BIG PLAINS WATER SPECIAL SERVICE DISTRICT MEETING

BOARD OF DIRECTORS, REGULAR MEETING
1777 N Meadowlark Dr, Apple Valley
Wednesday, March 15, 2023 at 6:00 PM

AGENDA

Notice is given that a meeting of the Water District of the Town of Apple Valley will be held on **Wednesday, March 15, 2023**, commencing at **6:00 PM** or shortly thereafter at **1777 N Meadowlark Dr, Apple Valley**.

Chairman| Andy McGinnis
Board Members| Frank Lindhardt | Harold Merritt | Ross Gregerson | Jarry Zaharias |

Pursuant to the Executive Order issued by Governor Gary Herbert on March 18, 2020 regarding Electronic Public Meetings, please be advised that the meeting will be held electronically and broadcast via Zoom. Persons allowed to comment during the meeting may do so via Zoom. Login to the meeting by visiting:
https://us02web.zoom.us/j/88667363731
if the meeting requests a password use 1234
To call into meeting, dial (253) 215 8782 and use Meeting ID 886 6736 3731

CALL TO ORDER
PLEDGE OF ALLEGIANCE
ROLL CALL

DECLARATION OF CONFLICTS OF INTEREST

CONSENT AGENDA
The Consent Portion of the Agenda is approved by one (1) non-debatable motion. If any Board Member wishes to remove an item from the Consent Portion of the agenda, that item becomes the first order of business on the Regular Agenda.

1. Disbursement Listing for February 2023.
2. Budget Report for Fiscal Year 2023 through February 2023.
3. Minutes: February 08, 2023.
4. Minutes: February 16, 2023.

DISCUSSION AND POSSIBLE ACTION

5. Open Engineering Services RFP's and Consider Approval of Contract Award.
6. Consider approval of amendment to the Interlocal Agreement, Resolution BPW-R-2023-01.
7. Washington County Conservancy District Study.

CHAIRMAN | WATER SUPERINTENDENT REPORT

8. January 2023 Water Usage Comparison

REQUEST FOR A CLOSED SESSION

ADJOURNMENT

CERTIFICATE OF POSTING: I, Jenna Vizcardo, as duly appointed Recorder for the Town of Apple Valley, hereby certify that this Agenda was posted at the Apple Valley Town Hall, the Utah Public Meeting Notice website http://pmn.utah.gov, and the Town Website www.applevalleyut.gov.

THE PUBLIC IS INVITED TO PARTICIPATE IN ALL COMMUNITY EVENTS AND MEETINGS
In compliance with the Americans with Disabilities Act, individuals needing special accommodations (including auxiliary communicative aids and services) during this meeting should notify the Town at 435-877-1190 at least three business days in advance.

Big Plains Water Special Service District
Disbursement Listing
Checking - SBSU - 02/01/2023 to 02/28/2023

Payee Name	Reference Number	Payment Date	Payment Amount	Void Date	Void Amount	Source
Scholzen Products Company, Inc.	1321	02/01/2023	$2,409.54			Purchasing
Pelorus Methods	1322	02/01/2023	$500.00			Purchasing
Revco Leasing	1325	02/01/2023	$151.20			Purchasing
Ken's	1334	02/01/2023	$519.48			Purchasing
Superior Technical Solutions, LLC	STS02022023	02/02/2023	$98.21			Purchasing
Apple Valley Storage, LLC	AVS02032023	02/03/2023	$95.00			Purchasing
City of St. George	1324	02/06/2023	$45.00			Purchasing
Hinton Burdick CPA's	1326	02/06/2023	$2,500.00			Purchasing
Ruesch & Reeve	1327	02/06/2023	$950.00			Purchasing
State Bank of Southern Utah	SBSU02072023	02/07/2023		02/07/2023	$4,711.46	Purchasing
State Bank of Southern Utah	SBSU02082023	02/08/2023	$4,711.45			Purchasing
ChemTech-Ford Laboratories	1323	02/09/2023	$290.00			Purchasing
Health Equity	HE02092023	02/09/2023	$2.25			Purchasing
Payroll	0210231200	02/10/2023	$1,638.10			Paycheck
Internal Revenue Service	EFTPS0210202	02/10/2023	$493.77			Payroll
Health Equity	HE02102023	02/10/2023	$134.62			Payroll
Utah Retirement Systems	URS02102023	02/10/2023	$374.49			Payroll
Town of Apple Valley	1329	02/14/2023	$8.10			Purchasing
Galloway & Company, Inc.	1328	02/15/2023	$7,025.00			Purchasing
USDA Rural Development	USDA02152023	02/15/2023	$1,269.00			Purchasing
USDA Rural Development	USDA02152023	02/15/2023	$9,271.00			Purchasing
Rocky Mountain Power Company	1331	02/23/2023	$5,105.00			Purchasing
Zaharias, Jarry	1332	02/23/2023	$368.20			Purchasing
Rocky Mountain Power Company	RMP02232023	02/23/2023	$1,054.17			Purchasing
Payroll	0224231200	02/24/2023	$1,638.10			Paycheck
Public Employees Health Program	1330	02/24/2023	$566.99			Payroll
Internal Revenue Service	EFTPS0224202	02/24/2023	$493.77			Payroll
Health Equity	HE02242023	02/24/2023	$134.62			Payroll
Utah Retirement Systems	URS02242023	02/24/2023	$374.49			Payroll
ChemTech-Ford Laboratories	1333	02/27/2023	$2,013.00			Purchasing
ChemTech-Ford Laboratories	1335	02/28/2023	$330.00			Purchasing
			$44,564.55		**$4,711.46**	

Big Plains Water Special Service District

Operational Budget Report

51 Big Plains Water & Sewer SSD - 07/01/2022 to 02/28/2023

66.67% of the fiscal year has expired

	Prior YTD	Current Month	Current YTD	Annual Budget	Percent Used
Income or Expense					
Income From Operations:					
Operating income					
5140 Water Sales	237,722.73	24,583.37	220,481.03	378,000.00	58.33%
5150 Water Standby Fees	28,830.82	2,922.50	24,800.26	34,840.00	71.18%
5310 Connection Fees	8,230.00	0.00	5,030.00	9,000.00	55.89%
5410 Late Penalties and Fees	0.00	318.98	2,523.30	15,000.00	16.82%
5490 Other Operating Income	150.00	1,279.70	111,324.45	2,250.00	4,947.75%
Total Operating income	**274,933.55**	**29,104.55**	**364,159.04**	**439,090.00**	**82.93%**
Operating expense					
6010 Clerical Contractor Labor	(5,660.08)	0.00	0.00	0.00	0.00%
6011 Town Interlocal Agreement Costs	0.00	0.00	5,646.96	15,336.00	36.82%
6013 Water Salaries and Wages	37,494.07	4,168.00	35,428.00	55,000.00	64.41%
6014 Water Benefits	27,634.68	1,884.36	15,274.83	37,051.00	41.23%
6016 Admin Benefits	4.50	0.00	0.00	0.00	0.00%
6021 Public Postings	0.00	0.00	0.00	400.00	0.00%
6023 Travel	0.00	(2,565.40)	0.00	800.00	0.00%
6024 Training	0.00	0.00	295.00	700.00	42.14%
6025 Books/Subscriptions/Memberships	2,068.00	0.00	2,177.00	2,800.00	77.75%
6030 Admin Supplies and Expenses	2,900.52	749.41	3,689.13	3,500.00	105.40%
6032 Postage	238.25	8.10	91.03	700.00	13.00%
6035 Bank Service Charges	69.39	0.00	0.00	100.00	0.00%
6040 Professional Service	(18,670.41)	7,025.00	39,433.95	7,500.00	525.79%
6043 Accounting & Audit Fees	7,300.00	2,500.00	11,200.00	12,000.00	93.33%
6044 Water Testing	5,134.00	2,689.43	5,594.09	7,800.00	71.72%
6045 Legal Fees	0.00	950.00	11,742.85	7,500.00	156.57%
6050 System Maintenance and Repairs	(775.80)	368.20	9,450.47	7,500.00	126.01%
6051 System Equipment	3,225.12	4,468.55	10,833.40	11,100.00	97.60%
6052 Well Maintenance and Repairs	3.20	2,409.54	26,168.04	7,500.00	348.91%
6053 Tank Maintenance and Repairs	48.85	0.00	1,251.72	11,500.00	10.88%
6060 Equipment Costs other than Fuel	3,157.43	845.95	2,844.68	3,500.00	81.28%
6061 Equipment Fuel	1,695.90	2,565.40	4,948.19	3,500.00	141.38%
6067 Utilities	16,844.92	6,159.17	16,440.26	24,200.00	67.93%
6070 Insurance	2,890.08	0.00	5,907.41	5,000.00	118.15%
6095 Depreciation Expense	90,042.80	11,255.35	90,042.80	135,065.00	66.67%
Total Operating expense	**175,645.42**	**45,481.06**	**298,459.81**	**360,052.00**	**82.89%**
Total Income From Operations:	**99,288.13**	**(16,376.51)**	**65,699.23**	**79,038.00**	**83.12%**
Non-Operating Items:					
Non-operating income					
5510 Grants	0.00	0.00	0.00	1,140,000.00	0.00%
5520 Impact Fees	39,976.00	0.00	22,894.09	120,000.00	19.08%
5610 Interest Income	228.53	635.46	4,704.69	500.00	940.94%
5690 Sundry Revenue	0.00	(29.00)	(29.00)	100.00	-29.00%
Total Non-operating income	**40,204.53**	**606.46**	**27,569.78**	**1,260,600.00**	**2.19%**
Non-operating expense					
6080 Interest Expense	61,316.60	7,112.39	53,907.02	85,528.00	63.03%
Total Non-operating expense	**61,316.60**	**7,112.39**	**53,907.02**	**85,528.00**	**63.03%**
Total Non-Operating Items:	**(21,112.07)**	**(6,505.93)**	**(26,337.24)**	**1,175,072.00**	**-2.24%**
Total Income or Expense	**78,176.06**	**(22,882.44)**	**39,361.99**	**1,254,110.00**	**3.14%**

BIG PLAINS WATER SPECIAL SERVICE DISTRICT MEETING

BOARD OF DIRECTORS, REGULAR MEETING
1777 N Meadowlark Dr, Apple Valley
Wednesday, February 08, 2023 at 6:00 PM

MINUTES

Chairman| Andy McGinnis
Board Members| Frank Lindhardt | Harold Merritt | Ross Gregerson | Jarry Zaharias |

CALL TO ORDER- Co-Chairman Harold Merritt called the meeting to order at 6:00 p.m.
PLEDGE OF ALLEGIANCE
ROLL CALL
PRESENT
Board Member Frank Lindhardt
Board Member Harold Merritt
Board Member Ross Gregerson
ABSENT
Chairman Andy McGinnis
Board Member Jarry Zaharias

DECLARATION OF CONFLICTS OF INTEREST

None declared.

CONSENT AGENDA

1. Disbursement Listing for January 2023.

   Board Member Gregerson asked about the Galloway payment and if we have been holding that payment for a couple of months. Town Administrator Jauna McGinnis confirmed we have been holding back for a couple of months now.

   MOTION: Board Member Gregerson motioned that we approve the January 1st to January 31st Disbursement Listing.
   SECOND: The motion was seconded by Board Member Lindhardt.
   VOTE: Co-Chairman Merritt called for a vote:

   Co-Chairman | Board Member Merritt - Aye
   Board Member Gregerson - Aye
   Board Member Lindhardt - Aye
   Board Member Zaharias - Absent
   Chairman McGinnis - Absent

   The vote was unanimous and the motion carried.

2. Budget Report for Fiscal Year 2023 through January 2023.

MINUTES

Board Member Lindhardt asked what the other income was for on the $104,000. Town Administrator Jauna McGinnis answered on line 99888 that was the ARPA funds that were transferred over from the Town.

MOTION: Board Member Lindhardt motioned that we approve the Operational Budget for July 1, 2022 to 1/31/2023.
SECOND: The motion was seconded by Board Member Gregerson.
VOTE: Co-Chairman| Board Member Merritt called for a vote:

Co-Chairman | Board Member Merritt - Aye
Board Member Gregerson - Aye
Board Member Lindhardt - Aye
Board Member Zaharias - Absent
Chairman McGinnis - Absent

The vote was unanimous and the motion carried.

APPROVAL OF MINUTES

3. Minutes: January 11, 2023.

MOTION: Board Member Lindhardt motioned that we approve the minutes for January 11, 2023.
SECOND: The motion was seconded by Board Member Gregerson.
VOTE: Co-Chairman Merritt called for a vote:

Co-Chairman | Board Member Merritt - Aye
Board Member Gregerson - Aye
Board Member Lindhardt- Aye
Board Member Zaharias - Absent
Chairman McGinnis - Absent

The vote was unanimous and the motion carried.

WATER SUPERINTENDENT | CHAIRMAN REPORT

MINUTES

Co-Chairman Merritt excused Water Superintendent due to being ill. He continued that he would fill us in on a few things that they have been working on. On Well 59 water samples were sent again yesterday. On Rock Well work will begin on Monday sending samples. Board Member Lindhardt asked for the Rock Well is it the first time we are sending samples. Co-Chairman Merritt answered for the Rock Well yes. Board Member Gregerson asked Board Member Lindhardt if it would be ok to pick up his personal generator on Monday because we should have the bottles for that. Board Member Lindhardt answered yes and asked how close we are on getting Well 59 back online. He continued to ask what's our number supposed to be and what are we getting. Co-Chairman Merritt commented that he is not aware of the actual parameters but does know we are pumping without any distress at about 50 gallons a minute but we have to have a radium test and that takes two months for the results. He continued, the bottles for the radium test were sent yesterday so in two months we would anticipate a report on that well and be able to put it back online. We scrubbed it, pulled the pump out the had a sand trap, and it was felt that contaminants in the bottom of the well was from the sand trap.

Board Member Lindhardt commented that he went to a meeting in Hildale recently and there was a company present, that he gave the information to Charman McGinnis. This company has come up with something new to keep wells contaminant free. He is wondering if anyone has been able to contact them yet and if not for one of the Board Members that has more expertise in that area, to follow-up and contact the company. He will provide the contact information.

Co-Chairman Merritt commented after scrubbing and cleaning Well 59 if it comes back clean then we are good to goo. If not, we will have to put a scrubbing device to clean it and get it online. He continued if we could get it online within the next couple of months, we can beat summer. If the samples don't come back clean, we will need to get a cleanup device within the next three months. Board Member Lindhardt commented alternatively we could get the Rock Well online. Co-Chairman Merritt answered yes. The Board discussed the Rock Well was test pumped at 100 gallons per minute. Board Member Gregerson commented that he believes Rock Well is going to be our best well. He continued a lot of this radium in individual wells may be bigger problem in the region due to the drought. We are not the only place in the region that is dealing with this issue. The Board discussed ways to solve this and one of them being blending. Rock Well was discussed as being the easy connection running the line down to Cooke Well and tying in. This would enable blending. The Board is going for the cheapest way to solve this issue and have three to four contingency plans that could develop within a week or two. Cooke Well and Jessop Well are both online currently. Board Member Gregerson commented from what the Water Superintendent Dale Harris has relayed the Jessop Well has improved. We were at 17 gallons a minute and we are up to 31 gallons a minute due to maintenance work.

4. January 2023 Water Usage Comparison

Town Administrator Jauna McGinnis clarified the reports in the agenda packet. It is from July 2022 through January 2023. The next one is July 2021 through January 2022. On the comparable accounts

MINUTES

January 2023 and January 2022 all that was pulled into that report was if the accounts had usage in both of those years. All the zero accounts were pulled out. In the total system that's our total overall amount from each of those years. Board Member Lindhardt commented so were up by 731,000 gallons in January compared to last year. Town Administrator answered yes but we put on quite a few homes plus we put on the RV park. She continued our usage is more but we would except that. If you look at the comparable accounts people are still doing some conservation for us because you know were minus 128,000 from last January. The overall usage for the comparable accounts, five million is what we've saved over those last six to seven months. The community is doing an awesome job.

Co- Chairman Merritt commented that he went to a meeting at Washington Conservancy District last week. He continued, on their website they have status on drought level and what they except people to do based on that level. It's a tool that we can use as well. Board Member Lindhardt asked about the Ground Water Study and if it is complete. Co-Chairman Merritt answered yes it is complete. The highpoints of that study are originally there was way more paper water than weight water. They didn't go into what they planned to do but openly stated that is an issue. In St George and surrounding areas, they have reservoirs and other surface water. We don't have anything to recharge our aquifer in Apple Valley. The Board discussed that current homeowners have vested interest. We need to stay on top of it and to not allow any more development that would compromise the people already here. The Board also discussed agricultural (ag) water and that is something that is different than municipal water. The Board discussed different options that could be done possibly with the ag water and one was putting their money in municipal category water bank. It should be opened to everybody in a form that everyone understands it. If anyone has a suggestion or idea let's have it.

