# APPENDIX E

## Slug Test Results

**SLUG TEST PROCEDURES**

The slugs and bailers were lowered into the wells using 3/16-inch diameter hollow braid polypropylene rope. Solinst Levelogger data loggers set to record water level and water temperature at 1-second intervals were used to collect the water level recovery data during the slug tests. A Solinst Barologger was used to record barometric pressure readings on the days the slug tests were performed so the water level data recorded by the Leveloggers could be compensated for changes in barometric pressure. No-stretch fishing line was used to hang the Leveloggers in the wells. An electronic water level meter was used to collect manual water level measurements in the wells and measure the total depth of the wells.

The Solinst Levelogger data loggers were pre-programmed in the office using a Solinst optical reading and the Solinst Levelogger software package with the project identification, the name of the monitoring well in which the data logger would be placed, the approximate elevation at which the data logger would be set in the well, and the sampling interval (1-second). The Barologger was also pre-programmed in the office with the project identification and sampling interval. A laptop personal computer, Solinst optical reader and the Solinst Levelogger software package were used to program the start time of the Leveloggers and Barologger in the field. Most of the Leveloggers used for the slug tests were able to be programmed to start at a specific time so that the Leveloggers could be placed in the wells before they started recording data, but some of the Leveloggers had to be started while still connected to the laptop computer. The slug test procedures are outlined below:

1. Before the start of the slug test, an electronic water level meter was used to measure the depth to groundwater in the monitoring wells (static water level). The depth to the bottom of the well was also measured with the electronic water level meter.

2. No-stretch fishing line was tied to the top cap of the Levelogger. A tape measure was used to measure out the length of no-stretch fishing line so that the Solinst Levelogger would hang at the pre-selected depth in the well that corresponded to the approximate elevation programmed into the Levelogger. A permanent marker was used to mark the end of the desired length on the fishing line.

3. Hollow braid polypropylene rope was tied to the end of the solid slug or PVC bailer and a tape measure was used to measure out the length of rope so that the slug or bailer could be lowered several inches below the top of the static water level measured in the well. For the slugs, a permanent marker was used to mark the point on the rope that would place the bottom of the slug at the top static water level in the well. A second mark corresponding to the depth that would place the slug or bailer several inches below the top of the static water level in the well was also marked on the rope with the permanent marker. The end of the rope was tied to an extension cord wrap so that the extension cord wrap could be placed across the protection casing of the well when the slug was in the well.

4. The laptop computer, optical reader and Solinst Levelogger software package were used to program the Levelogger to start at a specific time or the Levelogger was started immediately. For the first well tested, the Barologger was also programmed to start at a specific time that would correspond to the estimated start of the first slug test.

**SLUG TEST PROCEDURES**

5. The Levelogger was lowered into the well until the mark on the fishing line was even with the top of the well casing. Duct tape was used to secure the fishing line to one side of the well casing. The end of the fishing line was also secured to the well plug or tied to the protective casing. Non-stretch fishing line and duct tape was also used to place the Barologger approximately 1 to 2 feet below the top of the well casing in the first well slug tested on both days the slug tests were performed. The fishing line connected to the Barologger was also secured to the well plug or tied to the protective casing of the well.

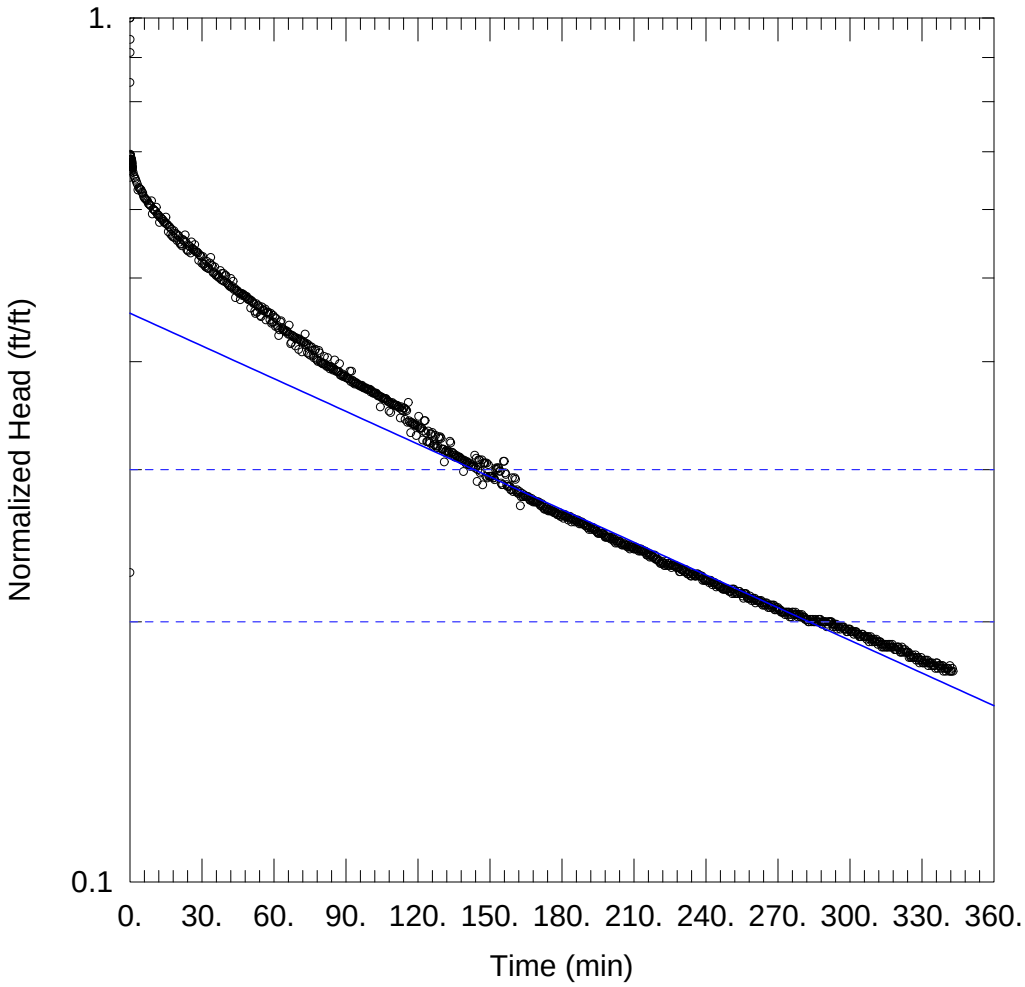
6. For the slug-out tests performed using PVC bailers, the bailer was lowered into the well so that the top of the bailer was several inches below the top of the static water level in the well. The rope connected to the bailer was then tied off at the surface so that the bailer remained several inches below the top of the static water level in the well. The electronic water level meter was used to monitor the water level in the well. Once the water level in the well returned to static conditions, the PVC bailer was rapidly pulled from the well. The start time of the slug-out test was noted. Manual water level measurements were periodically taken from the well using the electronic water level meter during the slug-out test to gauge the rate of water level recovery in the well and determine when the test was completed.

   For the slug-in tests performed using a solid slug, the slug was lowered into the well so that the bottom of the slug was located at the top of the static water level in the well. The slug was held in place at this depth and the extension cord wrap that the rope was tied to was placed over the top of the well. The rope was then released so that the slug dropped below the top of the static water level in the well and was held in place by the extension cord wrap placed across the top of the protective casing. The start time of the slug-in test was noted. Manual water level measurements were periodically taken from the well using the electronic water level meter during the slug-in test to gauge the rate of water level recovery in the well and determine when the test was completed.

