

DRINKING WATER SOURCE PROTECTION PLAN

EAST CREEK WELL FIELD

BRYCE CANYON NATIONAL PARK

December 1998

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List of Figures

1. General location of Bryce Canyon National Park and East Creek well field.
2. Average monthly water use.
3. Plate 24 from Marine (1963); Map of Bryce Canyon National Park area, Utah, showing physiographic features and the location of springs and wells.
4. Plate 25 from Marine (1963); A. Map of East Creek Valley showing area underlain by alluvium. B. North-south section of East Creek valley showing inferred maximum depth to bedrock and the position of the water table in May 1957.
5. Figure 58 from Marine (1963); Selected schematic cross sections across East Creek valley showing approximate thickness of alluvium.
6. Figure 59 from Marine (1963); Schematic diagrams of saturated alluvium in parts of East Creek valley, May 1957.
7. Geologic map of the East Creek well field area.
8. Hydrograph of static water level measurements at East Creek Well No. 1.
9. Hydrographs of water table response to pumping at Well No. 1.
10. Time-drawdown data and type curves.
11. Protection zones based on computer modeling only.
12. Protection zones based on computer modeling and interpretation of hydrogeologic conditions.
13. Delineation of East Creek drainage basin upstream of the well field.

DRINKING WATER SOURCE PROTECTION PLAN

Bryce Canyon National Park

East Creek Well Field

EXECUTIVE SUMMARY

Drinking water for the public water supply at Bryce Canyon National Park is obtained from shallow wells completed in the alluvium of East Creek. Hydrogeologic analyses shows that the area contributing groundwater to wells in East Creek is limited to the alluvial deposits between the well field and the main road through the park. There are no known contaminant sources within this area that would threaten water quality of the drinking water supply.

Dispersed cattle grazing occurs on a seasonal basis on Forest Service land surrounding the wellfield. Dispersed grazing is not considered a contaminant source. However, the National Park Service should maintain a fence to exclude cattle from the proximity of the wells. Surface runoff from anywhere in the drainage basin upstream of the East Creek well field could quickly transport contaminants to the vicinity of the well field where they could infiltrate into the alluvial aquifer and pose a threat to the drinking water supply. All major park facilities are outside the East Creek drainage basin. Three small parking areas are located within the drainage basin of East Creek. These are at Inspiration Point, Bryce Point, and Paria View. Any contaminants in runoff from these parking areas would be present in only small quantities and would be greatly diluted as they were transported

downstream. The other potential contaminant source is automobile or RV accidents along that section of the park road traversing the drainage basin of East Creek. Traffic accidents are not expected to be a threat to the drinking water supply as these would be infrequent events, relatively small quantities of contaminant would be involved, recovery of spilled material and natural dilution would mitigate effects, and it would take approximately 15 years for groundwater to travel from the vicinity of the road to the well field.

Management actions should be initiated to assure long-term continued protection of the water supply for the East Creek wellfield. These actions include; signage to make persons aware they are in the source area of a public water supply, enlarging the fenced area around the wellfield, and possibly restricting access to the source area on Forest Service land surrounding the wellfield.

1.0 INTRODUCTION

1.1 System Information:

System Name: Bryce Canyon National Park System

System Number: 1258/9045

Address: Superintendent

Bryce Canyon National Park

Bryce Canyon, UT 84717

The water system at Bryce Canyon National Park is a public community system, supplying water to various visitor facilities, campgrounds, park staff housing, administration offices, maintenance area, and the Bryce Canyon Lodge. Springs and shallow wells in East Creek have been the main water supply for the park and associated facilities since 1926.

1.2 Source Information:

This report is the hydrogeologic analysis and protection plan for the East Creek well field at Bryce Canyon National Park (Figure 1). The well field consists of three shallow wells completed in the alluvium of East Creek. The wells are located on a 100 acre parcel owned by the National Park Service. This tract of land is not contiguous with the park, being located about one mile northwest of the park boundary, and surrounded by National Forest land. Water is piped from the well field to storage tanks and a distribution system in the park. Water use averages 80-120,000 gallons per day in summer and 15-20,000 gallons per day in winter. Monthly water use from June 1988 through December 1996 is shown on Figure 2.

- | | | | |
|--------------|-------------|----------------|----------------------|
| Overlook | Trail | Ranger station | Campground |
| Unpaved road | Horse Trail | Picnic area | Backcountry campsite |
| | | Restrooms | |

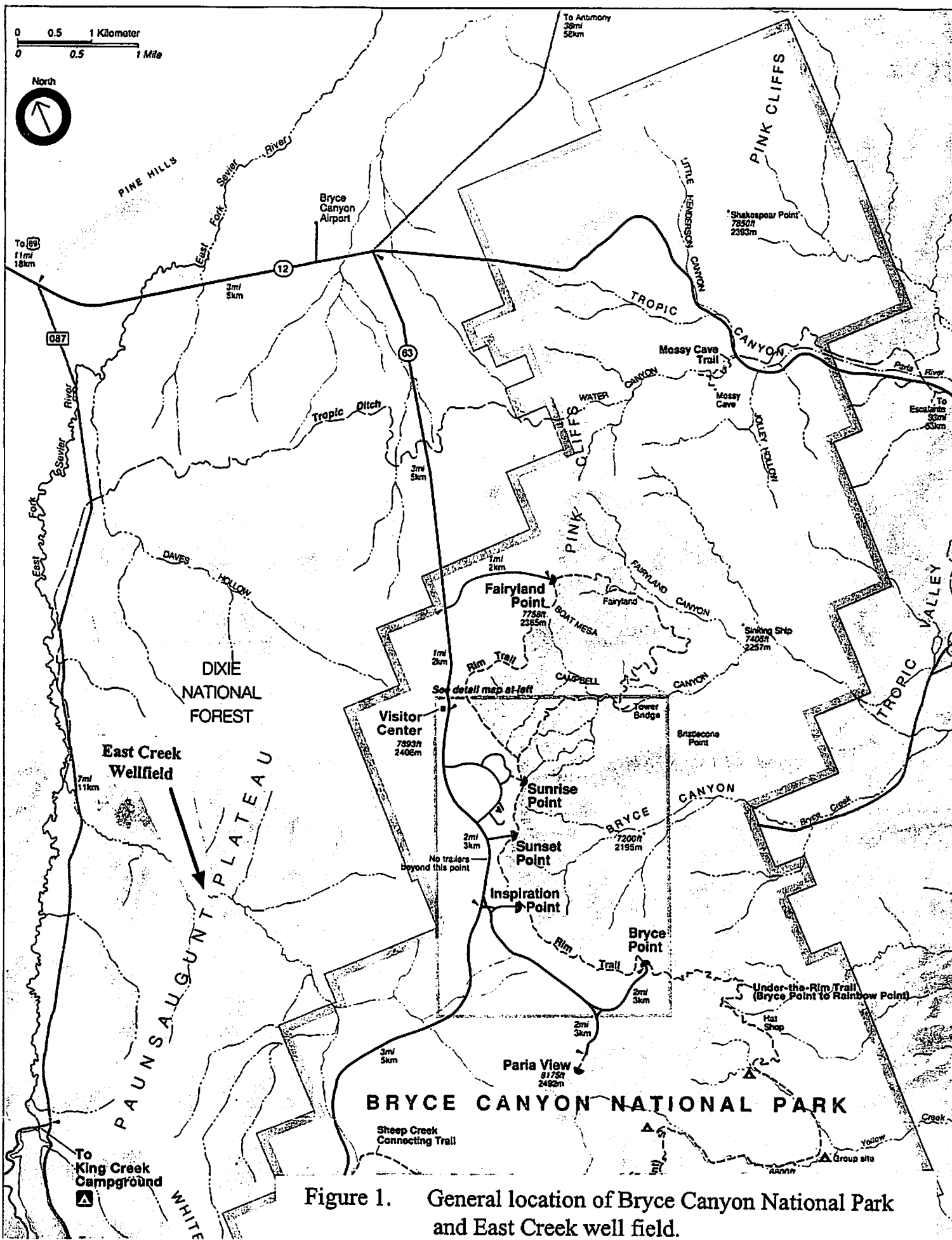


Figure 1. General location of Bryce Canyon National Park and East Creek well field.

