

TECHNICAL MEMORANDUM

To: Nevada Environmental Response Trust

Cc: Nevada Division of Environmental Protection
United States Environmental Protection Agency

From: Arul Ayyaswami and Dan Pastor

Date: October 19, 2018

Subject: Unit 4 Source Area In-Situ Bioremediation Treatability Study Monthly Progress Report

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Tetra Tech, Inc. (Tetra Tech) has prepared this memorandum that summarizes Tetra Tech's progress made during August 2018 toward successfully implementing the Unit 4 Source Area In-Situ Bioremediation Treatability Study. The location of the treatability study is depicted on Figure 1 and the location of the borings and wells are depicted on Figure 2.

Task Progress Update: August 2018

Task M21 – Unit 4 Source Area In-situ Bioremediation (ISB) Treatability Study

- Task Leader – Arul Ayyaswami
- Current Status
 - The University of Nevada – Las Vegas (UNLV) started the final set of microcosms with a combination of molasses, molasses with acetate, mixed microbial cultures, and soil and groundwater collected from boring and well locations in the vicinity of the Unit 4 Building. No additional sample results are currently available to report for these microcosms.
 - A constant-rate test was performed on deep well U4-E-01D between July 30 and August 1, 2018. The well was pumped for a total of 60 hours at an average extraction rate of 0.36 gpm. The constant-rate test was stopped after verifying the stabilization criteria of less than 0.03 ft change in water levels over 15 minutes was achieved at the closest monitoring well, U4-IS-MW-02D. After the conclusion of the pumping test, recovery monitoring of groundwater levels was conducted from August 2 to 3, 2018 and concluded after confirming the groundwater levels had recovered to baseline level.
 - The data obtained from the step-drawdown and constant-rate tests conducted in July and August 2018 are being analyzed. Table 1 provides a summary of pumping performance during the step-drawdown and constant-rate tests. Table 2 provides the draft laboratory analytical results from samples collected during the constant-rate tests. Attachment 1 provides hydrographs depicting groundwater drawdown during the tests.

- Treatability / Pilot Study Modification No. 4 for the Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan was submitted to NDEP in August 2018. NDEP requested additional information regarding the modification which is currently being compiled for submittal. The modification proposed the following:
 - Perform a groundwater extraction test to determine if short-term groundwater extraction (up to 3 months) will reduce total dissolved solids (TDS) and chemicals of potential concern (COPCs) in groundwater to concentrations that have been successfully bioremediated in the bench-scale tests.
- Schedule and Progress Updates
 - The following activities are scheduled to be conducted in September 2018:
 - Continued UNLV microcosm testing and start of column tests in accordance with the Unit 4 Source Area In-Situ Bioremediation Treatability Study Bench-Scale Work Plan and Treatability Study Modification No. 1.
 - Groundwater modeling using data obtained during pre-implementation field activities.
 - Begin developing the final injection and extraction system design including well design, injection and extraction rates, cycling frequency, performance monitoring program, and conveyance pipeline.
 - Submit the additional information requested by NDEP regarding the Treatability / Pilot Study Modification No. 4 for the Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan.
 - Part 1 findings of the pre-design investigation activities and a summary of the treatability study design are anticipated to be presented in first or second quarter of 2019.
- Health and Safety
 - There were no health and safety incidents related to Task M21 during August 2018.

CERTIFICATION

Unit 4 Source Area Bioremediation Treatability Study Monthly Progress Report

Nevada Environmental Response Trust Site (Former Tronox LLC Site) Henderson, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the systems(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Signature: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

not individually, but solely as President

Name: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Title: Solely as President and not individually

Company: Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Date: 10/19/18

CERTIFICATION

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been prepared in a manner consistent with the current standards of the profession, and to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

Description of Services Provided: Prepared Unit 4 Source Area Bioremediation Treatability Study Monthly Progress Report, Nevada Environmental Response Trust Site, Henderson, Nevada.



October 19, 2018

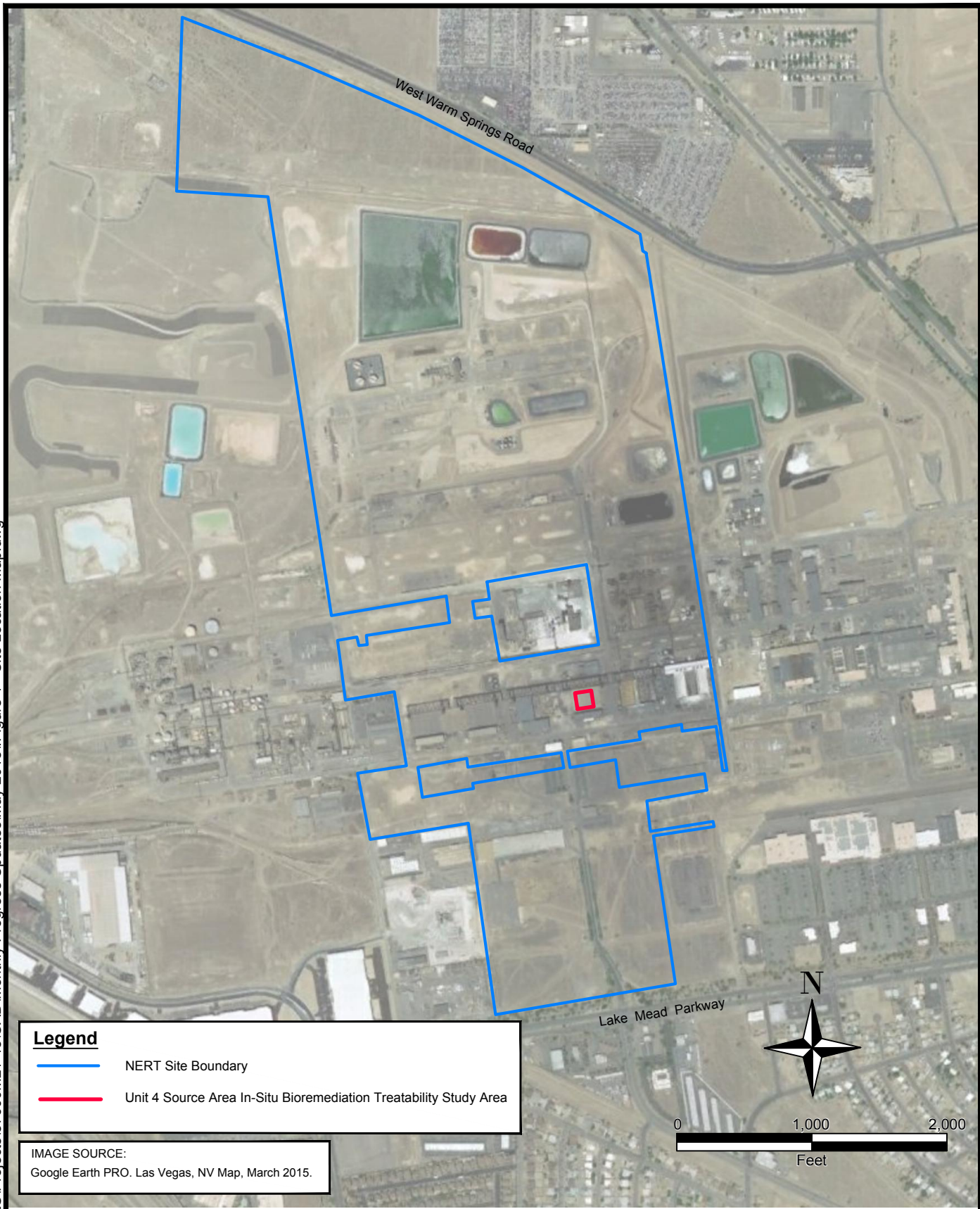
Kyle Hansen, CEM
Field Operations Manager/Geologist
Tetra Tech, Inc.