   After the October 25, 2013 slug-in test was completed in monitoring well MW-107, the slug was rapidly removed from the well and a slug-out test was performed. The start time of the slug test was noted and an electronic water level meter was used to collect water level measurements to determine when the test was completed.

7. The Leveloggers were removed from the wells after the slug tests were completed. The data on the Leveloggers was downloaded from the Leveloggers using the Solinst optical reader and Solinst Levelogger software package. The Levelogger files were then converted to character-separated values (.csv) files so they could be edited in Excel and used in the AQTESOLV® for Windows Professional Version 4.50 software package.

8. The AQTESOLV® for Windows Professional Version 4.50 software package was used to calculate hydraulic conductivity values from the slug test results by the Bouwer and Rice (1976) straight-line method.




## P-103 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\P-103 Slug Test.aqt
Date: 10/29/13 Time: 14:02:39

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: P-103
Test Date: 2/2/2012

## AQUIFER DATA

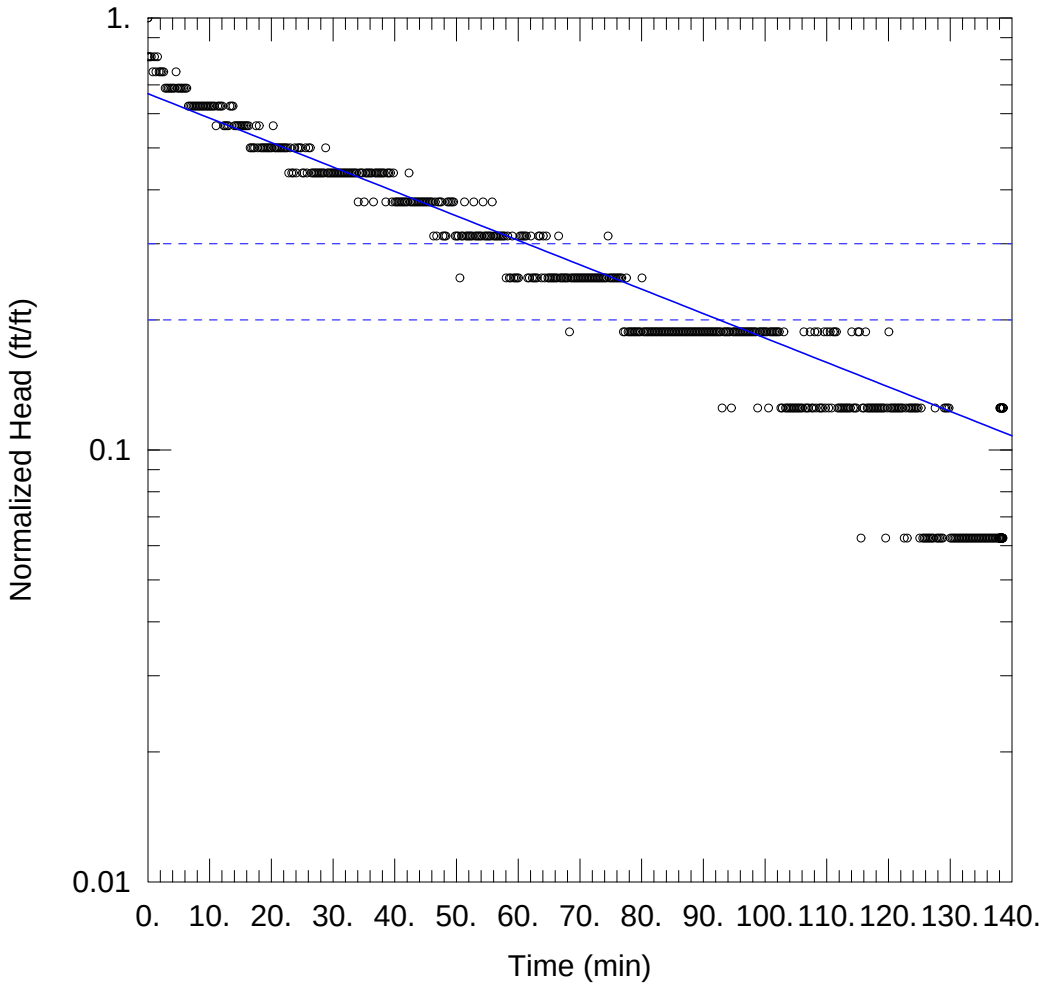
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (P-103)

Initial Displacement: 1.079 ft
Total Well Penetration Depth: 42.92 ft
Casing Radius: 0.0797 ft
Static Water Column Height: 42.92 ft
Screen Length: 5. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.2E-5 cm/sec
y0 = 0.4912 ft




## MW-105 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\MW-105 Slug Test.aqt
Date: 10/29/13 Time: 14:08:24

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-105
Test Date: 2/2/2012

## AQUIFER DATA

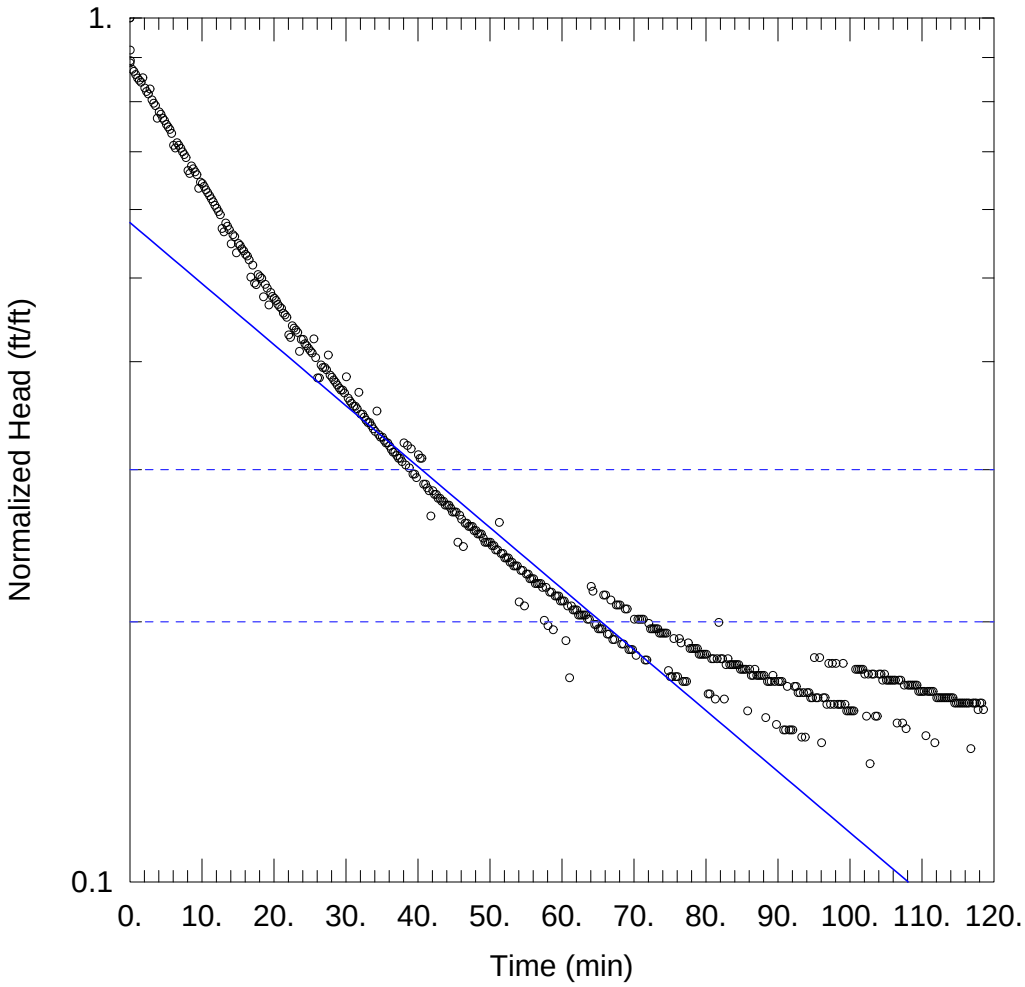
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-105)