Bryce Canyon National Park Monthly Water Use

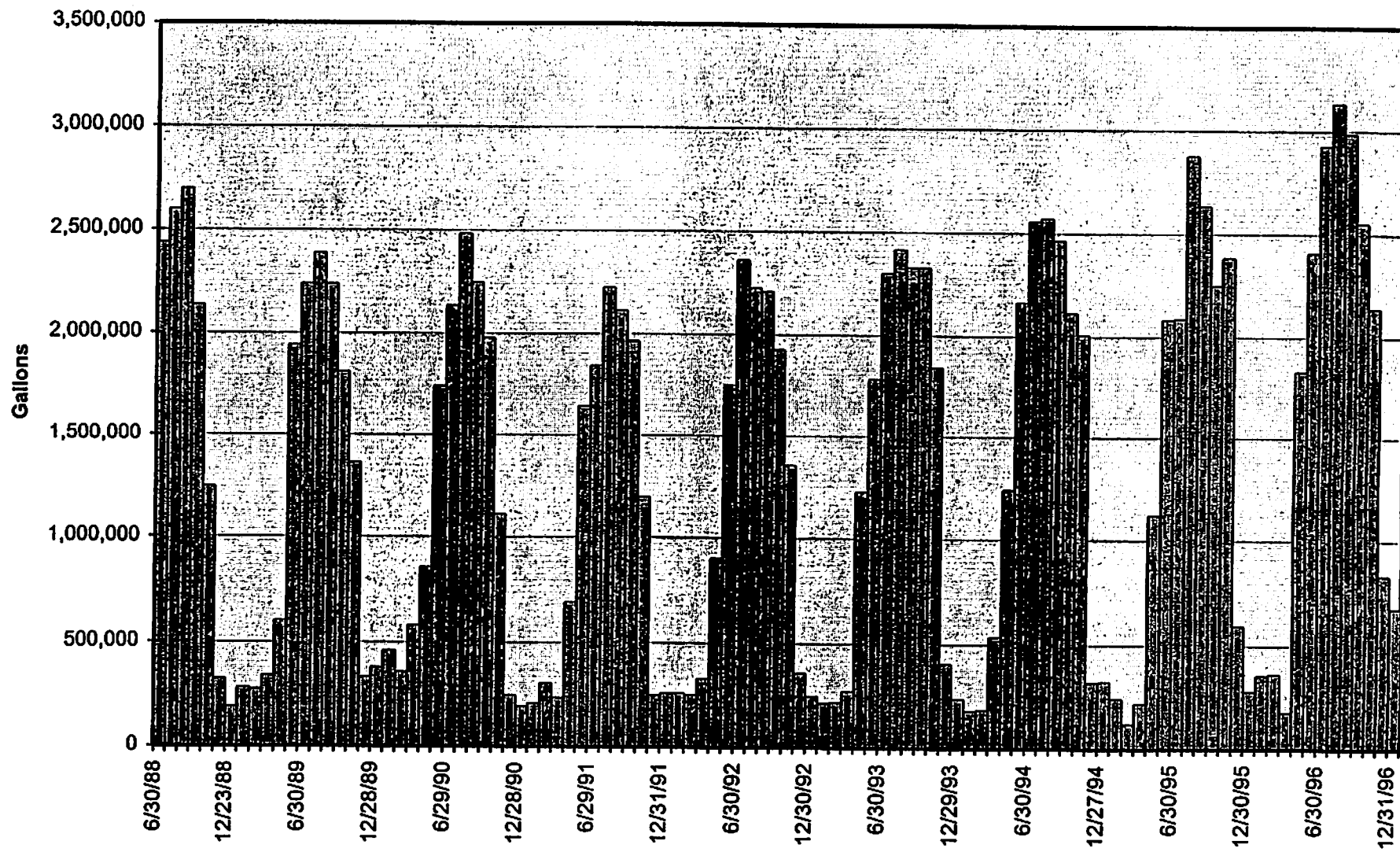


Figure 2. Average monthly water use.

There are three wells constructed to draw water from the alluvium underlying East Creek. These wells were apparently constructed in the mid-1950's by the Utah Parks Company, a subsidiary of the Union Pacific Railroad. Construction details, including well design, could not be found in the course of the investigation for this report. Well No. 1 is 90 feet deep and may have perforated casing from 50-60 feet below ground surface. Well No. 2 is 52½ feet deep, and presumably would have about 10 feet of perforated casing at the bottom of the well. Well No. 3 is currently not used and has no pump. The location of these wells is shown on Figure 4.

1.3 Designated Person - R309-113-5:

The designated person for this well and public water system is;

Superintendent

Bryce Canyon National Park

Bryce Canyon, UT 84717

2.0 DELINEATION REPORT - R309-113-9(5)

2.1 Geologic Data - R309-113-9(5) (a) (i):

Geology and hydrogeology of the East Creek well field are described by Marine (1962). The alluvium in the East Creek valley consists of alternating beds of gravel, clay, and sand. Generalized geologic logs for two wells and eight auger holes all indicate several feet of clay or clayey sand at the surface. The geologic log for Well No. 1 is reproduced below as an example of the material forming the alluvial aquifer;

	<u>Thickness (ft)</u>	<u>Depth (ft)</u>
Alluvium:		
Clay	12	12
Gravel	3	15
Porous formation	9	24
Tight formation	6	30
Wasatch Formation: dry, chalky	50	80

Prior to construction of wells, water was obtained by pumping from springs in the East Creek drainage. The presence of discrete springs indicates that areally extensive beds of clay, or similar fine-grained materials, are present over much of the valley. Where the clay thins, or is absent, groundwater erupts at the surface forming a spring. Pumping of groundwater has lowered the water table of the alluvial aquifer, resulting in loss or decrease of springflow near the East Creek wells.

Water in the alluvial aquifer underlying the East Creek valley is recharged by infiltration of rainfall and streamflow in the drainage basin. Average annual rainfall is about 16 inches per year. Precipitation amounts vary considerably throughout the park depending on elevation and topography. The drainage area of East Creek, upstream from the well field is approximately 10 square miles. Discharge of bedrock springs, such as Whiteman Spring, provides an additional source of recharge for the alluvium.

Several figures from Marine's report (1963) are reproduced for this report to provide a pictorial description of the

hydrogeologic conditions of East Creek. Figure 3 shows the general location of the wells on East Creek in relation to other park features. The wells are located at the area designated on Figure 3 as, "Utah Parks Co. Spring Enclosure". The "Headquarters Well" shown on Figure 3 is no longer used.

Figure 4 is a map of East Creek showing the extent of alluvium and locations of wells and auger holes constructed during Marine's investigation of this area. Figures 5 and 6 depict schematic cross sections showing approximate depth of alluvium and volume of saturated alluvium. Marine estimated that 2.6 million cubic feet of water are stored in the alluvium from the East Creek well field to the park boundary.

A geologic map of Bryce Canyon National Park was prepared by Bowers (1990). That portion of the map which includes the East Creek well field and the drainage basin of East Creek upstream of the well field is shown on Figure 7. Formations of interest for this investigation include;

Qal (yellow)	Clay, silt, sand, and gravel.
Tcw (buff)	White Limestone Member of the Claron Formation
Tcp (pink)	Pink Limestone Member of the Claron Formation

2.3 Well Construction Data - R309-113-9(5) (a) (ii) & (iii):

The wells in East Creek were constructed in the mid-1950's. Construction details are not available. Well No. 1 is 90 feet deep and has perforated casing from 50-60 feet below ground surface. This description of the perforated interval does not correlate

