Note: three different size of slugs were used at each well in May-July 2017. We call them “medium” (Brad), “small” (Brad), and “smallest” (the one built by UW Physical Plant). After the cross-hole pumping tests this summer, plan is to go back and evaluate the wellbore condition (further development from the pumping tests?) by repeating the slug tests using the same slugs (medium, small, smallest) as well as a Geoprobe-hoisted large slug (i.e., Brad Carr has this one).

#	Test	Purpose	Date	Duration	Result	Comments
1	Slug test at BW6	Determine the K and S_s near BW6.	5/17/2017	10 hours and 20 minutes total (1 hour for preparation and 1 hour to download data, the total time for slug test is around 8 hours): We used two slug sizes, one is 6’0.5’’long,3.7’’ diameter; the other one is 5’4’’ long, 2.375’’ diameter. The volume of the slugs is 0.01277m^3 and 0.00465m^3, respectively. We did a *medium-small-medium* sequence of tests. For each test, we did it twice, except the last one (time was not enough). So totally, 5 slug-in and slug-out test were performed.	T is estimated from the drawdown Data using Cooper (1967) sln[*1]: 4.4E-5 m^2/s We consider the thickness of saturated open hole[*2] is 60.76-17.07= 43.69m, then the K_H=T/D=1.0E-6m/s. K_H is estimated using Cooper et a. (1967) solution. S_s=3.3E-5 (1/m) *1Assumptions: confined, homogenous, isotropic, no leakage. *2 we doubled check against BW6 WL data to determine that the open hole was fully saturated at the time of this test. We have also done this for all the other boreholes.	Before slug test, we first measured DTW manually for BW6, 1, 7, 8 &9 which are hydraulically cross-connected from observations made in the 2016 hydraulic tests. Then we set the transducers for BW8&9 to 1 second, and BW6, 7 & 1 to 0.5 second before the slug test. For slug testing in BW6, BW 1, 7, 8, & 9 were considered as monitoring points for potential cross-hole connection. For BW6, we marked two knot, one is 11 m and the other is 14 m. We put the medium slug in at 10:30 am, and take manual measurement every 5 to 10 minutes. At 11:08 am the block of wood rolled over. Medium slug out at about 11:21 am. The second slug in at 12:10 pm, and then slug out at about 12:55 pm. The first time small slug was put in at about 1:35 pm, and then out at about 2:10 pm; the second time small slug in at about 2:45 pm and the out at about 3:20 pm. Then we redid the medium slug in at about 4:05 pm, and slug out at 4:50 pm. No cross-connection was found from slug test by looking at pressure data from BW 1, 7, 8, & 9. Light rain began at about 1:30 Heavy rain/snow began at about 3:00

#	Test	Purpose	Date	Duration	Result	Comments
2	Slug test at BW7	Determine the K and S_s near BW7.	5/24/2017	We used two size of slugs, one is 6'0.5''long,3.7'' diameter; the other one is 5'4'' long, 2.375'' diameter. The volume of each slug is 0.01277m^3 and 0.00465m^3, respectively. We did medium-small-medium test and for each test we did twice. So totally 6 slug-in and slug-out test were performed.	T is estimated from the drawdown data: 3.1E-4 m^2/s We consider the thickness of saturated open hole is 55.76 m, then the K_H=T/D=5.5E-6m/s. K_H is estimated using Cooper et a. (1967) solution. S_s=2.6E-12(1/m)	Weather was sunny and windy, about 60 degrees F, with some melting snow on the ground. Initial DTW is 12.181m. The transducer is set to 1 second interval. We put the medium slug in at 9:57 am, and take manually measurement every 5 to 10 minutes. Medium slug out about 10:30 am. The second time slug in at 11:05 am, and then slug out at about 11:28 am. The first time small slug in at about 11:55 am, and then out at about 12:15 pm; the second time small slug in at about 12:37 am and the out at about 12:58 pm. Then we redo the medium slug in at about 1:23 pm, and slug out at 1:52 pm; the second slug in at 2:13 pm and slug out at 2:43 pm.