Date

Nevada CEM Certificate Number: 2167
Nevada CEM Expiration Date: September 18, 2020

Figures

tts318fs3.tl.local\CES\Projects\87600M21-18\CAD\Monthly Progress Updates\May 2018\Figure 1 - Site Location Map.dwg





Legend	
	NERT Site Boundary
	Unit 4 Source Area In-Situ Bioremediation Treatability Study Area

IMAGE SOURCE:
Google Earth PRO. Las Vegas, NV Map, March 2015.

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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY
SITE LOCATION MAP

Project No:	117-7502018
Date:	JUNE 13, 2018
Designed By:	PK
Figure No.	1



Legend

- Geotechnical Soil Boring Location
- Existing Third Mobilization Monitoring Well
- Nested Monitoring Well (I - Intermediate; D - Deep)
- UMCf Injection/Extraction Well Cluster (2 Screen Intervals; I - Intermediate; D - Deep)
- Unit 4 Treatability Study Area
- Department of Homeland Security Restricted Area
- Existing Unit 4 Building

Notes:

1. All locations are approximate.
2. Imagery Source: Aerotech Mapping, August 2016.
3. Well location source: Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan, Tetra Tech, 2017.



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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
 UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY

BORING AND WELL LOCATIONS

Project No:	117-7502018
Date:	JULY 10, 2018
Designed By:	CL
Figure No.	2

Tables

Table 1
Summary of Step-Drawdown and Constant-Rate Tests
 Unit 4 Source Area In-Situ Bioremediation Treatability Study

Well ID	Event	Step	Time Pumped (min)	Maximum Draw Down (ft)	Average Pumping Rate ¹ (gpm)
U4-E-01I	Step-Drawdown Test	1	120	12.63	1.25
		2	120	31.07	2.77
		3	120	48.96	3.39
U4-E-02I	Step-Drawdown Test	1	120	11.65	1.49
		2	120	21.98	3.47
		3	120	40.77	5.96
		4	7	55.27	8.09
U4-E-05D	Step-Drawdown Test	1	120	35.33	0.82
		2	120	53.05	1.57
		3	120	70.34	2.34
U4-E-01D	Step-Drawdown Test	1	120	66.18	0.39
		2	120	71.14	0.34
		3	42	74.14	0.36
U4-E-02I	Constant-Rate Test	--	2,880	54.54	6.38
U4-E-01D	Constant-Rate Test	--	3,600	75.01	0.38

Notes:

¹ The average pumping rate for U4-E-01D is approximate due to the accuracy of the flow meter at flow rates below 0.5 gpm.

ft feet
 gpm gallons per minute
 min minutes

Table 2
Summary of Groundwater Analytical Results During Constant-Rate Pumping Tests
 Unit 4 Source Area In-Situ Bioremediation Treatability Study

Well ID	Sample ID	Date	Time	Perchlorate by USEPA Method 314.0 (µg/L)	Hexavalent Chromium by USEPA Method 7199 (µg/L)	Anions by USEPA Method 300.0 (mg/L)			Ammonia (as N) (mg/L)	Chloroform by USEPA Method 8260B (µg/L)	Total Dissolved Solids (mg/L)	General Water Quality Parameters								
						Nitrate as N	Sulfate	Nitrate as NO3				Temperature (°C)	pH	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Turbidity (NTU)	Ferrous Iron (mg/L)	Ferric Iron (mg/L)	Sulfide (mg/L)
U4-E-02I	U4-E-02I-BL	07/24/18	03:30	290,000	6,800	4.9	1,000	22	<0.10	490	4,700 J	24.45	8.51	5.49	6.02	187	6.5	<0.02	<0.01	<0.01
	U4-E-02I-12	07/24/18	15:30	370,000	9,100	6.4	1,100	28	0.11 J	610	5,500 J	22.87	8.69	6.23	6.09	88	0.0	<0.02	<0.01	<0.01
	U4-E-02I-24	07/25/18	03:30	400,000	7,700	6.2	1,000	28	0.38	700	5,600 J	24.73	8.75	6.00	4.55	62	0.7	<0.02	<0.01	<0.01
	U4-E-02I-36	07/25/18	15:30	390,000	9,100	6.5	1,100	29	<0.10	610	5,700 J	22.05	8.89	6.55	5.83	116	1.8	<0.02	<0.01	<0.01
	U4-E-02I-48	07/26/18	03:30	360,000	8,000	6.4	1,100	28	<0.10	540	6,000 J	21.08	9.12	6.34	5.95	110	0.5	<0.02	<0.01	<0.01
U4-E-01D	U4-E-01D-BL	07/30/18	10:00	4,100,000	160,000	77	1,300	340	<0.10	6,800	60,000 J	23.26	9.02	45.1	5.89	-14	16.9	0.21	0.22	<0.01
	U4-E-01D-10	07/30/18	20:00	3,700,000	110,000 J-	78	1,200	350	<0.10	7,300	59,000 J	23.86	8.66	46.7	5.29	104	21.0	0.19	0.07	<0.01
	U4-E-01D-10-FD	07/30/18	20:00	3,800,000	120,000 J-	75	1,200	330	<0.10	6,400	62,000 J	--	--	--	--	--	--	--	--	--
	U4-E-01D-20	07/31/18	06:00	3,600,000	140,000	77	1,200	340	<0.10	7,900	59,000 J	23.74	8.68	45.9	5.39	131	1.3	<0.02	0.34	0.01
	U4-E-01D-30	07/31/18	16:00	3,800,000	110,000	76	1,300	340	<0.10	7,200	56,000 J	24.31	8.48	45.1	4.62	144	0.0	0.04	0.15	0.02
	U4-E-01D-40	08/01/18	02:00	3,500,000	110,000	75	1,200	330	<0.10	9,100	59,000 J	24.33	8.38	45.0	4.13	164	2.1	0.19	0.36	<0.01
	U4-E-01D-50	08/01/18	12:00	3,400,000	120,000	75	1,200	330	<0.10	8,600	62,000 J	24.41	8.36	44.7	4.05	162	0.3	0.11	0.25	<0.01
U4-E-01D-60	08/01/18	22:00	3,500,000	140,000	65	1,300	290	<0.10	8,900	62,000 J	23.95	8.35	45.3	4.27	182	9.4	0.13	0.20	0.01	

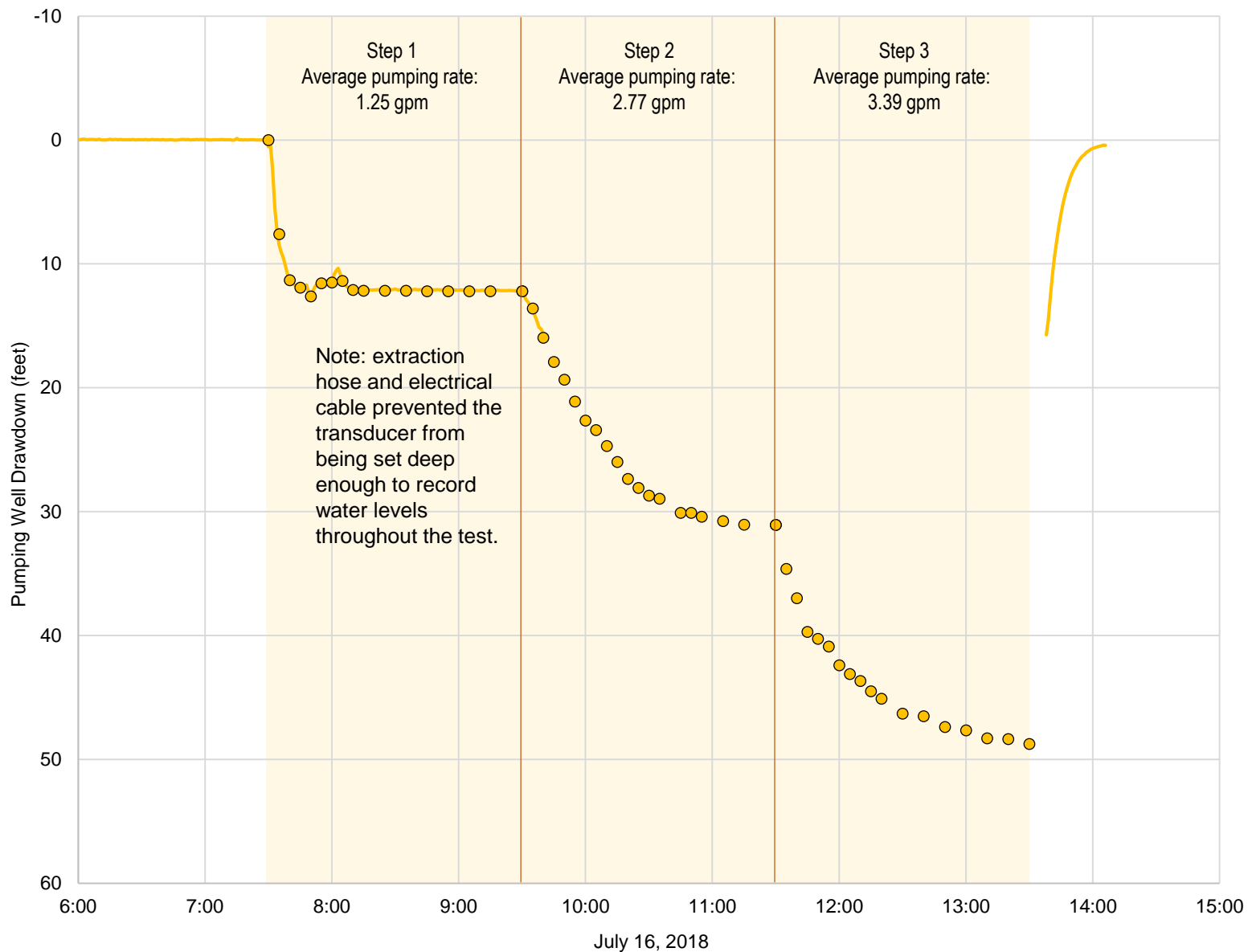
Notes:

- ID Identification
- °C Celsius
- DO Dissolved Oxygen
- µg/L Microgram per liter
- mg/L Milligram per liter
- mL/min Milliliters per minute
- mV Millivolts
- mS/cm MilliSiemens per centimeter
- mV Millivolt
- NTU Nephelometric Turbidity Unit
- USEPA United States Environmental Protection Agency
- < Denotes concentration is less than the method detection limit indicated
- J Denotes estimated value.
- J- The result is an estimated quantity, but the result may be biased low
- Not Analyzed

Attachment 1
Draft Step-Drawdown and Constant-Rate
Pumping Test Hydrographs

Figures 1 to 8: Hydrographs for Step-Drawdown Tests
Figures 9 to 12: Hydrographs for Constant-Rate Tests

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HYDROGRAPH FOR PUMPING WELL U4-E-01I DURING STEP-DRAWDOWN TEST

Project No.: 117-7502018

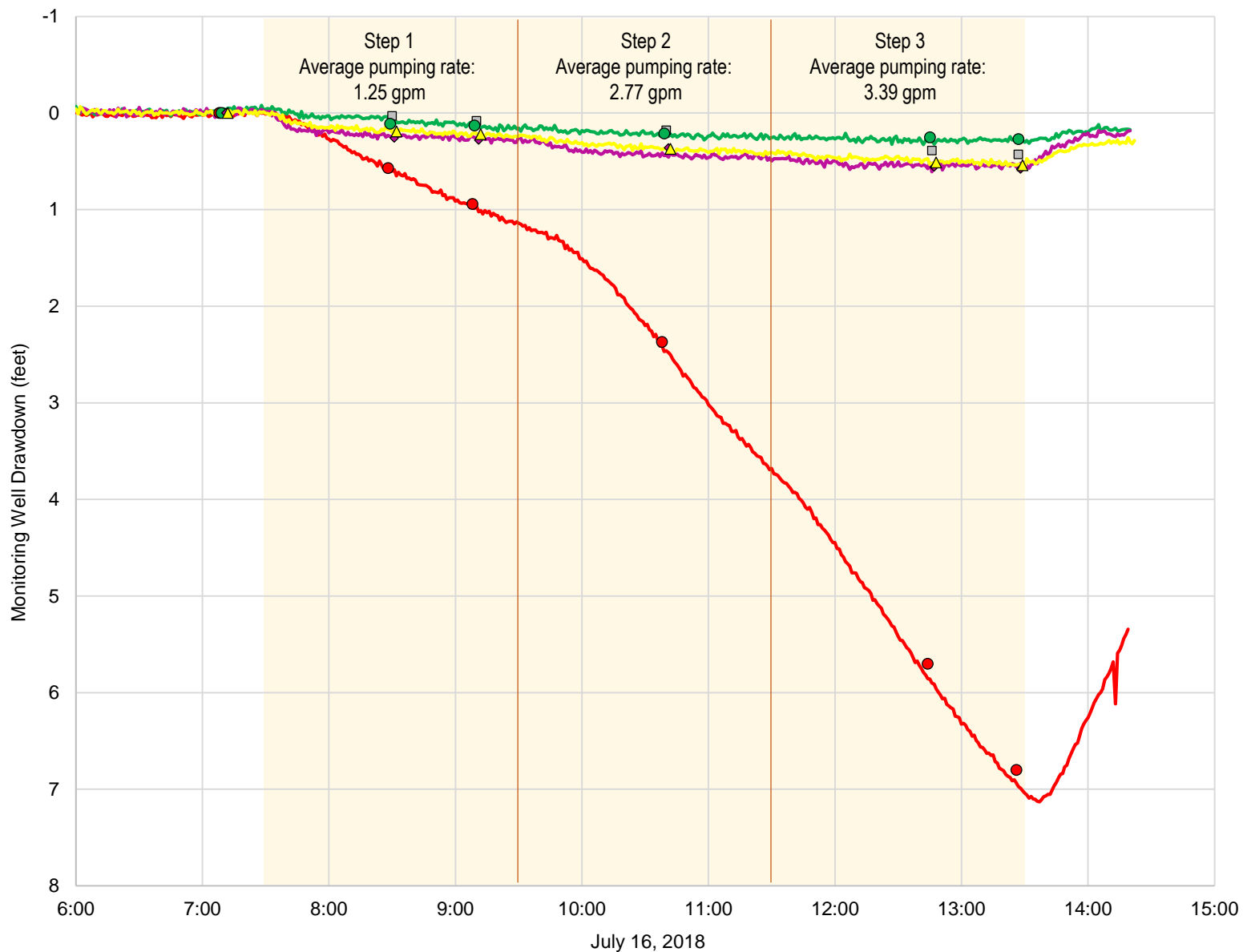
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Figure No.