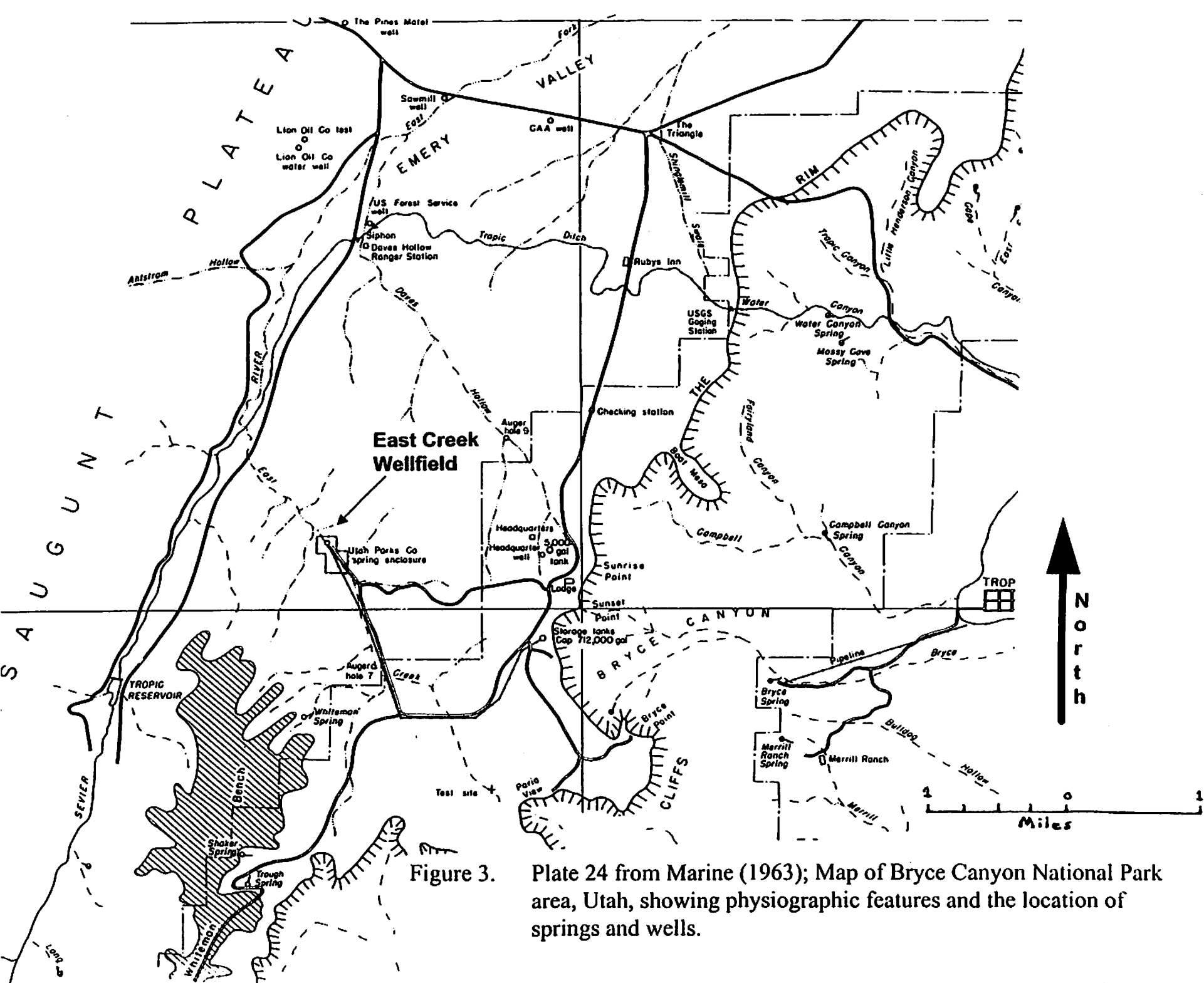
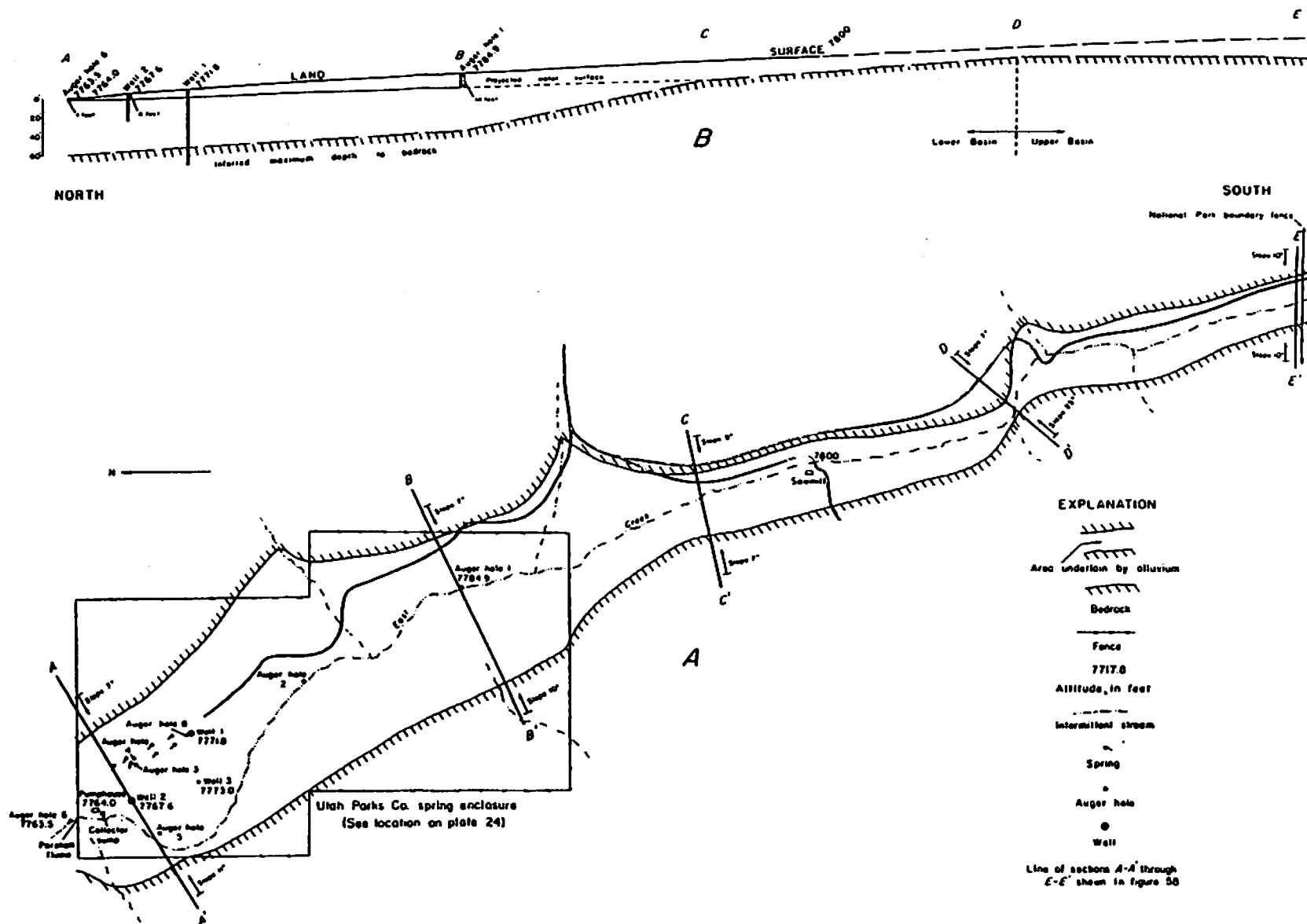


Figure 3. Plate 24 from Marine (1963); Map of Bryce Canyon National Park area, Utah, showing physiographic features and the location of springs and wells.



A. MAP OF EAST CREEK VALLEY SHOWING AREA UNDERLAIN BY ALLUVIUM; B. NORTH-SOUTH SECTION OF EAST CREEK VALLEY SHOWING INFERRED MAXIMUM DEPTH TO BEDROCK AND THE POSITION OF THE WATER TABLE IN MAY 1957

Figure 4. Plate 25 from Marine (1963)

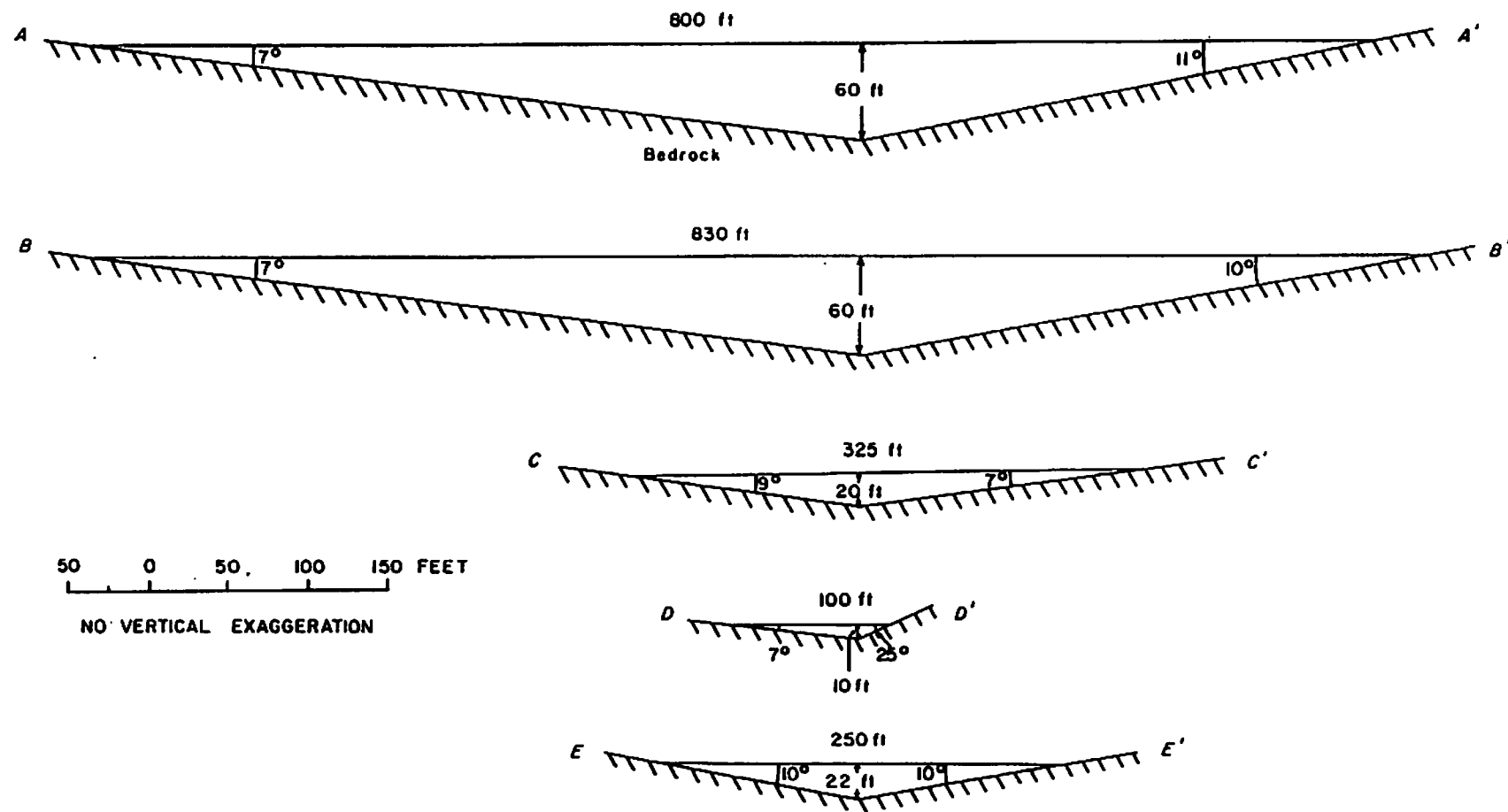


FIGURE 58.—Selected schematic cross sections across East Creek valley showing approximate thickness of alluvium. The locations of the cross sections are shown on plate 25A.