Board Member Lindhardt asked on the status of the water rights study. Co- Chairman Merritt answered it has been sent back to Galloway and Sunrise. Co- Chairman Merritt commented it is critical we get a handle on this and everyone in the community will benefit. For development these numbers are so critical.

Board Member Lindhardt commented from Planning/Town point of view update. Pat Melfi received preliminary plat approval in Canaan for 36 lots. His is coming online. A reliable source informed us that Travis Holm was able to buy previous property back for West Temple subdivision and Crimson Peaks which is the old Desert rose subdivision. The old golf course property we have received an application for zone change that wants to do Cabins, this was presented to the Planning Commission and discussed amongst the Board. Gooseberry Preserve was discussed amongst the Board. Discussed developer to build a tank and run a pipe down to hook onto our system and then we take from tank to property line. Co-Chairman Merritt discussed sewage and Ash Creek will be taking care of that.

ENGINEERING

Co-Chairman Merritt commented that our Engineer isn't here this evening.

BIG PLAINS WATER SPECIAL SERVICE DISTRICT MEETING

BOARD OF DIRECTORS, REGULAR MEETING
1777 N Meadowlark Dr, Apple Valley
Wednesday, February 08, 2023 at 6:00 PM

MINUTES

REQUEST FOR A CLOSED SESSION

No request.

ADJOURNMENT

MOTION: Board Member Gregerson motioned to adjourn the meeting.
SECOND: The motion was seconded by Board Member Lindhardt.
VOTE: Co-Chairman Merritt called for a vote:

Co-Chairman | Board Member Merritt - Aye
Board Member Gregerson – Aye
Board Member Lindhardt- Aye
Board Member Zaharias – Absent
Chairman McGinnis - Absent

The vote was unanimous and the motion carried.

Meeting adjourned at 6:55 p.m.

Date Approved: _____

Approved BY: _____
Chairman | Andy McGinnis

Attest BY: _____
Town Clerk/Recorder | Jenna Vizcardo

SPECIAL WORK MEETING - BIG PLAINS WATER SPECIAL SERVICE DISTRICT

BOARD OF DIRECTORS, REGULAR MEETING
1777 N Meadowlark Dr, Apple Valley
Thursday, February 16, 2023 at 9:00 AM

MINUTES

Chairman| Andy McGinnis
Board Members| Frank Lindhardt | Harrold Merritt | Ross Gregerson | Jarry Zaharias |

CALL TO ORDER- Chairman McGinnis called the meeting to order at 9:01 a.m.
ROLL CALL
PRESENT
Chairman Andy McGinnis
Board Member Frank Lindhardt
Board Member Harold Merritt
ABSENT
Board Member Ross Gregerson
Board Member Jarry Zaharias

STAFF MEMBERS PRESENT
District Attorney Ben Ruesch (via online-zoom)
Water Superintendent Dale Harris
Recorder Jenna Vizcardo

OTHERS PRESENT
Kendra Webb (Kenstal LLC)
Attorney for Kendra Webb (Kenstal LLC) Kimball Forbes

DECLARATION OF CONFLICTS OF INTEREST

None declared.

DISCUSSION

1. Discussion of request to sublease BLM/Wilderness leased agreement - Spring#1 and #2. Applicant: Kenstal LLC.

   The Board members present as well as the others present discussed the request to sublease BLM/Wilderness leased agreement - Spring#1 and #2. It was discussed amongst to not pursue sublease request. No action was taken.

SPECIAL WORK MEETING - BIG PLAINS WATER SPECIAL SERVICE DISTRICT

BOARD OF DIRECTORS, REGULAR MEETING
1777 N Meadowlark Dr, Apple Valley
Thursday, February 16, 2023 at 9:00 AM

MINUTES

ADJOURNMENT

MOTION: Board Member Merritt motioned to adjourn the meeting.
SECOND: The motion was seconded by Board Member Lindhardt.
VOTE: Chairman McGinnis called for a vote:

Board Member Merritt - Aye
Board Member Lindhardt- Aye
Chairman McGinnis – Aye
Board Member Gregerson - Absent
Board Member Zaharias - Absent

The vote was unanimous and the motion carried.

The meeting was adjourned at 10:31 a.m.

Date Approved: _____

Approved BY: _____
Chairman | Andy McGinnis

Attest BY: _____
Recorder | Jenna Vizcardo

REQUEST FOR PROPOSALS

District Engineering Services

Issue Date:

February 13, 2023

Qualification Due Date and Time:

THURSDAY, March 9, 2023 3:00 pm (Mountain Time)

Mailing/Delivery Address:

1777 N Meadowlark Drive
Apple Valley, UT 84737

Contact:

Andy McGinnis, Chairman 435-877-1194 amcginnis@applevalleyut.gov
Jenna Vizcardo, Clerk 435-877-1190 clerk@applevalleyut.gov (clerical questions only)

DESCRIPTION

Big Plains Water Special Service District ("District") is requesting proposals from qualified engineering firms who are well-versed with water engineering services related to a water district. Responders should be qualified to provide the type of general engineering services common to Utah districts, i.e., grants, bids, impact fee studies, aquifer studies, water rights segregation and classification, and banking, water system design, etc.

ABOUT THE DISTRICT

The District was formed in 2012 to provide water services to all of Apple Valley. Currently it manages three (3) separate systems. It intends to connect all of these systems together in the near future.

The District is governed by a Board of five Directors and has one employee. The majority of operating funds for the District comes from user fees with a current operating budget of $440,000. The District utilizes grants from the USDA and the State of Utah to assist in the funding of capital projects.

DISTRICT LOCATION

The District covers the complete boundary of Apple Valley, an area approximately 39.74 square miles and a population of 894. It is located twelve (12) miles south of Hurricane, Utah along SR-59. Currently we serve 430 water connections with 63 connections on standby.

GENERAL CONDITIONS

- Preference will be given to those firms with extensive water engineering experience.
- The District reserves the right to withdraw this RFP at any time without prior notice and reject any and all proposals submitted without indicating any reasons. Any award of contract for services shall be made to the firm best qualified and responsive in the opinion of the District.
- Proposals may, at the District's option, be rejected if they contain any alterations, additions, conditional or alternatives, are incomplete, or contain erasures or irregularities of any kind.
- The District expressly reserves the right to postpone submittal opening for its convenience.
- The proposal will be opened publicly.
- The selected firm must agree to indemnify and hold harmless the District, its officers, agents and assigns from any liability or loss resulting from suits, claims, or actions brought against the District which result directly or indirectly from the wrongful or negligent actions of the consultant or company in the performance of the contract.
- The selected firm will be required to comply with all existing State and Federal labor laws including those applicable to equal opportunity employment provisions.
- The District reserves the right to negotiate special requirements and proposed service levels using the selected proposal as a basis.
- All responses to this RFP shall become the property of the District and will be retained or disposed of accordingly.

- No amendments, additions or alternates shall be accepted after the submission date and time.
- All documents, records, designs and specifications developed by the selected firm in the course of providing services for the District shall be the property of the District.
- Anything considered to be proprietary should be designated by the firm.
- Acceptance by the District of any proposal submitted pursuant to this RFP shall not constitute any implied intent to enter into a contract for services.
- The District reserves the right to issue a written notice in the same manner as the original notice of any change in the proposal requirements or submission schedule should the District determine, in its sole discretion, that such changes are necessary.
- All services provided by the firm shall be in accordance with Federal, State, County, and District standards.

NATURE OF SERVICES

The District wishes to retain a qualified consulting engineer to provide the District services as District Engineer.

District Engineer Functions

- Manages all aspects of engineering for the District.
- Reviews all matters pertaining to engineering to ensure that undertakings proposed and implemented by the District and others are done in a manner that protects the District's interests, and are in keeping with District goals, specifications and practices as well as with local, state and federal laws.
- Assist in planning, coordinating, supervising and evaluating programs, plans, services, equipment and infrastructure.
- Evaluates the District's needs and formulates short- and long-range plans to meet needs in all areas of improvements.
- Provides engineering services on projects.
- Reviews construction plans for development for consistency with District-adopted engineering specifications, District policies and relevant laws, rules and regulations and ensures Board actions are implements.
- Makes presentations to the public and the District Board.
- Is available to meet with developers to handle matters dealing with the engineering functions of the District.
- Maintains engineering records and maps required to ensure accurate information is available to the District and public.
- Prepare reports, investigations, studies and evaluations as, from time to time, may be required and directed by the District Chairman or Designee.
- Perform other engineering-related functions as directed by the District Chairman or Designee.
- Advise the District as to engineering and construction financing available to the District and prepare and initiate applications for funding.

- Prepares capital improvement projects, improvement plans, specifications, bid documents and public improvement project management.
- Solicit proposals for capital improvement project design work.
- Review and evaluation of bid submittals.
- Provide construction observation and management during the course of District projects. Act as Resident Engineer. Assist with inspection, approval of payments, cost estimating, filing of notices and other related tasks.
- Coordinate activities with other departments and outside agencies to obtain various approvals an agreements such as environmental clearances, permits, land acquisitions and rights-of-way for assigned engineering projects.

Development Review Function

- Review proposed improvements and land developments and provide recommendations as to engineering matters to ensure conformance with District standards and policies.
- Establish performance, labor and material bond amounts when required and ensure the posting of such bonds with the proper time sequence of such development control.
- Provide necessary and related functions as the normal practice of a District engineer.

Federally Funded Capital Projects Engineering Services

- Design bidding, construction review/inspection and federal aid administration services required to complete the federally funded projects in conformance with bid requirements and subject to State and Federal regulations and law.

PROPOSAL REQUIREMENTS AND CONTENTS

Proposals submitted for this project are to follow the outline describe below and must address all requested information. Any additional information that the firm wishes to include that is not specifically requested should be included in an appendix to the proposal. Firms are encouraged to keep the proposals brief and to the point, but sufficiently detailed to allow evaluation of the proposal approach. **SEVEN** (7) copies of the proposal must be submitted.

SECTION 1 OVERVIEW OF FIRM

Provide a narrative description of your firm and your firm's experience with the following:

- As it relates to public entities.
- Grant identification, application, success, and management.
- The firm's familiarity with our area.
- Water projects.
- Funding agencies such as United States Department of Agriculture (USDA), Community Development Block Grants (CDBG, etc. and Firm's success in acquiring funding from each agency.
- Identify any unique approaches or strengths that your firm may have related to the provision of District Engineer services.

SECTION 2 DISTRICT ENGINEER TEAM

A District engineer shall be identified and associated responsible personnel should also be identified. A project team organization diagram and a brief resume of each team member shall be included. Any sub-consultants should be listed. Full resumes may be included in an appendix.

Include client names, addresses and telephone numbers for the District to check references.

SECTION 3 CONFLICTS OF INTEREST

Firms must disclose any actual, apparent, direct or indirect, or potential conflicts of interest that may exist with respect to the firm, management, or employees of the firm or other persons relative to the services to be provided under the agreement for engineering services to be awarded pursuant to this RFP.

SECTION 4 PROPRIETARY INFORMATION

Firms must provide a statement that nothing contained in the submitted proposal will be proprietary. All proposals shall become the property of the District once submitted.

SECTION 5 INSURANCE AND OTHER REQUIREMENTS

The District will require the individual or engineering firm selected to maintain general liability, automobile, workers' compensation, and errors and omissions insurance. The contract will contain provisions requiring the selected firm to indemnify the District and provide that the District Engineer is an independent contractor serving at the will of the District. Other required provisions will include the District's right to terminate the agreement, at its sole discretion, upon the provision of notice.

SECTION 6 COMPENSATION

The proposal shall incorporate by reference a detailed compensation proposal for services. Describe how the firm intends to provide engineering services on either an hourly or flat rate and any proposal related to a retainer agreement. Define what type(s) of work considered to be extra or specialized work that would be billed in addition to basic services. State the hourly rates for the designated District engineer and associates for general work and specialized services. Define the type and unit rates for reimbursement for expenses such as mileage, reproduction of documents, faxed documents and word processing charges. The firm shall indicate the minimum increment of time billed for each service including phone calls, correspondence and personal conferences.

SECTION 7 SIGNATURE AND ACCEPTANCE OF CONDITIONS

The proposal shall be signed by an official authorized to bind the consulting firm and shall expressly state the proposal is valid for 90 days. Additionally, this section will be a statement offering the firm's acceptance of all conditions listed in the Request for Proposal document. Any exceptions or suggested changes to the RFP of any contractual obligations, including the suggested change, the reasons therefore and the impact it may have on cost or other considerations on the firm's behalf must be stated in the proposal. Unless specifically noted by the firm, the District will assume that the proposal is in compliance with all aspects of the RFP.

PROPOSAL DEADLINES

March 9, 2023 Due date for Proposals (allows 4 weeks for interested firms to respond)

March 15, 2023 Opening of bids in regular meeting and possible award of contract by the Board

March 15, 2023 Contract start date for services, unless determined otherwise at meeting

SEVEN (7) COPIES OF THE PROPOSAL IN A SEALED ENVELOPE MUST BE SUBMITTED TO THE DISTRICT OFFICE AT THE ADDRESS BELOW BY: 3:00 p.m. on Thursday, March 9, 2023

SUBMIT PROPOSALS TO:

Big Plains Water Special Service District
ATTN: Jenna Vizcardo, Recorder
1777 N. Meadowlark Dr
Apple Valley, UT 84737

Inquiries concerning this RFP should be addressed to Andy McGinnis, Chairman at 435-877-1194 or amcginnis@applevalleyut.gov

PROPOSAL TERMS AND CONDITIONS

The District will not pay any costs incurred by the firm in preparing or submitting the proposal. The District reserves the right to modify or cancel, in part or in its entirety, this RFP. The District reserves the right to reject any or all proposals, to waive defects, irregularities, or informalities, and to offer to contract with any firm in response to any RFP. This RFP does not constitute any form of offer to contract.

During the evaluation process, the District reserves the right, where it may serve the District's best interest, to request additional information or clarification from proposers, or to allow corrections of errors or omissions. At the discretion of the District, firms submitting proposals may be requested to make oral presentations as part of the evaluation process.

The District reserves the right to retain all proposals submitted and to use any idea(s) in the proposal regardless of whether that proposal is selected. Submission of a proposal indicates acceptance by the firm of the conditions contained in the request for proposals and of the Districts standards terms and conditions for professional services, unless clearly and specifically noted in the proposal submitted and confirmed in the contract between the District and the firm selected.

RIGHT OF REFUSAL

The District reserves the right to reject any and all proposals without cause. Proposals will be evaluated in their entirety. The District reserves the right to negotiate specific requirements and costs using the selected proposal as a basis.

SELECTION PROCEDURES

Written proposals submitted by the deadline will be evaluated based upon qualifications, experience, ability to perform, and understanding of specific services to be provided. **The proposing firm must be represented at the March 15, 2023 meeting.**

In reviewing the proposals for ranking, the District will carefully weight the following:

- The firm's approach to and understanding of the Scope of Work;
- Previous District experience with the proposing firm, if any and familiarity with Apple Valley and the District;
- The firm's experience with similar contracts and clients;
- The experience and qualifications of the proposed staff in providing similar services;
- The firm's demonstrated ability to deliver work on time and within budget;
- The extent of involvement by key personnel;
- The extent to which previous clients have found the firm's services acceptable;
- Communication skills;
- Other qualifications/criteria as deemed appropriate.

INTERLOCAL AGREEMENT AMENDMENT FOR USE OF PERSONNEL

THIS AMENDMENT to the INTERLOCAL AGREEMENT FOR USE OF PERSONNEL AND PHYSICAL RESOURCES ("AGREEMENT") dated April 21, 2022 is made and entered effective as of the 15th day of March 2023, by and between the Town of Apple Valley, Utah, a Utah municipal corporation ("Town") and Big Plains Water Special Service District, a Utah special service district ("District").

RECITALS

WHEREAS, the Town, pursuant to Utah law, caused the creation of the District in order to provide for water services within the Town; and

WHEREAS, both the Town and the District are authorized under Utah law to enter into agreements for joint or cooperative action; and

WHEREAS, it is in the best interests of both the Town and the District to operate in an effective and efficient manner for the good of the citizens; and

WHEREAS, an amendment to Section 1 of the Agreement is necessary to accommodate the use of personnel other than administrative;

AGREEMENT

NOW THEREFORE, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows to amend section 1 to include the following paragraph:

USE OF TOWN PERSONNEL OTHER THAN ADMINISTRATIVE

> For personnel other than administrative, the District agrees to pay the actual cost incurred by the employees utilized for District labor. The Town employees shall keep a record of hours worked for the District, which shall be reimbursed by the District on a quarterly basis at actual rate of pay plus payroll taxes of 7.85%.