1

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Legend

Manual

- U4-E-01D
- U4-E-02D
- U4-E-02I
- ▲ U4-E-04I
- ◆ U4IS-MW-02I

Transducer

- U4-E-01D
- U4-E-02I
- U4-E-04I
- U4IS-MW-02I

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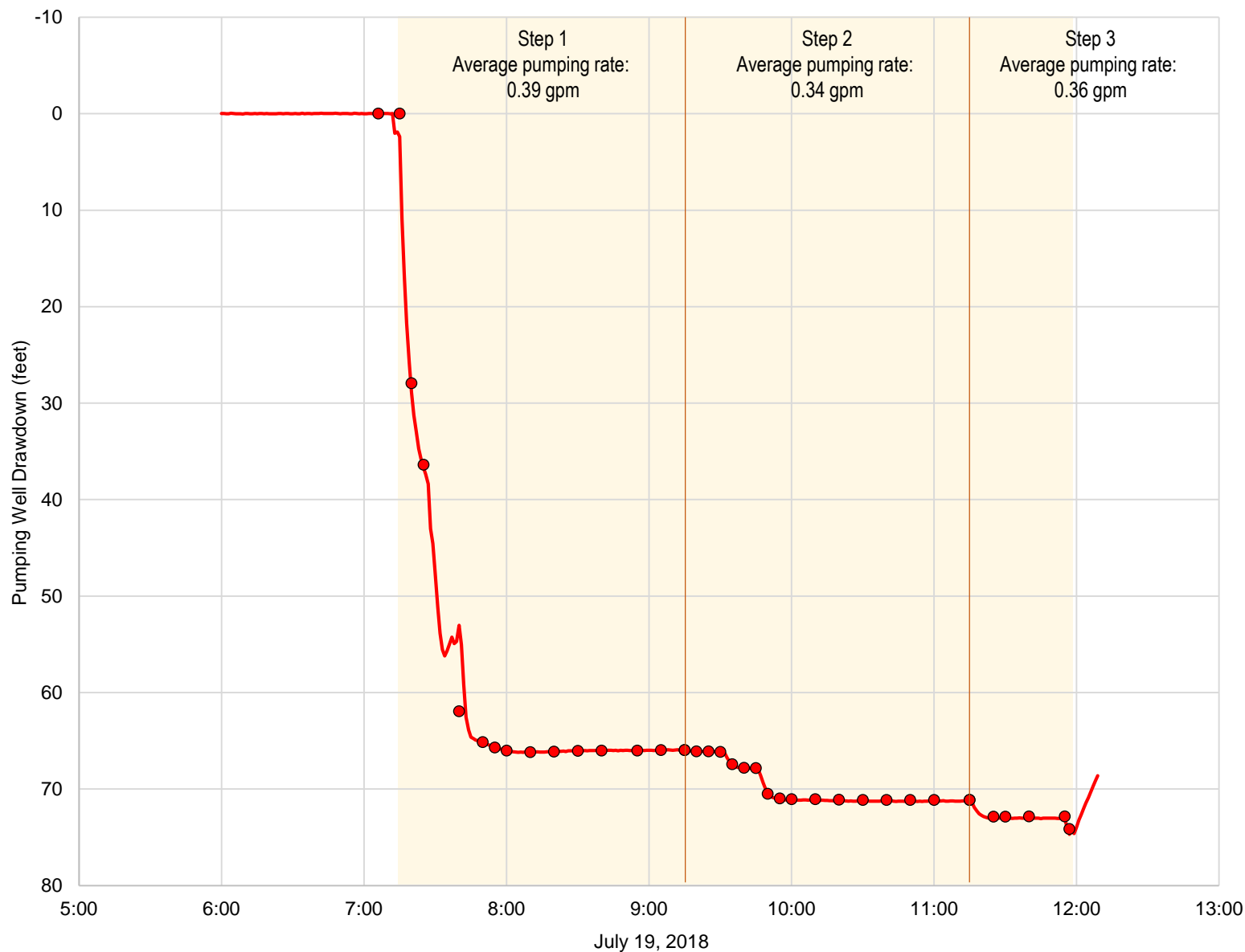
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Figure No.

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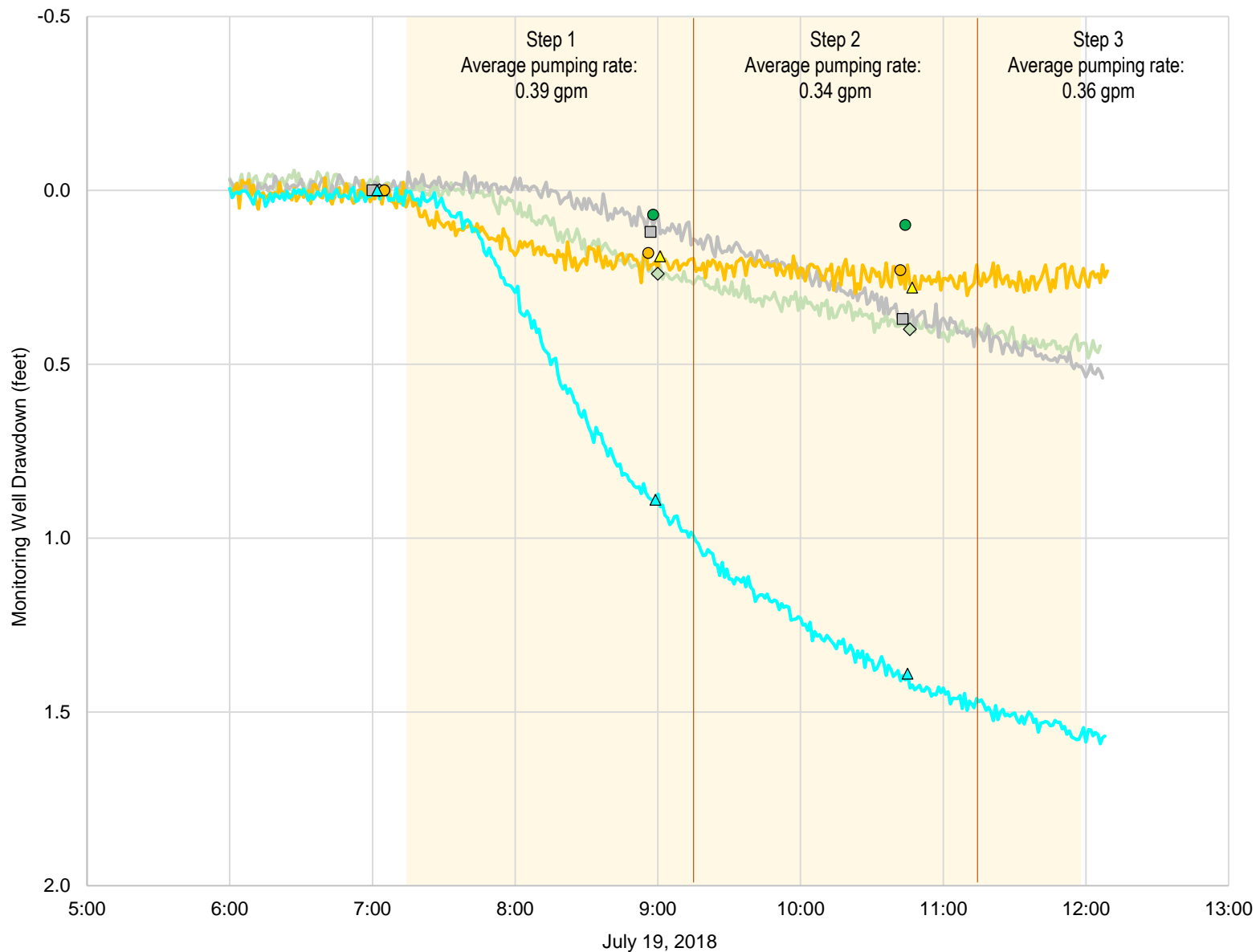
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Figure No.