Figure 5. Figure 58 from Marine (1963)

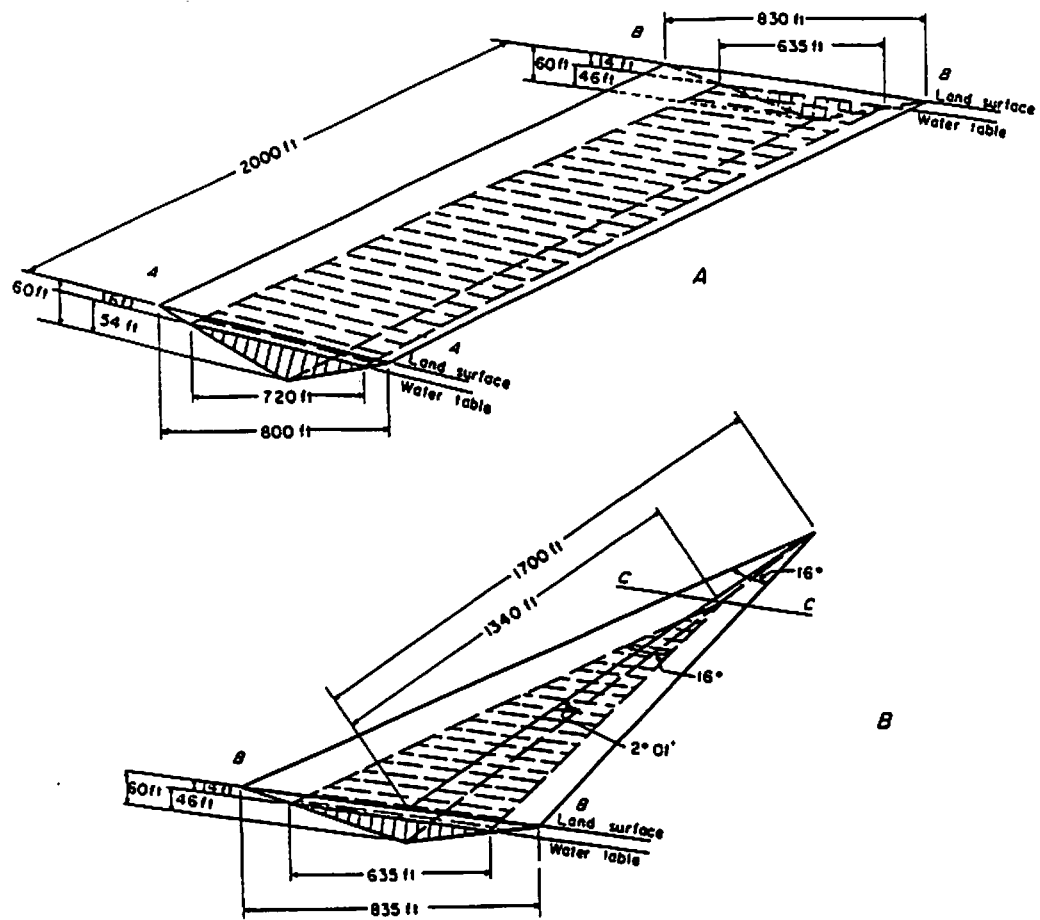


FIGURE 59.—Schematic diagrams of saturated alluvium in parts of East Creek valley, May 1957. A, segment between cross sections A-A' and B-B'; B, segment between cross sections B-B' and C-C'. Locations of cross sections are shown on plate 25A.

Figure 6. Figure 59 from Marine (1963)

with the geologic log for the well, but does make sense if the depth of the alluvium is 60 feet, as reported by Marine (1962). Well No. 2 is reported to be 52½ feet deep. Well No. 3 is probably about the same depth. Both Wells 2 and 3 presumably have about 10 feet of perforated casing at the bottom of the well.

Finished floor elevation of the pumphouse for Well No. 1 is 7774 feet msl. Finished floor elevation for Well No. 2 is 7771 feet msl.

2.3 Aquifer Data - R309-1 13-9(5) (a) (iv):

Figure 8 is a hydrograph of the static water level measurements in Well No. 1. The water table is lower in the summer months in response to pumping (approximately 3,000,000 gallons per month), higher evapotranspiration rates, and less recharge from precipitation. The aquifer is generally fully recharged in the winter and spring in response to precipitation and snowmelt.

A controlled test was conducted at the well field on September 7-12, 1997. Static water level measurements were taken twice daily for 3 days preceding the start of the pumping portion of the test. Well No. 1 was pumped at 145 gpm (gallons per minute) for 24 hours. Water level recovery was monitored for 24 hours following the pumping period. Water levels were monitored in Wells No. 1, 2, and 3 throughout the test period. A hydrograph of water levels in each of the monitor wells during the testing period is shown on Figure 9. Aquifer test data are included in Appendix A.

Bryce Canyon National Park
East Creek Well No. 1

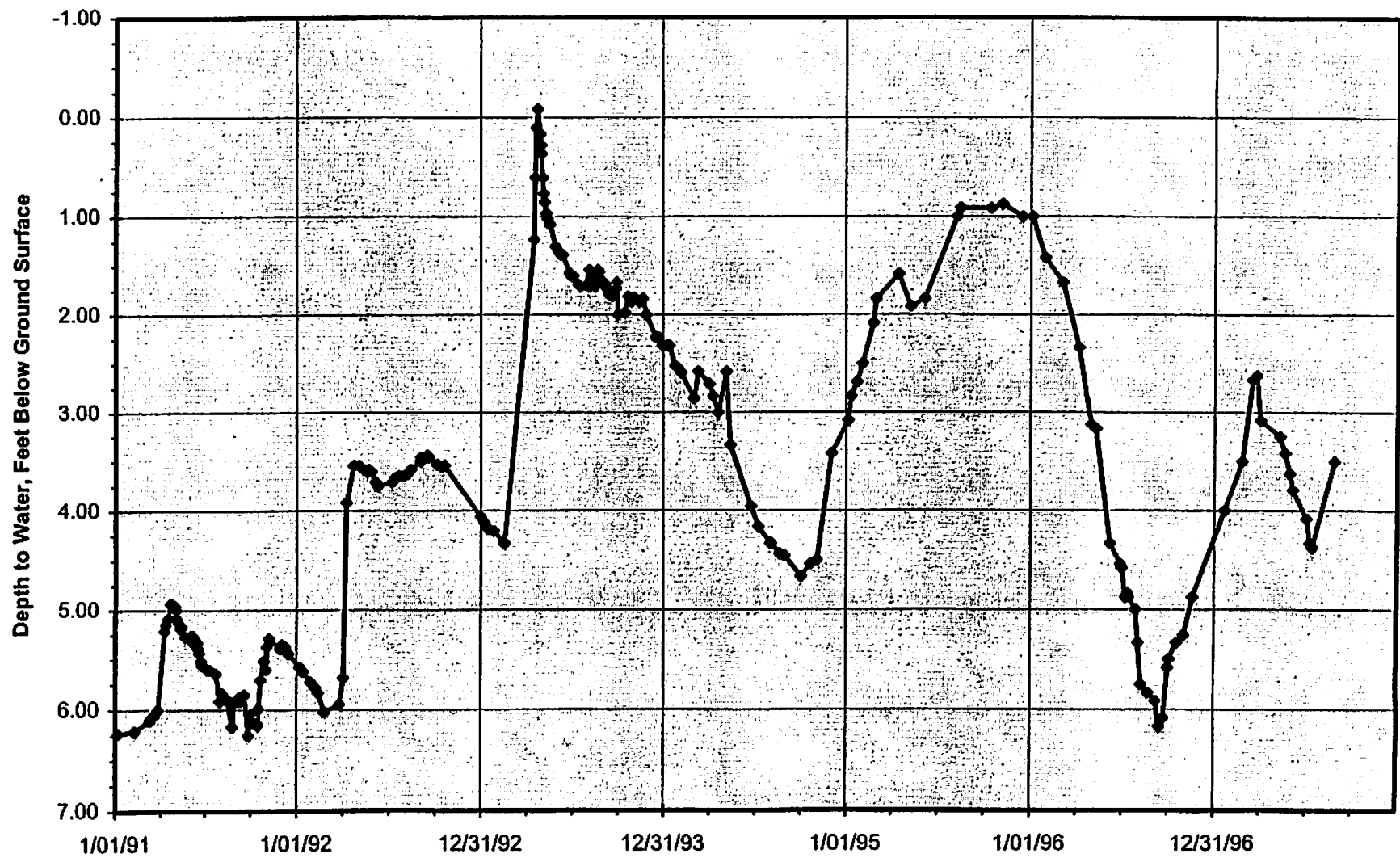


Figure 8. Hydrograph of static water level measurements at East Creek Well No. 1.