All other sections shall remain as written.

IN WITNESS WHEREOF, the parties hereto have caused this Amendment to the Agreement to be executed on the date set forth above to be effective as of the effective date set forth above.

[Signature Block on Next Page]

TOWN

Frank Lindhardt, Mayor

ATTEST:

Jenna Vizcardo, Town Clerk

DISTRICT

Andy McGinnis, Chairman

BIG PLAINS WATER SPECIAL SERVICE DISTRICT

RESOLUTION NO. BPW-R-2023-01

A RESOLUTION APPROVING THE AMENDMENT TO THE INTERLOCAL AGREEMENT FOR USE OF PERSONNEL AND PHYSICAL RESOURCES (AGREEMENT) BETWEEN BIG PLAINS WATER SPECIAL SERVICES DISTRICT AND THE TOWN OF APPLE VALLEY AND AUTHORIZING THE CHAIRMAN TO EXECUTE AN AMENDMENT TO THE AGREEMENT BETWEEN SAID DISTRICT AND SAID TOWN OF APPLE VALLEY

WHEREAS, the Town, pursuant to Utah law, caused the creation of the District in order to provide for water services within the Town; and

WHEREAS, both the Town and the District are authorized under Utah law to enter into agreements for joint or cooperative action; and

WHEREAS, it is in the best interests of both the Town and the District to operate in an effective and efficient manner for the good of the citizens; and

WHEREAS, an amendment to Section 1 of the Agreement dated April 21, 2022 is necessary to accommodate the use of personnel other than administrative;

NOW, THEREFORE, BE IT HEREBY RESOLVED by the District that the Interlocal Agreement Amendment for Use of Personnel, attached hereto and by this reference incorporated herein, is hereby approved, and the Chairman is hereby authorized to execute said agreement on behalf of the District.

RESOLVED this 15th day of March 2023.

BIG PLAINS WATER SPECIAL SERVICE DISTRICT

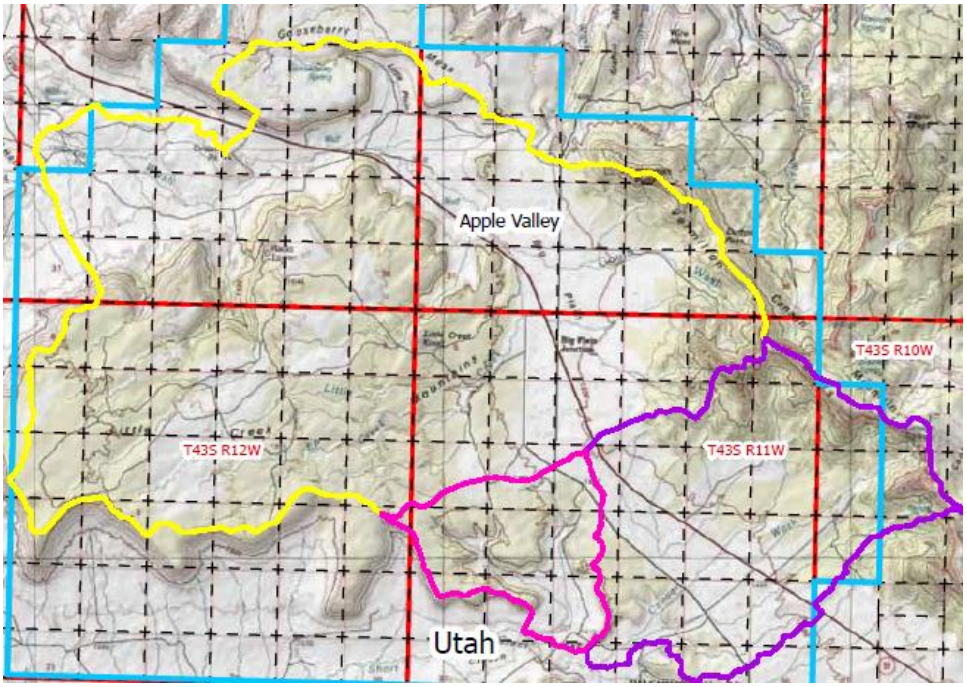
_____
Chairman Andy McGinnis

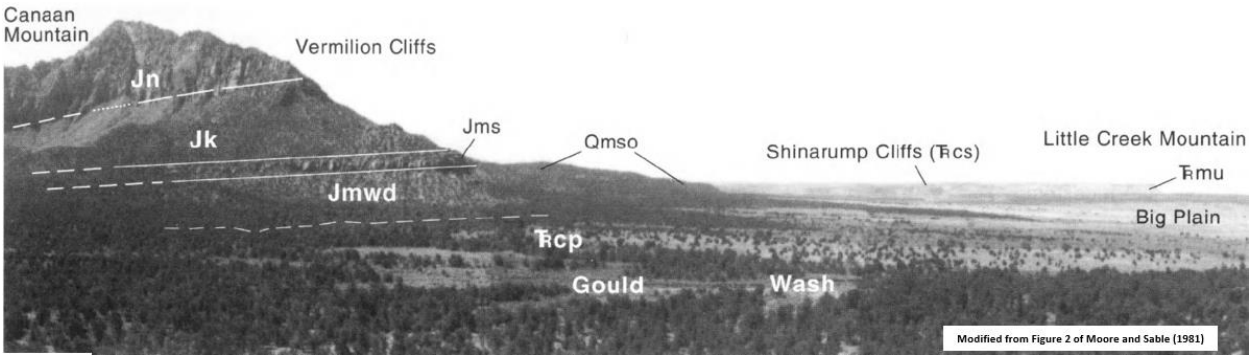
ATTEST:

_____
Jenna Vizcardo, Recorder

	AYE	NAY	ABSENT	ABSTAIN
Chairman | Andy McGinnis	_____	_____	_____	_____
Board Member| Frank Lindhardt	_____	_____	_____	_____
Board Member | Harold Merritt	_____	_____	_____	_____
Board Member | Ross Gregerson	_____	_____	_____	_____
Board Member | Jarry Zaharias	_____	_____	_____	_____

ASSESSMENT OF SUSTAINABLE YIELD
FOR
APPLE VALLEY AREA
FOR
WASHINGTON COUNTY
WATER CONSERVANCY DISTRICT
WASHINGTON COUNTY, UTAH





Prepared by:
Loughlin Water Associates, LLC
3100 Pinebrook Rd, Ste. 1100
Park City, UT 84098
(435) 649-4005

Prepared for:
Washington Co. Water Conservancy Dist.
Attn: Mr. Corey Cram
Associated General Manager
533 E. Waterworks Dr.
St. George, Utah 84770

January 2023

LOUGHLIN
WATER ASSOCIATES LLC

January 14, 2023

Washington County Water Conservancy District
Attn: Mr. Corey Cram
533 E. Waterworks Dr.
St. George, UT 84770

Subject: **Transmittal – Assessment of Sustainable Yield**
Apple Valley Area, Washington County, Utah
For Washington County Water Conservancy District

Dear Corey:

Please find enclosed our assessment of sustainable yield of the Apple Valley area of Washington County, Utah for the Washington County Water Conservancy District (the Water District) dated January 14, 2023. We conducted our assessment in accordance with the Agreement between the Water District and Loughlin Water Associates, LLC (Loughlin Water) dated August 16, 2022.

If you have any questions or need more information, please do not hesitate to call me at (435) 649-4005 (office).

Loughlin Water Associates, LLC

William D. Loughlin, P.G.
Manager, Principal Hydrogeologist

Enclosure: Assessment of Sustainable Yield for Apple Valley Area

Cc: Zach Renstrom, General Manager – Washington Co. Water Conservancy District

3100 W. Pinebrook Road, Ste. 1100 ▲ Park City, Utah 84098
Phone: 435.649.4005 ▲ Fax: 435.649.4085 ▲ Mobile: 435.659.1752 ▲ www.LoughlinWater.com

ASSESSMENT OF SUSTAINABLE YIELD
FOR
APPLE VALLEY AREA
FOR
WASHINGTON COUNTY WATER CONSERVANCY DISTRICT
WASHINGTON COUNTY, UTAH

Prepared for:

Washington County Water Conservancy District
Attn: Corey Cram
Associate General Manager
533 E. Waterworks Dr.
St. George, Utah 84770

Prepared by:

William D. Loughlin, P.G.
Manager, Principal Hydrogeologist

Loughlin Water Associates, LLC
3100 Pinebrook Road, Suite 1100
Park City, Utah 84098
(435) 649-4005
www.LoughlinWater.com

Date: January 14, 2023

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1.0 INTRODUCTION

Apple Valley (the study area) lies along and on both sides of the southeast-to-northwest trending Utah Highway 59, between the communities of Hurricane and Hildale, Utah. The study area includes almost all of Township 43 South, Ranges 12 and 11 West and portions of Township 42 South, Ranges 11 and 12 West, Salt Lake Base & Meridian (SLB&M). Figure 1 is a regional map and Figure 2 is a local map that show the study area. The Town of Apple Valley is the only incorporated community in the study area.

Water supply in Apple Valley is almost entirely from groundwater via wells and springs. Big Plains Special Service District (Big Plains) and the Little Creek Travel Center (Little Creek) are the only active Utah Division of Drinking Water (DDW) Public Water Systems (PWSs). Big Plains includes the Apple Valley, Canaan Springs (Canaan Ranch), and Cedar Point PWSs. Little Creek supplies two convenience stores. Areas not supplied by Big Plains or Little Creek obtain water mostly from individual wells. The Water District does not supply water to the Apple Valley area.

During 2015, Ensign Engineering (Ensign) conducted a study for Big Plains to (1) determine the status of the aquifer(s), (2) estimate recharge to and discharge from the aquifers, and (3) assess the feasibility of drilling new wells. Ensign (2015):

- Estimated total recharge in the study area to be 10,334 acre-feet per year (afy) and total discharge to be 10,651 afy which indicates a potential overdraft (discharge exceeding recharge) of 317 afy.

- Cautioned that there is uncertainty in their estimates of recharge and discharge.

- Concluded that "…*developing sustainable wells in Apple Valley is going to be very difficult because of the stress already on the aquifer.*"

We understand that:

- Appropriated water rights have exceeded groundwater supplies causing groundwater levels to fall in other parts of Washington County.

- There has been and continues to be considerable growth along with the issuing of new water connections and permits to drill new wells in the Apple Valley area.

- The Water District seeks to assess and estimate the sustainable yield of groundwater supplies for comparison with current and estimated future water demand in the Apple Valley area.

2.0 OBJECTIVE AND APPROACH

To assess and estimate the sustainable yield of groundwater supplies for comparison with current and estimated future water demand in the Apple Valley area, we:

- Compiled and assessed publicly available geologic, hydrogeologic, water quality, and water right information;
- Evaluated data and reports provided by the Water District;
- Modified existing geologic cross sections;
- Estimated the potential recharge to area aquifers; and
- Prepared this report to summarize our findings, including our estimate of sustainable yield and provide our recommendations for follow-on aquifer analysis.

Utah Code, Title 73, Water and Irrigation (Utah Water Law), Section 73-5-15, defines *Safe Yield* as "*…the amount of groundwater that can be withdrawn from a groundwater basin over a period of time without exceeding the long-term recharge of the basin or unreasonably affecting the basin's physical and chemical integrity.*" Although Utah Water Law does not define *Sustainable Yield*, *The Glossary of Terms* provided by the Utah Division of Water Rights (DWRi), also known as (aka) the *Utah State Engineer* states "*See Safe Yield*" for the definition of *Sustainable Yield*; see https://www.waterrights.utah.gov/wrinfo/glossary.asp.

Determination of the amount of groundwater that can be withdrawn without unreasonably affecting the physical and chemical integrity of the basin would require a numerical model and considerably more data than are available for the Apple Valley area. As such, for the purpose of this assessment, we define:

- Sustainable Yield as the amount of groundwater that can be withdrawn from the three principal aquifers of Apple Valley on an annual basis without exceeding the long-term recharge and

- The three principal aquifers as the unconsolidated (basin or valley fill) deposits, the basalt flows, and the Shinarump Conglomerate.

3.0 HYDROGEOLOGIC SETTING

The study area lies at the west end of Colorado Plateau physiographic province. The Hurricane Cliffs, located to the west, coincides with the Hurricane fault, which marks the transition between the generally gently dipping (tilting) geologic formations of Colorado Plateau and the complexly folded and faulted geologic units of the Basin and Range physiographic province (Heilweil and others, 2000). The Colorado Plateau has relatively high elevations, and deeply incised drainages.

The study area is at the north end of the Uinkaret plateau which is within the Grand Staircase portion of the Colorado Plateau. Rock layers within the Grand Staircase are

relatively consistent in thickness and extent and dip gently (less than 10 degrees) to the north. The Grand Staircase consists of a step-like sequence of resistant layers that form escarpments (cliffs) and less resistant layers (shale and mudstones) that form valleys.

Local physiographic features within the Apple Valley study area include the Big Plain and Little Plain bajadas, Little Creek Mountain, Gooseberry Mesa, Smithsonian Butte, the Vermillion Cliffs, and Canaan Mountain; see Figure 2. Bates and Jackson (1987) define a bajada as "*A broad continuous alluvial slope or gently inclined detrital surface extending from the base of mountain ranges out into and around an inland basin, formed by the lateral coalescence of a series of separate but confluent alluvial fans, and having an undulating character due to the convexities of the component fans…*"

Elevations rise from about 4800 feet in Big and Little Plain to 5700 feet in the Little Creek and Gooseberry Mountains and as high as 6600 feet on Smithsonian Butte and 7299 feet on Canaan Mountain (Rowley, 2003).

Gould Wash drains the western and northern two thirds and Canaan Wash and an unnamed wash drain the southern and eastern third of the study area. Gould Wash, Canaan Wash, and the unnamed wash are ephemeral drainages within the study area. Canaan Wash and the unnamed wash are tributaries of Short Creek. Gould Wash flows generally to the northwest and joins the Virgin River to the south and west of Hurricane. Gould Wash drains about 60 square miles of the study area. Short Creek flows south into Arizona where it joins Fort Pearce Wash, which flows west and north back into Utah and St. George where it joins the Virgin River. Short Creek (Canaan Wash and the unnamed wash) drains about 23 square miles of the study area.

3.1 GEOLOGY

Moore and Sable (2001), Willis and others (2002), Hayden (2004), and Hayden and Sable (2008) mapped the geology of the Smithsonian Butte, Springdale West, Little Creek Mountain, and Virgin 7.5-minute U.S. Geological Survey (USGS) quadrangle maps, respectively at a scale of 1:24,000. Each of these four 7.5-minute quadrangle maps cover a portion of the study area. The entire study area lies within the St. George 30x60-minute quadrangle, 1:100,000-scale, geologic map of Biek and others (2009). Billingsley and Workman (2000) mapped the Littlefield 30x60-minute quadrangle at a scale of 1:100,000 which covers the area to the south in Arizona.

We modified Figure 3 from the geologic map of Biek and others (2009) and Billingsley and Workman (2000) to illustrate the geology of the study area. Table 1 lists and provides keys and descriptions of the geologic units shown on Figure 3.

TABLE 1
DESCRIPTIONS OF GEOLOGIC UNITS [a]

Formation Name	Geologic Age	Thickness (feet)	Description
Stream Alluvium (Qa,)	Holocene	<100 [b]	Stratified, moderately to well-sorted gravel, sand, silt, and minor clay deposited in river and stream channels and flood plains; includes local small alluvial-fan and colluvial deposits, stream-terrace deposits
Fan Alluvium ($Qaf_{1,2}$, Qafo)	Holocene to Pleistocene	10 to 50	Poorly to moderately sorted, non-stratified, subangular to subrounded, boulder to clay-size sediment deposited at the mouth of streams and washes.
Eolian Sand (Qes, Qeo)	Holocene to upper Pleistocene	<20	Well sorted, fine- to medium-grained, well-rounded, frosted quartz sand; sand is recycled principally from the Navajo Sandstone and Kayenta Formation; locally forms small dunes partly stabilized by vegetation.
Alluvial and Eolian Deposits (Qae)	Holocene to upper Pleistocene	<20	Moderately sorted gravel, sand, and silt deposited in small channels and on alluvial flats, and well-sorted, fine- to medium-grained, reddish-brown eolian sand locally reworked by alluvial processes.
Alluvial and colluvial deposits (Qac, Qaco)	Holocene to upper Pleistocene	<30	Poorly to moderately sorted, generally poorly stratified, clay- to boulder-size, locally derived sediment deposited principally in swales, small drainages, and the upper reaches of large streams by fluvial, slope-wash, and creep processes; gradational with both alluvial and colluvial deposits.
Talus (Qmt)	Holocene to upper Pleistocene	<30	Poorly sorted, angular boulders and finer-grained interstitial sediment deposited principally by rock fall on and at the base of steep slopes; typically grades downslope into colluvial deposits and may include colluvial deposits.
Landslide Deposits (Qms)	Holocene to middle Pleistocene	0 to 100	Poorly sorted, clay- to boulder-size, locally derived material deposited by rotational and translational landslide movement; characterized by hummocky topography and small ponds, numerous internal scarps, and chaotic bedding attitudes.
Little Creek Cinder Cone (Qblcc) and Lava Flow (Qblc)	Middle Pleistocene	15 to 40	Medium-gray, fine-grained basalt to trachybasalt (Qblc) with sparse olivine phenocrysts; erupted from a vent at Gray Knoll cinder cone (Qblcc) and from a series of northwest-trending vents marked by spatter cones on top of Little Creek Mountain.
Gould Wash Cinder Cones (Qbgwc) and Lava Flow (Qbgw)	Middle Pleistocene	20 to 30	Dark-gray, fine-grained basalt (Qbgw) with abundant olivine phenocrysts; erupted from vents at two cinder cones (Qbgwc).
Crater Hill lava Flow (Qbc) and Cinder Cone (Qbcc)	Middle Pleistocene	40 to 80	Medium-gray basalt to trachybasalt (Qbc) with small olivine phenocrysts; erupted from a vent at Crater Hill, which is a large cinder cone (Qbcc) east of Virgin.