Initial Displacement: 1.6 ft
Total Well Penetration Depth: 15.92 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 15.92 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.6E-5 cm/sec
y0 = 1.068 ft




## MW-106 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\MW-106 Slug Test.aqt
Date: 10/29/13 Time: 14:04:39

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-106
Test Date: 2/2/2012

## AQUIFER DATA

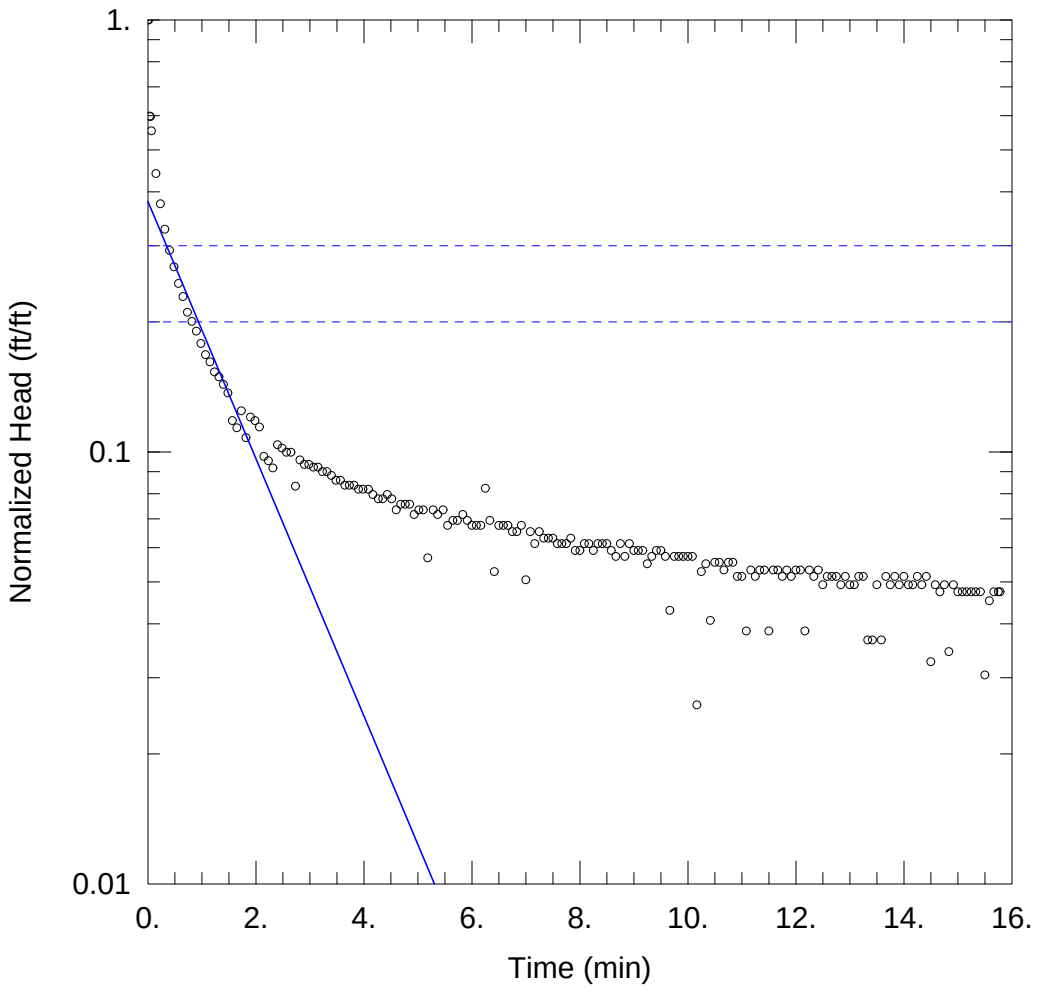
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-106)

Initial Displacement: 1.788 ft
Total Well Penetration Depth: 14.38 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 14.38 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.2E-5 cm/sec
y0 = 1.036 ft




## MW-107 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\MW-107 Slug Test.aqt
Date: 10/29/13 Time: 14:07:39

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-107
Test Date: 2/2/2012

## AQUIFER DATA

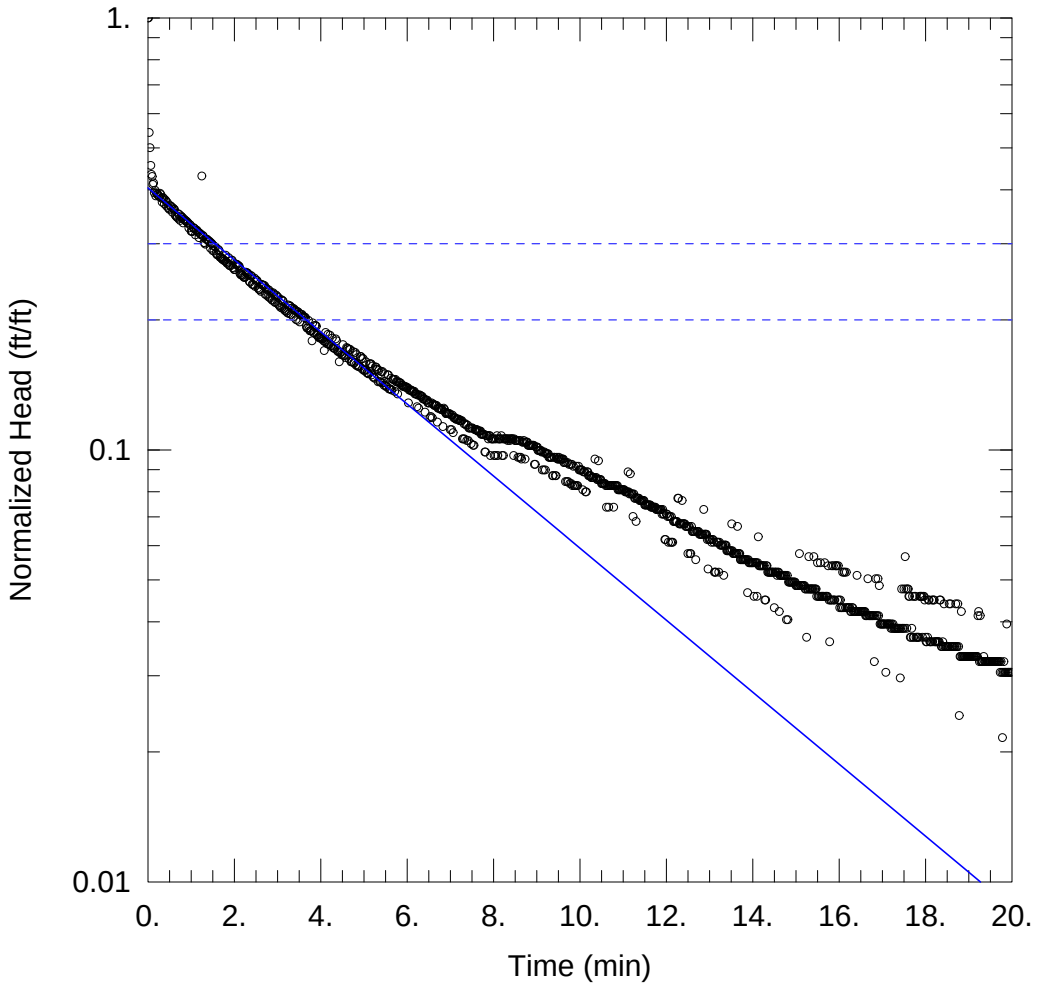
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-107)