Bryce Canyon National Park
East Creek Well Field

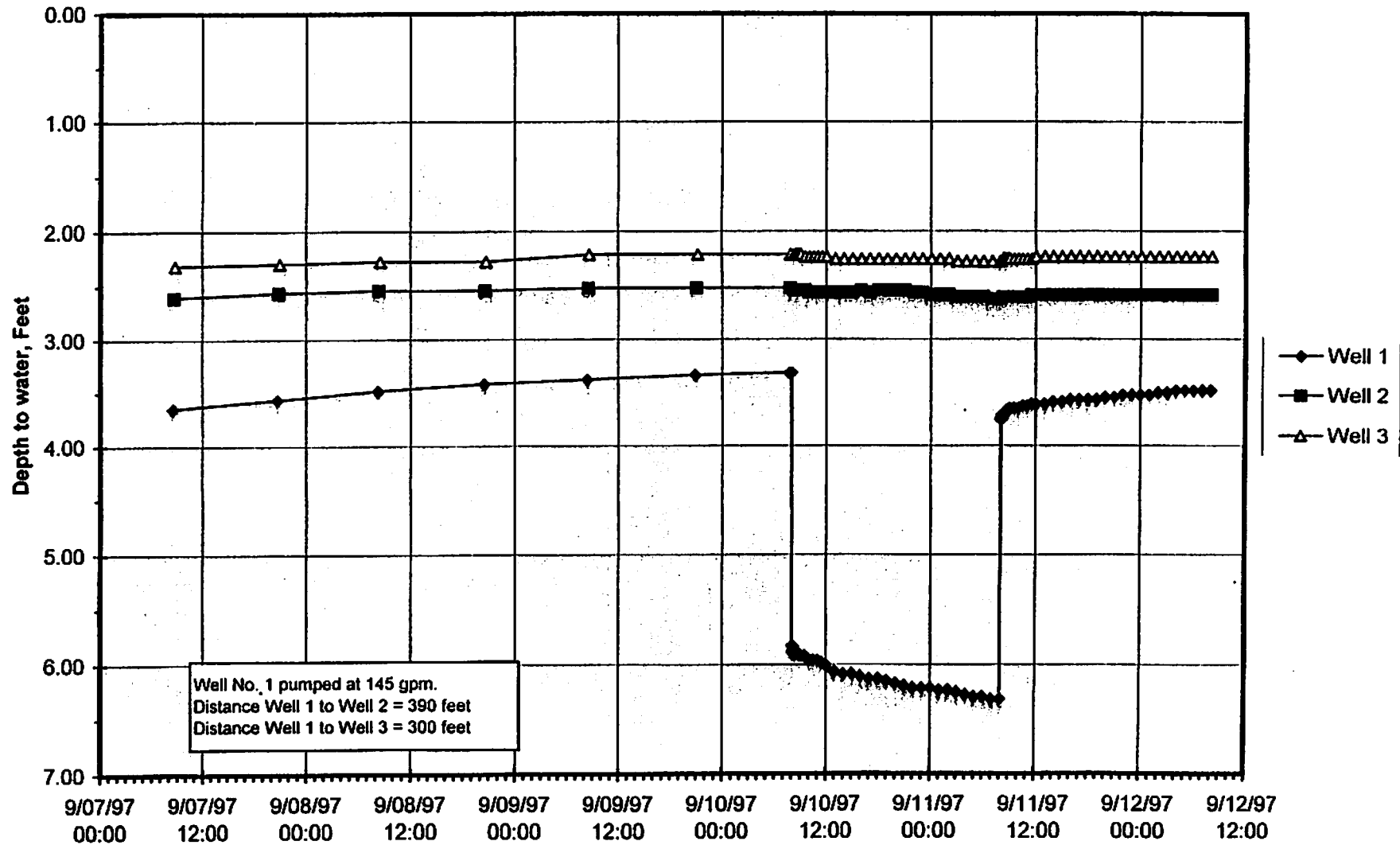


Figure 9. Hydrographs of water table response to pumping at Well No. 1.

Water level in Well No. 1 was drawn down $2\frac{1}{2}$ feet immediately after the pump was turned on. The water level was gradually drawn down another 0.5 foot over the next 24 hours. Water level in the well rose $2\frac{1}{2}$ feet immediately after the pump was turned off and then continued to rise slowly for the remainder of the 24-hour recovery period. Recovery during the 24-hour period was incomplete, remaining 0.17 foot below the pre-pumping static level. Water level in Well No. 2 was gradually drawn down about 0.1 foot during the course of the 24-hour test. Recovery during the 24-hour period following pumping was incomplete, stopping at 0.06 feet below the pre-pumping static level. Water level in Well No. 3 was gradually drawn down about 0.06 foot during the course of the 24-hour test. Recovery during the 24-hour period following pumping was incomplete, stopping at 0.02 feet below the pre-pumping static level.

Aquifer test data were analyzed by a method described by Moench (1993) which uses the analytical model of Neuman (1974) for flow to a partially penetrating well in a water table aquifer. To perform the analysis, water level measurements were converted to drawdown, and time was divided by the square of the radial distance between the pumped well and the observation well. A radial distance of 0.5 foot was used for measurements at the pumped well. Composite time-drawdown plots (h as a function of t/r^2) were then drawn for type curve analysis. The procedure described by Moench (1993) was used to generate computed values for the type curves.

Composite time-drawdown plots for the monitor wells are shown on Figure 10. Superimposed on the data are the type curves that resulted in the "best" fit to the data, as determined by visual inspection. Also shown for reference purposes is the Theis type curve with dimensionless time defined with respect to specific yield. To avoid confusion, the type curves are plotted without displaying the coordinate axes. The type curves are plotted on the same scale as the composite time-drawdown data plots and the match points are located at a dimensionless drawdown of $h_D=1$ and dimensionless time of $t_{Dy}=1$. Transmissivity and specific yield are calculated from the definitions of h_D and t_{Dy} , and from the value of the match points in the figures.

$$h_D = \frac{4\pi T(h_i - h)}{Q} \quad (1)$$

$$t_{Dy} = \frac{Tt}{r^2 S_y} \quad (2)$$

Trial-and-error calibration was used to determine that a best fit of observed data to type curves occurred for a K_z/K_r ratio of 0.10 (1:10). (K_z/K_r is the ratio of vertical to horizontal hydraulic conductivity.)

The match point of the type curves and time-drawdown plots occurs at $h_D=1$, $t_{Dy}=1$, $t/r^2=0.06 \text{ ft/min}^2$, and $h-h_i=0.25$ feet. Substituting these values in equations 1 and 2, along with the pumping rate (Q) of 145 gpm allows calculation of transmissivity (T) and specific yield (S_y) for the aquifer. Calculated transmissivity of the

East Creek Aquifer Test Data

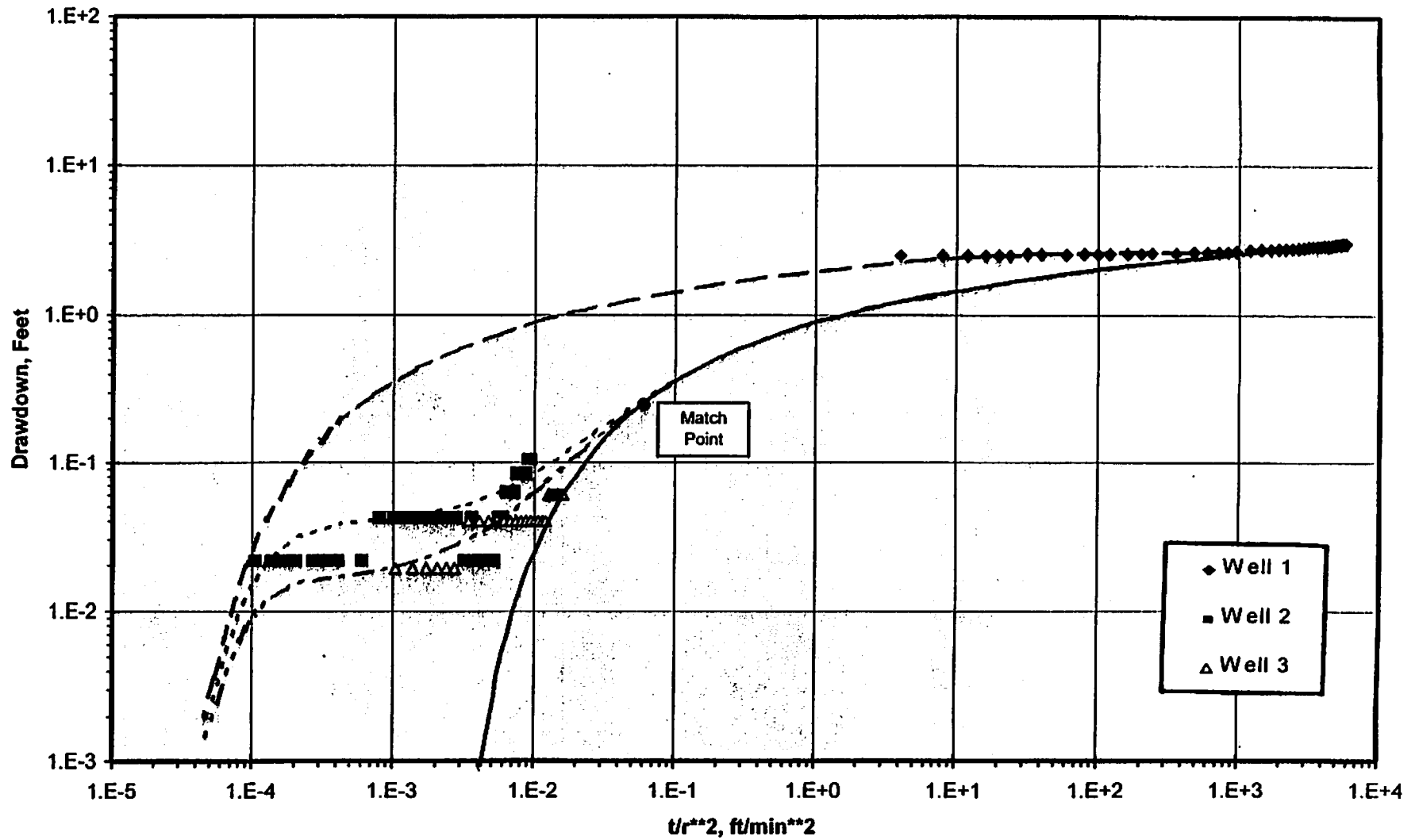


Figure 10. Time-drawdown data and type curves.

alluvial aquifer is 8900 ft²/day and calculated specific yield is 0.37. Based on a transmissivity of 8900 ft²/day and an aquifer thickness of 60 feet, the calculated horizontal hydraulic conductivity (K_r) is 150 ft/day. These values are within the expected range for this type of hydrogeologic setting.