Formation Name	Geologic Age	Thickness (feet)	Description
Navajo Sandstone (Jn)	Lower Jurassic	1350	Pale-reddish-orange, reddish-brown, or white, cliff-forming, cross-bedded, quartz sandstone; forms spectacular sheer cliffs, deep canyons, and impressive spires, promontories, and monoliths; consists of well sorted, well-rounded, fine to medium-grained, frosted quartz sand; bedding consists of high-angle, large-scale cross-bedding; locally prominently jointed.
Kayenta Formation (Jk)	Lower Jurassic	550 to 700	Moderate- to dark-reddish-brown, thin- to thick-bedded siltstone, fine-grained sandstone, and mudstone with planar, low-angle, and ripple cross-stratification; contains several thin, light-olive-gray-weathering, light-gray dolomite beds in the lower third of the formation above the Springdale Sandstone; forms steep ledgy slope grading up to ledgy cliffs at top.
Kayenta Formation: Springdale Sandstone Member (Jks)	Lower Jurassic	90 to 150	Medium- to thick-bedded, fine- to medium-grained sandstone with planar and low-angle cross-stratification, and minor, thin, discontinuous lenses of intraformational conglomerate and thin interbeds of moderate-reddish-brown or greenish-gray mudstone and siltstone; contains locally abundant petrified and carbonized fossil plants; forms conspicuous cliffs.
Moenave Formation (JTRm)	Lower Jurassic to Upper Triassic	300 to 340	Consists of two undivided members: Whitmore Point Member and the Dinosaur Canyon Member. The Whitmore Point Member (Lower Jurassic) consists of pale-red-purple, greenish-gray, and blackish-red mudstone and claystone, lesser moderate-reddish-brown, fine-grained sandstone and siltstone, and uncommon dark-yellowish-orange micaceous siltstone. The Dinosaur Canyon Member (Lower Jurassic to Upper Triassic) consists of generally thin-bedded, moderate-reddish-brown and moderate-reddish-orange, fine-grained sandstone, fine-grained silty sandstone, and lesser siltstone and mudstone with planar, low-angle, and ripple cross-stratification.
Chinle Formation: Petrified Forest Member (TRcp)	Upper Triassic	400 to 650	Varicolored, typically gray to purple mudstone, claystone, and siltstone, lesser white to yellow-brown sandstone and pebbly sandstone, and minor chert and nodular limestone; regionally divisible into three parts, in ascending order: (1) the bentonitic Blue Mesa, (2) the pebbly sandstone of the Moss Back or Sonsela (depending on clast provenance), and (3) the bentonitic Painted Desert.
Chinle Formation: Shinarump Conglomerate Member (TRcs)	Upper Triassic	75 to 175	Medium- to coarse-grained sandstone, pebbly sandstone, and lesser pebbly conglomerate, locally with silty sandstone, claystone, and smectite claystone interbeds, that forms prominent cliffs, hogbacks, and mesas; clasts are subrounded chert and quartzite; mostly thick bedded with both planar and low-angle cross-stratification.

Formation Name	Geologic Age	Thickness (feet)	Description
Moenkopi Formation: Upper Red Member (TRmu)	Lower Triassic	200 to 280	Moderate-reddish-orange to moderate-reddish-brown, mostly thin- to medium-bedded siltstone, mudstone, and fine-grained sandstone with planar, low-angle, and ripple cross-stratification; locally contains thin gypsum beds and abundant discordant gypsum stringers and typically forms ledgy slopes.
Moenkopi Formation: Shnabkaib Member (TRms)	Lower Triassic	350 to 500	Forms "*bacon-striped*," ledgy slopes of laminated to thin-bedded, gypsiferous, pale red to moderate-reddish-brown mudstone and siltstone, resistant, white to greenish-gray gypsum, and minor thin, laminated, light-gray dolomite beds; gypsum is present.
Moenkopi Formation: Middle Red Member (TRmm)	Lower Triassic	450 to 550	Interbedded, slope-forming, laminated to thin-bedded, moderate-reddish-brown to moderate-reddish-orange siltstone, mudstone, and fine-grained sandstone with thin interbeds and veinlets of greenish gray to white gypsum; lower part includes several thick gypsum beds.
Moenkopi Formation: Virgin Limestone Member (TRmv)	Lower Triassic	250	Light-gray, light-olive-gray, and yellowish-brown limestone and silty limestone that typically forms three thin, resistant ledges at the base, middle, and top of the member.
Moenkopi Formation: Lower Red Member (TRml)	Lower Triassic	300	Interbedded, slope-forming, laminated to thin-bedded, moderate-reddish-brown mudstone, siltstone, and fine-grained sandstone with local, thin, laminated, light-olive-gray gypsum beds and veinlets.
Moenkopi Formation: Timpoweap Member (TRmt)	Lower Triassic	50 to 180	Lower part consists of light-brown-weathering, light gray to grayish orange, thin- to thick-bedded limestone, and cherty limestone; chert occurs as small, disseminated blebs, thus giving weathered surfaces a rough texture; upper part consists of grayish-orange, thin- to thick-bedded, slightly calcareous, fine-grained sandstone, siltstone, and mudstone.
Kaibab Formation: Harrisburg Member (Pkh)	Lower Permian	350	Thin- to thick-bedded limestone and cherty limestone, and medium- to thick-bedded, laminated gypsum and gypsiferous mudstone.

[a] Descriptions and thicknesses are modified principally from Biek and others (2009) with local variations from Moore and Sable (2001), Willis and others (2002), Hayden (2004), and Hayden and Sable (2008).
[b] Cordova (1981) reports that the unconsolidated deposit aquifer in the study area is 100 to 300 feet thick which is considerably thicker than the less than 100 feet reported by Moore and Sable (2001) and Biek and others (2009).

The Big Plain and Little Plain bajadas consist of coalesced alluvial fans that extend southward from the Vermillion Cliffs and northward from the Little Creek Mountains into the Gould Wash and Short Creek drainages. Figure 4 delineates Gould Wash and the Canaan and Unnamed washes, which are tributaries of the Short Creek drainage. Erosion has removed the Triassic-age (about 200 to 250 million years ago) bedrock and deposited up to about 100 feet of Quaternary-age (younger than about 2.6 million year) unconsolidated sediments within these two drainages.

We modified Figure 5, inserted below, from Figure 2 of Moore and Sable (2001) to show some of the geologic units and related physiographic features of the study area.

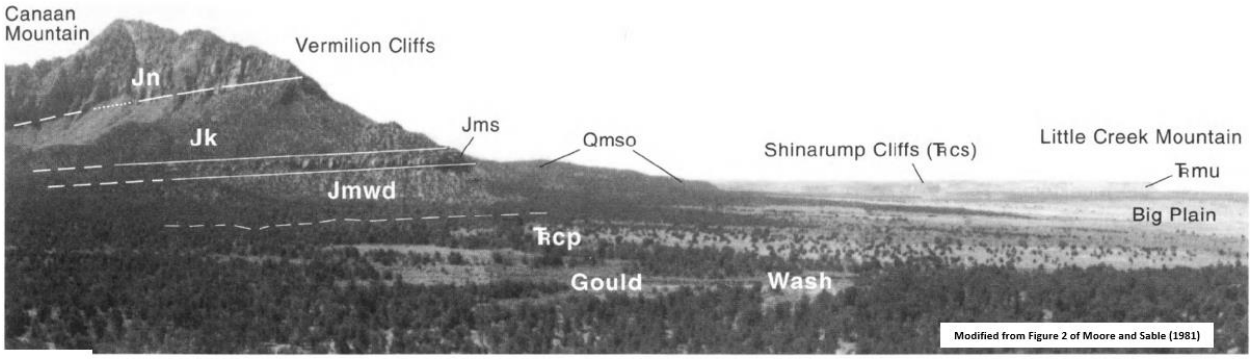

Figure 5. *View south from Smithsonian Butte toward Arizona state line on right skyline. On left, 1,200 feet (366 m) of eroded Jurassic Navajo Sandstone (Jn) caps Canaan Mountain, which is about 2,000 feet (610 m) higher than the plain in middle ground. Units under the Navajo are: Kayenta Formation (Jk), Moenave Formation consisting of the Springdale Sandstone Member (Jms), Whitmore Point and Dinosaur Canyon Members (Jmwd), Triassic Chinle Formation consisting of the easily eroded Petrified Forest Member (Trcp) and resistant Shinarump Member (Trcs), and the upper red member of the Moenkopi Formation (Trmu). The latter forms slopes under the distant Shinarump Cliffs. Some unconsolidated surficial deposits include an old megaslide complex (Qmso), merged alluvial fans (Big Plain), and colluvium and talus (not labeled) on steep slopes.*

Note that there are minor differences between the geologic unit names and symbols used by Moore and Sable (2001) and shown on Figure 5 and those shown on Figure 3 and listed in Table 1.

Rocks exposed in the Apple Valley area consist primarily of Jurassic-age (about 150 to 200 million years ago) and Triassic-age (about 200 to 240 million years ago) sedimentary rocks covered by a thin veneer (less than about 300 feet) of unconsolidated Quaternary alluvial, colluvial, and land slide deposits and eolian (windblown) deposits. Basaltic (lava) flows of Pleistocene age (about 0.01 to 2.6 million years ago) are exposed in the western part of Apple Valley in the Little Creek Mountains and in Gould Wash.

3.2 HYDROGEOLOGY

Cordova and others (1972), Cordova (1978), Sandburg and Sultz (1985), Hurlow (1998), Heilweil and others (2000), Rowley (2003), and Inkenbrandt and others (2013), among other authors, describe the regional groundwater and surface water resources of the area. Rowley (2003) reports that "*There is no permanent surface-water supply, so all water resources are from ground water.*"

3.2.1 Aquifers

The three principal aquifers, in sequence from younger/shallower to older/deeper are the (1) unconsolidated valley-fill (basin-fill) deposits, (2) Little Creek and Gould Wash basalt/lava flows, and (3) Shinarump Conglomerate Member of the Chinle Formation (the Shinarump Conglomerate). The aquifers are formed in layers of permeable sedimentary and igneous strata. The C and R aquifers are present at depths of more than 1600 feet (Inkenbrandt and others, 2013) in the area, but are not included in the principal aquifers because they are deep, have not been developed, and have yields and water quality that are unknown (Rowley, 2003).

We modified Figure 6, inserted below, from Figure 20 of Inkenbrandt and others (2013) to show the relative position of the aquifers in cross section.

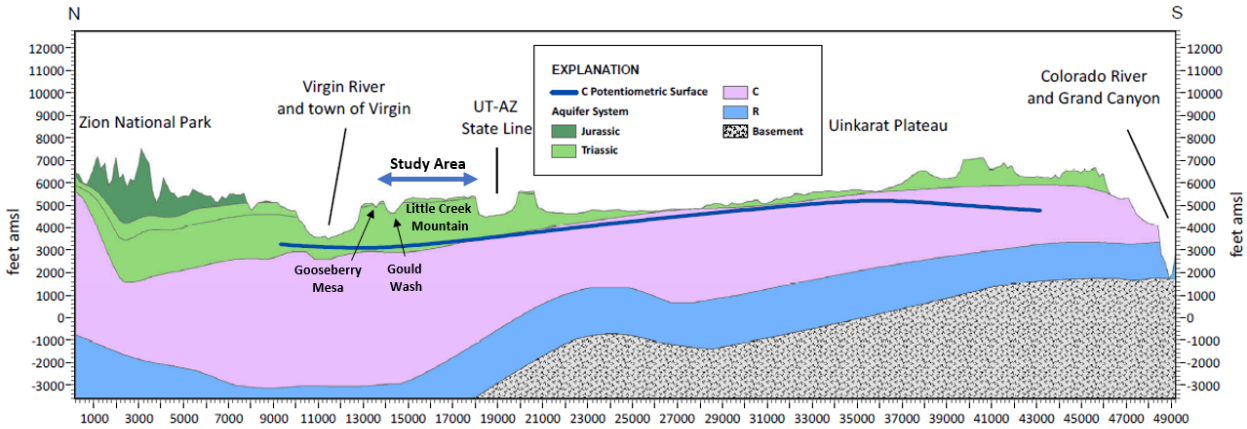

Figure 6. Hydrostratigraphic cross section; modified from Figure 20 of Inkenbrandt and others (2013)

Rowley (2003) reports that (1) most of the water supply is from the "*…unconsolidated alluvial sediments that underlie the broad valley of Gould Wash…,"* (2) permeable, water producing zones within these sediments occur in narrow "*shoestring"* sands that are interbedded with less permeable zones if silt and clay, and (3) these shoestring sands are narrow, irregular in shape and location, and their location is difficult to predict from the surface.

Figure 3 shows that basalt/lava flow (Qbgw and Qblc) and associated cinder cones (Qbgwc and Qblcc) are present overlying (1) the Shinarump Conglomerate in the north central part of Little Creek Mountain and (2) unconsolidated deposits in the western part of the Little Plain area. These volcanic units are buried/overlain by unconsolidated deposits in some areas and, according to Rowley (2003), "*…make excellent aquifers…"* with low total dissolved solids (TDS) concentrations and individual wells producing as much as 800 gallons per minute (gpm).

Well Driller Reports (well logs) available from the DWRi online website and Drinking Water Source Protection (DWSP) plans for area wells that we obtained from the DDW through a Government Records Access and Management Act (GRAMA) indicate that in the Little Plain area, unconsolidated deposits and basalt are interbedded and groundwater comingles in these aquifers.

Figure 3 shows that the Shinarump Conglomerate Member of the Chinle Formation (Shinarump Conglomerate) forms the caprock (resistant erosional surface) of the Little Creek Mountains and Gooseberry Mesa. According to Rowley (2003) wells in the Shinarump Conglomerate can produce as much as 500 gpm; however, Ensign (2015) reports that few wells produce more than 50 gpm. Yields from the Shinarump Conglomerate are greater where the aquifer is thicker (Ensign, 2015). The Shinarump Conglomerate thins from about 150 feet in the eastern part to 40 feet in the western part of the study area.

Table 2 summarizes properties of the principal aquifers.

TABLE 2
HYDROGEOLOGIC PROPERTIES OF PRINCIPAL AQUIFERS [a]

Aquifer	Thickness (feet)	Reported Yields (gpm)	Specific Capacities [b] (gpm/ft)	Transmissivities (ft^2/day)	TDS Concentrations (mg/L)
Unconsolidated Deposits	100 to 300	100 to 600	0.4 to 12	80 to 2700[d]	<1000 to 10,000
Basalt	50 to 150	3 to 800	≤10 to 40[c]	≤200 to 2700[d]	<1000 to 3000
Shinarump Conglomerate	75 to 175	10 to 500	0.3 to 10.5	120 to 6800	<1000 to 3000

ft^2day = feet squared per day; gpm/ft = gallons per minute per foot; TDS = Total Dissolved Solids; mg/L = milligrams per liter.
[a] Except where noted, data are from Cordova (1981), Rowley (2003), Hayden (2004), InSite Engineering, P.C. (2007a, 2007b, 2007c), Inkenbrandt (2013), Ensign (2015), RM² Consultant Engineering (2020), and from Well Driller Reports (well logs).
[b] Specific capacity is pumping rate in gpm divided by drawdown in feet for a specific duration of pumping and typically decreases with increased pumping duration (time since pumping started) and increased pumping rate.
[c] Specific capacity of 40 gpm/ft is from pumping test of Well Identification Number (WIN) 35571.
[d] Transmissivity estimated from pumping test and specific capacity of WIN 8181 using method of Driscoll (1986).