Initial Displacement: 2.234 ft
Total Well Penetration Depth: 11.09 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 11.09 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0013 cm/sec
y0 = 0.8485 ft




## MW-109 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\MW-109 Slug Test.aqt
Date: 10/29/13 Time: 14:01:58

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-109
Test Date: 2/2/2012

## AQUIFER DATA

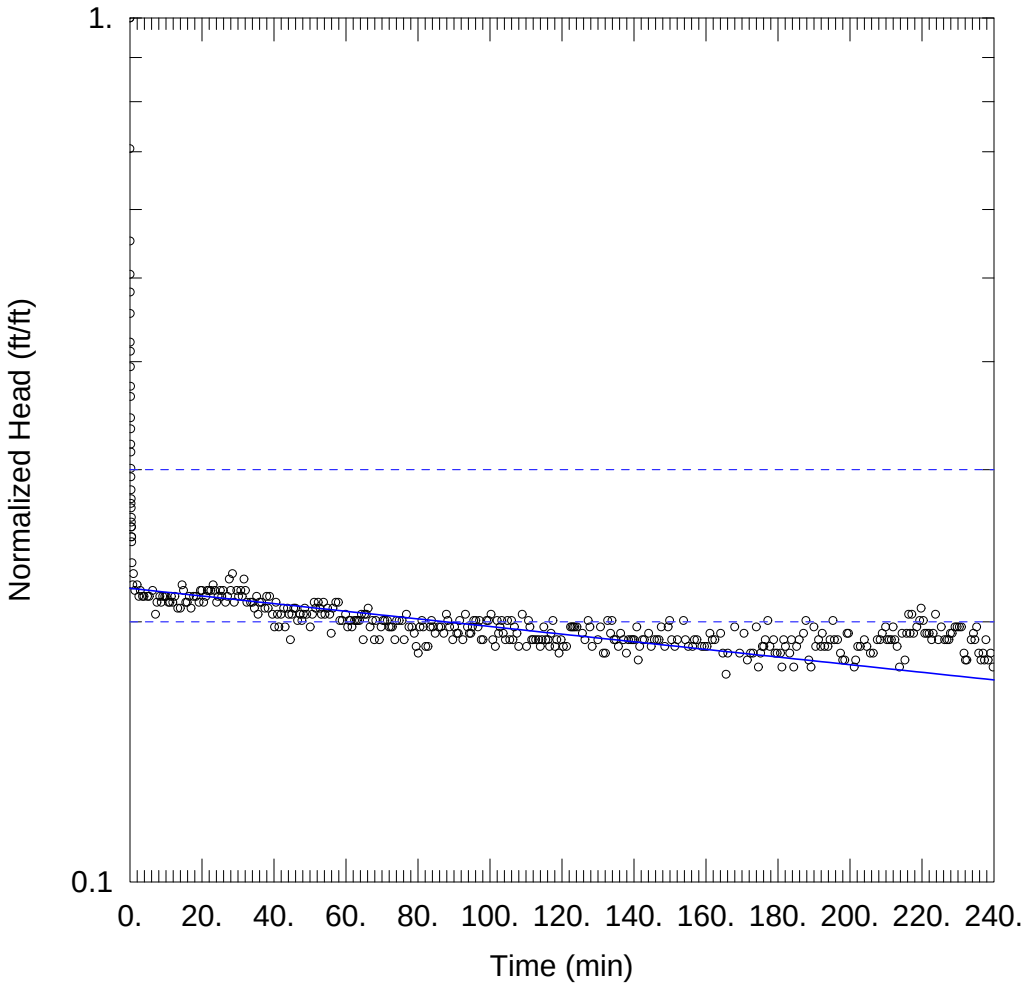
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-107)

Initial Displacement: 1.113 ft
Total Well Penetration Depth: 12.43 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 12.43 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.00037 cm/sec
y0 = 0.4496 ft




## MW-116 SLUG TEST

Data Set: P:\Beazer\Wabash Site\2011 Investigation\Slug Tests\MW-116 Slug Test.aqt
Date: 10/30/13 Time: 11:19:31

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-116
Test Date: 2/2/2012

## AQUIFER DATA

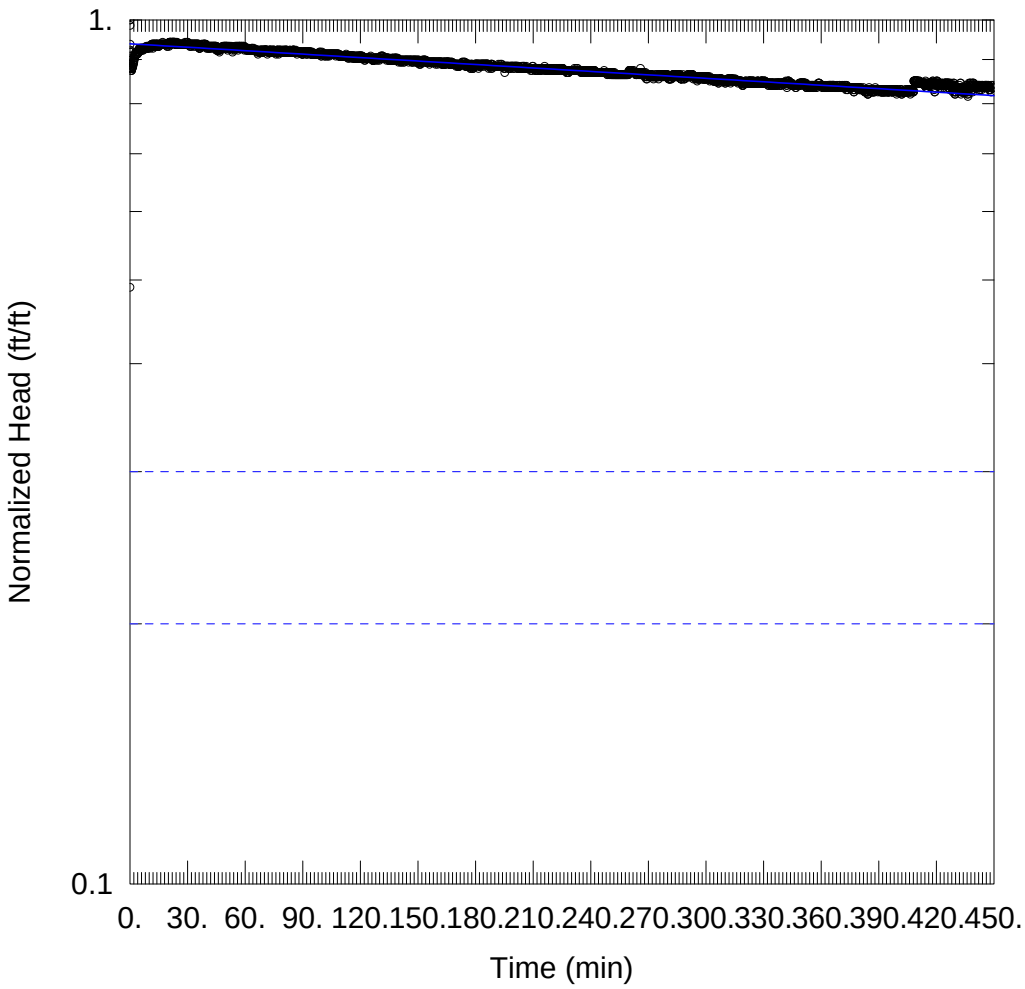
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-116)