#	Test	Purpose	Date	Duration	Result	Comments
3	Slug test at BW1	Determine the K and S_s near BW1.	5/31/2017	We used two size of slugs, one is 6'0.5''long,3.7'' diameter; the other one is 5'4'' long, 2.375'' diameter. The volume of each slug is 0.01277m^3 and 0.00465m^3, respectively. We did medium-small-medium test and for each test we did twice. So totally 6 slug-in and slug-out test were performed.	T is estimated from the drawdown data: 2.1E-4 m^2/s We consider the thickness of saturated open hole is 13.27 m, then the K_H=T/D=1.6E-5m/s. K_H is estimated using Cooper et a. (1967) solution. S_s=1.6E-11(1/m)	Weather was sunny, about 65 degrees F in the morning. Light rain at 2:20 pm, and hail at 3:30 pm. Initial DTW is 13.014 m. The transducer is set to 0.5 second interval. We put the medium slug in at 10:00 am, and take manually measurement every 5 to 10 minutes. Medium slug out about 10:42 am. The second time slug in at 11:22 am, and then slug out at about 12:03 pm. The first time small slug in at about 12:41 pm, and then out at about 1:12 pm; the second time small slug in at about 1:45 pm and the out at about 2:17 pm. Then we redo the medium slug in at about 2:49 pm, and slug out at 3:26 pm; the second slug in at 4:03 pm and slug out at 4:37 pm.

#	Test	Purpose	Date	Duration	Result	Comments
4	Slug test at BW9	Determine the K and S_s near BW9.	6/1/2017	We used one size slug, 6'0.5''long, 3.7'' diameter. The volume of each slug is 0.01277m^3. For one slug in and out test it takes more than 8 hours, so we only did one slug in and out with the slug.	T is estimated from the drawdown data: 4.4E-6 m^2/s We consider the thickness of saturated open hole is 43.89 m, then the K_H=T/D=1.0E-7m/s. K_H is estimated using Cooper et a. (1967) solution. S_s=3.3E-5 (1/m)	Weather was sunny, about 65 degrees F in the morning, cloudy in the afternoon, no rain. Initial DTW is 12.898 m. The transducer is set to 1 second interval. We put the medium slug in at 9:20 am, and take manually measurement every 5 to 10 minutes. Medium slug out about 1:32 pm. We only have time to do one slug in and out with the medium size slug.

#	Test	Purpose	Date	Duration	Result	Comments
5	Slug test at BW8	Determine the K and S_s near BW8.	6/2/2017	We used two size of slugs, one is 6'0.5''long, 3.7'' diameter; the other one is 5'4'' long, 2.375'' diameter. The volume of each slug is 0.01277m^3 and 0.00465m^3, respectively. We only have time to do one time medium slug in and out and one time small slug in and out, because this well is less permeable.	T is estimated from the drawdown data: 1.3E-5 m^2/s We consider the thickness of saturated open hole is 59.44 m, then the K_H=T/D=2.2E-7m/s. K_H is estimated using Cooper et a. (1967) solution. S_s=2.4E-9 (1/m)	Weather was cloudy all day, about 60 degrees F, rain on and off beginning at 1:10. Initial DTW is 13.768 m. The transducer is set to 1 second interval. We put the medium slug in at 9:14 am, and take manually measurement every 5 to 10 minutes. Medium slug out about 11:57 am. Small slug in at 2:32 pm, and slug out at 4:25 pm. We do one time slug in and out with the medium and small slug, respectively.

#	Test	Purpose	Date	Duration	Result	Comments
6	Slug test at BW4	Determine the K and S_s near BW1.	6/5/2017	We used two size of slugs, one is 5'4'' long, 2.375'' diameter; the other one is 1.2m long, 5cm diameter. The volume of each slug is 0.00465m^3 and 0.00236m^3, respectively. We did small-smallest-small test and for each test we did twice. So totally 6 slug-in and slug-out test were performed.	T is estimated from the drawdown data*: 8.44E-4 m^2/s We consider the thickness of saturated open hole is 48.81 m, then the K_H=T/D=1.8E-5m/s. K_H is estimated using Cooper et a. (1967) solution. Ss=2.4E-5 (1/m)	Weather was sunny, about 65 degrees F. Initial DTW is 10.691 m. The transducer is set to 1 second interval. We put the small slug in at 9:28 am, and take manually measurement every 5 to 10 minutes. Small slug out about 9:38 am. The second time slug in at 10:03 am, and then slug out at about 10:28 am. The first time smallest slug in at about 10:54 am, and then out at about 11:18 am; the second time smallest slug in at about 11:53 am and the out at about 12:16 pm (the transducer cable was pulled up some while the slug was pulled out) .Then we redo the medium slug in at about 12:38 pm, and slug out at 1:10 pm; the second slug in at 1:31 pm and slug out at 1:51 pm. Note: Borehole of BW4 was not fully saturated on this day, thus the estimated T and S will need to be refined.

