mar | 3 | 0 | 2789 | 44 | 320 | 12.1 | 671 | 1.2 | 0 | 0 | 10 | 701 | 1 | 0 | |
| Apr | 4 | 3000 | -996 | 29 | -10 | 11.5 | 390 | 1.8 | 0 | 0 | -63 | 238 | 1 | 0 | |
| May | 5 | 3000 | -4000 | 31 | -280 | 12.2 | 280 | 32.3 | 0 | 0 | -121 | 246 | 1 | 0 | |
| Jun | 6 | 3000 | -4850 | 16 | -296 | 12.5 | 180 | 17.4 | 0 | 0 | -191 | 238 | 0 | 0 | |
| Jul | 7 | 3000 | -5333 | 17 | -415 | 12.3 | 120 | 15.4 | 0 | 0 | -268 | 184 | 0 | 0 | |
| Aug | 8 | 3800 | -4245 | 14 | -273 | 12.4 | 110 | 25.5 | 0 | 0 | -252 | 184 | 0 | 0 | |
| Sep | 9 | 3800 | -1397 | 17 | -30 | 12.4 | 160 | 25.5 | 0 | 0 | -174 | 179 | 0 | 0 | |

| Demands (TAF) | | | | | | | | | | | | | | | | | | | | |
|---------------|----------------|--------------------|-----------|-----------------------------|-------------------|------|---------------|------------------|-------------------|--------------------|---------------------|--------------------|-----------------|------------|--------------------|--------------------|-----------------------|--------------------|------------------|---------------------|
| | Folsom Pumping | Folsom South Canal | OID/SS/JD | New Melones CVP Contractors | Thermolito Demand | CCWD | Barker Slough | F. Banks On-Peak | F. Banks Off-Peak | North Bay Aqueduct | Delta Mendota Canal | Federal Dos Amigos | Fed O/N to D.A. | San Felipe | Cross Valley Canal | Fed Exchange Oneil | Fed Exchange San Luis | South Bay/San Jose | State Dos Amigos | Spring Creek Tunnel |
| Oct | 10 | 11 | 2 | 10 | 0 | 30 | 3.5 | 0 | 0 | 0 | 30 | 8 | 0 | 3 | 0 | 0 | 0 | 5 | 32 | 0 |
| Nov | 11 | 5 | 2 | 0 | 0 | 131 | 4.3 | 0 | 0 | 0 | 10 | 5 | 0 | 2 | 0 | 0 | 0 | 3 | 16 | 0 |
| Dec | 12 | 5 | 2 | 0 | 0 | 96 | 4.7 | 0 | 0 | 0 | 10 | 5 | 0 | 2 | 0 | 0 | 0 | 3 | 23 | 30 |
| Jan | 1 | 4 | 1 | 0 | 0 | 0 | 4.7 | 0 | 0 | 0 | 0 | 5 | 0 | 2 | 0 | 0 | 0 | 0 | 42 | 30 |
| Feb | 2 | 4 | 1 | 0 | 0 | 0 | 3.5 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 73 | 30 |
| Mar | 3 | 5 | 1 | 20 | 0 | 12 | 3.5 | 0 | 0 | 0 | 20 | 27 | 0 | 3 | 0 | 0 | 0 | 1 | 119 | 30 |
| Apr | 4 | 7 | 1 | 50 | 0 | 11 | 8.7 | 0 | 0 | 0 | 20 | 32 | 0 | 3 | 0 | 0 | 0 | 1 | 141 | 30 |
| May | 5 | 10 | 2 | 85 | 0 | 122 | 8.7 | 0 | 0 | 0 | 40 | 55 | 0 | 4 | 0 | 0 | 0 | 2 | 152 | 30 |
| Jun | 6 | 14 | 2 | 85 | 0 | 128 | 8.7 | 0 | 0 | 0 | 50 | 61 | 0 | 3 | 0 | 0 | 0 | 2 | 222 | 75 |
| Jul | 7 | 15 | 2 | 75 | 0 | 129 | 8.0 | 0 | 0 | 0 | 60 | 71 | 0 | 3 | 0 | 0 | 0 | 1 | 266 | 87 |
| Aug | 8 | 14 | 2 | 72 | 0 | 118 | 8.3 | 0 | 0 | 0 | 50 | 46 | 0 | 3 | 0 | 0 | 0 | 2 | 187 | 75 |
| Sep | 9 | 12 | 2 | 53 | 0 | 47 | 8.7 | 0 | 0 | 0 | 40 | 15 | 0 | 3 | 0 | 0 | 0 | 5 | 65 | 40 |