Initial Displacement: 2.99 ft
Total Well Penetration Depth: 10.05 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 10.05 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.9E-6 cm/sec
y0 = 0.6538 ft




## MW-102 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-102 Slug-In Test.aqt
Date: 10/29/13 Time: 14:16:49

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-102
Test Date: 10/25/2013

## AQUIFER DATA

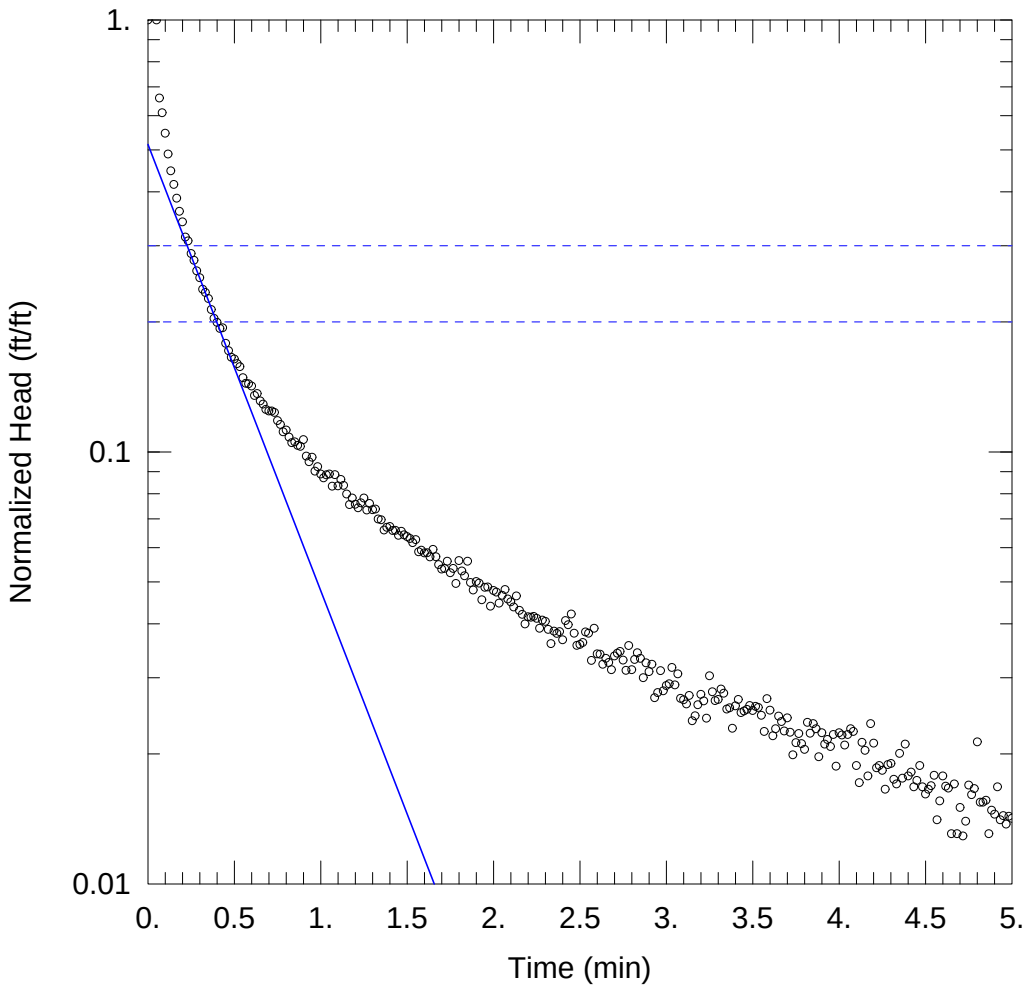
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-102)

Initial Displacement: 2.06 ft
Total Well Penetration Depth: 12.14 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 12.14 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.9E-7 cm/sec
y0 = 1.933 ft




## MW-107 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-107 Slug-In Test.aqt
Date: 10/29/13 Time: 14:27:55

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-107
Test Date: 10/25/2013

## AQUIFER DATA

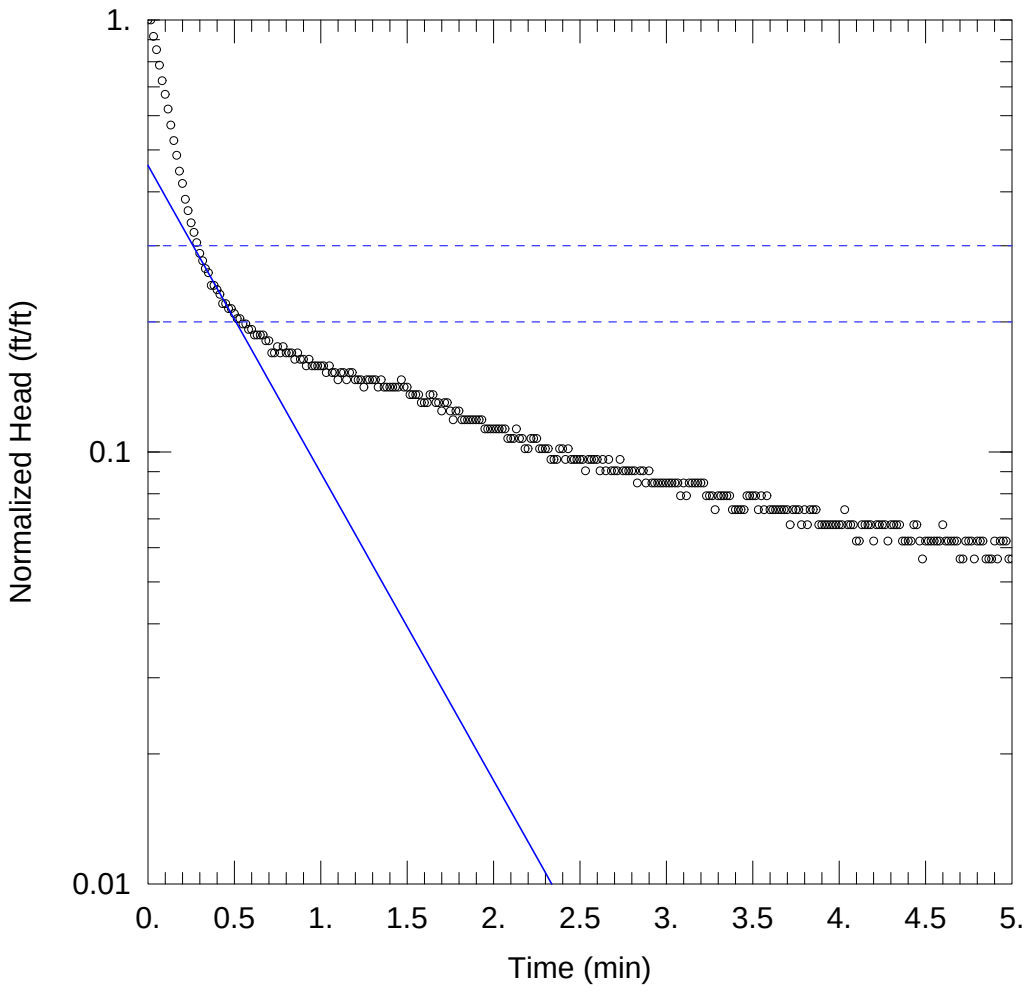
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-107)

Initial Displacement: 1.89 ft
Total Well Penetration Depth: 10.92 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 10.92 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0045 cm/sec
y0 = 0.9728 ft




## MW-107 SLUG-OUT TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-107 Slug-Out Test.aqt
Date: 10/29/13 Time: 14:32:07