The hydraulic gradient in the alluvial aquifer was estimated from water level measurements in Well 1 and 2. These two wells are approximately aligned with the profile of the valley, with Well 2 being down the valley from Well 1. Water table elevations at the two wells were determined from known elevations at each well and depth to water measurements at the start of the aquifer test (Sept. 10, 1997). The water table elevation at Well 1 was 7770.69 and at Well 2 it was 7768.48. The distance between wells is 390 feet. The calculated hydraulic gradient between the wells is 0.0057 ft/ft.

Marine (1963) also provided data suitable for calculating the gradient of the water table in the vicinity of the well field. Auger hole 1 (upstream from the well field) had a surface elevation of 7784.9 and depth to water of 14 feet. Auger hole 6 (downgradient of the well field) had a surface elevation of 7763.5 and depth to water of 1 foot. The distance between auger hole 1 and 6 is 2000 feet. Calculated hydraulic gradient is 0.0042 ft/ft.

2.4 Hydrogeologic Methods, Procedures, and Calculations - R309-113-9(5) (a) (vii) :

Water use at Bryce Canyon National Park ranges from about 15-20,000 gallons per day in winter to 80-120,000 gallons per day in summer. For purposes of estimating contributing area and protection zones for the well, average daily use was assumed to be 112,000 gallons per day (15,000 ft³/day). This is approximately the daily pumpage in summer, but greatly overestimates the average daily pumpage in winter. The result is that estimates of the size of contributing areas and protection zones are larger than if the average annual pumping rate had been used in the groundwater models. Because the aquifer transmits large volumes of water from the upper part of the drainage basin through the alluvial aquifer and past the well field, it seemed reasonable to delineate protection zones based on a large pumping rate to highlight the vulnerability of the aquifer to potential pollution.

Zones of contribution to the well for time periods of 250 days, 3 years, and 15 years were estimated using the MWCAP module of EPA's WHPA groundwater model (Blandford and Huyakorn, 1991). The model area was originally set up to resemble the actual field conditions; a linear alluvial aquifer trending toward the NNW, a depth of 60 feet, and having impermeable lateral boundaries. It was determined that the highly transmissive nature of the aquifer resulted in computation of narrow, linear contributing areas. The lateral impermeable boundaries did not affect the size or shape of contributing areas and were deemed irrelevant to delineating the contributing areas to the wells. Although the model area was 3

miles by 3 miles, for practical purposes, the only relevant part of the model is the linear alluvial valley aquifer upstream from the well field. The following parameters were used in the MWCAP module of EPA's WHPA module.

Grid Size.....	15,840 by 15,840 feet
Well Location.....	x=2,530 feet, y=13,710 feet
Well Discharge Rate.....	15,000 ft ³ /d
Transmissivity.....	8,900 ft ² /d
Hydraulic Gradient.....	0.005 ft/ft
Angle of Ambient Flow.....	120 degrees
Aquifer Porosity.....	0.35
Aquifer Thickness.....	60 feet
Boundary Type.....	Barrier
Distance from Well to Boundary....	500 feet
Orientation of Barrier.....	210 degrees
Capture Zone Type.....	Time-Related
Travel Time.....	250, 1100, and 5500 days
Number of Pathlines.....	20

Results of the computer modeling are shown in Figure 11. The computer model depicts a contributing area to the well which is about 400 feet wide and extends 800, 2600, and 12,000 feet upstream from the well for the 250-day, 3-year, and 15-year groundwater travel times. These predictions are based on assuming the aquifer is homogeneous, isotropic, infinite areal extent, etc. Obviously, this is not true. It would be unrealistic to attempt to

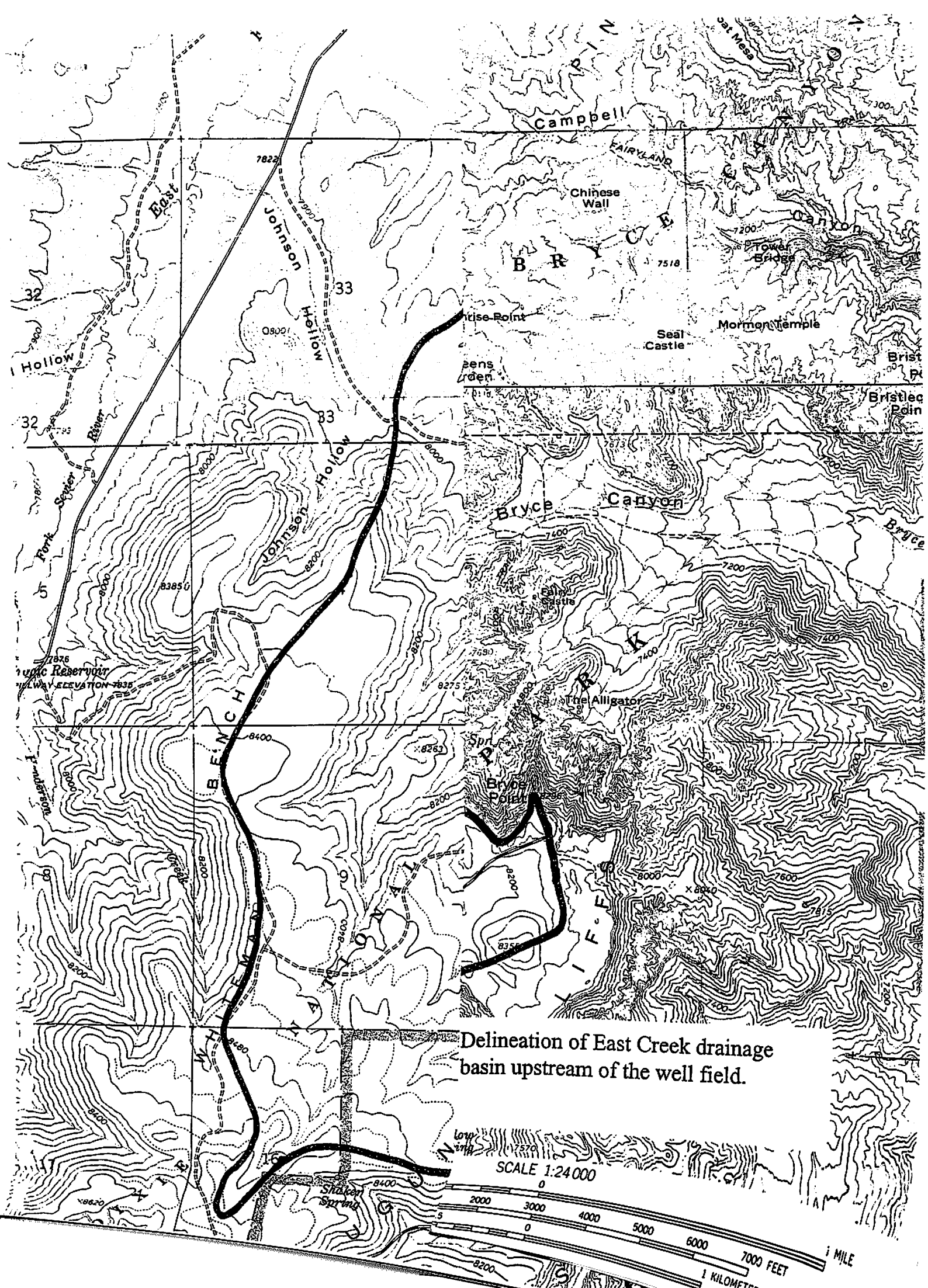
prepare a model of sufficient detail to allow more accurate prediction of contributing areas to the well.

2.5 Map Showing Boundaries of the DWSP Zones -

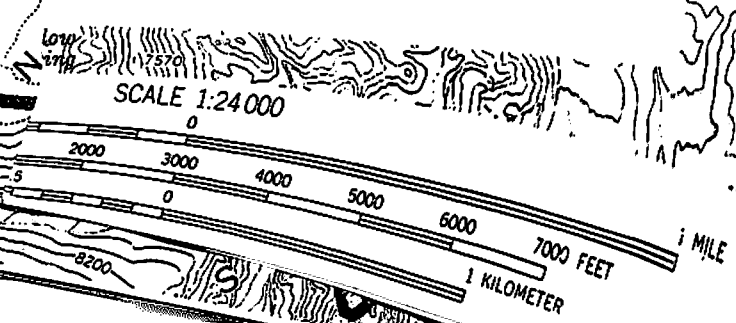
R309-1 13-9(5) (a) (viii):

A more realistic depiction of protection areas for the East Creek well field is shown in Figure 12. This figure is a combination of computer modeling predictions and hydrogeologic interpretation. Zone II, 250-day groundwater travel time, is unchanged. Zone II includes an area about 400 feet wide and extending about 100 feet downstream and 700 feet upstream from the well. Zone III, 3-year groundwater travel time, coincides with Zone II at the downstream side of the well and gradually widens to include the entire alluvial valley a couple hundred feet upstream from the fenced well field enclosure. Zone IV, 15-year groundwater travel time, includes the entire alluvial valley upstream from the well field to the highway inside the park.

The alluvial aquifer and East Creek are hydrologically interconnected. Water (and contaminants) in the creek can readily enter the aquifer at any point upstream of the well field. Any contaminant that might be spilled anywhere in the drainage basin can be transported by surface runoff and enter the alluvial aquifer near the well field, greatly reducing the travel time from the contaminant source to the well field. The drainage area upstream of the East Creek well field is shown in Figure 13. Any contaminants introduced or spilled on the surface anywhere in the drainage area could be transported downstream with surface runoff,



Delineation of East Creek drainage basin upstream of the well field.



infiltrate into the alluvial aquifer (possibly very near the well field), and potentially contaminate the drinking water supply. Thus it is very important for park staff to be aware that any surface activities in the drainage basin can affect their drinking water supply.

