Understanding and quantifying focused, indirect groundwater recharge from ephemeral streams using water table fluctuations

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DOI:
10.1002/2015WR017503

Water Resources Research

Supporting Information for

Understanding and quantifying focused, indirect, groundwater recharge from ephemeral streams using water table fluctuations

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Introduction

Table S1 contains construction details of piezometers from which data was collected and analysed in this paper.

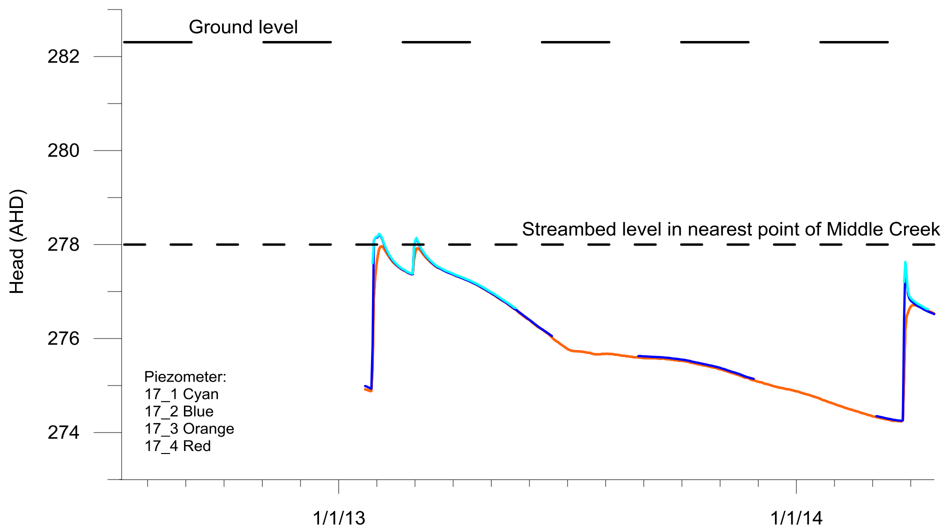
Figure S1 contains the groundwater hydrographs from Figure 7, but plotted in groups to allow more detail to be seen including their relationship to ground level and streambed levels.

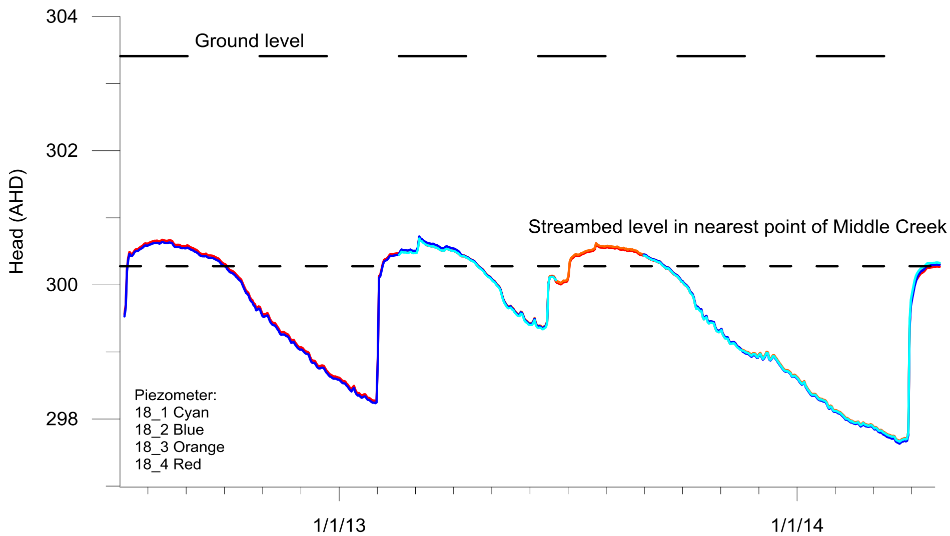
Figure S2 contains data from a pumping test which is used to support the analysis given in the paper. A description of the test is given below the figure.