We modified Figure 7, inserted below, from Figure 20 of Inkenbrandt and others (2013) to show the relative position of the three principal aquifers.

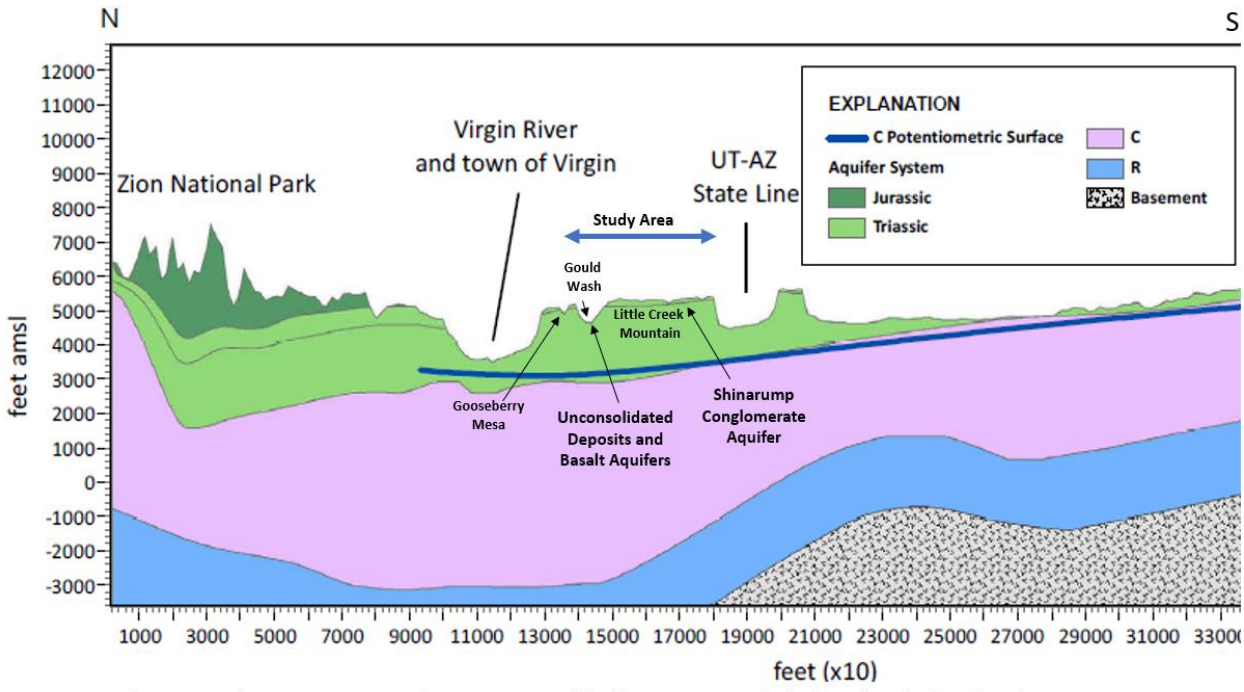

Figure 7. Hydrostratigraphic cross section, northern portion; modified from Figure 20 of Inkenbrandt and others (2013)

The Shinarump Conglomerate is part of the larger "*Triassic Aquifer System*" described by Inkenbrandt and others (2013). The lower part of the Triassic Aquifer System consists of the Moenkopi Formation which contains abundant gypsum beds and poor quality (high TDS) groundwater; see Rowley (2003) and Inkenbrandt and others (2013).

We modified the Figure 8, inserted below, from Figure 7 of Inkenbrandt and others (2013) to illustrate the stratigraphic position of the Shinarump Conglomerate relative to underlying aquifers, including the Moenkopi Formation and the "*C*" and "*R*" aquifers.

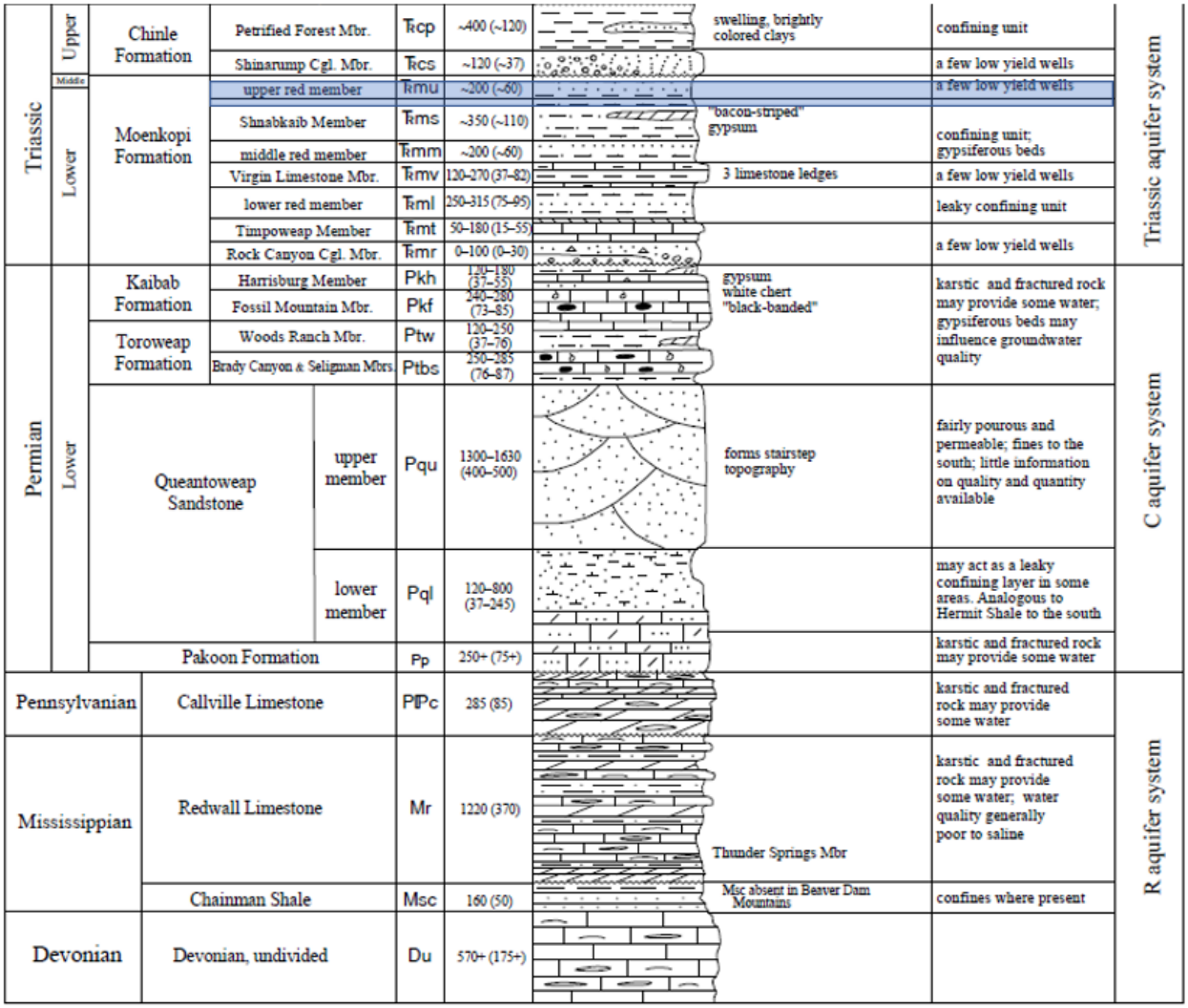

Figure 8. Stratigraphic column; modified from Figure 7 of Inkenbrandt and others (2013)

The C aquifer consists of the Lower Permian-age (about 250 to 300 million years ago) Kaibab Formation, Toroweap Formation Queantoweap Sandstone, and Pakoon Limestone. We do not include the C aquifer in our assessment of sustainable yield of the study area because (1) the top of the aquifer occurs below an elevation of 3000 to 1600 feet (depth of 1600 to 2000 feet), (2) TDS concentrations are likely high to the presence of highly soluble gypsum beds, and (3) we did find records any area wells completed in the C aquifer.

The R aquifer underlies the C aquifer and consists of the Pennsylvanian-age (300 to 320 million years ago), Mississippian-age (about 320 to 360 million years ago) Callville and Redwall limestones, and undivided Devonian-age (about 360 to 420 million years ago) carbonate rocks.

3.2.2 Groundwater Flow

Figure 9, inserted below, is modified from Plate 1 of Cordova (1981) to illustrate the direction of groundwater flow in the unconsolidated deposits aquifer. Figure 9 shows that the direction of groundwater flow in the unconsolidated deposits is to the northwest and west, toward the Hurricane Cliffs, and approximately follows Gould Wash.

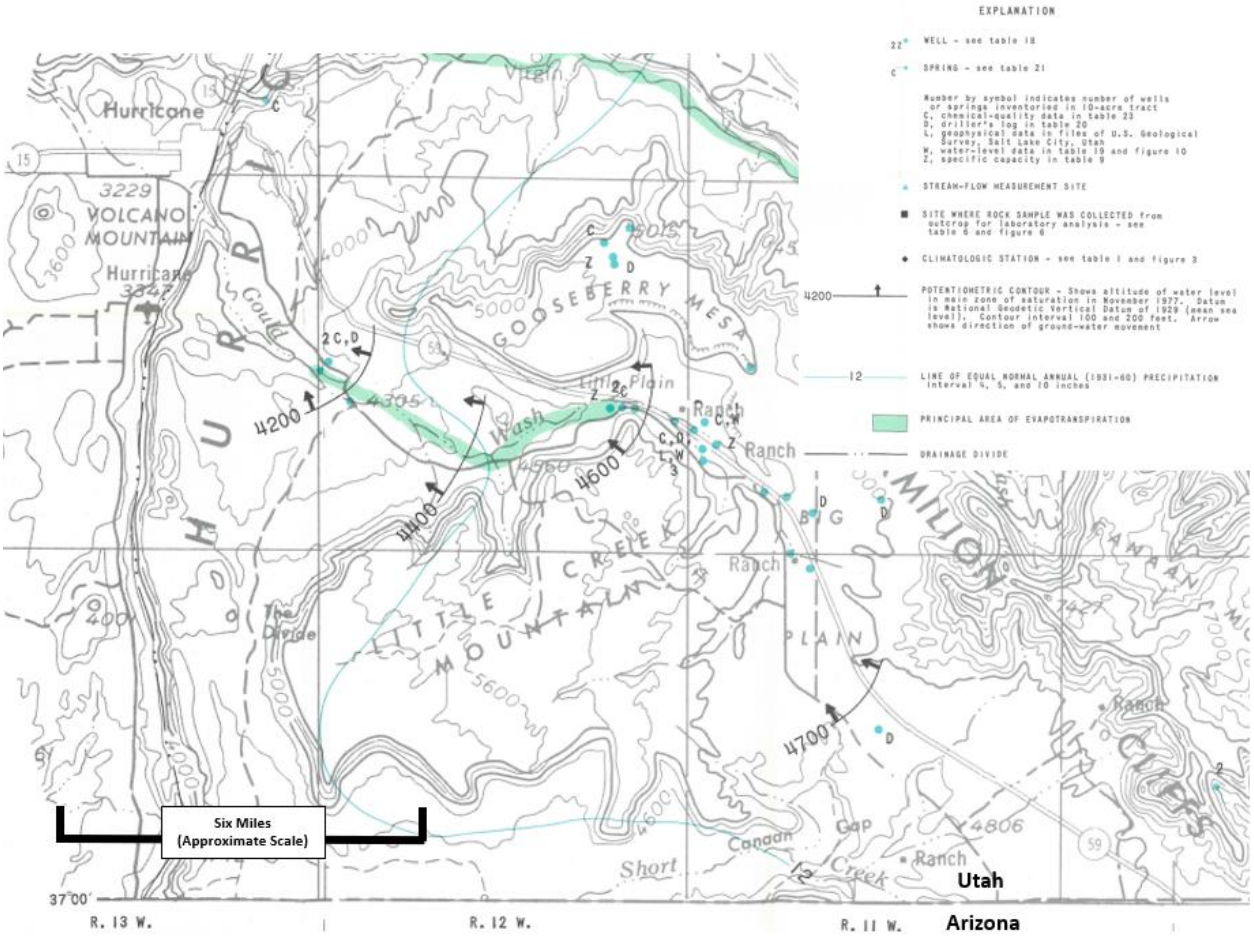

Figure 9. Potentiometric surface in unconsolidated deposits aquifer; modified from Plate 1 of Cordova (1981)

We did not find published water level elevation or flow direction data or maps for the basalt aquifer; however, Ensign (2015) reports and we concur from our review of well logs and DWSP plans for area wells that this aquifer is interbedded and in hydraulic connection with the unconsolidated deposits and has similar groundwater flow directions.

Figure 10, inserted below, is modified from Figure 13 of Inkenbrandt and others (2013) to show the direction of groundwater flow in the Triassic-age rocks, which includes the Shinarump Conglomerate aquifer. Figure 10 shows that groundwater flow in the Shinarump Conglomerate aquifer within (1) most of the study area is approximately west and northwest, towards the Hurricane Cliffs, (2) the southern part of the study area is generally towards the south, towards Arizona, and (3) the Gooseberry Mesa is mostly northward toward the Virgin River and away from the study area.

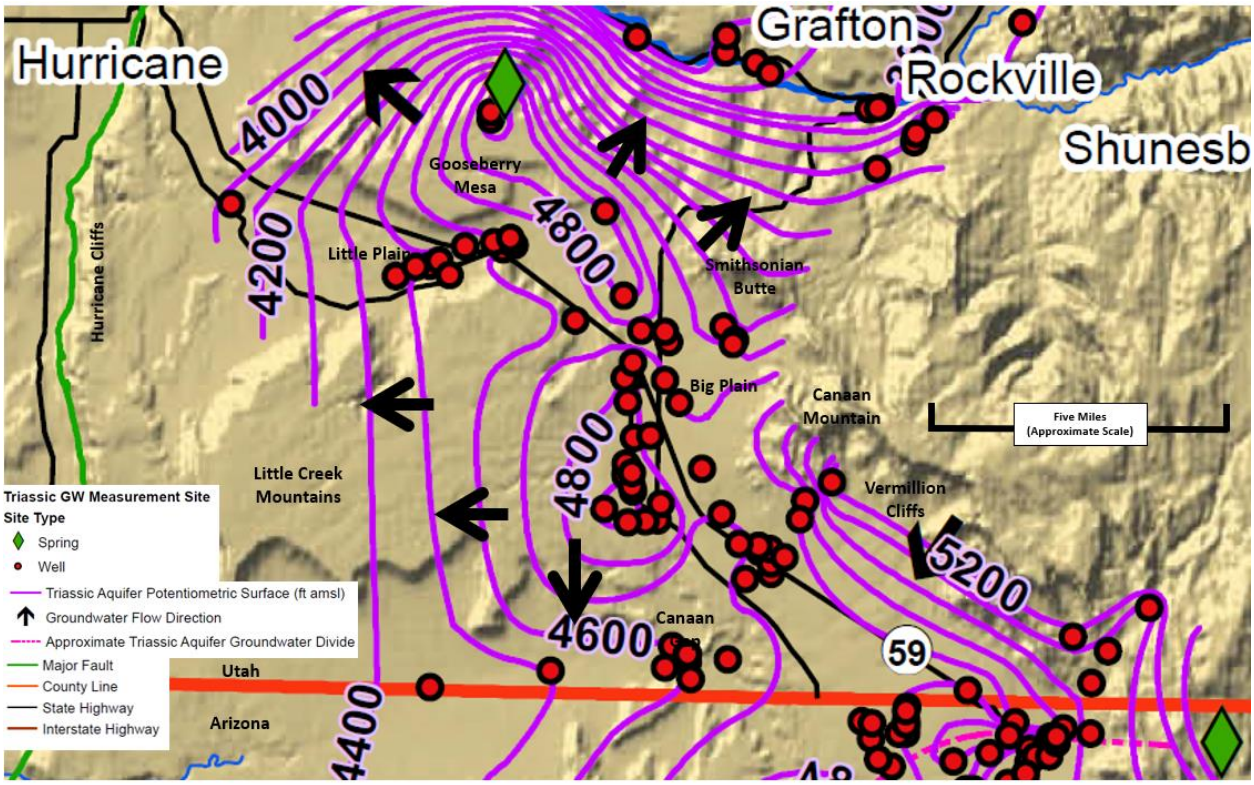

Figure 10. Potentiometric surface in Triassic-age aquifers; modified from Figure 13 of Inkenbrandt and others (2013)

The geologic map on Figure 3 shows that erosion has removed the Shinarump Conglomerate from the Big and Little Plain areas and from the western part of the Canaan Gap area. Therefore, the groundwater flow directions shown above for these areas reflect the underlying deeper Triassic-age rock aquifers and not for the Shinarump Conglomerate.