3



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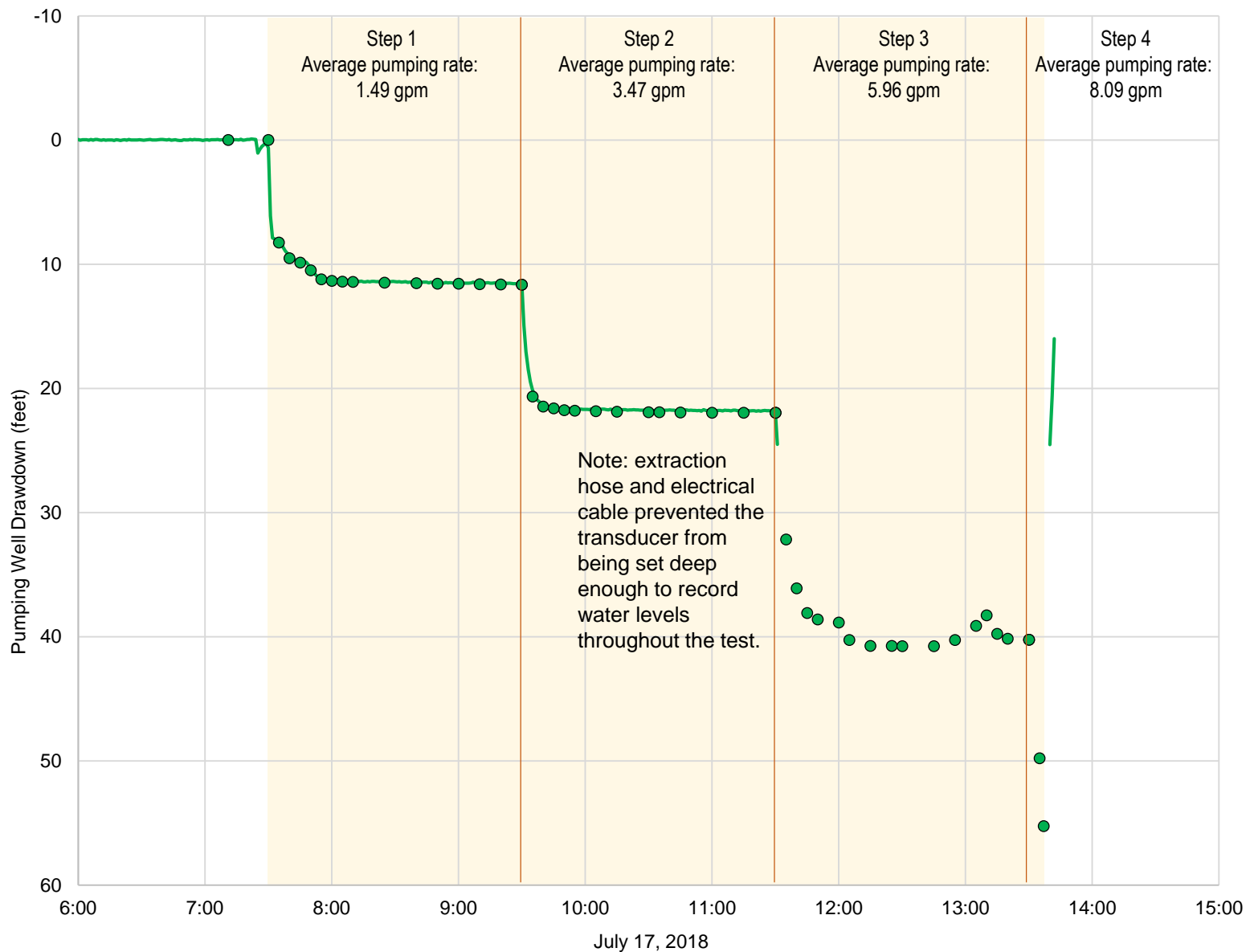
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Figure No.

4



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HYDROGRAPH FOR PUMPING WELL U4-E-02I DURING STEP-DRAWDOWN TEST

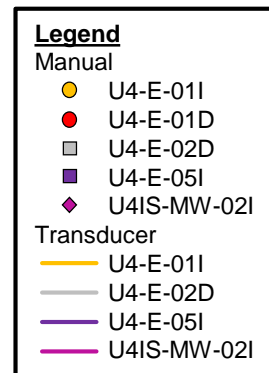
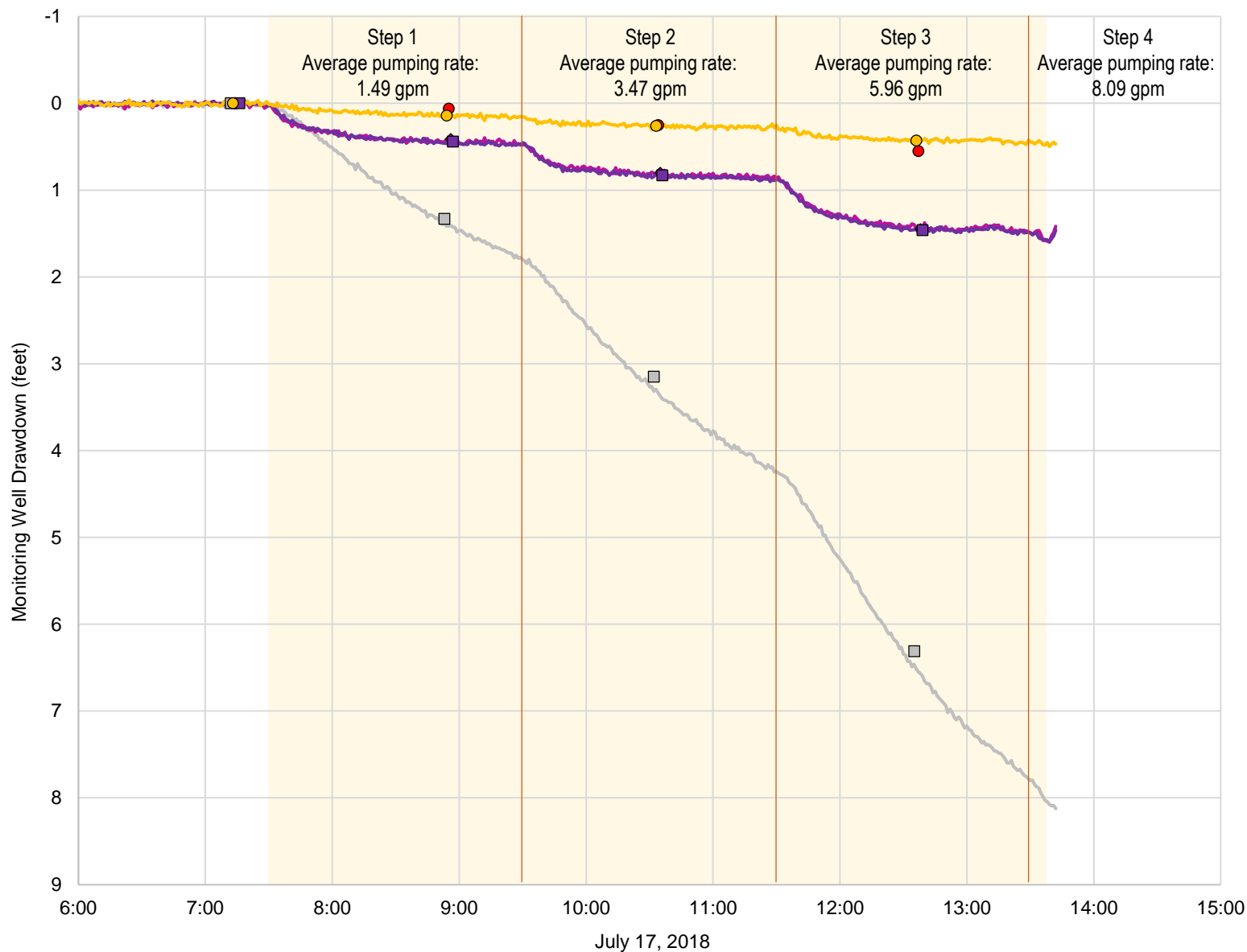
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Figure No.