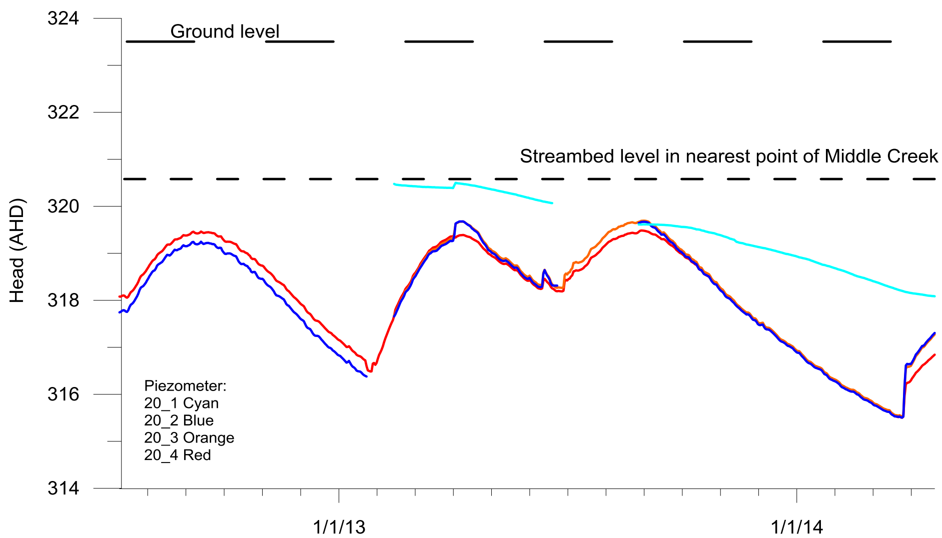
Piezometer	Easting	Northing	Datum elevation (m AHD)	Screen interval (m below datum)	Screen length, radius (m)	Height of datum above ground level (m)
BH17_1	225275	6623934	283.11	6.93-7.11	0.175, 0.015	0.97
BH17_2	225275	6623934	283.11	9.49-10.49	1.000, 0.025	0.97
BH17_3	225275	6623934	283.11	26.51-26.69	0.175, 0.015	0.97
BH17_4	225275	6623934	283.11	35.47-36.47	1.000, 0.025	0.97
BH18_1	227599	6626170	304.28	9.27-9.45	0.175, 0.015	1.01
BH18_2	227599	6626170	304.28	10.96-11.96	1.000, 0.025	1.01
BH18_3	227599	6626170	304.28	17.19-17.37	0.175, 0.015	1.01
BH18_4	227599	6626170	304.28	21.78-22.78	1.000, 0.025	1.01
BH19_1	227555	6626196	303.76	8.83-9.83	1.000, 0.025	0.94
BH19_2	227555	6626196	303.76	22.37-23.37	1.000, 0.025	0.94
BH20_1	228718	6627763	324.63	9.27-9.45	0.175, 0.015	1.16
BH20_2	228718	6627763	324.63	9.21-10.21	1.000, 0.025	1.16
BH20_3	228718	6627763	324.63	29.45-29.63	0.175, 0.015	1.16
BH20_4	228718	6627763	324.63	39.79-40.79	1.000, 0.025	1.16
BH21_1	228683	6627765	324.12	5.48-5.66	1.075, 0.015	1.04
BH21_2	228683	6627765	324.12	12.28-13.28	1.000, 0.025	1.04
BH22_1	227619	6627915	312.96	8.74-8.92	0.175, 0.015	0.93
BH22_2	227619	6627915	312.96	8.36-9.36	1.000, 0.025	0.93
BH22_3	227619	6627915	312.96	29.71-29.89	0.175, 0.015	0.93
BH22_4	227619	6627915	312.96	32.73-33.73	1.000, 0.025	0.93

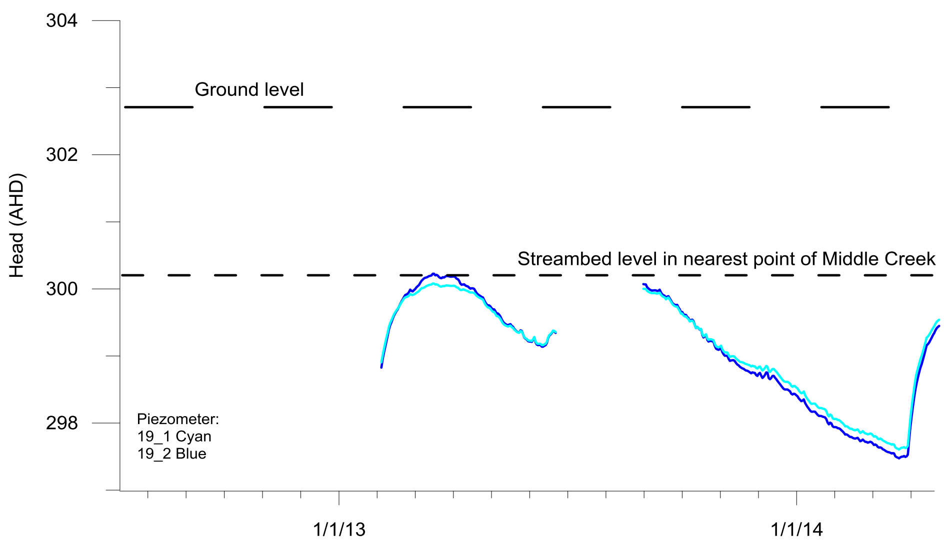
Table S1. Piezometer construction details