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-107
Test Date: 10/25/2013

## AQUIFER DATA

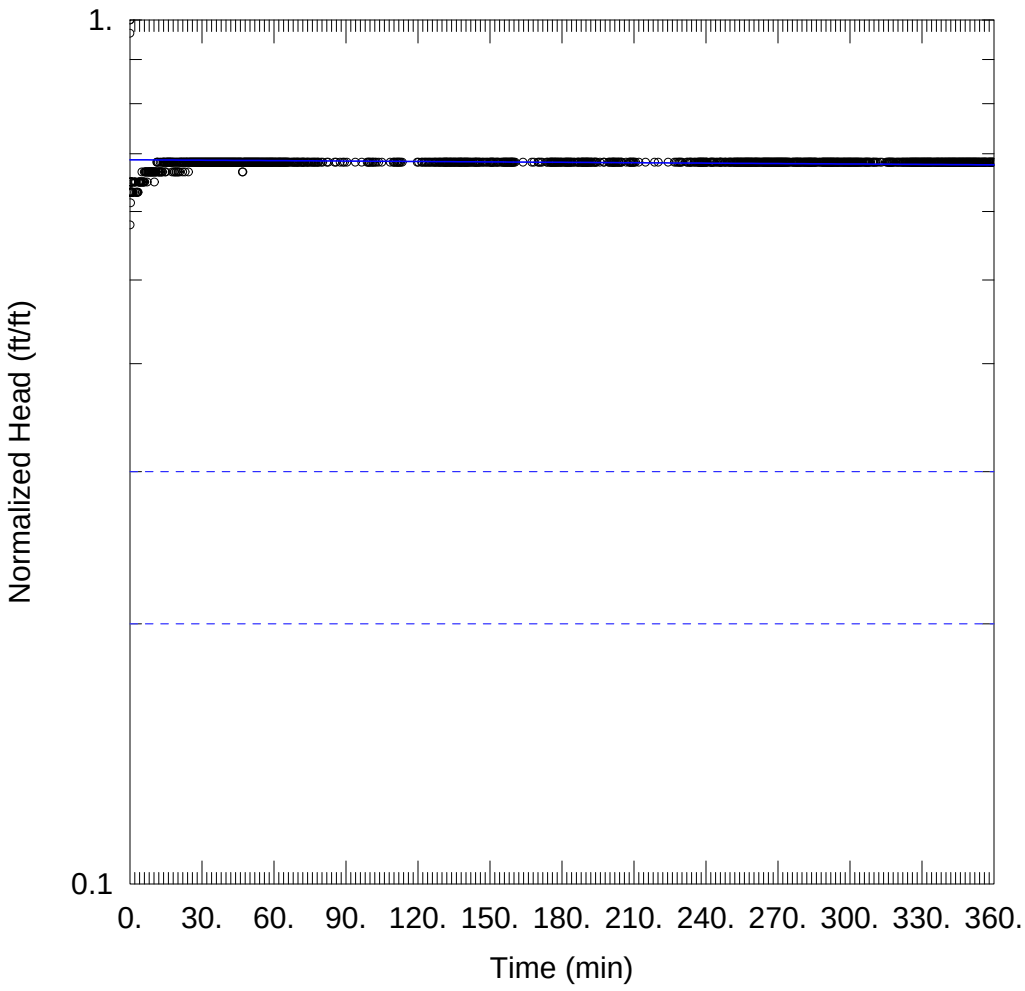
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-107)

Initial Displacement: 1.77 ft
Total Well Penetration Depth: 10.92 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 10.92 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0031 cm/sec
y0 = 0.8147 ft




## P-110 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\P-110 Slug-In Test.aqt
Date: 10/30/13 Time: 08:53:53

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: P-110
Test Date: 10/25/2013

## AQUIFER DATA

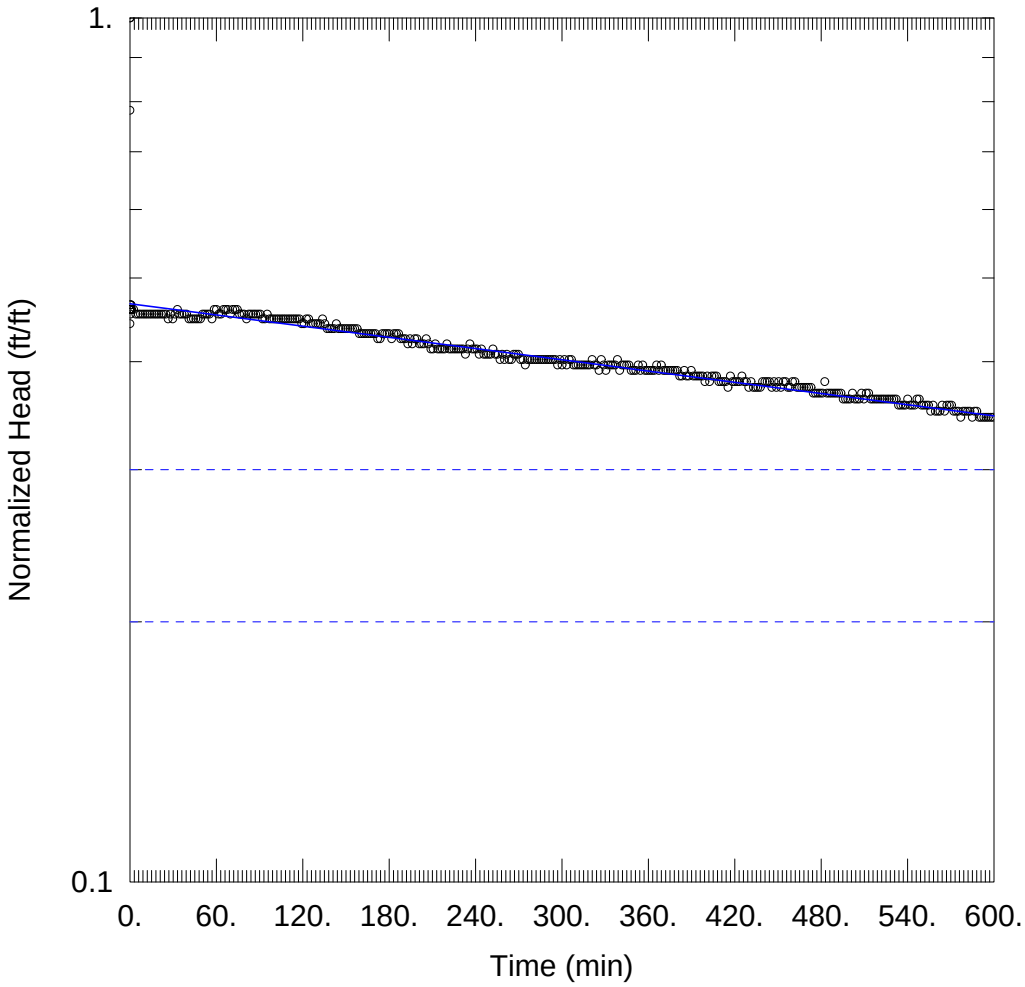
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (P-110)

Initial Displacement: 5.7 ft
Total Well Penetration Depth: 39.11 ft
Casing Radius: 0.0797 ft
Static Water Column Height: 39.11 ft
Screen Length: 5. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.5E-7 cm/sec
y0 = 3.926 ft