3.0 LIST OF POSSIBLE POTENTIAL CONTAMINATION SOURCES AND ASSESSMENT OF THEIR CONTROLS - R309-113-10

Potential contaminants could occur as three distinct sources at Bryce Canyon National Park. The first source is contaminants that may occur, or are introduced, in the groundwater system within the protection zones. The second source is contaminants that occur, or are released, on the surface outside the protection zones, but which may enter the protection zones by surface runoff and infiltration. A third source, contaminants occurring or introduced in the groundwater outside the protection zones, are not included in further discussions, as they are beyond the 15-year groundwater travel time to the well and therefore beyond the scope of this plan.

There are no known contaminant sources within the delineated protection zones for the East Creek well field. Possible potential contamination sources include; fecal contamination from cattle and wildlife, spills related to traffic accidents, illegal dumping, road construction and maintenance, and pesticide or herbicide use.

Primary land uses within the area include dispersed seasonal grazing on Forest Service land and dispersed recreation within the park and on Forest Service land. All campgrounds and major visitor facilities in the park are outside the drainage basin of East Creek. Three small parking areas occur within the drainage basin of East Creek. These are at Inspiration Point, Bryce Point, and Paria View. Runoff from parking areas at these sites might introduce small quantities of contaminants to ephemeral streams which are tributary to East Creek. The effect of these contaminants would be greatly reduced by dilution as they traveled downstream from headwaters areas. The other main concern is automobile or RV accidents along that section of the park road traversing the drainage basin of East Creek. This segment of the road is approximately 3½ miles long, starting just south of Sunset Campground. The road is at the upgradient end of the estimated 15-year groundwater travel time zone.

Any accident along the road which resulted in a spill of gas or oil would result in response from park crews who would recover much of the spilled material. Dilution would further reduce the potential impact. Monitoring would be conducted more frequently to determine if further action needed to be taken. A spill from a traffic accident along the road would be an infrequent event, rather than a chronic, long-term or large source. The road deadends in the park so there is no through traffic. Delivery trucks traveling to park offices or the Bryce Canyon Lodge would not travel into this part of the park.

Accidental spills from traffic accidents along the segment of the park road in the drainage basin of East Creek are not considered a contaminant source for the East Creek well field. Accidental spills would occur infrequently and be transient occurrences. Recovery of spilled material at the accident site and dilution would mitigate effects of spilled materials. Much of the spilled material that was not recovered at the site, would likely flow down the creek, past the well field, without infiltrating into the aquifer. Contaminants that did infiltrate into the groundwater system at the spill site would have approximately a 15-year travel time to reach the well field.

3.1 List Possible Potential Contamination Sources

R309-113- 10(1):

Potential contamination sources that could occur within the source areas include; illegal dumping, pesticide or herbicide use on Forest Service land, traffic accidents on National Park Service or Forest Service roads, cattle grazing, and fuel and oil spills from road construction and maintenance equipment. None of these contaminant sources are known to exist within the source areas for the wells at this time. There is a potential for these types of contaminant sources to occur, especially given the large tracts of Forest Service land with uncontrolled access, surrounding the wellfield.

3.2 Identify Hazards:

Cattle grazing and large herds of elk and deer occur regularly in the open valley surrounding the wellfield. Concentrations of large mammals are a potential source of fecal contamination of the water source. Fuels, oils, chemicals, etc. are not routinely stored within the drainage area of East Creek upstream from the

wells. Traffic accidents, road construction and maintenance, and illegal dumping all have the potential to introduce unknown quantities of various contaminants. Illegal chemical dumping may be especially tempting on the Forest Service lands where uncontrolled access and limited traffic decreases the potential for detection of this type of activity.

3.3 Identify Current Controls - R309-113-10(4):

Part of the National Park Service land comprising the East Creek wellfield is fenced. The Park boundary is fenced and access via Park roads requires passage through the entrance station. There is no control of access to Forest Service land surrounding the wellfield.

3.4 Assess Current Controls - R309-113-10(5):

Cattle, elk, and deer occasionally breach the fence enclosing the wellfield. The fence should be replaced with a more sturdy construction and the fenced area enlarged to include the entire 100 acre parcel under the ownership of the National Park Service. This would maximize the source area protected from fecal contamination by large mammals.

Access to that portion of the source area within the park boundary is controlled by the presence of an entrance station on the main road entering the park. All other roads have locked gates at the park boundary.

Access to Forest Service land surrounding the wellfield is uncontrolled. Visitors to Forest Service lands within the source area are most likely unaware that they are within the source area for a public water supply.

3.5 Assess Management Procedures:

Current management procedures, while adequate, could be better. Maximum protection for the East Creek water supply wells would require limiting access to the wellfield area and contributing zones by humans and animals. The fenced area should be enlarged to include the entire three year travel time protection zone. The fence should be sturdy enough to withstand entry by cattle, elk, or deer. Access to surrounding Forest Service land is uncontrolled. Visitors to Forest Service land are unaware they are within the source area of a public water supply. Signage should be placed along the park road to inform visitors they are entering or leaving a public water supply area.

3.6 Assess if Risk is Negligible:

Dispersed grazing by cattle, elk, and deer represents a negligible risk to the East Creek wells. Better maintenance of the fence and enlargement of the fenced area would provide more protection from fecal contamination. The water supply is chlorinated in the park, further reducing the potential risk of bacterial contamination.

Accidental spills of oil and gas from traffic accidents and road construction or maintenance projects are a negligible risk to the East Creek wells. Spills should be an infrequent occurrence and of limited quantities. Cleanup and spill recovery following accidents should limit the quantities of contaminants released to the environment. Large tanker trucks are not likely to be on park roads in the drainage of East Creek, except during periods of road maintenance, as there is no through traffic in the park.

Illegal dumping in the drainage basin of East Creek upstream of the wellfield is unlikely to occur because there is poor access to this area. Access to the main park road is limited by presence of an entrance station near park headquarters. Illegal

dumping in the park would require stopping along a well-traveled, patrolled road. Illegal dumping on Forest Service roads would require significant diligence on the part of the perpetrator as there are no direct, easy routes to this area. It would appear that there are many other more accessible areas that would not bring the perpetrators within close proximity of a national park, where large numbers of people might potentially observe and report suspicious activities. However, it would be prudent to limit access and travel to this part of the national forest to provide maximum protection for the wellfield.

4.0 PRIORITIZED INVENTORY OF POTENTIAL CONTAMINATION SOURCES

R309-113-10

There are no known contaminant sources (as defined in the Utah Source Protection User's Guide) within the delineated protection zones for the East Creek wellfield.

4.1 Prioritized Inventory - R309-113-10(1)

Not Applicable

4.2 Potential Contamination Source Location - R309-113-10(1)

Not Applicable

4.3 Potential Contamination Sources Plotted on Map

Not Applicable

**5.0 MANAGEMENT PROGRAM TO CONTROL EACH PREEXISTING POTENTIAL
CONTAMINATION SOURCE - R309-113-11**

There are no contaminant sources (as defined in the Utah Source Protection User's Guide) within the delineated protection zones for the East Creek wellfield.

**6.0 MANAGEMENT PROGRAM TO CONTROL AND PROHIBIT FUTURE POTENTIAL
CONTAMINATION SOURCES - R309- 113-12**

Bryce Canyon National Park will not construct additional facilities or change land management practices that might result in introduction of potential contaminants in the delineated protection zones for the East Creek well field. The park will vigorously resist any proposals for land use changes on Forest Service land which might result in adverse impacts to the park's water supply.

Several potential contaminant sources could be introduced to the source area of the wells if adequate protective actions are not taken, as described below.

The fenced area surrounding the wellfield should be enlarged to include all of the three year protection zone. The fence should be sturdy enough to resist the pressure of large numbers of cattle, elk, and deer.

Any vehicle passing through the source area within the park or on Forest Service land represents a potential contaminant source. Park staff must be made aware of which sections of the roads in the park are within the source area of the wellfield and act accordingly when responding to traffic accidents or performing

road maintenance in this area. Signage along the park road would alert visitors and remind park staff regarding which section of the park road is within the source area. The park will have an approved Spill Plan in place and the appropriate clean-up equipment available in the event of a hazardous materials spill.

Uncontrolled access to Forest Service land surrounding the East Creek wellfield presents an ongoing threat to the Park's drinking water supply. Management options to reduce this threat include; signage along all roads to alert users they are in the source area of a public water supply, increased patrolling on Forest Service land by National Park Service and Forest Service rangers, initiating Forest Service closure of the area by installation of locked access gates, or transfer of all land within the source area to National Park Service ownership (with fencing and locked gates to limit access).

7.0 IMPLEMENTATION SCHEDULE- R309-113-7(1) (e)

Not Applicable

8.0 RESOURCE EVALUATION - R309-1 13-7(1) (f)

Not Applicable

9.0 RECORDKEEPING - R309-1 13-7(1) (g)

Not Applicable

10.0 CONTINGENCY PLAN - R309-113-14

Bryce Canyon National Park's water supply wells in East Creek are subject to regular water quality monitoring as required by the State of Utah and the National Park Service, both bacteriological and chemical quality. There are no contaminant sources within the delineated protection zones for the well. There is no planned future development, within protection zones, that might result in introduction of contaminants in the protection zones.

In the unlikely event that the water source for this well did become contaminated, some combination of the following actions would be taken. The actual contingency plan would be developed depending on the type of contamination, extent of time the well is expected to be affected, and potential for remediation of the problem.

