

SELECTED SLUG TEST REFERENCES

General

Butler, *The Design, Performance, and Analysis of Slug Tests (2nd Edition)*, CRC Press, 257 pp., 2019 – henceforth, Butler - DPAST.

Midwest GeoSciences Group, *Field Guide for Slug Testing and Data Analysis*, 2009 - henceforth, MidwestGeo - FGST.

Initiation Mechanisms

Butler - DPAST - Chapters 3 and 11.

MidwestGeo - FGST – Pages 2-3.

Butler, Slug tests in site characterization: Some practical considerations, *Environmental Geosciences*, 3(3), 154, 1996 – non-instantaneous initiation.

Butler, Healey, McCall, Garnett, and Loheide, Hydraulic tests with direct-push equipment, *Ground Water*, 40(1), 25, 2002 – direct-push initiation approaches.

Mace, Estimation of hydraulic conductivity in large-diameter, hand-dug wells using slug-test methods, *Jour. Hydrology*, 219, 34, 1999 – non-instantaneous initiation.

Pandit and Miner, Interpretation of slug test data, *Ground Water*, 24(6), 743, 1986 - non-instantaneous initiation.

General Design Guidelines

Butler - DPAST - Chapters 2, 11, and 13.

MidwestGeo - FGST – Page 3.

Aller, Bennett, Hackett, Petty, Lehr, Sedoris, Nielsen, and Denne, *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, National Water Well Assoc., Dublin, 1989 – well development from a monitoring-well perspective.

Black, The practical reasons why slug tests (including falling and rising head tests) often yield the wrong value of hydraulic conductivity, *Quarterly Journal of Engineering Geology and Hydrogeology*, 43(3), 345, 2010 – discussion of problems often met in practice and how to identify and deal with them.

Butler, Hydrogeological methods for estimation of spatial variations in hydraulic conductivity, in *Hydrogeophysics*, edited by Rubin and Hubbard, Springer, The Netherlands, pp. 23-58, 2005 – overview of methods for estimation of spatial variations in K – extensive discussion of multilevel slug tests (slug tests in zones isolated by straddle packers).

Butler and Healey, Relationship between pumping-test and slug-test parameters: Scale effect or

artifact? *Ground Water*, 36(2), 305, 1998 – demonstration of impact of low-K skin.
 Butler, McElwee, and Liu, Improving the quality of parameter estimates obtained from slug tests, *Ground Water*, 34(2), 480, 1996 – general design guidelines.
 Driscoll, *Groundwater and Wells*, Johnson Division, St. Paul, 1986 - well development from a water-well perspective.
 Kill, Monitoring well development - why and how, in *Ground Water and Vadose Monitoring - ASTM STP 1053*, Nielsen and Johnson, Eds., American Soc. for Testing and Materials, Philadelphia, 82, 1990 – well development from a monitoring-well perspective.

Design of Tests in Low-K Media

Butler - DPAST - Chapter 7.

Bredehoeft and Papadopoulos, A method for determining the hydraulic properties of tight formations, *Water Resour. Res.*, 16(1), 233, 1980 – shut-in slug test.
 Neuzil, On conducting the modified "slug" test in tight formations, *Water Resour. Res.*, 18(2), 439, 1982 – shut-in slug test.
 Novakowski and Bickerton, Borehole measurement of the hydraulic properties of low-permeability rock, *Water Resour. Res.*, 33(11), 2509, 1997 – tests in very low-K media.
 Ostendorf and DeGroot, Slug tests in the presence of background head trends, *Ground Water*, 48(4), 609, 2010 – incorporating background head trends into the analysis of slug tests in low-K media.

Design of Tests in High-K Media

Butler - DPAST - Chapter 8.

Butler, Garnett, and Healey, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, 41(5), 620, 2003 – field guidelines and analysis procedures for slug tests in high-K media.
 Butler and Zhan, Hydraulic tests in highly permeable aquifers, *Water Resour. Res.*, 40, W12402, doi:10.1029/2003WR002998, 2004 – math and theory underlying new solution for hydraulic tests in high-K media.
 Kipp, Type curve analysis of inertial effects in the response of a well to a slug test, *Water Resour. Res.*, 21(9), 1397, 1985.
 McElwee, Application of a nonlinear slug test model, *Ground Water*, 39(5), 737, 2001 – analysis model for slug tests with reproducible head dependence.
 Springer and Gelhar, Characterization of large-scale aquifer heterogeneity in glacial outwash by analysis of slug tests with oscillatory responses, Cape Cod, Massachusetts, U.S. Geological Survey *Water Resour. Inv. Rept. 91-4034*, 36, 1991.
 Zenner, Near-well nonlinear flow identified by various displacement well response testing, *Ground Water*, 47(4), 526, 2009 – most complete assessment of slug tests with reproducible head dependence.