## MW-111 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-111 Slug-In Test.aqt
Date: 10/30/13 Time: 11:02:43

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-111
Test Date: 10/25/2013

## AQUIFER DATA

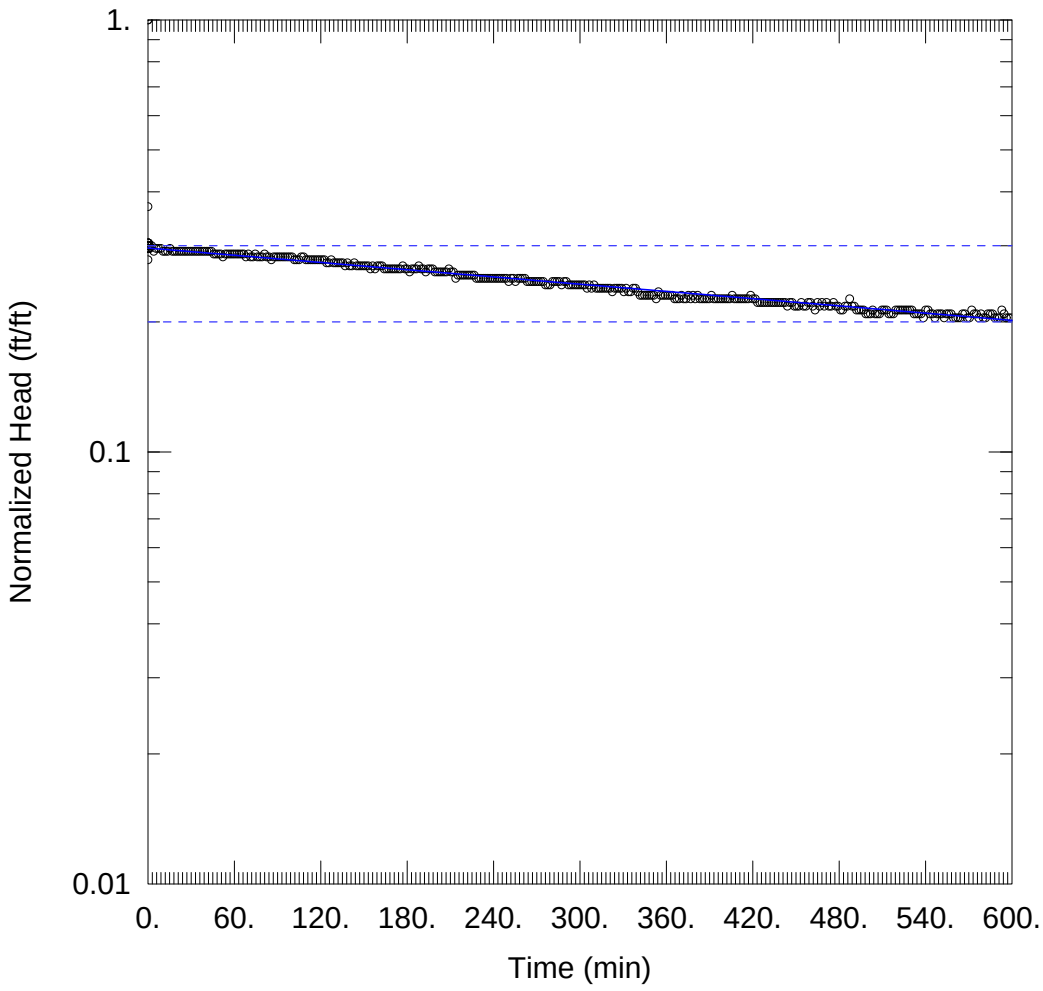
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-111)

Initial Displacement: 1.74 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0853 ft
Static Water Column Height: 6.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 9.3E-7 cm/sec
y0 = 0.8123 ft




## MW-112 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-112 Slug-In Test.aqt
Date: 10/30/13 Time: 11:05:19

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-112
Test Date: 10/25/2013

## AQUIFER DATA

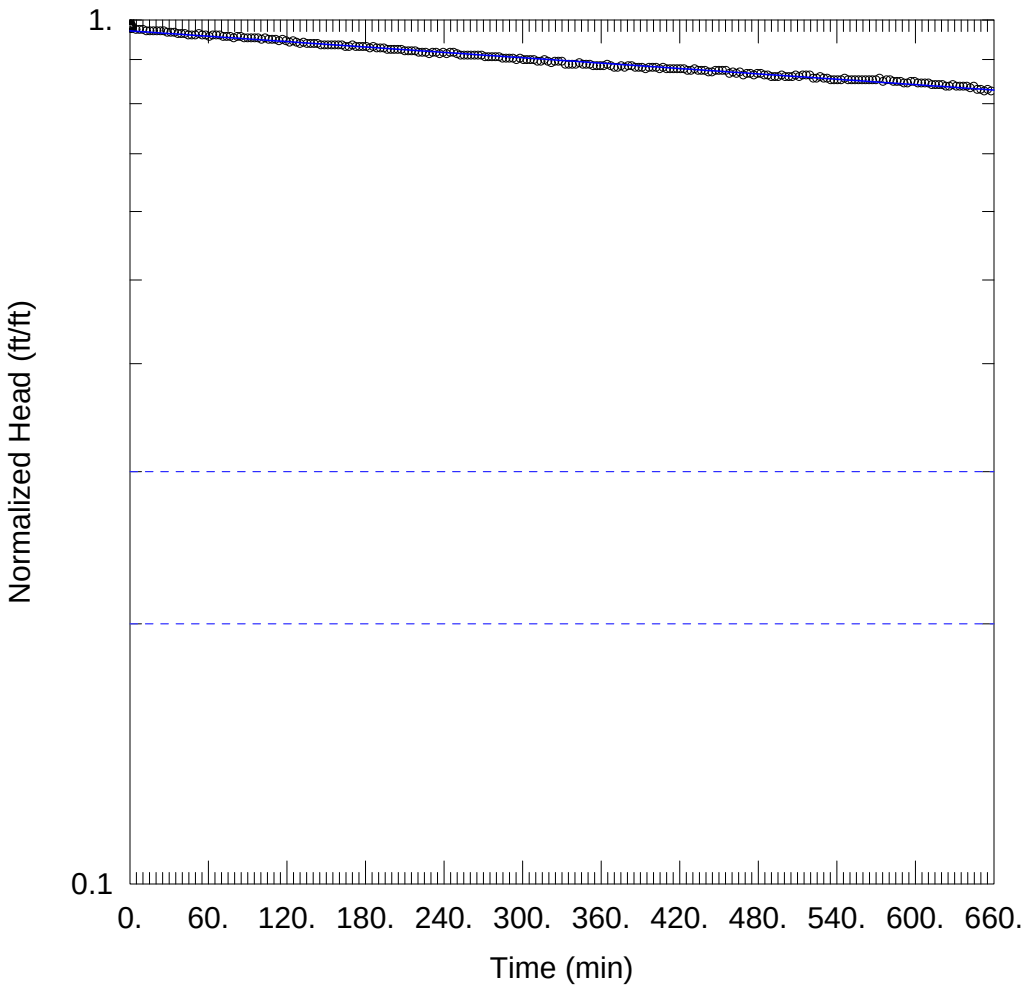
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-112)

Initial Displacement: 2.3 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.0853 ft
Static Water Column Height: 8.32 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.2E-6 cm/sec
y0 = 0.682 ft




## P-113 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\P-113 Slug-In Test.aqt
Date: 10/30/13 Time: 10:17:21

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: P-113
Test Date: 10/25/2013

