

June 17-22 trip notes and discussion points on water quality monitoring July 1, 2001 shk

MEMO

July 1, 2001

To: Lee MacDonald, Freeman Smith, John Stednick, Melinda Laituri, Dept of Earth Resources, CSU

From: Sam Kunkle, Santa Fe

Subject: Notes on my June 17-22 trip to SW Utah parks and agency offices.

Dear Lee,

As discussed with Lee and Freeman, I am mailing you a box of items collected on my trip last week to ZION, PISP, CEBR, BRCA, and CARE.

The box includes: maps of the areas; a few "project statements" (NPS proposal on water); an annotated lists of the "gray literature" that I found on water quality in the park files; and copies of some of those literature items or excerpts.

Lee, can you please be the "keeper of these files," since the information mainly is of value as background material for developing monitoring concepts and understanding issues. I'll bring a second batch of materials to Fort Collins when I see you on July 20 at 1:00 pm and mail or bring the third batch in mid August --following my last trip.

I will be in Fort Collins for most of the week of August 27, so can go through all of the papers, maps, etc with you and provide my input on issues, monitoring design concepts, ideas for cooperation/dovetailing, etc. In August, I also assume we will want to draft up a master matrix of issues/impacts for all of the parks.

Melinda: what dates do you visit GOSP, DINO, and FOBU?

As mentioned, after the project completion I would suggest that we give all the collected maps, report copies, etc to the Water Resources Division (WRD) archives room, where they maintain files on water resources on individual parks.

1. THE MAPS IN MY BOX TO YOU ARE:

- Dixie National Forest (east part) --shows drainages around BRCA and some of CARE
- Dixie National Forest (west part) --shows drainages around ZION and CEBR
- Park overview, brochure maps of CARE, CEBR, and BRCA
- Topographic map with the park features of ZION
- Topographic map with the park features of BRCA
- Topographic map with the park features of CARE
- 3' X 3' GIS printout map of ZION drainages
- BLM map of the Grand Staircase-Escalante area.
- Maps in some reports (e.g., the chemicals in the streams in maps of Technical Publication No. 83 on Reconnaissance of the quality of surface water in the Upper Virgin River Basin).

2. "PROJECT STATEMENTS"

Some "project statements" (NPS proposals for projects) are included in the box shipped to you and on my literature lists. These are statements that relate to water quality

monitoring, stream assessments, or related topics that give us a notion of the parks' desire for monitoring.

3. LITERATURE LISTS AND COPIES OF CERTAIN PAPERS

The lists of (mostly) gray literature in each park provide an impression the issues or topics related to water quality monitoring. I have annotated the lists to highlight points pertinent to our project. I copied some papers or excerpts that: discuss water issues; review monitoring needs; summarize pollution concerns; or relate to monitoring.

4. OTHER AGENCIES

On this trip to SW Utah, Dave and I visited Forest Service watershed specialists Joni Brazier and Rich Jaros in Cedar City, and I met with hydrologist Dan Range in Escalante. Dave and I also talked with Joni Vanderbilt, BLM, Grand Staircase-Escalante NM. I have scheduled visits to the State Division of Environmental Quality (DEQ) and several other agencies in Salt Lake City during July 11-12; I have visits planned with FS, USGS, and BLM in Grand Junction, Delta, CO (Grand Mesa/Gunnison NF), and Moab (BLM, FS, and USGS) during July-August.

Some federal agencies have ongoing monitoring relevant to our interests. For example, in several cases, the BLM or FS are cooperating with Utah DEQ and/or the Utah State Univ/BLM "Bug Lab" in Logan. The Utah DEQ people are providing no-cost analyses of certain water samples for the Dixie National Forest (both Cedar City and Escalante areas) and BLM in Moab at this time (as well as SEUG-NPS I gather). These agencies carry out all field sampling, and DEQ conducts lab analyses. DEQ also provides training on sampling techniques. Question we need to ask parks at some point: would such sharing of work be feasible in their particular park?

Lee et al: I have talked with several of the state water quality people in Denver (note my attached updated rolodex of names), but I do not have an adequate grasp of their programs yet and have not visited Denver. I need to talk with you about Denver connections when we meet. What would you add to my rolodex?

5. SOME PRELIMINARY NOTES ON THE PARK VISITS

5.1. SOME BRIEF NOTES ON ZION

I visited with Dave Sharrow, natural resources chief, and Jo Starr, GIS specialist. (I also met briefly with Marty Ott, Superintendent). Zion is a special park in having a hydrologist on staff (Sharrow) and --from what I can tell so far-- probably one of a minority of parks in the NCPN with significant ongoing surface water quality monitoring. Fortunately Dave is willing to take time to lend us a much appreciated hand!