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HYDROGRAPH FOR MONITORING WELLS DURING U4-E-02I STEP-DRAWDOWN TEST

Project No.: 117-7502018

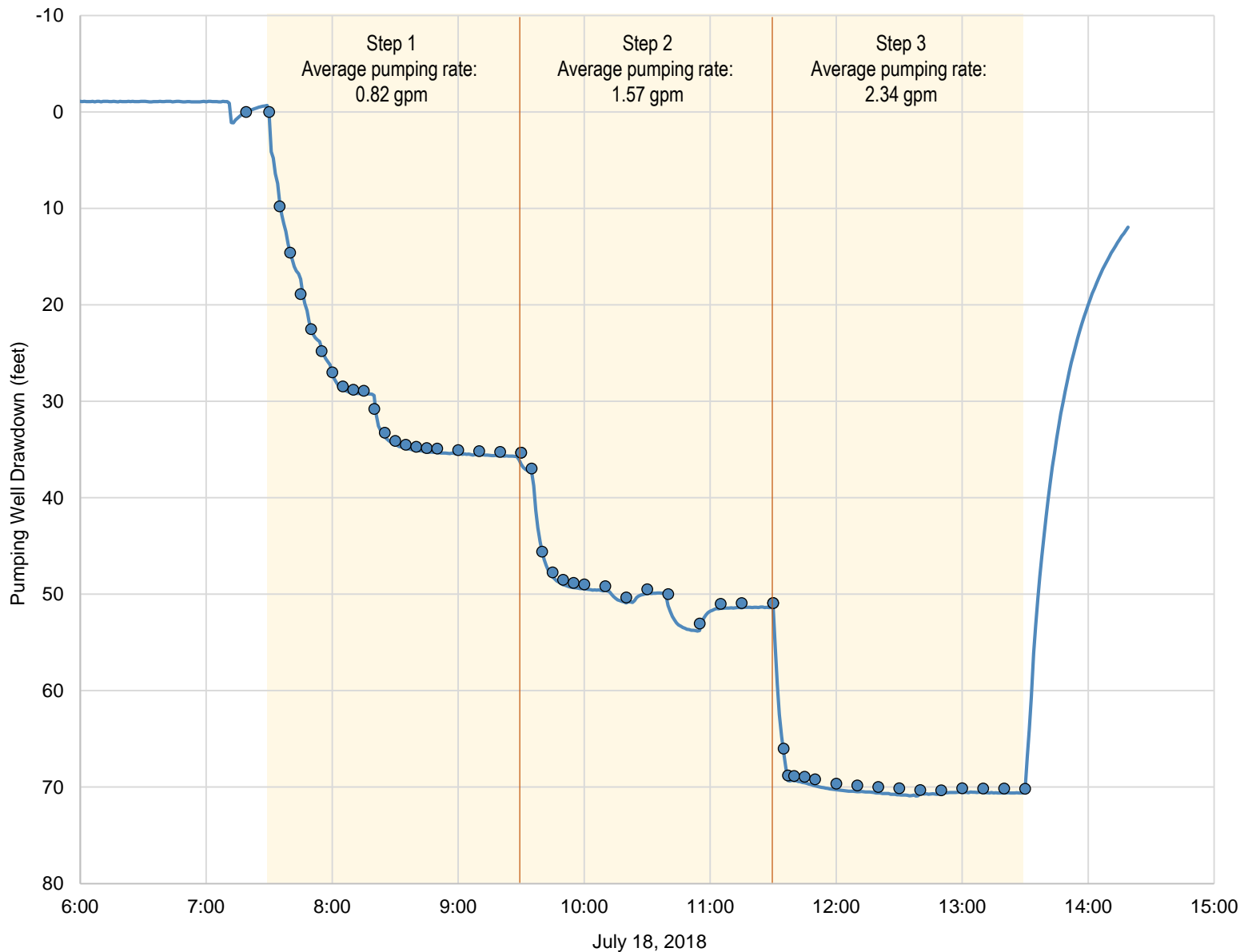
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Figure No.

6

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Legend

Manual
• U4-E-05D
Transducer
— U4-E-05D

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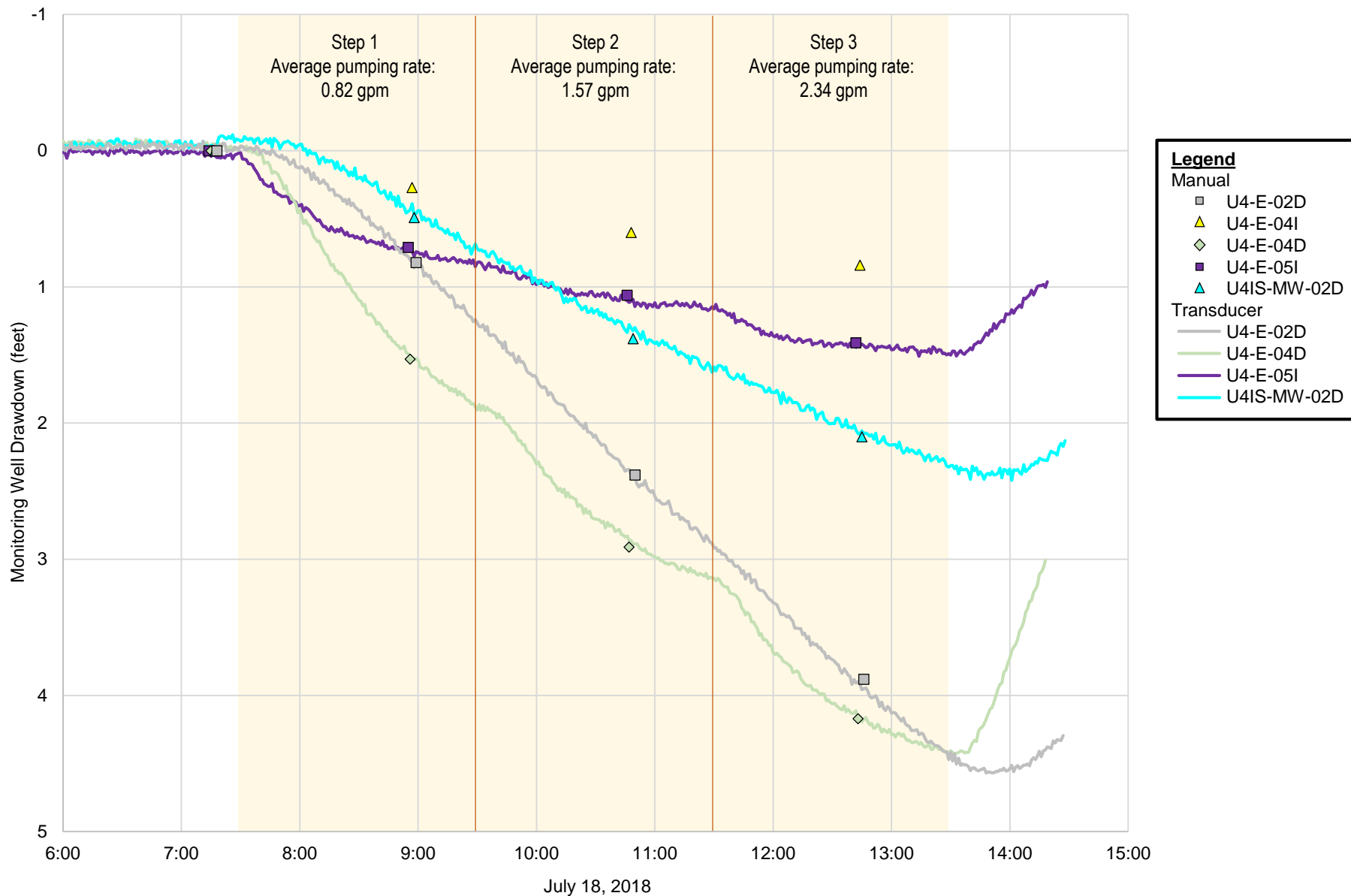
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HYDROGRAPH FOR PUMPING WELL U4-E-05D DURING STEP-DRAWDOWN TEST

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Figure No.
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HYDROGRAPH FOR MONITORING WELLS DURING U4-E-05D STEP-DRAWDOWN TEST