## AQUIFER DATA

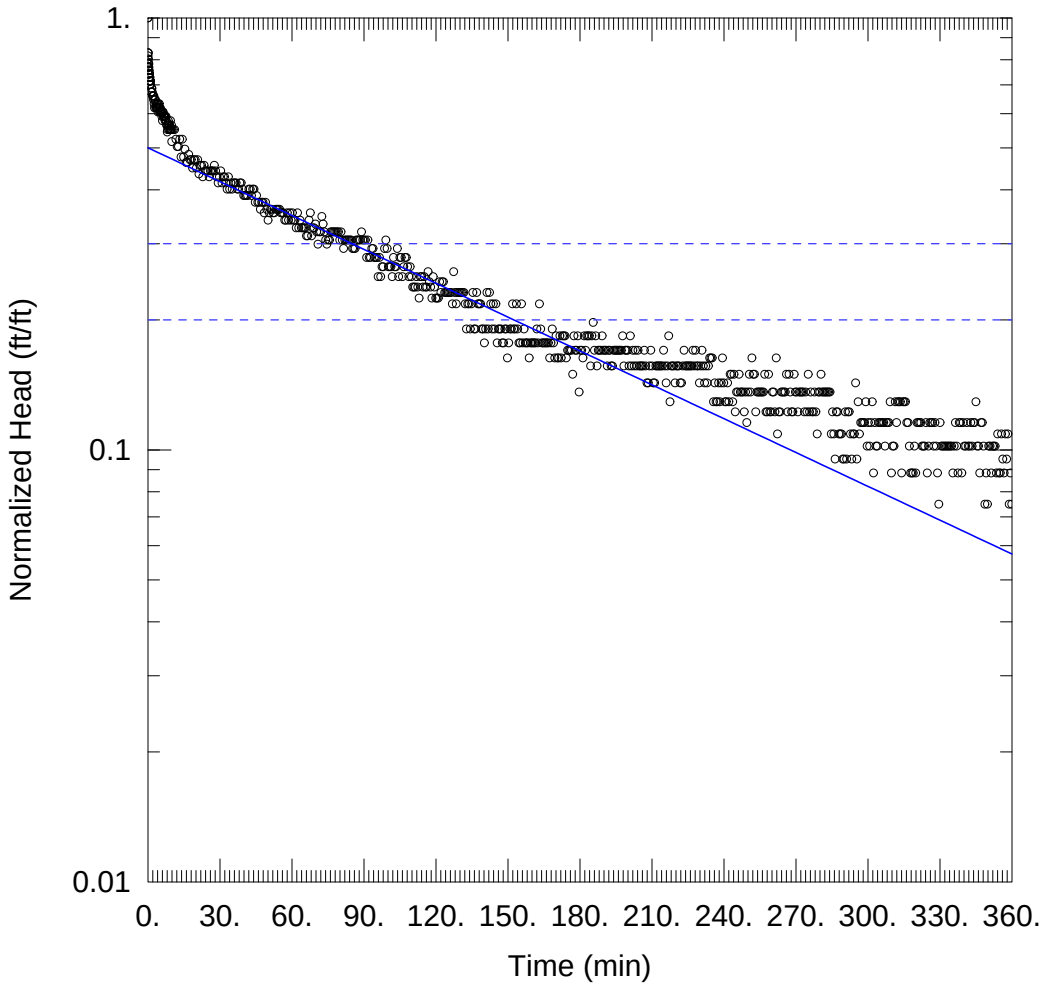
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (P-113)

Initial Displacement: 2.78 ft
Total Well Penetration Depth: 40.27 ft
Casing Radius: 0.0797 ft
Static Water Column Height: 40.27 ft
Screen Length: 5. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 9.7E-7 cm/sec
y0 = 2.7 ft




## MW-117 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\MW-117 Slug-In Test.aqt
Date: 10/30/13 Time: 10:45:20

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: MW-117
Test Date: 10/25/2013

## AQUIFER DATA

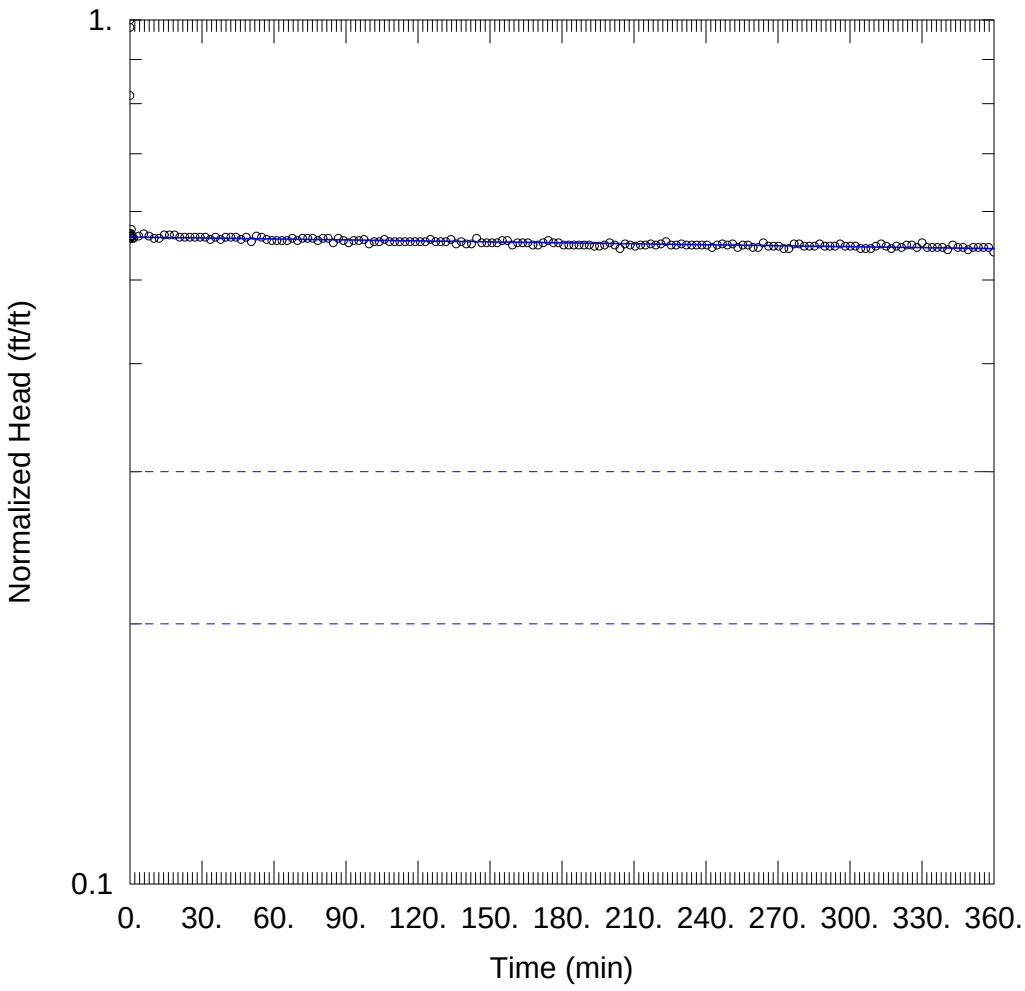
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-117)

Initial Displacement: 1.47 ft
Total Well Penetration Depth: 15.85 ft
Casing Radius: 0.0853 ft
Static Water Column Height: 15.85 ft
Screen Length: 10. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.2E-5 cm/sec
y0 = 0.7357 ft




## P-120 SLUG-IN TEST

Data Set: P:\Beazer\Wabash Site\2013 Investigation\2013 Slug Tests\P-120 Slug-In Test.aqt
Date: 10/30/13 Time: 10:51:58

## PROJECT INFORMATION

Company: Tetra Tech
Client: Beazer
Project: 117-2201313
Location: Oak Creek, WI
Test Well: P-120
Test Date: 10/25/2013

## AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (P-120)

Initial Displacement: 5.96 ft
Total Well Penetration Depth: 36.15 ft
Casing Radius: 0.0797 ft
Static Water Column Height: 36.15 ft
Screen Length: 5. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.4E-7 cm/sec
y0 = 3.342 ft