(Note, the literature or maps mentioned below refers to copies of reports, maps or excerpts in the box that I have sent to MacDonald)

Dave's completed questionnaire describes the water resources and issues well at Zion well. My comments add a few additional impressions and flag certain good references in the box I've sent.

A synopsis of the hydrology of the park appears in "General information on Zion hydrology" (3 pp) by Sharrow; this note gives flow characteristics, precipitation depth, flood frequencies, a note on sediment, and a summary of water use.

Dixie National Forest lies adjacent to the park's western and northeastern boundary, while much of the land upstream from the park is in private ownership (see the Dixie National Forest map as well as the page 77 foldout map in the Zion General Management Plan). The large NPS GIS printout of the park also illustrates how upstream influences are prevalent.

Grazing, mining, and other land uses upstream can affect the park's water quality, pointing to a need for the park to monitor incoming waters. The USGS report by Cordy et al describes the "potential effects of mining on ... Zion National park ... less than 3 miles from the (coal-lease tract). The report reviews the water quality concerns and gives good background data.

An overview of water quality impacts from upstream appears in the Sandberg and Sultz Utah/USGS report. They review possible effects of natural geology, irrigation, and grazing, and present a summary of sediment, turbidity, cations/anions metals, DO, bacteria, and conductance data. The Five County Governments report reviews impacts of septic tanks, recreation (including horses), and natural contaminants also inside the park. The Utah Department of Environmental Quality 1998 "Report to Congress" summarizes the water quality concerns in the area (see their page 90 table), as does the report by Vaughn Hansen Assoc (1977).

In the park, recreation impacts and waste disposal are concerns (as Dave also notes in his questionnaire). The Project Statement "Design/implement a water quality monitoring program," describes backcountry and river recreation impacts. The Project Statement also notes concern over the effects of garbage dumps and cattle upstream. Certain areas in the park have particularly heavy recreational use (e.g., "the Narrows" –see Zion map), and are viewed as sites in need of monitoring.

Sharrow (2001) has been conducting interesting monitoring to evaluate recreational impacts, using bacterial DNA techniques to help identify the bacterial source organisms (working with Prof Samandpour at the U of Washington). The report by Shakarjian and Stanford (1997) also gives information on biological work in the park to identify water quality impacts.

Background information exists in the Horizon report (copy at WRD in Ft Collins). Some information on water quality appears in the copies I'm sending you by Gates (1965) on inorganic chemistry, by Hamilton (1975) on springwater, and by Kimball/Christensen (1996) plus Lindahl (1976) on springs/seeps. Yelken (1996) offers geochemical descriptions and data on three springs in the park. Note that a comprehensive inventory of springs is needed (according to Sharrow). Peterson presents a summary of water temperature. The park has expressed the need for monitoring to establish more baseline information, as proposed in the Project Statement "Inventory and monitor aquatic ecosystems."

Maddox et al (1977 –see all three reports) give valuable (albeit now dated) information on chemistry, bacteria, and turbidity and provide useful interpretations. Some of the Maddox et al reports also discuss potential coal mining impacts.

The Dixie National Forest has cooperative water quality monitoring underway northeast of Zion (close to Cedar Breaks) and near Bryce NP, as described in the Mangum (1996) report and gathered from our visits. They emphasize macroinvertebrate monitoring as "one of the best (tools) for monitoring (to)... provide valuable information to assist in making resource decisions." They work with the BLM/USU "Bug Lab" in Logan (replaces the Mangum FS/BYU lab in Provo, now that Fred Mangum has retired).

Joni Brazier, Dixie NF, is buying certain water quality monitoring equipment (e.g., temperature recorders). Dan Range, FS in Escalante, is monitoring turbidity, EC, pH, SO₄ (Hach), temperature, DO (Winkler in field), and macroinvertebrates, also working with the "Bug Lab" of BLM/Utah State University in Logan and the State DEQ (Richard Denton).

The FS is looking for impacts of roads, fire, timber sales, and grazing. DEQ also helps on training for sample collection. Zion and the other parks could possibly cooperate with the Forest Service and BLM in monitoring activities as well as DEQ. Note that the Forest Service is using the State water quality standards, but finds them "hard to understand." (note also that WRD in Fort Collins has been looking at state standards around the country, and reportedly also finds the present Utah standards a challenge to use).

In summary, the park has some distinct needs for WQ monitoring: to characterize baseline water quality prior to future impacts; to evaluate park internal impacts (e.g., recreationists); to track impacts from outside the park (e.g., grazing & mining) impacts; to monitor trends; and as a tool to help protect resources as well as public health.

5.2. SOME BRIEF NOTES ON PIPE SPRING NM

Sharrow also handles the water resource responsibilities for Cedar Breaks and Pipe Spring National Monuments, near Zion.