4.0 WATER BALANCE

For this assessment, we define:

- Sustainable Yield as the amount of groundwater that can be withdrawn from the three principal aquifers of Apple Valley on an annual basis without exceeding the long-term recharge and

- The three principal aquifers as the unconsolidated (basin or valley fill) deposits, the basalt, and the Shinarump Conglomerate.

Ensign (2015) calculated a water balance for the three principal aquifers over a 50,000-acre area and estimated (1) recharge at 10,334 acre-feet per year (afy), (2) withdrawal (discharge) at 10,651 afy, and (3) an overdraft (withdrawal greater than recharge) of 317 afy. The Sustainable Yield of Ensign (2015) using our definition, is 10,334 afy. We followed a similar approach as Ensign (2015) to develop independent estimates of recharge (Sustainable Yield), withdrawal, and water balance.

4.1 ESTIMATE OF GROUNDWATER RECHARGE

Precipitation within and seepage from streams that originate in the study area are the source of nearly all recharge to the three principal aquifers. There is no significant surface water inflow or groundwater underflow into the aquifers from outside of the study area.

According to Heilweil and others (2007), (1) net water infiltration is percolation flux that passes beneath the depth of the root zone and is not lost to evaporation or consumed by evapotranspiration and (2) groundwater recharge is water that reaches the aquifer at the water table.

4.1.1 Precipitation

Cordova (1981) reports that most precipitation occurs during midwinter as snow and late summer as rain. Snow accumulates on the highest plateaus during winter and then melts, runs off, and slowly seeps into the ground during late spring-early summer. Heavy rain that falls during late summer thunderstorms typically runs off rapidly in flash floods. Figure 11, inserted below is modified from Plate 1 of Cordova (1981) to show that average annual precipitation is greater than 12 inches in most of the study area. Cordova (1981) used annual precipitation data for 1931 through 1960.

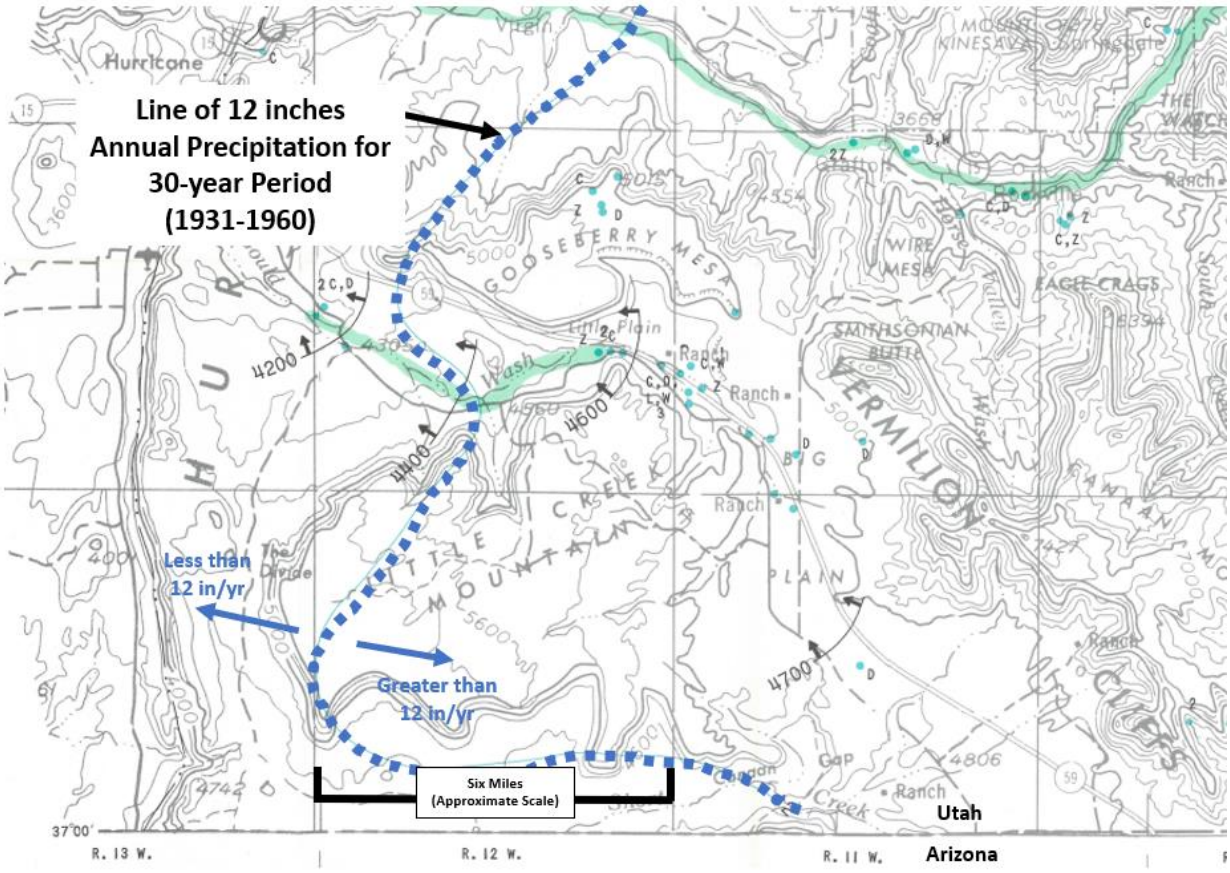

Figure 11. Map of average annual precipitation; modified from Plate 1 of Cordova (1981)

Table 3 summarizes average annual precipitation estimated by Ensign (2015) for "*Uplands*" and "*Valley Floor*" drainage areas. Ensign (2015) defined (1) Uplands as Little Creek Mountain, Gooseberry Mesa, Smithsonian Butte, Canaan Mountain, and the Vermillion Cliffs and (2) Valley Floor as Big and Little Plains. According to Ensign (2015) average annual precipitation in the study area is 61,670 afy.

TABLE 3
ESTIMATES OF AVERAGE ANNUAL PRECIPITATION BY ENSIGN (2015)

Drainage	Surface Area (acres)	Precipitation Rate (in/yr)	Precipitation Amount (afy)
Uplands	30,000	16	40,000
Valley Floor	20,000	13	21,670
Totals	***50,000***		***61,670***

[a] *in/yr = inches per year*

Table 4 lists the National Weather Service (NWS) weather stations used by Ensign (2015). Ensign (2015) did not provide the period of record for their precipitation data.

TABLE 4
NATIONAL WEATHER SERVICE (NWS) STATIONS USED BY ENSIGN (2015)

Weather Station	Approximate Distance and Direction from Apple Valley (miles)	Average Annual Precipitation (in/yr)
Zion National Park	11 to Northeast	16.1
La Verkin	10.5 to Northwest	11.6
Colorado City	11 miles to Southeast	13.5

We estimated precipitation separately for the Gould Wash, Canaan Wash, and unnamed wash drainages (the three drainages). Figure 4 delineates the extents of the three drainages on a topographic base map.

We estimated average annual precipitation for the study area using data for the 30-year period from 1991 to 2020 that are available from the Natural Resources Conservation Service (NRCS) Parameter-elevation Regressions on Independent Slopes Model (PRISM). Heilweil and others (2007) and Heilweil and McKinney (2007) describe PRISM which is available from the Oregon State University Spatial Climate Analysis Service (http://www.ocs.oregonstate.edu/prism/).

Figure 12, inserted below, is output from PRISM that shows the outline of individual cells and average annual precipitation for individual cells. Each PRISM cell model is 800 x 800 meters, which is 640,000 square meters (m^2) and equivalent to an area of about 158 acres. The 312 cells cover the three drainages in the PRISM model of the study area for a total area of 49,340 acres. We delineated the three drainages and show average annual precipitation (1991 to 2020) on Figure 12 for Gould Wash (14.5 in/yr), Canaan Wash (14.6 in/yr), and the unnamed wash (14.1 in/yr).

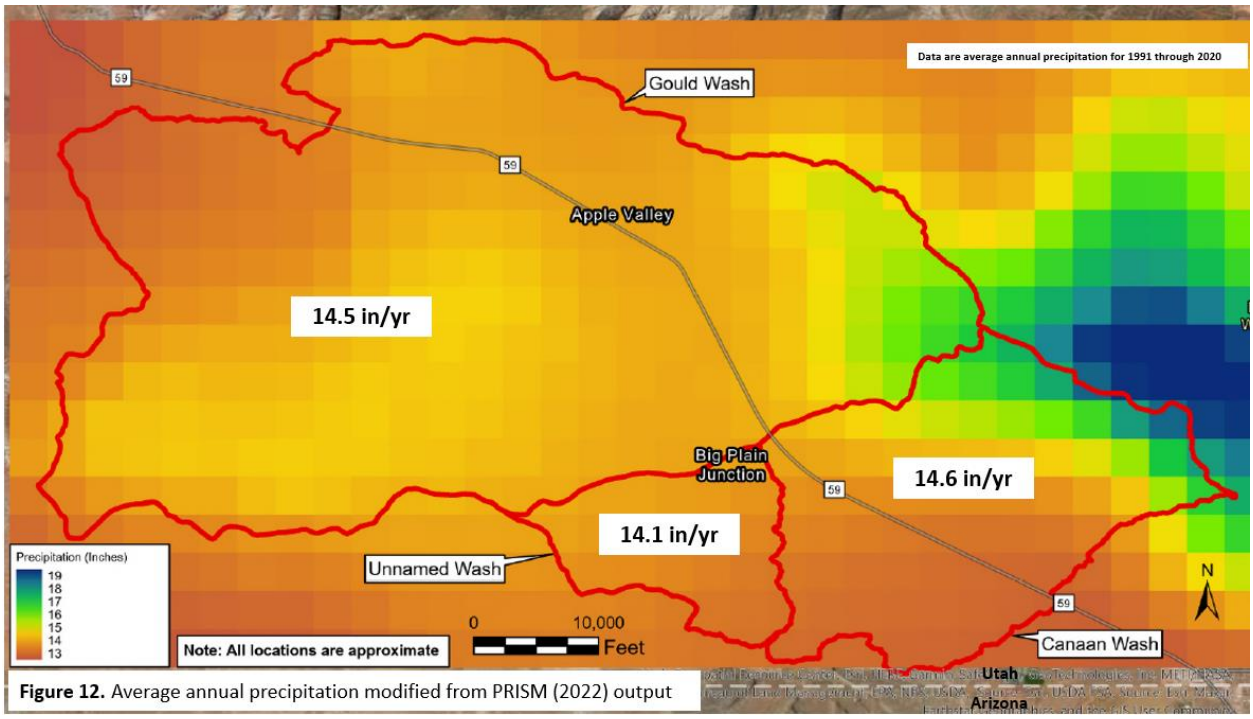

Figure 12. Average annual precipitation modified from PRISM (2022) output

We used PRISM to estimate a total annual precipitation of 57,590 afy for the three drainages which is slightly less than the 61,670 afy of precipitation estimated by Ensign (2015). Note that (1) Ensign (2015) estimated average precipitation to be about 1.23 acre-feet per year in their 50,000-acre study area and (2) we estimated average precipitation to be about 1.17 acre-feet per year in our 49,340-acre study area.

4.1.2 Recharge from Precipitation

The percentage of precipitation that infiltrates the ground, reaches the water table, and becomes groundwater recharge depends on many factors including the amount and duration of precipitation, topographic setting, elevation, temperature, aspect, vegetation, latitude, and others; see Heilweil and others (2000). Most precipitation in the study area is lost to evaporation and evapotranspiration. Estimates of the percentage of precipitation that recharges aquifers in the region range from less than 4 to 15 percent; see Cordova (1981); Danielson and Hood (1984), Heilweil and others (2000), and Heilweil and others (2007).

Heilweil and others (2007) calculated a recharge rate of 10 percent from detailed infiltration studies of the Navajo Sandstone that they conducted at Sand Hollow Reservoir and surrounding areas. Sand Hollow Reservoir is about 5 to 6 miles to the west of Apple Valley.

Ensign (2015) assumed a recharge rate of 15 percent for precipitation for both their Upland and Lowland areas to estimate a combined total recharge from precipitation of 9,250 afy for the study area.

We estimated average annual recharge from precipitation using the (1) Maxey-Eakin (1949) approach (the Maxey-Eakin Method), (2) PRISM/infiltration rate approach described by Heilweil and others (2007), and (3) a range of recharge rates.

The Maxey-Eakin Method assumes that (1) there is a linear relationship between precipitation and recharge and (2) a larger proportion (percentage) of precipitation results in recharge in areas where precipitation is greater. Table 5 summarizes the Maxey-Eakin Method recharge coefficients (percent of annual precipitation) for ranges in annual precipitation.

TABLE 5
MAXEY-EAKIN RECHARGE COEFFICIENTS

Precipitation Ranges of Average Annual Precipitation (in/yr)	Maxey-Eakin Recharge Coefficients (percent of precipitation)
>20	25
15-20	15
12-15	7
8-12	3
<8	0

To estimate annual recharge using the Maxey-Eakin Method, we:

- Downloaded elevation data from the USGS Earth Explorer tool from the GISGeography website.
- Digitized the point data and created a digital elevation model in ArcGIS Pro.
- Generated and assigned latitude and longitude coordinates to each point.
- Calculated annual precipitation in inches using coordinate attributes and elevations in feet in a linear regression equation.
- Calculated the percent of precipitation that infiltrates and recharges local aquifers by applying the conditional Maxey-Eakin coefficients provided in Table 5 to the precipitation data.
- Estimated the total annual recharge from precipitation in the study area by (1) averaging the percent of recharge from precipitation for each drainage, (2) multiplying that average by the area of each drainage, and (3) totaling the recharges from the individual drainages.

We estimated average annual recharge from precipitation to be 4,720 afy using the Maxey-Eakin Method. Flint and Flint (2007) (1) developed the Basin Characterization Model (BCM) to estimate recharge and runoff potential in the Basin and Range Carbonate-Rock Aquifer System (BARCAS) of Nevada and adjacent areas in Utah, (2) compared their estimates of recharge to those using the Maxey-Eakin Method, and (3)

found their estimates of recharge to be about 60 percent greater than recharge estimated using Maxey-Eakin Method.

For the PRISM/infiltration rate approach, we multiplied the annual precipitation calculated for each cell using PRISM by (1) the area of each cell (158 acres) and (2) recharge rates of 4, 10, and 15 percent. Our estimates of average annual recharge from precipitation using this method range from 2,300 afy for a recharge rate 4 percent, to 5,760 afy for a rate of 10 percent, to 8,640 afy for rate of 15 percent.

Table 6 compares the annual recharge from precipitation using the PRISM approach to recharge values estimated using the Maxey-Eakin Method and by Ensign (2015).

TABLE 6
ESTIMATES OF AVERAGE ANNUAL RECHARGE FROM PRECIPITATION

Method	Recharge Rate (percent of precipitation)	Average Annual Recharge from Precipitation (afy)
Ensign (2015)	15	9,250
Maxey-Eakin (1949)	7 to 15	4,720
PRISM/Infiltration Rate Approach	4	2300
	10	5760
	15	8640

4.1.3 Recharge from Ephemeral Streams

Gould Wash, Canaan Wash, and an unnamed wash drain the study area; see Figure 4. Although none of these drainages are perennial, they can carry large volumes of water for short periods of time in response to heavy rain. There are no perennial streams that bring surface water into the study area. Studies in western Washington County by Wolkowsje and others (1998) and Heilweil (2000) indicate that recharge from ephemeral streams averages about 3.2 afy per mile. Ensign (2015) used this rate to estimate total recharge of 64 afy for the 20 miles of ephemeral streams in Apple Valley.

4.1.4 Recharge from Irrigation Return

Ensign (2015) reports that unconsumed irrigation water contributes about 1,020 afy of recharge to the principal aquifers in the study area. However, we believe that there is essentially no net recharge from unconsumed irrigation water in the study area because most of the (1) water for irrigation is groundwater pumped from wells or diverted from springs located in the study area and (2) recharge to groundwater is from precipitation. Therefore, we believe that this recharge is already included in the estimate of recharge from precipitation.

4.1.5 Recharge from Interbasin Flow and Underflow

There is essentially no groundwater flow into the study area within the principal aquifers.

4.1.6 Total Estimated Groundwater Recharge

Total groundwater recharge in the study area is the sum of recharge from precipitation and seepage from ephemeral streams. There is no significant recharge from irrigation return or from surface water or groundwater inflow to the principal aquifers from outside the study area. Due to the level of uncertainty and lack of data, our estimate of the long-term recharge to the principal aquifers in the study area is a range from about 4790 for the Maxey-Eakin Method to about 8700 afy using the PRISM data and a recharge rate of 15 percent. This estimate includes both recharge from precipitation and recharge from ephemeral streams. The high end of our estimate (8700 afy) is less than the Ensign (2015) estimate of 10,334 afy. Note that the Ensign (2015) estimate of recharge is 9,314 afy if irrigation return is not included.