Legend

Manual

- U4-E-02D
- △ U4-E-04I
- ◇ U4-E-04D
- U4-E-05I
- ▲ U4IS-MW-02D

Transducer

- U4-E-02D
- U4-E-04D
- U4-E-05I
- U4IS-MW-02D

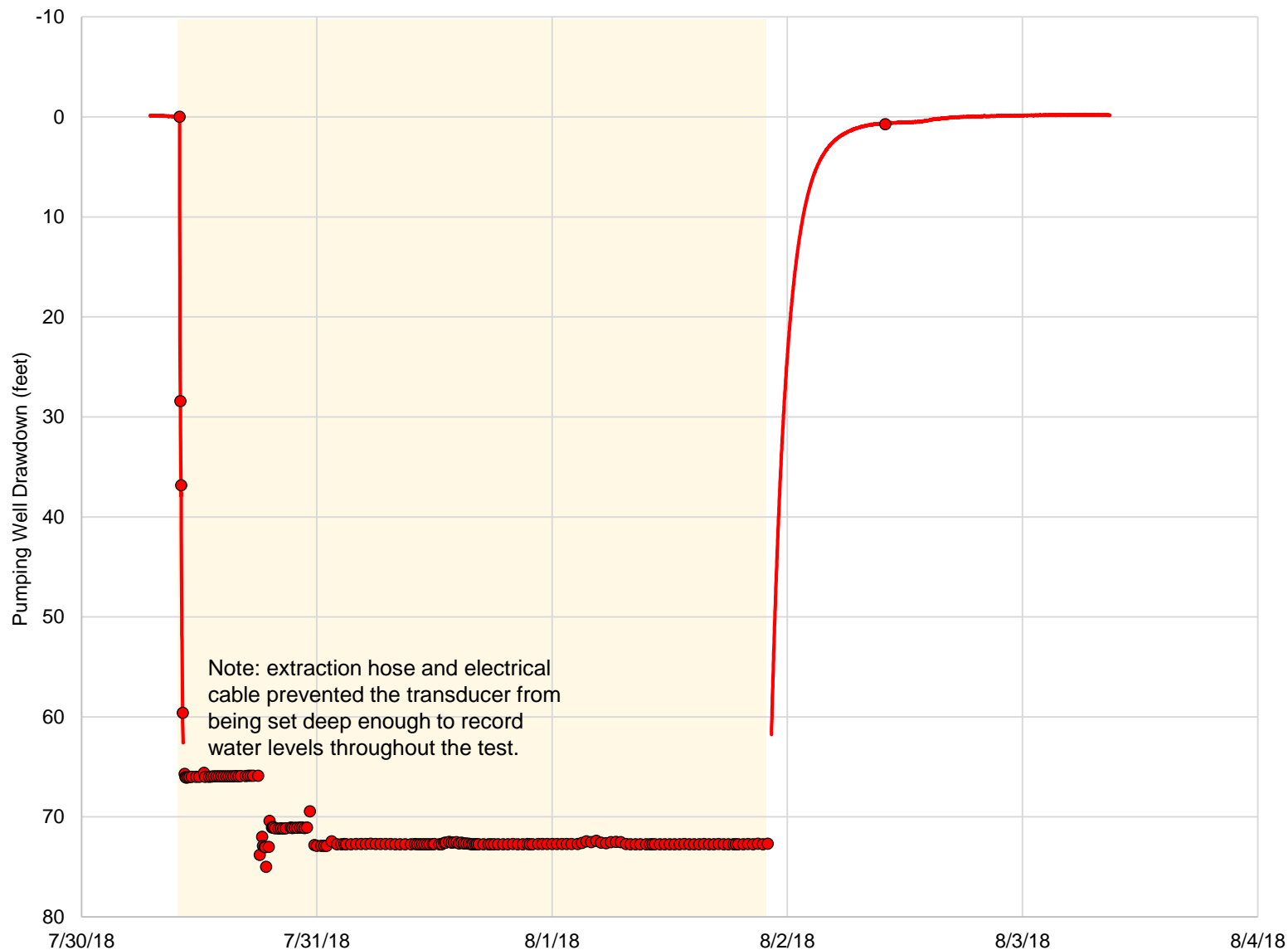
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Figure No.

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- Manual U4-E-01D Transducer
- U4-E-01D

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HYDROGRAPH FOR PUMPING WELL U4-E-01D DURING CONSTANT-RATE PUMPING TEST

Project No.: 117-7502018

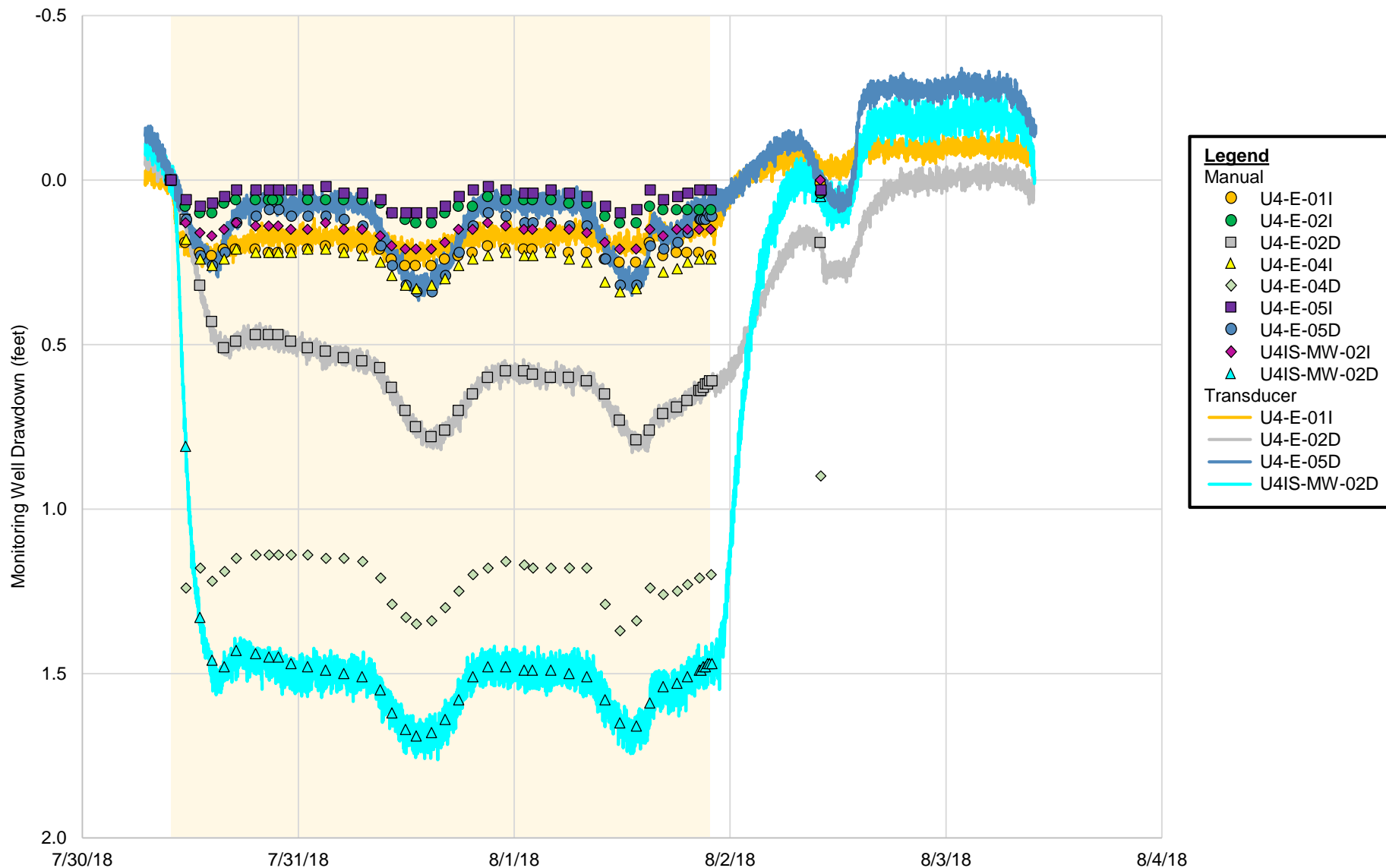
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Figure No.