(The literature or maps that I mention below refers to copies or excerpts in the box that I have sent MacDonald)

The water resources of the 40-acre Pipe Spring NM consist of five springs or seeps in north-central Arizona, about 8 miles from the state line and about 20 miles from Kanab, UT. The springs flow from a fault contact where the permeable Navajo Sandstone aquifer meets an impervious (gypsiferous) bed. Barrett and Williams (1986), Truini (1999), and Inglis (1990) provide good descriptions of the springs and nearby NPS culinary well. Truini (1999) provides details and valuable maps in her report on wells and springs in the general area around the monument. The NPS culinary well, drilled to supplement the springs, sits about 2 miles north of the monument.

The Kaibab-Paiute Indians, the town of Moccasin, and the NPS use water from the springs and wells for domestic and agricultural purposes. The tables in Truini (1999) show data on water quality, including pH, conductance, temperature, hardness, alkalinity, the principal cations and anions, a suite of 19 metals, nitrogen, phosphorus, tritium, H²/H¹, O¹⁸/O¹⁶, strontium, carbon-13 and carbon-14 data (for Truini's tracing and dating work). The water is considered suitable for domestic purposes, although contains somewhat elevated hardness, sulfate, and nitrate.

Water *quantity*, not quality, is the principal issue in the wells and springs of the area. Since 1976, the NPS has observed a decline of about 50 percent in discharge from springs at the monument, with the combined spring discharges decreasing about 2 (gal/min)/yr (Truini, 1999; Barrett and Williams, 1986). Truini's Figures 2 and 3 show this

steady decline over the past quarter century. Possibly well pumping in the area is affecting the spring flows.

Public Health Service monitoring of potable water at NPS sites is routine and will continue. Observation of spring discharge will continue, since this is a clear concern. However, as of this stage at least, Pipe Spring does not appear to be a likely site where additional "surface water monitoring" will be called for.

5.3. SOME BRIEF NOTES ON CEDAR BREAKS NM

Sharrow also handles water resource responsibilities for Cedar Breaks National Monuments, near Zion. We had a brief look at the park together.

(The literature or maps that I mention below refers to copies or excerpts in the box that I have sent MacDonald)

Cedar Breaks NM is a steep, fan-shaped, amphitheater-like, rugged drainage covering an area of about 2 by 4 miles. The monument sits at the upper limits of a watershed divide, at about 10,400 ft. elevation, in an area that receives heavy snows. The drainage from the monument essentially consists of steep ravines sloping to the west. Dixie National Forest surrounds nearly all the monument, and a wilderness area wraps around the monument's west side.

Dave's questionnaire describes the water features well, which mainly are springs. Ashdown Creek originates in the southern edge of Cedar Breaks at about 9,500 ft, but otherwise streams in the monument basically are ephemeral ravines. Because of limited land use around the monument and the headwater, high-elevation setting, very little to no upstream or outside impacts on water quality are expected. No settlements are found in the area.

The park's Statement for Management (1994) focuses on the natural geologic beauty and wonder of the area and how to provide interpretation for visitors. Water resource per se is not discussed in this Statement; however, protection of resources is recognized as a need.

Sumsion (1971) reviews the spring discharges in the monument, which flowed up to about 6 gallons per minute during his observations. He also provides data on water chemistry, displaying water of good quality, with moderate calcium, magnesium, and bicarbonate, cool temperatures, and neutral to slightly alkaline pH. [I did not have the opportunity to review the Public Health Service analyses of the spring, but presumably the quality is still satisfactory].

The Forest Service conducts macroinvertebrate and other monitoring on Mammoth Creek, which originates only a mile from the monument and flows to the east (personal comm., Joni Brazier, June, 2001, and report by Mangum, 1996). Any consideration of monitoring at CEBR naturally will want to coordinate with the FS.

Park water resources are basically the springs. Only a small reach of flowing Ashdown Creek exists in the lower edge of the park (see map) --which is quite difficult to access. Within a regional program of water quality monitoring, the CEBR spring(s) could perhaps play a role as a site to observe baseline or background levels, indicative of pristine springs in these geologic formations.

5.4. SOME BRIEF NOTES ON BRYCE CANYON NP

Dave Sharrow spent most of the day with me at Bryce, giving us the opportunity to meet with Rick Wallen (Natural Resource Chief) and Kelly Cahill (she's Biological Tech and Data Mgt Specialist) and also have a brief look in the field with Rick. I also discussed some park water history with Kelly Shakespear (he's maintenance/facility person).

The park's General Management Plan is 13 years old and Rick advised that it would not be very useful for our needs. I went over the questionnaire with Kelly Cahill, to advise some on its completion (I have not had a chance to see a completed questionnaire at this time).