Direct Push Applications

Butler - DPAST - Chapter 11.

- Butler, A simple correction for slug tests in small diameter wells, *Ground Water*, 40(3), 303, 2002.
- Butler, Healey, McCall, Garnett, and Loheide, Hydraulic tests with direct-push equipment, *Ground Water*, 40(1), 25, 2002 – slug tests in direct-push rods.
- Liu, Butler, Reboulet, and Knobbe, Hydraulic conductivity profiling with direct-push methods, *Grundwasser*, 17(1), 19, 2012 – review of direct-push methods.
- McCall, Butler, Healey, Lanier, Sellwood, and Garnett, A dual-tube direct-push method for vertical profiling of hydraulic conductivity in unconsolidated formations, *Environmental & Engineering Geoscience*, 8(2), 75, 2002 – dual-tube slug test method.
- Sellwood, Healey, Birk, and Butler, Direct-push hydrostratigraphic profiling: Coupling electrical logging and slug tests, *Ground Water*, 43(1), 19, 2005.

Major Methods for Data Analysis

Butler - DPAST - Chapters 5-11.

- Bouwer, The Bouwer and Rice slug test - an update, *Ground Water*, 27(3), 304, 1989.
- Bouwer and Rice, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, *Water Resour. Res.*, 12(3), 423, 1976.
- Butler, Garnett, and Healey, Analysis of slug tests in formations of high hydraulic conductivity, *Ground Water*, 41(5), 620, 2003.
- Cooper, Bredehoeft, and Papadopoulos, Response of a finite-diameter well to an instantaneous charge of water, *Water Resour. Res.*, 3(1), 263, 1967.
- Hvorslev, Time lag and soil permeability in ground-water observations, *U.S. Army Corps of Engrs. Waterways Exper. Sta. Bull no. 36*, 1951.
- Hyder and Butler, Slug tests in unconfined formations: An assessment of the Bouwer and Rice technique, *Ground Water*, 33(1), 16, 1995 – KGS Model.
- Hyder, Butler, McElwee, and Liu, Slug tests in partially penetrating wells, *Water Resour. Res.*, 30(11), 2945, 1994 – KGS Model.
- Zlotnik, Interpretation of slug and packer tests in anisotropic aquifers, *Ground Water*, 32(5), 761, 1994 – discussion of how to modify Bouwer and Rice model for anisotropic aquifer, requires that anisotropy ratio be known.
- Zlotnik, Goss, and Duffield, General steady-state shape factor for a partially penetrating well, *Ground Water*, 48(1), 111, 2010 – shape factors for revised Bouwer and Rice method.

Wells Screened Across the Water Table

Butler - DPAST – Chapters 6 and 11.

- Binkhorst and Robbins, Conducting and interpreting slug tests in monitoring wells with partially submerged screens, *Ground Water*, 36(2), 225, 1998 – method to calculate effective casing radius, essentially same as approach developed for DPAST.
- Butler, Slug tests in wells screened across the water table: Some additional considerations, *Groundwater*, 52(2), 311, 2014 – discussion of four considerations for slug tests performed in this setting.
- Dagan, A note on packer, slug, and recovery tests in unconfined aquifers, *Water Resour. Res.*, 14(5), 929, 1978 – analytical solution that can be used for slug tests in wells screened across the water table – key points with less mathematics covered in DPAST, Chapter 6.
- Kirkman, Refinement of Bouwer-Rice baildown test analysis, *Ground Water Monitoring and Remediation*, 33(1), 105, 2013 – LNAPL baildown test procedures that are incorporated in new API spreadsheet – use with care – see DPAST, Chapter 11.

Slug Tests in Fractured Media

Butler - DPAST - Chapter 11.

- Karasaki, Long, and Witherspoon, Analytical models of slug tests, *Water Resour. Res.*, 24(1), 115, 1988.
- Shapiro and Hsieh, How good are estimates of transmissivity from slug tests in fractured rock? *Ground Water*, 36(1), 37, 1998.
- Wang, Narasimhan, Tsang, and Witherspoon, Transient flow in tight fractures, in *Proc. Invitational Well-Testing Symp.*, Lawrence Berkeley Lab. Rept. LBL-7027, 1977.

Data Analysis Strategies

Butler - DPAST - Chapter 12.
MidwestGeo - FGST – Page 4.

- Butler, McElwee, and Liu, Improving the quality of parameter estimates obtained from slug tests, *Ground Water*, 34(2), 480, 1996.