4.2 ESTIMATE OF GROUNDWATER DISCHARGE

To estimate groundwater discharge (withdrawal) for comparison with recharge, we compiled the following information for Apple Valley:

- Approved water right diversions;
- Reported diversions by PWSs;
- Estimates of evapotranspiration;
- Discharge to streams; and
- Discharge to groundwater outflow.

4.2.1 Discharge to Wells and Springs

To estimate the amount of groundwater potentially discharged to wells and springs, we (1) inventoried approved water right diversions and (2) compiled diversion records for area water systems. We inventoried the DWRi online database and found approximately 9,270 afy of approved water right diversions located within the study area. This is slightly greater than the 9,085 afy of approved diversions reported by Ensign (2015). Pending (unapproved) water rights consist mostly of changes of points of diversion (POD) located within the study area and will not add significant new diversions.

Not all the approved water right diversions are being fully used. For example, Table 7 summarizes approved water right diversions and actual diversions for area water systems.

TABLE 7
REPORTED DIVERSIONS BY AREA WATER SYSTEMS [a]

Water System	Number of Connections (2021)	Number of Sources (2021)	Water Rights [a] (afy)	Total 2021 Diversions (ac-ft)	Range of Annual Diversions [b] 2017 to 2021 Minimum (ac-ft)	Range of Annual Diversions [b] 2017 to 2021 Maximum (ac-ft)
Big Plains – Apple Valley	258	2	564	114	83	131
Big Plains – Canaan Springs [b]	14	2	45	177	11	177
Big Plains – Cedar Point	148	3[c]	[g]	80	36	80
Tru South	NR [d]	6	1155	0	0	0
Little Creek Travel Center	NR [e]	2	NR [e]	NR [e]	NR [e]	NR [e]
Apple Valley Water Co.	NR [f]	NR [f]	[g]	0 [f]	0 [f]	0 [f]
Gubler Family Trust	NR [f]	NR [f]	[g]	0 [f]	0 [f]	0 [f]
Thirsty Stone Resources, Inc.	NR [f]	NR [f]	2	0 [f]	0 [f]	0 [f]
Totals	***420***	***15***	***1766***	***371***	***130***	***388***

NR = Not Reported; gpm = gallons per minute; afy = acre-feet per year; ac-ft = acre feet
[a] DWRi website https://www.waterrights.utah.gov/asp_apps/generalWaterUse/WaterUseList.asp.
[b] Data are for 2018 to 2021 (there are no data for 2017).
[c] DDW lists four sources (wells); one source (Jessup Well) was inactive in 2021.
[d] DWRi (1) does not report any connections, (2) shows all six sources (wells) as "active" but no diversions for 2021 or any other year; DDW reports that Tru South serves a population of 314.
[e] Little Creek Travel Center not listed in DWRi database; however, DDW reports that they are a Transient Non-Community PWS, serve a population of 250 have one source (Travel Center Well 1).
[f] Reported by DWRi to be inactive; water system not listed in DDW database.
[g] Included in total for Big Plains – Apple Valley

Note from Table 7 that:

- Eight water systems are listed, but it appears that Big Plains – Apple Valley, Canaan Springs, and Cedar Point and Little Valley Travel Center were the only active systems that diverted water from 2017 to 2021.

- A total of 371 acre-feet was diverted during 2021 which is considerably less than the 1766 afy that is allowed to be diverted by the approved water rights of these systems.

4.2.2 Discharge by Evaporation and Evapotranspiration

As discussed by Ensign (2015), discharge by evaporation and evapotranspiration is accounted for in the estimated of recharge rates of Cordova (1981); Danielson and Hood (1984), Heilweil and others (2000), and Heilweil and others (2007).

4.2.3 Discharge to Streams

As discussed by Ensign (2015), there are no perennial streams that flow out of the study area.

4.2.4 Groundwater Outflow from Unconsolidated Deposits and Basalt Aquifers

Figure 13, inserted below, is modified from Plate 1 of Cordova (1981) to show that essentially all groundwater in the unconsolidated deposits aquifer flows to the west northwest, out of the study area. Well logs and DWSP plans for Apple Valley Wells (Alpha Engineering Company, 1998) indicate that groundwater in the unconsolidated and basalt aquifers comingle in the Little Plain area before flowing out of the study area.

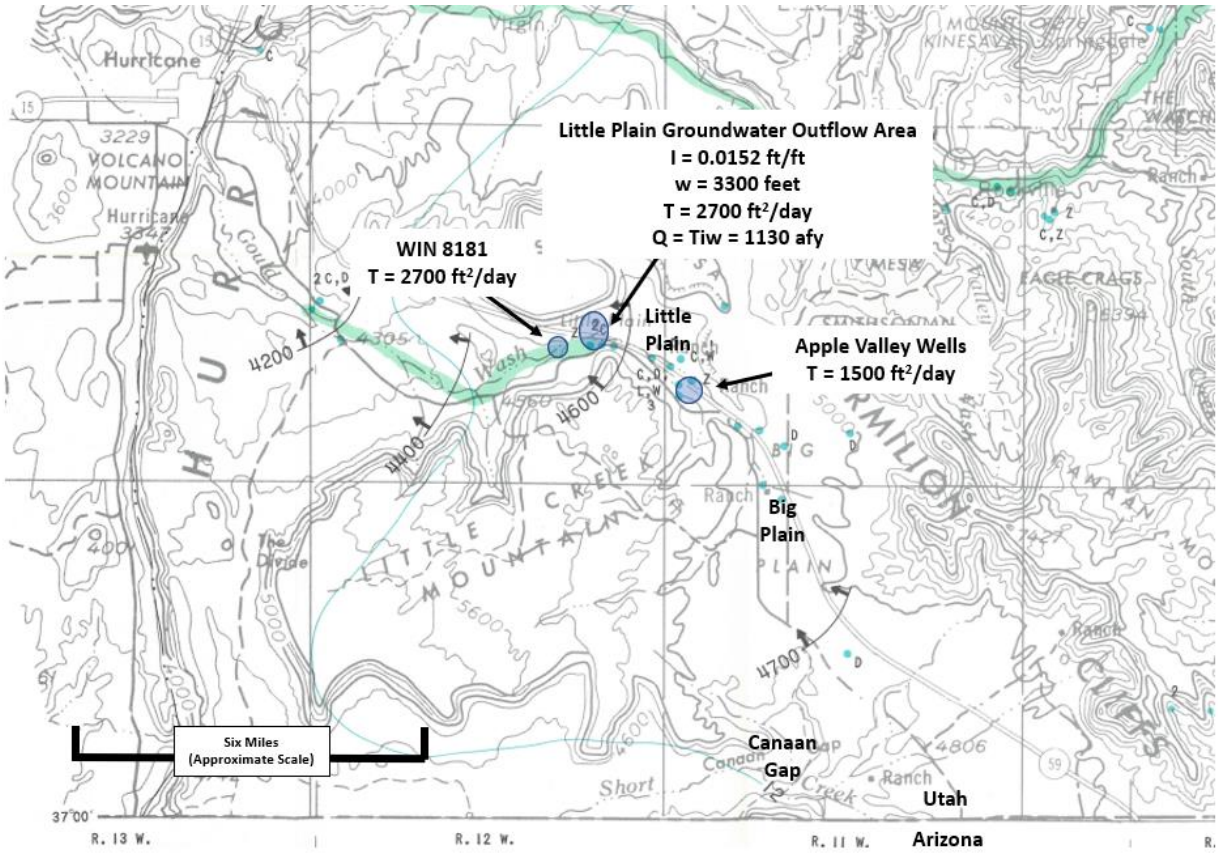

Figure 13. Estimated groundwater flow in unconsolidated deposits aquifer; modified from Plate 1 of Cordova (1981)

As indicated on Figure 13, we estimate that groundwater in the unconsolidated deposits and basalt aquifers leaves the study area at an average annual rate of about 1130 afy. The Darcy equation, as described by Cordova (1981) and Driscoll (1986) is:

Q = TIw, where

Q = groundwater outflow in afy,
T = Transmissivity in ft^2/day,
I = Hydraulic gradient, and
w = Width of section through which groundwater flows in feet.

Figure 13 indicates that we used the following input parameters: (1) hydraulic gradient (I) of about 0.0152 ft/ft, (2) width of the aquifer (w) of about 3300 feet, and (3) transmissivity (T) of 2700 ft^2/day. We used the method of Driscoll (1986) to estimate a transmissivity of 2700 ft^2/day from a specific capacity of 10 gpm/ft that we calculated from the 10 feet of drawdown produced by an 800-gpm, 36-hour constant-rate pumping test of WIN 8181. Note that Alpha Engineering Company (Alpha, 1998) estimated a transmissivity of 1500 ft^2/day for Apple Valley Water Company Well Nos. 1 and 2 (the Apple Valley wells) that are located about 2.5 miles to the southeast. WIN 8181 and the Apple Valley wells are completed in and produce groundwater from both the unconsolidated deposits and basalt aquifers (Alpha, 1998).

Our estimate of 1130 afy is less than the 1449 afy of aquifer outflow estimated by Ensign (2015) for the Little Plain area.

Ensign (2015) estimated that an additional 117 afy flows out of the study area in the unconsolidated deposits aquifer in the Canaan Gap area. However, we believe that very little groundwater leaves the study area through the unconsolidated deposits in Canaan Gap because this aquifer is very narrow, thin, and clayey and appears to be discontinuous in this area; see Figure 3.

4.2.5 Groundwater Outflow from Shinarump Conglomerate Aquifer

Figure 14, inserted below, is modified from Figure 13 of Inkenbrandt and others (2013) to (1) show the direction of groundwater flow in the Triassic-age rocks, which includes the Shinarump Conglomerate aquifer and (2) estimate groundwater outflow within the Shinarump Conglomerate. As noted earlier, erosion has removed the Shinarump Conglomerate from the Big and Little Plain areas and from the western part of Canaan Gap. Therefore, (1) the groundwater flow directions shown below for these areas are for the underlying deeper Triassic-age rock aquifers and are not for the Shinarump Conglomerate, (2) very little if any groundwater in the Shinarump Conglomerate aquifer leaves the study area through Canaan Gap, and (3) almost all the outflow in the Shinarump Conglomerate aquifer is through the narrow area shown below.

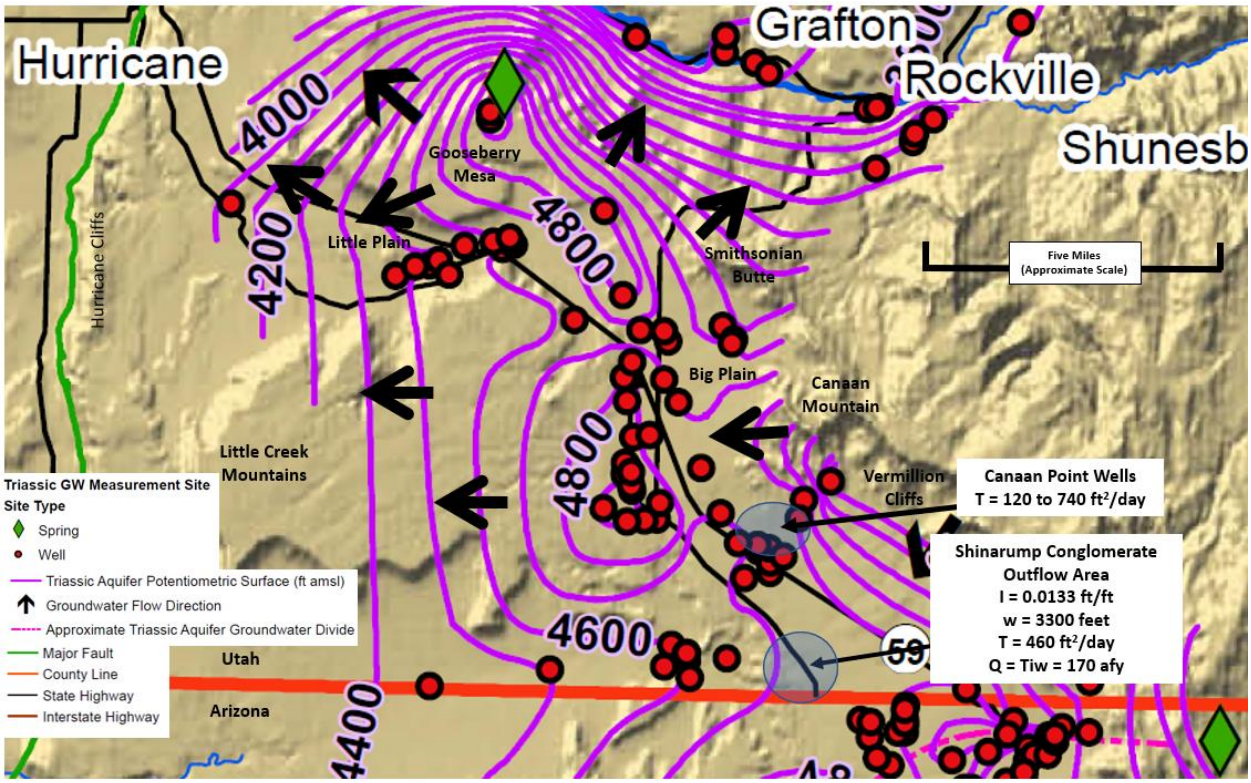

Figure 14. Estimated groundwater flow in Triassic-age aquifers; modified from Figure 13 of Inkenbrandt and others (2013)

We used the Darcy equation and the following input parameters to estimate that about 170 afy of groundwater leaves the southern part of the study area in the Shinarump Conglomerate: (1) hydraulic gradient (I) of about 0.0133 ft/ft, (2) width of the aquifer (w) of about 3300 feet, and (3) transmissivity (T) of 460 ft²/day. Our estimated transmissivity of 460 ft²/day is the average of four transmissivities reported for the Shinarump Conglomerate aquifer in DWSP plans for four Cedar Point Water Company wells by InSite Engineering, P.C. (InSite, 2007a, 2007b, and 2007c) and RM² Consultant Engineering (RM², 2020).

4.2.6 Total Estimated Groundwater Discharge

Our estimate of total potential groundwater discharge from the study area is about 10,570 afy and is the sum of potential discharge from wells and springs (9,270 afy) and groundwater outflow in the unconsolidated deposits and basalt aquifers (1,130 afy) and Shinarump Conglomerate aquifer (170 afy). We do not include groundwater discharge via evaporation and evapotranspiration or surface water outflow because (1) there are no perennial streams that carry surface water out of the study area and (2) our estimate of net recharge already considers evaporation and evapotranspiration. Our estimate of 10,570 afy is essentially the same as the Ensign (2015) estimate of 10,651 afy.

We consider our estimate to be potential discharge because it assumes that all approved water right diversions are used to their allowed maximum amounts and the water is 100 percent consumed.

4.3 GROUNDWATER BALANCE

Our estimate of long-term recharge of about 4790 to 8700 afy is considerably less than our estimate of potential groundwater discharge of 10,570 afy and indicates a potential deficit (groundwater withdrawal greater than recharge) of 1870 to 5790 afy. If this were the case, then there would be significant mining of and a decline in groundwater levels. Rowley (2003) refers to anecdotal reports of wells going dry; however, we did not find any USGS observation wells in the area that would provide a long-term record of groundwater levels.

Although our estimate of groundwater discharge of 10,570 afy is essentially the same as the estimate of Ensign (2015) of 10,651 afy, our estimated potential deficit of 1870 to 5790 afy is significantly greater than the estimated deficit of Ensign (2015) of 317 afy due to our lower estimates of groundwater recharge.

5.0 ASSESSMENT OF SUSTAINABLE YIELD

Our estimate of the Sustainable Yield of the three principal aquifers in Apple Valley is the same as our estimate of long-term recharge which is about 4790 to 8700 afy. Our high end is less than the estimate of long-term recharge by Ensign (2015) of 10,334 afy. Both estimates of sustainable yield are less than estimated potential groundwater discharge of 10,570 to 10,651 afy.

6.0 RECOMMENDATIONS FOR FURTHER STUDY

The wide range in our estimate of long-term recharge and Sustainable Yield (about 4790 to 8700 afy) for Apple Valley is an indication of the high level of uncertainty in all our estimates. We recommend the following to refine our estimate of Sustainable Yield:

- Conduct a more detailed hydrogeologic study which would include the collection of field data;
- Construction of a water budget model such as the Utah Basin Model (UBM) that the Utah Geological Survey (UGS) has developed to estimate large water budget components; and
- Construction and calibration of a numerical groundwater model.

Collection of field data would, at a minimum, include measurements of:

- Soil properties, such as soil water content, field capacity, wilting point, and permeability;
- Climatological factors, such as precipitation, temperature, evaporation, and the like;
- Groundwater levels through the installation and monitoring of observation wells; and

- Stream flow through the installation and monitoring of surface water gages.