*(The literature or maps I mention below refers to copies
or excerpts in the box that I have sent MacDonald)*

As seen in the topographic map as well as the park brochure map in the box sent to you, Bryce essentially follows along a N-S ridge, with about a dozen small creeks or washes originating on the park's steeper east escarpments and flowing off easterly or southeasterly. On the much gentler western slopes of the park, fewer but larger creeks flow northwesterly out of the park and into the East Fork of the Sevier River. The park has a few perennial streams, and the Tropic (irrigation) Ditch traverses the northern end of the park and affects surface water resources in the park. Several tributaries to the Paria River appear in the north end of the park, some with perennial flows (Czarnowski, 1991).

Ground water flows along an aquifer and emerges as springs at points where the saturated stratum intersects the surface, for example, near the Under-the-Rim trail. Of special importance from a recreational perspective, the springs occur along the park's eastern boundary where hikers use the springs for drinking. Many of these springs have been impacted by cattle. (Naturally the park advises hikers to use chemical treatment or filtration).

Marine (1963) surveyed the ground-water resources of the park, including analysis of East Creek, the major creek flowing to the northwest and the main source of park water supply. The Czarnowski report (1991) also generally reviews the area's geohydrology. A well about 60 ft deep in East Creek is the park's main water supply (at the western edge of the park, toward the Sevier River) and pumped uphill. Routine water analyses are taken on the culinary water for public health protection. We looked over copies of data, showing good quality water. The analyses cover the common cations, anions, nutrients, and metals, plus periodic analyses for organisms such as *Giardia*, the primary pollutant list, and pesticides.

A spring on the eastern edge of the park supplies water to the town of Tropic. Yovimpa Spring supplies the water system at the south end of the park. Yovimpa Spring is described as excellent in water quality. In good times it can flow about 40-50 gpm, but in dry times can slow to less than 2 gpm (personal comm., Shakespear during park visit).

In the early 80's, a park volunteer sampled 15 springs for fecal coliforms and fecal streptococci (Nakashima, 1981) and found background FC's present at levels under 100 colonies/100ml. The park is not aware of *Giardia* in the waters.

Ott (1996) conducted a basic field inventory of 33 springs in the park, evaluating pH, temperature, conductance, and TDS from on-site measurements, plus stopwatch/bucket measurements of flow. Elevations at the springs range from about 6,800 to 8,400 feet.

Benham (1997) analyzed common cations, anions, nutrients, and some metals, and found cadmium, lead, and copper slightly higher than desirable from a public health perspective. He suggested additional sampling. Doremus and Kreamer (1999) analyzed the flow pattern and geochemistry for the springs, and provide some data on water quality. Some of their samples contained elevated levels of sulfate and chloride (probably mostly from geologic sources).

Dorr and Weiss (1994), U of AZ, surveyed macroinvertebrates in streams along the east slope of the park, apparently the first such survey in the park. Their report lists 13 orders, 40 families, and 34 genera identified at a dozen sites.

The Dixie National Forest surrounds most of the park, and the park touches the Grand Staircase-Escalante NM boundary (BLM) along several miles on its eastern edge. As seen on the Dixie National Forest map, private land abuts about 3-4 miles of the northwestern edge of the park and about 2 miles of boundary near the town of Tropic, on the east. The park receives some impacts from outside sources, for example silt-laden water in the Tropic Ditch (Czarnowski, 1991). According to Shakespear (personal comm.), several decades in the past logging, some mining, and grazing occurred much more in the area than now, including sheep grazing, and no doubt these activities posed more impact potential.

The Dixie NF's "cooperative water quality monitoring effort plan" includes work on the East Fork of the Sevier River to: "collect baseline water quality data in association with the land management activities within the watershed... (and) ... recreation activities (and) assess issues of livestock use." Joni Brazier, West Zone Hydrologist for the Dixie NF is conducting: pebble counts; macroinvertebrate surveys; evaluation of cross-sections for erosion; fish inventories; and temperature recordings on trout streams near Bryce (Dixie NF, 2001 and personal comm. Joni Brazier, June, 2001). Dan Range, the East Zone Hydrologist for the NF is conducting similar work east of Bryce (personal comm., Dan Range, June, 2001).

Note that the Dixie NF prepares an annual comprehensive, internal report about 2 inches thick with pictures on their water quality monitoring, to summarize the various work conducted by Brazier, Range, and others (we do not have a copy).

Melinda note: Dan Range receives help from Arlene Heap, GIS Specialist for the FS Regional Office, outposted in Cedar City. She prepares ArcView and ArcInfo layers for watershed boundaries and other watershed features. Since the Dixie NF borders much of Bryce, I assume that it could be valuable (for Melinda?) to establish contact with Heap. [Melinda, as discussed BRCA says they work with "Ifer" McCollum with the NPS in Denver to prepare all 'shape' files. She's at (303) 987-6653].