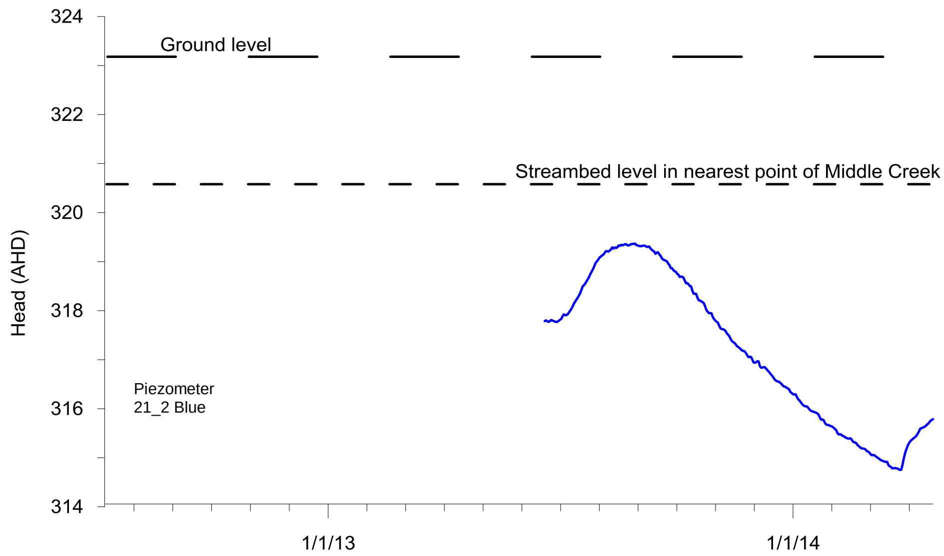
Figure S1. Groundwater hydrographs for each borehole (BH17-BH22) with respect to ground level and streambed level






Ground level
Streambed level in nearest point of Middle Creek
Head (AHD)
324
322
320
318
316
314
Piezometer:
20_1 Cyan
20_2 Blue
20_3 Orange
20_4 Red
1/1/13
1/1/14


Ground level
Streambed level in nearest point of Middle Creek
Head (AHD)
304
302
300
298
Piezometer:
19_1 Cyan
19_2 Blue
1/1/13
1/1/14


324
322
320
318
316
314
Ground level
Streambed level in nearest point of Middle Creek
Head (AHD)
Piezometer
21_2 Blue
1/1/13
1/1/14