#	Test	Purpose	Date	Duration	Result	Comments
7	Slug test at BW5	Determine the K and S_s near BW5.	6/7/2017	We used two size of slugs, one is 5'4'' long, 2.375'' diameter; the other one is 1.2m long, 5cm diameter. The volume of each slug is 0.00465m^3 and 0.00236m^3, respectively. We did small-smallest-small test and for each test we did twice. So totally 6 slug-in and slug-out test were performed.	T is estimated from the drawdown data: 1.6E-4 m^2/s We consider the thickness of saturated open hole is 21.02 m, then the K_H=T/D=7.4E-6m/s. K_H is estimated using Cooper et a. (1967) solution. Ss=5.3E-12 (1/m)	Weather was sunny, about 70 degrees F. Initial DTW is 11.454 m. The transducer is set to 1 second interval. We put the small slug in at 9:15 am, and take manually measurement every 5 to 10 minutes. Small slug out about 9:43 am. The second time slug in at 10:10 am, and then slug out at about 10:35 am. The first time smallest slug in at about 10:59 am, and then out at about 11:19 am; the second time smallest slug in at about 11:41 am and the out at about 12:01 pm. Then we redo the small slug in at about 12:25 pm, and slug out at 12:51 pm; the second slug in at 1:14 pm and slug out at 1:36 pm.

#	Test	Purpose	Date	Duration	Result	Comments
8	Slug test at BW2	Determine the K and S_s near BW2.	6/9/2017	We used the slug size is 5'4'' long, 2.375'' diameter. The volume of each slug is 0.00465m^3.We did totally 3 times slug in and out tests.	T is estimated from the drawdown data: 8.5E-4 m^2/s We consider the thickness of saturated open hole is 9.93 m, then the K_H=T/D=1.7E-4m/s. K_H is estimated using Cooper et a. (1967) solution. Ss=1.7E-8 (1/m)	Weather was cloudy, breezy, about 65 degrees F. Initial DTW is 11.146 m. The transducer is set to 1 second interval. We put the small slug in at 9:15 am, and take manually measurement every 5 to 10 minutes. Small slug out about 9:40 am. The second time slug in at 10:05 am, and then slug out at about 10:32 am. The third time slug in at about 10:56 am, and then out at about 11:22 am. #Although it recorded 7'' pvc casing, there is obstacle inside the casing, so only the small slug can be put into the borehole. Note: Borehole of BW2 was not fully saturated on this day, thus the estimated T and S will need to be refined.

#	Test	Purpose	Date	Duration	Result	Comments
9	Slug test at BW3	Determine the K and S_s near BW3.	6/13/2017	The slug size that we used is 6'0.5''long and 3.7'' diameter. The volume of each slug is 0.01277 m^3. We did one slug in only but did not complete the test.	We cannot get the transmissivity from the slug test.	Weather was cloudy, breezy, about 65 degrees F. The transducer is set to 1 second interval. We put the medium slug in at 8:50 am, and took manually measurement every 5 to 10 minutes. We wait for almost 1 hour and the DTW didn't change at all. Then we took the slug out and wait for another 1 hour, and DTW still kept the same. We concluded that the transmisivity of BW3 is very low and slug test method is not appropriate.

Slug tests derived K and T of Blair Wallis wells and related FLUTe and step test results

Well	Horizontal K (m/s)	Specific Storage (1/m)	Transmissivity (m^2/s)	Data used for curve fitting	FLUTe Transmissivity (m^2/s)	Step test derived K_H of BW6 (m/s)
BW1	1.6E-5	1.6E-11	2.1E-4	Slug In #5	_	_
BW2	1.7E-4	1.7E-8	8.5E-4	Slug In # 3	_	_
BW3	_	_	_	_	_	_
BW4	1.8E-5	2.4E-5	8.44E-4	Slug In # 6	_	_
BW5	7.4E-6	5.3E-12	1.6E-4	Slug In # 1	7.4 E-5	_
BW6	1.0E-6	3.3E-5	4.4E-5	Slug In #2	5.9 E-5	1.1 E-6
BW7	5.5E-6	2.6E-12	3.1E-4	Slug In #5	8.3 E-5	_
BW8	2.2E-7	2.4E-9	1.3E-5	Slug In #1	_	_
BW9	1.0E-7	3.3E-5	4.4E-6	Slug In #1	_	_

*Note that slug test derived K_H is very close to step test derived K_H of BW6, and the slug T compared to FLUTe T of the open hole interval for BW5, 6 &7 are within a factor of 4.

References:

Cooper, H.H. Jr., J.D. Bredehoeft, and l.S. Papadopulos. 1967. Response of a finite-diameter well to an instantaneous charge of water. *Water Resources Research* 3, no. l: 263-269.