In summary, unlike Zion, BRCA does not have a water quality monitoring program at this time; however, the park has a range of water issues and monitoring needs, as described above. As with Zion, water quality monitoring could provide data to help park resource managers with decisions, planning, protection of resources, and protection of visitors' health.

5.4. SOME BRIEF NOTES ON CAPITOL REEF NP

At CARE I met with Tom Clark, head of natural resources, and briefly saw Dave Worthington, GIS/natural resource specialist. In addition to the copies of maps and

literature from CARE, I also am including a list of about 100 GIS layers in the park (from Dave Worthington), including a few dozen in natural resources. Dave says he could email certain layers to Melinda, if she wants.

At this time the park is not engaged in water quality monitoring --although water planning is underway. However, Capitol Reef has conducted a wide array of water resources work in the past, especially by Norm Henderson --now in Glen Canyon (about 1984-94 in CARE) and Kevin Berghoff --now with the National Weather Service (mid to late 90's in CARE). Kevin is a useful contact (see my earlier email correspondence with him), since he indicates special willingness to be on call to contribute his advice (Henderson perhaps would be equally willing, but I haven't had a chance to talk with him as yet).

The elongated, basically north-south oriented park borders the Fishlake and Dixie National Forests and the BLM Grand Staircase/Escalante NM on most of its western edge (some private?), and touches BLM lands along the park's eastern boundary.

As seen in the park brochure map, the park topo map, and Dixie NF map, Capitol Reef has a most complex drainage and water resource pattern. A number of creeks and washes flow into the park from the forest lands to the north and west, mainly in the park's northern and central sections. Ephemeral washes or creeks flow in or out of the park in the park's geologically complex eastern and southern sections.

The vital, perennial Fremont River, which originates in the Fishlake NF, traverses the park near the Visitor Center. Halls Creek, perennial in part, flows out the south end of the park; it is popular with visitors and stream hikers. Tinajas are an important water resource for wildlife. The perennial streams are: the Fremont River; and Halls, Sulphur, Oak, and Pleasant Creeks. CARE's questionnaire summarizes these waterbodies.

The park has many springs and seeps, since sandstone formations trap, concentrate, and funnel the limited precipitation into springs. Because of the sandstone geology, springs are more numerous than one would expect for such a dry area. These springs are key for survival of wildlife, including birds, amphibians, bats, and desert bighorn sheep (CARE Project Statement on Water Res. Mgt Plan, 2001).

In the broader water perspective, the park is requesting WRD funds to conduct a "Water Resources Management Plan," and has a fresh, 2001 proposal for this. CARE wants to start a limited "scoping report" in preparation for the eventual WRMP (see CARE Project Statement on this).

As Tom notes in his questionnaire and is found in the Project Statements, water quality issues include: grazing; feedlots; septic tanks, agricultural chemicals; natural radioactivity; possibly eventual oil development upstream; trailing; increasing visitor use; water diversion; agriculture; and roads. The new Project Statement for a Water Resources Management Plan gives a good overview of these impacts.

Water quality in the Fremont River is a key concern, since, as pointed out by park staff, the Fremont River is the "life blood" of the park, and is the sole drinking water source for residents and park visitors (Project State, CARE, 2001). Woodbury and Musser (1963) looked at fish and amphibians in the river in the early 60's, to evaluate impacts. Baumann (1989) evaluated macroinvertebrates on the Fremont River, as did Mangum (1992), to assess impacts of grazing, irrigation, roads, and stream diversions. The CARE, RM

Staff report (1990) describes the 1988-89 CARE monitoring on the Fremont River upstream and within the park for temperature, turbidity, conductance, and fecal coliforms. In 1990, they also monitored nutrients. Christiana (1989) prepared a draft scoping report that points out that oil development upstream from CARE also could be a potential future impact on the river.

Millennium Science and Engineering (June, 2001) is the most recent water quality review of the Fremont River. MS&E is calculating total maximum daily loads for the river (TMDL = the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, using EPA methods in the Clean Water Act, Section 303(d)). According to MS&E, the Fremont River is listed as Utah's Year 2000 303(d) list as impaired for three WQ constituents --total phosphorus (TP); dissolved oxygen (DO); and total dissolved solids (TDS). The listing evolved from an intensive water quality study that the Division of Water Quality completed in 1997-98.

Barth and McCullough (1988) monitored Oak Creek (impacted by cattle) and Pleasant Creek (essentially pristine) in the 1985-86 period, measuring fecal coliforms and macroinvertebrates. Borthwick and Henderson (?1991) supplemented monitoring sites (to include all 5 of the park's perennial streams), and added analyses for metals, DO, and radiochemistry. Brammer and MacDonald (1997) of Purdue University studied basically pristine Pleasant Creek, identifying 100 species of macroinvertebrates in the park and 147 within the entire watershed.