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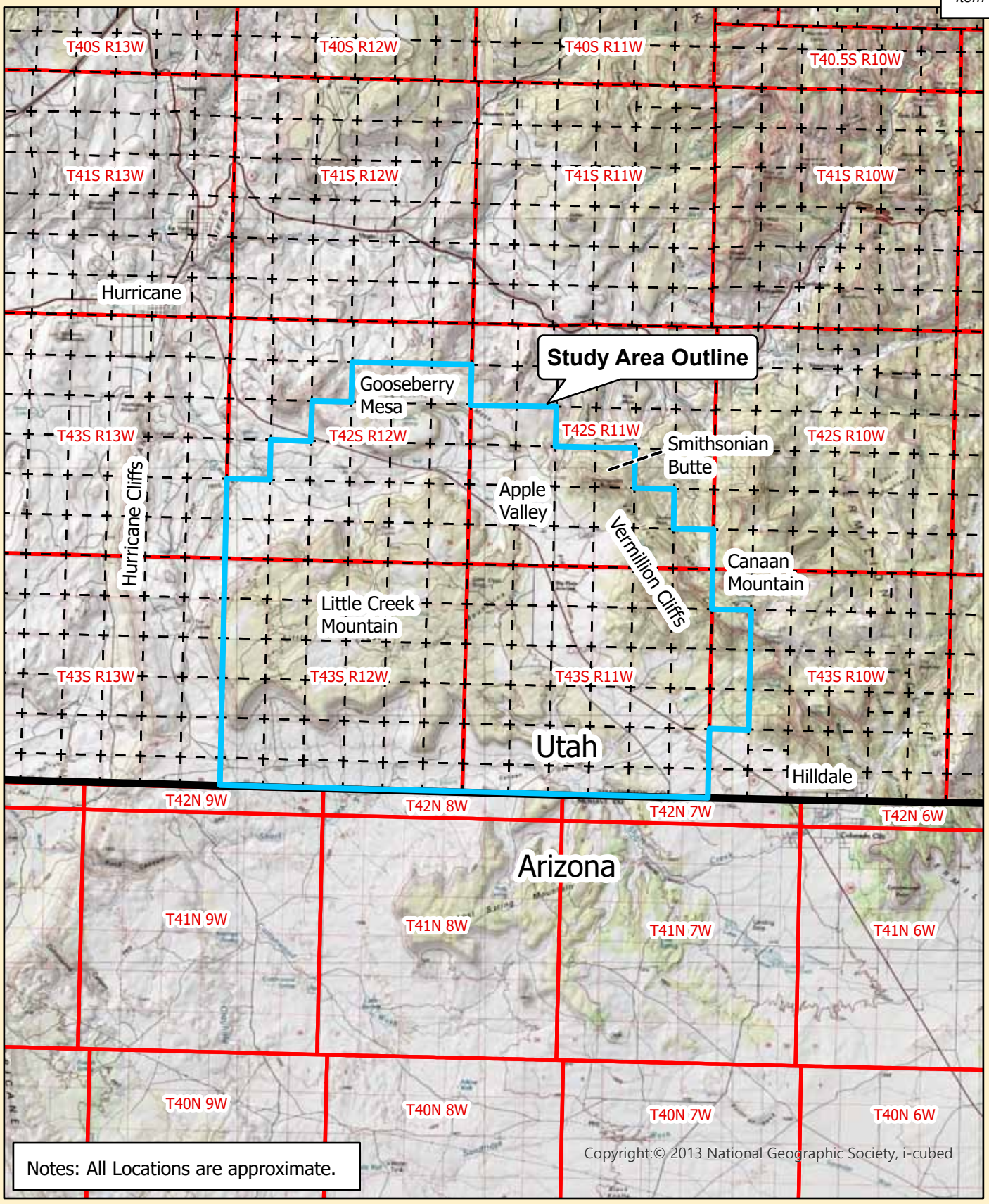
FIGURES



Prepared by Connor Smith

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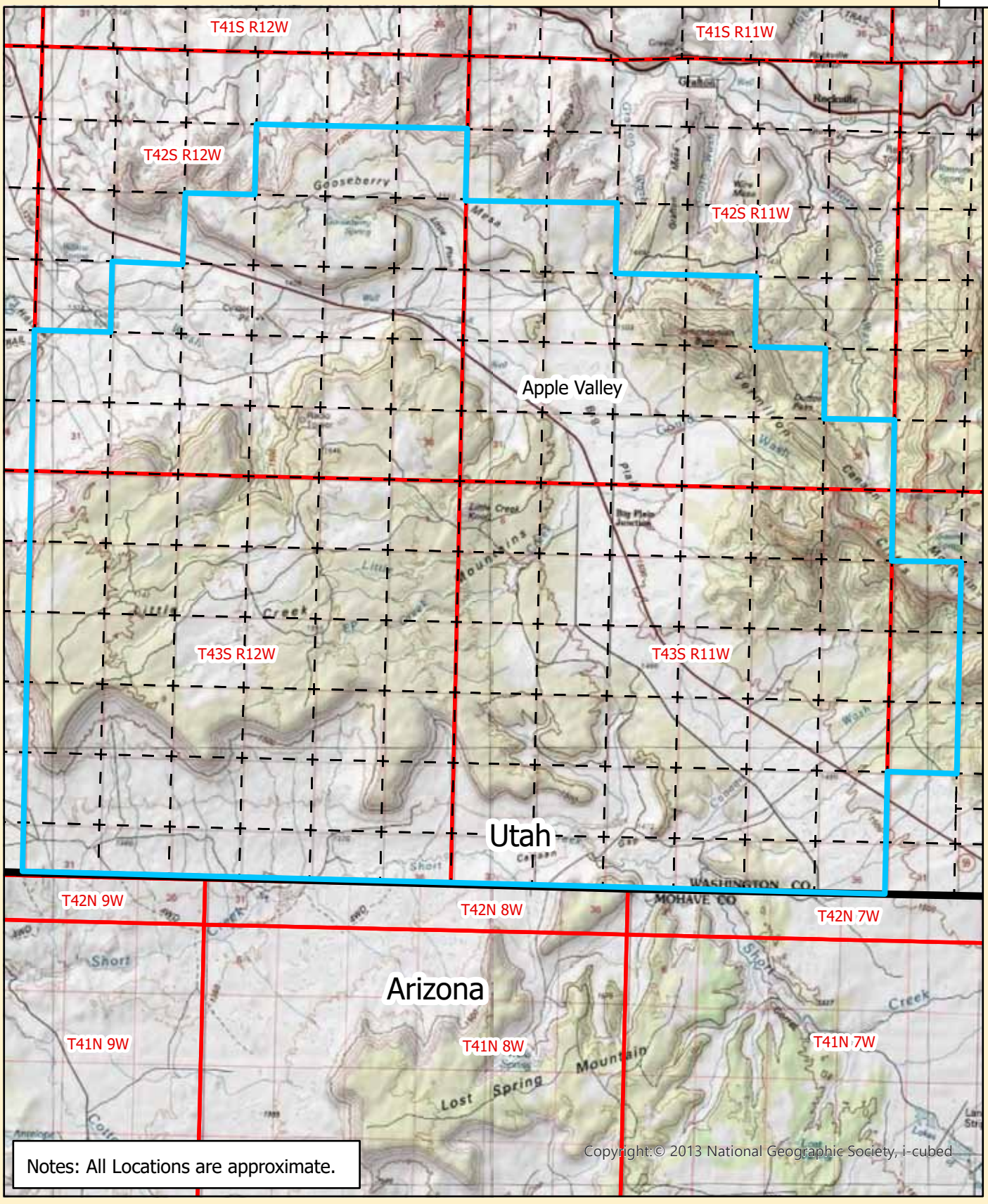
Washington County WCD
Apple Valley
Regional Map
Figure 1



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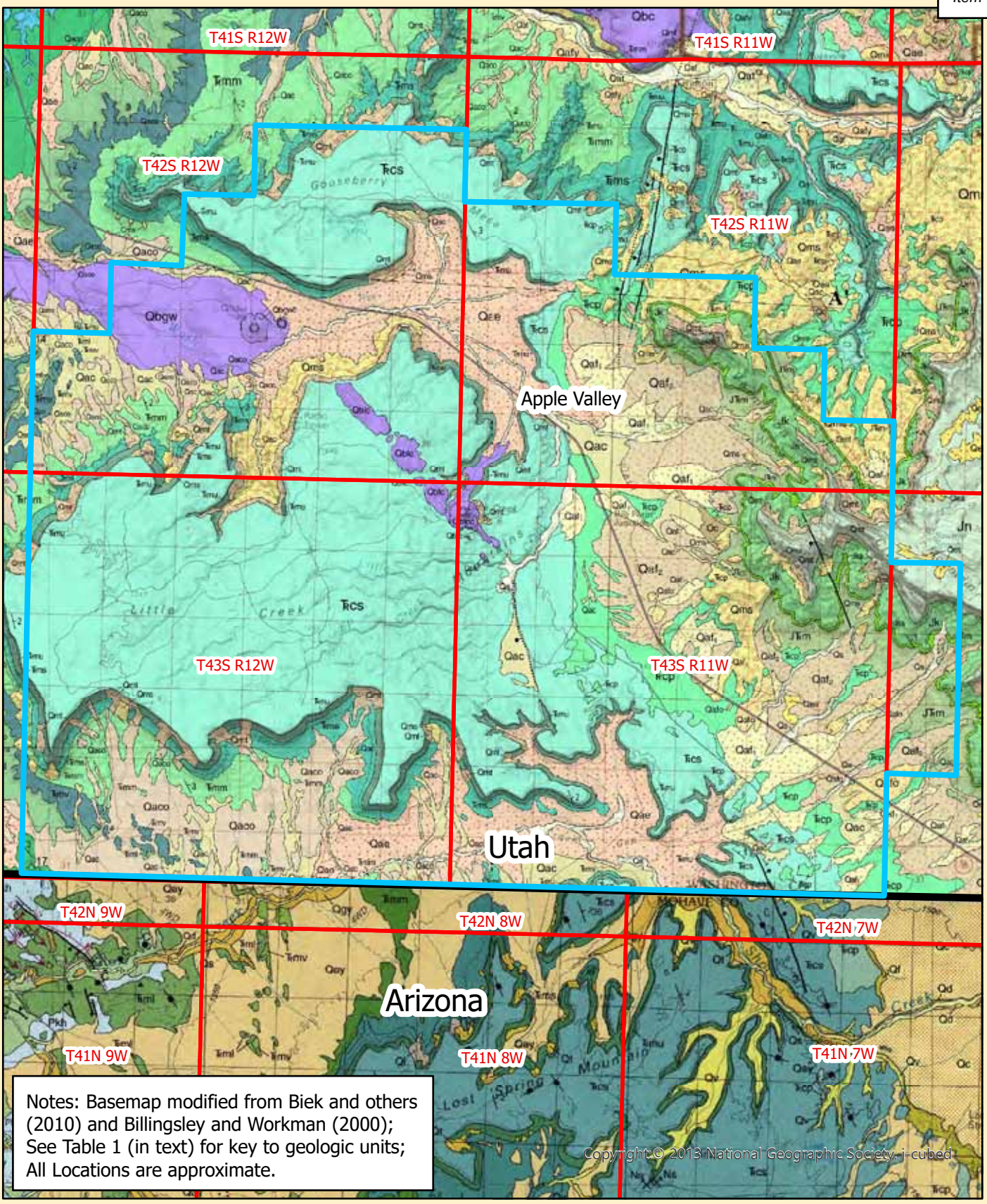
Washington County WCD
Apple Valley
Location Map
Figure 2



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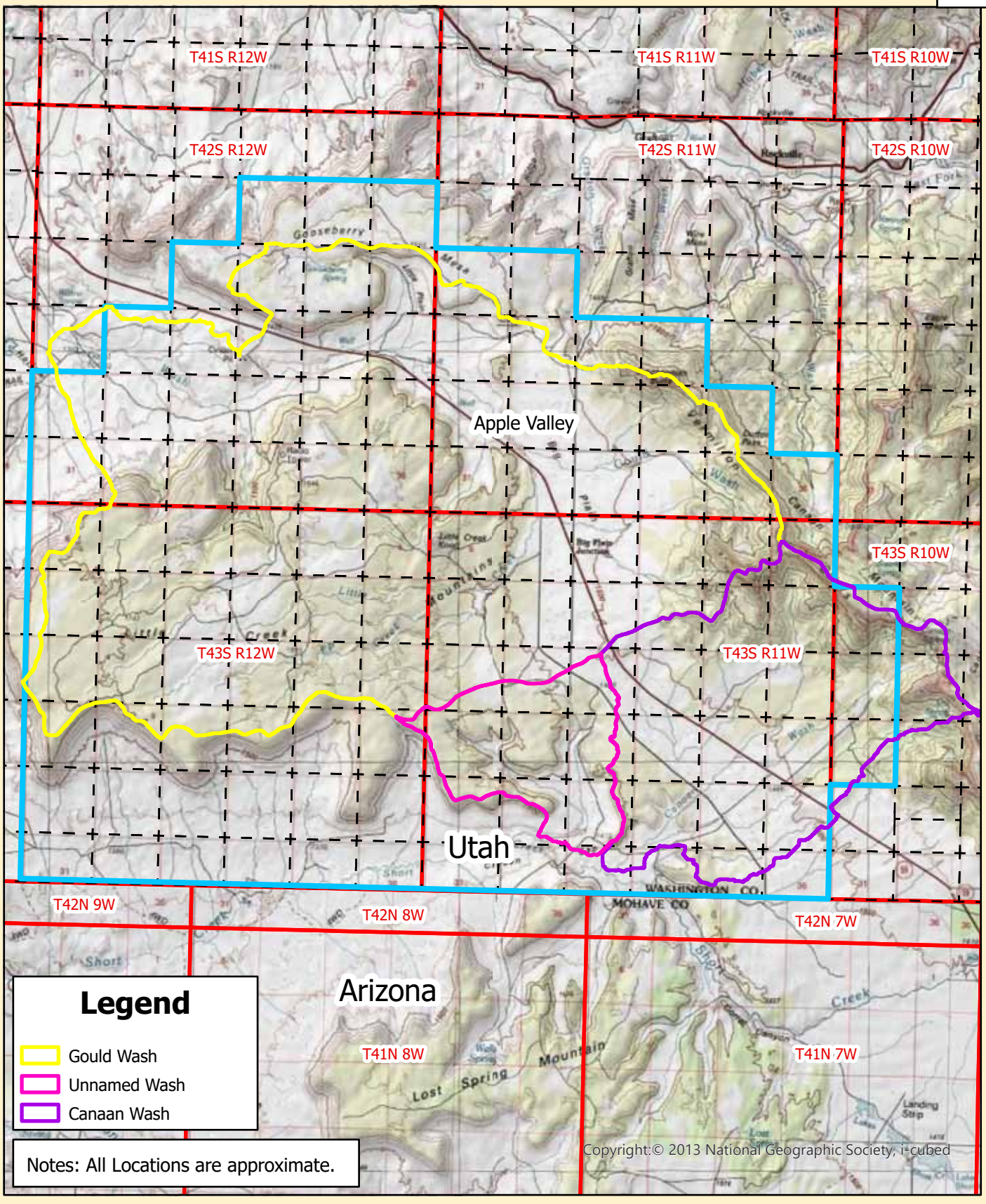
Washington County WCD
Apple Valley
Geologic Map
Figure 3



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Washington County WCD
Apple Valley
Drainage Map
Figure 4

Big Plains Water Special Service District

WATER USAGE ANALYSIS

	COMPARABLE ACCTS			TOTAL SYSTEM		
	2023/2022	2022/2021	Over/ (Under)	2023/2022	2022/2021	Over/ (Under)
JUL 2022	6,117,230	6,451,930	(334,700)	8,059,327	6,572,750	1,486,577
AUG	4,484,140	6,052,550	(1,568,410)	5,337,420	6,073,830	(736,410)
SEP	4,465,090	6,266,750	(1,801,660)	5,540,460	6,304,990	(764,530)
OCT	3,002,500	2,967,370	35,130	3,813,180	2,971,340	841,840
NOV	1,656,380	2,797,940	(1,141,560)	2,327,480	2,900,120	(572,640)
DEC	2,293,220	2,507,480	(214,260)	2,956,200	2,556,930	399,270
JAN 2023	1,543,380	1,671,920	(128,540)	2,406,879	1,675,760	731,119
FEB	1,418,710	1,534,640	(115,930)	1,715,637	1,549,020	166,617
TOTAL DECREASE/INCREASE			(5,025,460)			254,837

Comparable Accounts: Had usage in both years
Total System: All usage