1. Close the campgrounds and/or Bryce Canyon Lodge to reduce water demand.
2. Close down all visitor services.
3. Provide portable toilets to reduce water demand.
4. Close the park to visitors.
5. Truck water in for use by park residents.
6. Construct new water supply wells in East Creek, Daves Hollow, or other alluvial valleys.
7. Pump water from the deep test well and construct appropriate treatment facilities.
8. Reactivate the old "Headquarters Well".

REFERENCES

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APPENDIX A

AQUIFER TEST DATA

BRYCE CANYON NATIONAL PARK

EAST CREEK WELL FIELD

SEPTEMBER 7 - 12, 1997

Bryce Canyon National Park Well Test Data						
Well: East Creek # 1						
DATE	TIME	Pumping Time Minutes	Time Since Pump Off Minutes	DTW feet	Drawdown feet	Residual Drawdown Feet
9/7/97	8:30			3.65		
9/7/97	20:42			3.56		
9/8/97	8:18			3.48		
9/8/97	20:31			3.42		
9/9/97	8:25			3.38		
9/9/97	20:55			3.33		
9/10/97	7:45			3.31		
9/10/97	8:00			3.31		
9/10/97	8:01	1		5.83	2.52	
9/10/97	8:02	2		5.83	2.52	
9/10/97	8:03	3		5.83	2.52	
9/10/97	8:04	4		5.83	2.52	
9/10/97	8:05	5		5.83	2.52	
9/10/97	8:06	6		5.83	2.52	
9/10/97	8:08	8		5.90	2.59	
9/10/97	8:10	10		5.88	2.57	
9/10/97	8:15	15		5.85	2.54	
9/10/97	8:20	20		5.90	2.59	
9/10/97	8:25	25		5.88	2.57	
9/10/97	8:30	30		5.90	2.59	
9/10/97	8:40	40		5.90	2.59	
9/10/97	8:50	50		5.90	2.59	
9/10/97	9:00	60		5.92	2.61	
9/10/97	9:30	90		5.92	2.61	
9/10/97	10:00	120		5.96	2.65	
9/10/97	10:30	150		5.96	2.65	
9/10/97	11:00	180		5.96	2.65	
9/10/97	11:30	210		5.98	2.67	
9/10/97	12:00	240		6.00	2.69	
9/10/97	13:00	300		6.06	2.75	
9/10/97	14:00	360		6.08	2.77	
9/10/97	15:00	420		6.08	2.77	
9/10/97	16:00	480		6.10	2.79	
9/10/97	17:00	540		6.13	2.82	
9/10/97	18:00	600		6.13	2.82	
9/10/97	19:00	660		6.15	2.84	
9/10/97	20:00	720		6.17	2.86	
9/10/97	21:00	780		6.19	2.88	
9/10/97	22:00	840		6.21	2.90	
9/10/97	23:00	900		6.21	2.90	
9/11/97	0:00	960		6.21	2.90	
9/11/97	1:00	1020		6.23	2.92	
9/11/97	2:00	1080		6.23	2.92	
9/11/97	3:00	1140		6.25	2.94	

All measurements are feet below ground surface.

Bryce Canyon National Park Well Test Data

Well: East Creek # 2

DATE	TIME	Pumping Time Minutes	Time Since Pump Off Minutes	DTW feet	Drawdown feet	Residual Drawdown Feet
9/7/97	8:38			2.60		
9/7/97	20:51			2.56		
9/8/97	8:23			2.54		
9/8/97	20:37			2.54		
9/9/97	8:32			2.52		
9/9/97	21:05			2.52		
9/10/97	7:49			2.52		
9/10/97	8:16	16		2.54	0.02	
9/10/97	8:21	21		2.54	0.02	
9/10/97	8:26	26		2.54	0.02	
9/10/97	8:31	31		2.54	0.02	
9/10/97	8:41	41		2.54	0.02	
9/10/97	8:51	51		2.54	0.02	
9/10/97	9:02	62		2.54	0.02	
9/10/97	9:32	92		2.54	0.02	
9/10/97	10:02	122		2.56	0.04	
9/10/97	10:32	152		2.56	0.04	
9/10/97	11:02	182		2.56	0.04	
9/10/97	11:32	212		2.56	0.04	
9/10/97	12:02	242		2.56	0.04	
9/10/97	13:02	302		2.56	0.04	
9/10/97	14:02	362		2.56	0.04	
9/10/97	15:02	422		2.56	0.04	
9/10/97	16:02	482		2.54	0.02	
9/10/97	17:02	542		2.56	0.04	
9/10/97	18:02	602		2.54	0.02	
9/10/97	19:02	662		2.54	0.02	
9/10/97	20:02	722		2.54	0.02	
9/10/97	21:02	782		2.54	0.02	
9/10/97	22:02	842		2.56	0.04	
9/10/97	23:02	902		2.56	0.04	
9/11/97	00:02	962		2.58	0.06	
9/11/97	1:02	1022		2.58	0.06	
9/11/97	2:02	1082		2.58	0.06	
9/11/97	3:02	1142		2.60	0.08	
9/11/97	4:02	1202		2.60	0.08	
9/11/97	5:02	1262		2.60	0.08	
9/11/97	6:02	1322		2.60	0.08	
9/11/97	7:02	1382		2.63	0.11	
9/11/97	7:54	1434		2.63	0.11	

All measurements are feet below ground surface.

Bryce Canyon National Park Well Test Data						
Well: East Creek # 3						
		Pumping	Time Since			Residual
DATE	TIME	Time	Pump Off	DTW	Drawdown	Drawdown
		Minutes	Minutes	feet	feet	Feet
9/7/97	8:45			2.31		
9/7/97	20:58			2.29		
9/8/97	8:34			2.27		
9/8/97	20:44			2.27		
9/9/97	8:37			2.21		
9/9/97	21:14			2.21		
9/10/97	7:52			2.21		
9/10/97	8:18	18.00		2.21	0.00	
9/10/97	8:23	23.00		2.21	0.00	
9/10/97	8:28	28.00		2.21	0.00	
9/10/97	8:33	33.00		2.21	0.00	
9/10/97	8:43	43.00		2.21	0.00	
9/10/97	8:53	53.00		2.21	0.00	
9/10/97	9:04	64.00		2.21	0.00	
9/10/97	9:34	94.00		2.23	0.02	
9/10/97	10:04	124.00		2.23	0.02	
9/10/97	10:34	154.00		2.23	0.02	
9/10/97	11:04	184.00		2.23	0.02	
9/10/97	11:34	214.00		2.23	0.02	
9/10/97	12:04	244.00		2.23	0.02	
9/10/97	13:04	304.00		2.25	0.04	
9/10/97	14:04	364.00		2.25	0.04	
9/10/97	15:04	424.00		2.25	0.04	
9/10/97	16:04	484.00		2.25	0.04	
9/10/97	17:04	544.00		2.25	0.04	
9/10/97	18:04	604.00		2.25	0.04	
9/10/97	19:04	664.00		2.25	0.04	
9/10/97	20:04	724.00		2.25	0.04	
9/10/97	21:04	784.00		2.25	0.04	
9/10/97	22:04	844.00		2.25	0.04	
9/10/97	23:04	904.00		2.25	0.04	
9/11/97	00:04	964.00		2.25	0.04	
9/11/97	1:04	1024.00		2.25	0.04	
9/11/97	2:04	1084.00		2.25	0.04	
9/11/97	3:04	1144.00		2.27	0.06	
9/11/97	4:04	1204.00		2.27	0.06	
9/11/97	5:04	1264.00		2.27	0.06	
9/11/97	6:04	1324.00		2.27	0.06	
9/11/97	7:04	1384.00		2.27	0.06	
9/11/97	7:58	1438.00		2.27	0.06	

		Pumping	Time Since			Residual
DATE	TIME	Time	Pump Off	DTW	Drawdown	Drawdown
		Minutes	Minutes	feet	feet	Feet
9/11/97	8:18		18	2.25		0.04
9/11/97	8:23		23	2.25		0.04
9/11/97	8:28		28	2.25		0.04
9/11/97	8:33		33	2.25		0.04
9/11/97	8:43		43	2.25		0.04
9/11/97	8:53		53	2.25		0.04
9/11/97	9:04		64	2.25		0.04
9/11/97	9:34		94	2.25		0.04
9/11/97	10:04		124	2.25		0.04
9/11/97	10:34		154	2.25		0.04
9/11/97	11:04		184	2.25		0.04
9/11/97	11:34		214	2.25		0.04
9/11/97	12:04		244	2.23		0.02
9/11/97	13:04		304	2.23		0.02
9/11/97	14:04		364	2.23		0.02
9/11/97	15:04		424	2.23		0.02
9/11/97	16:04		484	2.23		0.02
9/11/97	17:04		544	2.23		0.02
9/11/97	18:04		604	2.23		0.02
9/11/97	19:04		664	2.23		0.02
9/11/97	20:04		724	2.23		0.02
9/11/97	21:04		784	2.23		0.02
9/11/97	22:04		844	2.23		0.02
9/11/97	23:04		904	2.23		0.02
9/12/97	00:04		964	2.23		0.02
9/12/97	1:04		1024	2.23		0.02
9/12/97	2:04		1084	2.23		0.02
9/12/97	3:04		1144	2.23		0.02
9/12/97	4:04		1204	2.23		0.02
9/12/97	5:04		1264	2.23		0.02
9/12/97	6:04		1324	2.23		0.02
9/12/97	7:04		1384	2.23		0.02
9/12/97	8:04		1444	2.23		0.02

All measurements are feet below ground surface.