The park has concern about the large numbers of recreationists trampling in Hall's Creek Narrows (which gets heavy visitor use, similar to Zion's Narrows). A Project Statement (updated April 2000) seeks funding to evaluate the effects of hikers and their waste on the creek.

In summary, as with ZION and BRCA, CARE has many water quality issues and distinct need for a monitoring activity.

SECTION 6 OF SK'S JULY 1 REPORT: PARK LITERATURE

6.1.ZION LITERATURE

= new items added in by SK (Sam Kunkle) on 6/20/01

SK NOTES = some comments from SK to Colorado State University colleagues working on the Northern Colorado Plateau water quality project in 2001-2 (comments below the article entry).

@ = indicates copy of some pages made for CSU use

@@ = indicates copy of the article or most of the article made for CSU use

DS = Dave Sharrow, Hydrologist at Zion .

ALSO SENDING A PACKET OF THE FOLLOWING ZION PROJECT STATEMENTS TO CSU. The ones highlighted in bold are the ones most useful from a monitoring design perspective:

OLDER PROJECT STATEMENTS

- Identify/map Virgin River flood plains. 1994. 3 pp.
- Protect instream flow --Federal reserved water right. 3 pp
- Map water pockets (tinajas) & inventory communities. 3 pp.
- **Design/implement a water quality monitoring program. 3 pp.**
- **Inventory and monitor aquatic ecosystems/aquatic insects. 6 pp.**
- **Water resources mgmt planning --scoping report. 4 pp.**
- Monitor zion snail populations. 3 pp.
- Monitor Virgin spinedace populations. 4 pp.
- Assess microhabitat utilization of fish. 6 pp.

NEWER PROJECT STATEMENTS CONSIDERED FOR FUNDING OR FUNDED

- **Develop standards and indicators for aquatic invertebrates for VERP. 10 pp.**
- Inventory and assess stock ponds. 1 p.
- Develop anthology of research conducted for Zion water rights settlement agreement. 7 pp.
- **Assessment of bacterial water quality and threats to recreationists. 7 pp.**
- Research endemic Zion snail. 8 pp.
- Restoration of a channelized reach of the Virgin River in Zion Canyon. 7 pp.
- Geologic mapping and seismic profile investigations in support of geohydrology of Pipe Spring. 10 pp.

Wilderness plan, Zion National Park map[map]. 1984 Jul. 1 map; 3' X 2'; 1"=1 mile.

Abstract: This map shows present wilderness in Zion national Park, potential wilderness additions, areas of water rights within the parks, major and minor roads, and trails.

SK NOTE: DS says that GMP more useful --when it comes off the press.

(Hardy, Addley, and Associates, Inc.). [spiral bound]. Addley, R. Craig and Hardy, Thomas B. The Current distribution and status of Virgin spinedace in the Virgin River Basin. 1993 Dec 1198 p.

Abstract: This report details the study of the Virgin spinedace at different sampling stations along the Virgin River, including Zion National Park; examined specifically are distribution, abundance, and habitat utilization.

Anderson, Jay E.; Bowen, Bonnie S., and Griffith, John S., Idaho State University. An Ecological inventory of a section of the North Fork of the Virgin River immediately upstream from Zion National Park, Utah. Pocatello, ID: Idaho State University; 1983 May51 p.

Abstract: This paper examines the ecological community present at the North Fork of the Virgin River. Includes over 25 pages of handwritten data.

Author unknown? (no author included in original record). Geology slides [slides]. later twentieth century 100? slides).

Abstract: These slides depict the following: minerals, stratigraphy, volcanic features, lake

deposits, paleontology, erosion, and structural features.

- . Great Basin Naturalist. Early to middle twentieth century; I-XXIV 8 Bound journals.
Abstract: A collection of the Great Basin Naturalist from 1939 through 1964; issues are bound, and include articles on natural resources within the basin area (some on Zion National Park).
- . Projects of the Division of Resource Management and Research. Springdale, Utah: Zion National Park; 1994 8 photographs; 3'x5' and 4'x6'.
Abstract: These photographs illustrate some of the projects the Division of Resource Management and Research conducts.
- . Water and canyon slides [slides]. later twentieth century 100? slides).
Abstract: These slides depict the water and canyons within Zion including the following; Virgin River, Navajo Lake, Kolob Creek, North Fork, Crawford Wash, Hop Valley, Timber Creek, LaVerkin Creek, Beartrap canyon, and Jolley Gulch, front and backcountry springs, and waterfalls.