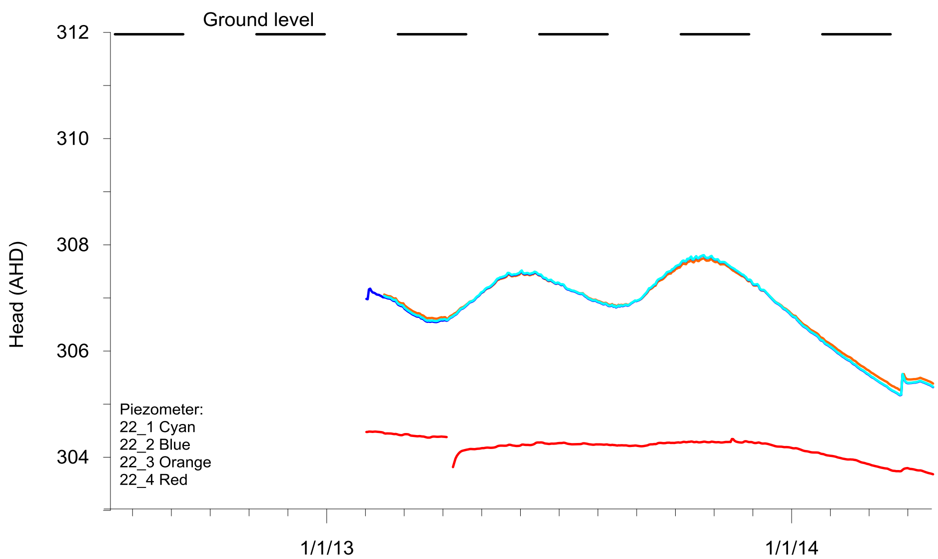
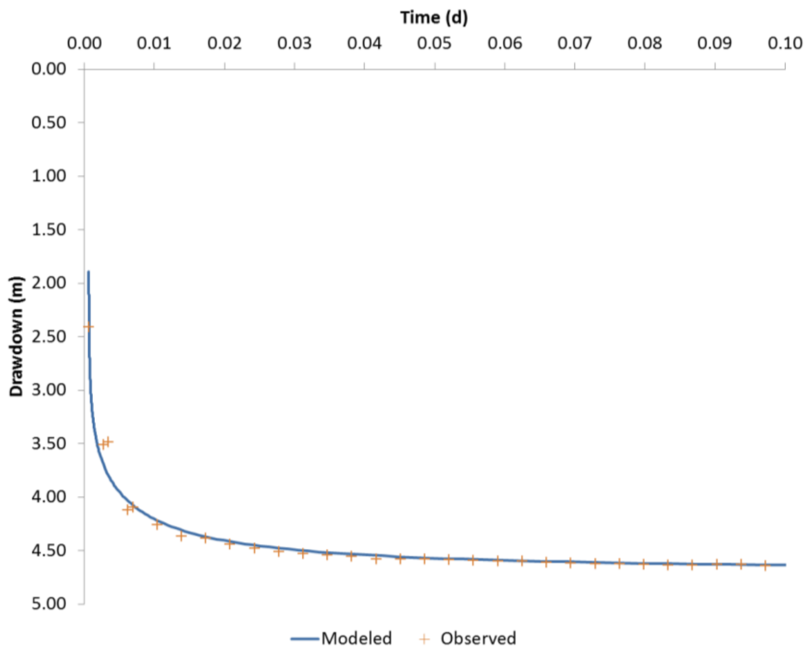

312
310
308
306
304
Ground level
Head (AHD)
Piezometer:
22_1 Cyan
22_2 Blue
22_3 Orange
22_4 Red
1/1/13
1/1/14

Figure S2. Drawdown data and model comparison for the Elfin Crossing Pumping Test



A pumping test was conducted in BH14 at Elfin Crossing (see Figure 6 for location), situated 35 m from edge of Maules Creek. The borehole has a diameter of 0.3 m, and is screened in the interval 12 to 24 m bgl. It was equipped with an electric pump (Grundfos SP60 with MS 4000 motor) powered by a 3-phase generator. The borehole was briefly tested for its response to pumping before starting the main test and allowed to fully recover. The pump was then continuously operated at an average rate of 5.5 L/s for 193 hours (8 days and 1 hour, from 13/01/2013 13:20 to 21/01/2013 14:20). The extracted water was released back into the creek further downstream so as not to affect the test. The drawdown in the pumping well, and in multiple short screened piezometers at various distances from the pumping well were monitored using pressure transducers. Highly variable pressure responses were seen in the piezometers indicating a very heterogeneous conditions and a full analysis is beyond the scope of this paper. Here we have analysed only the hydraulic response in the pumping well since, being screened through much of the saturated alluvial aquifer, unlike the short screened observation wells it should give an integrated hydraulic response from which the bulk properties of the aquifer can be derived.

The data were analysed using a transient model. For this analysis the Theis [1935] equation was used incorporating the superposition of an injection image well to implement a recharge boundary due to the close proximity of the perennial section of Maules Creek. The drawdown data were fitted to the model by varying the hydraulic parameters (T, S) in order to minimise the RMSE. The drawdown observations and model results are shown in Figure S2. Due to the connected adjacent creek acting as a recharge boundary, the water levels in the pumping well became steady by around 0.1 d into the test. The best fit parameters were T = 115 m^2/d and S = 0.001 indicating semi-confined conditions local to the well, with an R^2 value of 0.99.