9

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Legend

Manual

- U4-E-01I
- U4-E-02I
- U4-E-02D
- U4-E-04I
- U4-E-04D
- U4-E-05I
- U4-E-05D
- U4IS-MW-02I
- U4IS-MW-02D

Transducer

- U4-E-01I
- U4-E-02D
- U4-E-05D
- U4IS-MW-02D

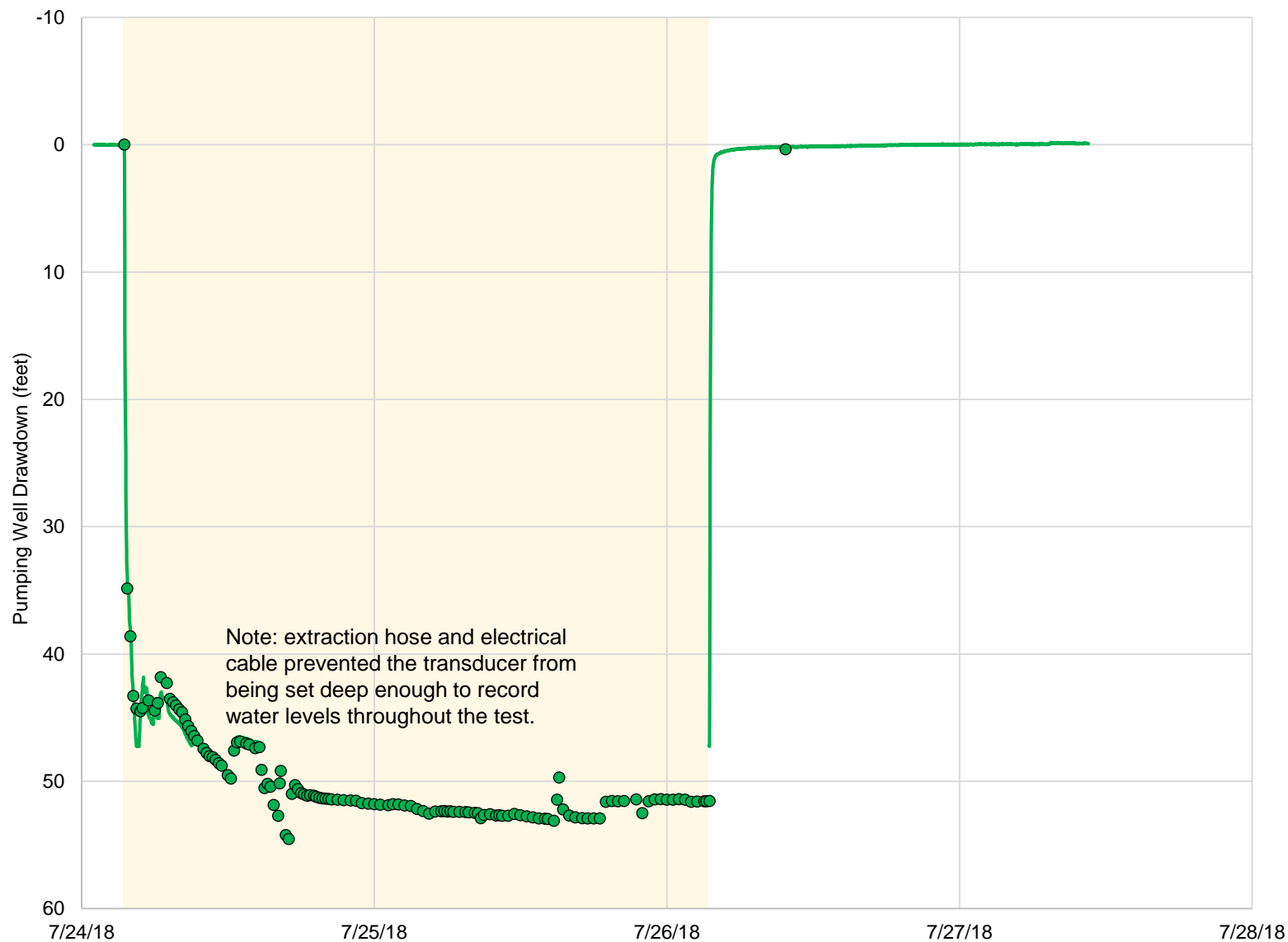
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HYDROGRAPH FOR MONITORING WELLS DURING U4-E-01D CONSTANT-RATE PUMPING TEST

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Figure No.	10



Legend
Manual
• U4-E-021
Transducer
— U4-E-021

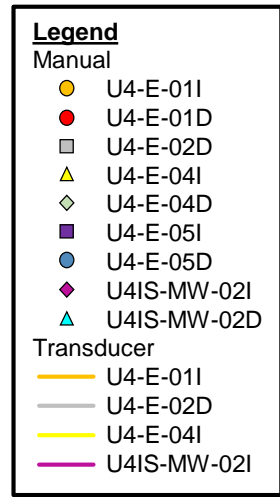
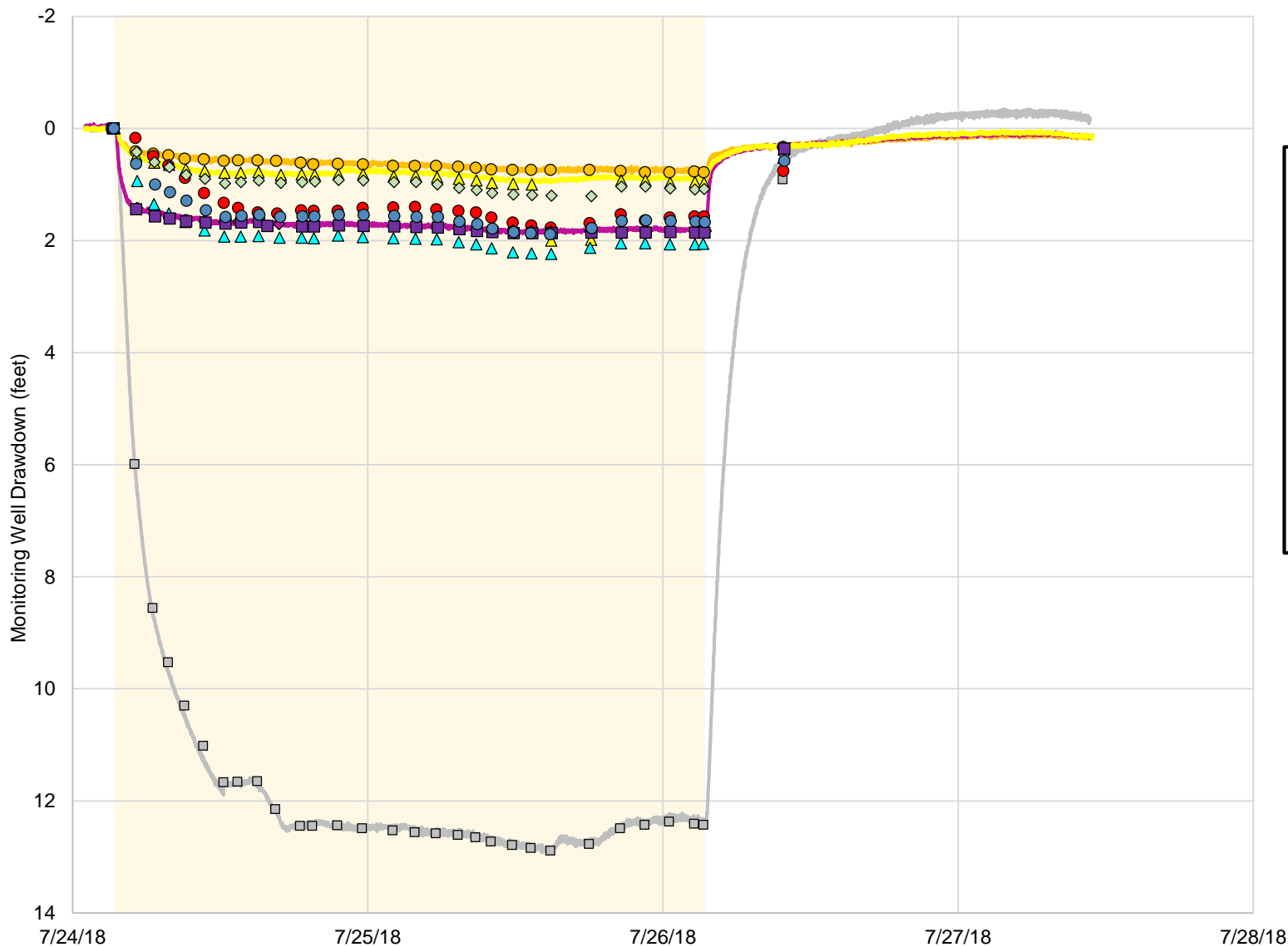
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HYDROGRAPH FOR PUMPING WELL U4-E-021 DURING CONSTANT-RATE PUMPING TEST

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HYDROGRAPH FOR MONITORING WELLS DURING U4-E-02I CONSTANT-RATE PUMPING TEST

Project No.: 117-7502018

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Figure No.

12