Author unknown (or not included when record was created). Natural resource project statements [file folder]. 19918 p.
Abstract: These project statement sheets outline current research projects being completed within the park. Information includes; project number, title, funding status, and problem statement. Some topics include; alien plant management, peregrine falcon surveys, Virgin River spinedace studies, and desert bighorn sheep studies.

- . Threatened, endangered, and sensitive species in Zion National Park [stapled photocopy]. 19921 p.
Notes: Numerous copies available at this location.
Abstract: This is a list of endangered, threatened, and sensitive species in Zion National Park.

(Arizona State University). [stapled photocopy]. Balling, Robert C., Jr. Analysis of historical climate patterns in the upper Virgin River Basin of Utah (preliminary description of assembled climate data). 1992 Jan 13 p.
Abstract: This report consists of tables showing climate variables for the Upper Virgin River, including dates and precipitation and temperature graphs.

SK NOTE: interesting point from DS that about 1940 the monsoon pattern changed in the area, so apparently have somewhat fewer floods now that the monsoon is shortened.

@@### Barrett, Donald C. and Owen R. Williams. 1986. An evaluation of the decline in spring flow at Pipe Spring NM. Trip report, NPS Water Resources Division. Fort Collins. 13 pp. Abstract: Reviews the declining flows at the spring and presents recommendation for certain actions to help protect the spring's continued flow.

@@ ### Biek, R.F., G.C. Willis, M.D. Hyland, and H.H. Doelling. 2000. Geology of Zion National Park, Utah. Pp 107-138 In Utah Geological Association Publication 28. Abstract: Provides detailed maps and describes the geologic processes that formed the park area.

SK NOTE: Maps and figures not focused on water resources, but useful in understanding the stream drainage patterns in the park.

(National Park Service/University of Nevada). [stapled photocopy]. Boyle, Terence P.; Deacon, James E., and Rebane, Anga. Research proposal: Food habits of the indigenous fish in the Virgin River Zion National Park. 6 p.
Abstract: This proposal details a study to inventory and monitor the indigenous fish to the Virgin River in Zion National Park, includes budget information.

Boyle, Terence P.; Hoefs, Nancy J., and Beeson, David R. Inventory of the Aquatic Resources of the

Virgin River Ecosystem, Zion National Park, Utah. Draft Copy ed.. Fort Collins, CO: National Park Service Water Resources Division Applied Research Branch; 199367+ pages.
Notes: Second copy in file.

SK NOTE: copy not found at Zion, but presume copy available in WRD files in Fort Collins.

[spiral bound]. Brookshire, David S.; McKee, Michael, and Schmidt, Christian. Draft economic analysis of critical habitat designation in the Virgin River Basin for the woundfin, Virgin River chub, and Virgin spindace. 1995 Mar232 p.
Abstract: This report details the economic impact of critical habitat designation for the Virgin spinedace, woundfin, and Virgin River chub.

(United States Geological Survey). [spiral bound]. Bullock, John H.; Barton, Harlan N.; Fey, David L., and Kennedy, Kay R. Analytical results and sample locality maps of stream-sediment and heavy-mineral-concentrate samples from the Deep Creek, la Verkin Creek, North Fork Virgin River, Orderville Canyon, and Parunuweap Canyon wilderness study areas, Kane and Washington Counties, Utah. Denver, CO: US Geological Survey; 1988; USGS Open-File Report 88-581. 23 p.
Abstract: This report examines and presents the findings of a reconnaissance geochemical survey of selected wilderness areas in Kane and Washington Counties.

(Southern California Coastal Water Research Project). Distribution of fish in the Virgin River, a tributary of the lower Colorado River [published article]. Cross, Jeffery N. Environmental Biology of Fishes. 1985; 12(1):13-21.
Abstract: This article examines the distribution of fish in the Virgin River, mainly that; the longitudinal distribution of native specis does not follow the author's theoretical expectionations, the native species present are depauperate, and most of the exotic fish present are not established in the river.

(University of Nevada). [stapled photocopy]. Cross, Jeffery N. Ecological distribution of the fishes in the Virgin River. Las Vegas, NV: University of Nevada; 1975 Jul187 p.
Abstract: This report examines the distribution of fish in the Virgin River, mainly that; the distribution of native specis and the effects of changes in the river on these species of fish.

@@### Cordy, G.E, R.L. Seiler, and B.J. Stolp. 1993. Hydrology of the L.C. Holding Coal-Lease Tract and adjacent areas, southwestern Utah, and potential effects of coal mining. U.S. Geological Survey Water-Resources Investigations Report 91-4111. Salt Lake City. 83 pp.
Abstract: Provides basic information on the area's streams, especially the North Fork of the Virgin River. Gives some values for dissolved solids, streamflow, and describes principal aquifers.

SK NOTE: report above contains a section on water quality for the river, presenting values for specific conductance, metals, and dissolved solids. Generally good overview of the area's hydrogeology.

Dalness, William Michael. The Parunuweap formation in the vicinity of Zion National Park, Utah [Bound thesis]: M.S. Thesis, University of Utah, Department of Geological and Geophysical Sciences; 1969 Jun76 p.
Abstract: This master's thesis examines the physiography of the Parunuweap area, the deposition, faulting, climate, and distribution of the area, the geomorphic expression and depositional history, and a heavy mineral analysis of the area.

Davis, John D., Sr. Fishes of the Virgin River and side pools [Photocopies]. 1962 Aug3 p.
Abstract: This list represents fish that had been identified in the Virgin River, North Fork or Main Fork, in Zion National Park.

Streamflow requirements of woundfin (Plagopterus argentissimus): cyprinidae in the Virgin River,

Utah, Arizona, Nevada [reprint of published article]. Deacon, James E. and Hardy, Thomas B. Festschrift for Walter W. Dalquest in Honor of His Sixty-Sixth Birthday. 1984; 45-56.
Abstract: This article examines the endangered species, woundfin and its habitat-streamflow requirements within the park.

[staple photocopy]. Deacon, James E.; LaBounty, James F., and Bradley, W. Glen. The Fishes of the Virgin River, a tributary of the lower Colorado River. 1969 16 p.
Abstract: This report examines the fish found within the Virgin River system. This study looks both at native and introduced species.

(University of Nevada). [stapled photocopy]. Deacon, James E. and Rebane, Anga. Final Report to National Park Service: A habitat preference analysis of the virgin spinedace in Zion National Park, Utah . 1989 Dec 15; Order Number PX 1200-8-0078/Requisition/Reference No. 1265-8-0078. 85 p.
Notes: There is a later version of this report, (1991) NRBIB: ZION-0485; with a 1990 version located in the same location.
Abstract: This report details the study of the virgin spinedace at nineteen stations along the Virgin River in Zion National Park; examined specifically are distribution, abundance, and habitat utilization.

SK NOTE: not much WQ info per se

(University of Nevada/Utah State University). [stapled photocopy]. Deacon, James E.; Rebane, Anga, and Hardy, Thomas B. Final Report to National Park Service: A habitat preference analysis of the virgin spinedace in Zion National Park, Utah . 1991 May 2; Order Number PX 1200-8-0078/Requisition/Reference No. 1265-8-0078. 80 p.
Notes: Drafts and semi-annual reports of this study are available in the same location; see also NRBIB: ZION-0608.
Abstract: This report details the study of the virgin spinedace at nineteen stations along the Virgin River in Zion National Park; examined specifically are distribution, abundance, and habitat utilization.

SK NOTE: not much WQ info per se

@@ ### Dixie National Forest. 2001. Cooperative water quality monitoring work plan for the Dixie National Forest with Utah Division of Water Quality for 2001-02 period. File report from Joni Brazier, Dixie NF. 3 pp. Abstract: gives overview of sampling sites, objectives, and parameters.

SK NOTE actually the sites are closer to BRCA, but worthwhile to see the parameters considered.

(University of Utah). [stapled photocopy]. Ehleringer, James R., principal investigator. Use of summer precipitation along a summer precipitation gradient. 1991 25 p.
Abstract: This is a National Science Foundation grant proposal. It includes a detailed explanation of the project, (the utilization of perennial plant species of summer precipitation inputs, literature review, and the proposed research.

[spiral bound]. Five county association of governments . Virgin River Basin study: Water Quality. 1989 Sep 35 p.
Abstract: This study examines the water quality of the Virgin River Basin, of which the East and North Fork run through Zion National Park; includes precipitation, evaporation, sampling integrity, total dissolved solids, (TDS), total suspended solids (TSS), bacteria, macroinvertebrates, dissolved oxygen, and pesticides.

Five County Association of Governments. 1977. Water quality phase of 208 waste water treatment management program. Report by Vaughn Hansen Assoc, Salt Lake City. 115 pp.

Five County Association of Governments. 1977. Water quality phase of 208 Water Management Program. July 1975-77. Vaughn Hansen Assoc. Salt Lake City. 115 pp.

@@ ### Five County Association of Governments. 1977. Water quality inventory and management plan for southwestern Utah. Abstract: reviews the water quality issues and concerns of the area and summarizes them by area, including impacts of septic tanks, recreation, sewage lagoons, metals, agriculture, livestock, mining, and natural sources.

SK NOTE: looks at WQ issues: impacts of septic tanks, recreation, sewage lagoons, metals, agriculture, livestock, mining, and natural sources. Some of these could be potential impacts in the streams coming into the park.

Foster, Robert C. (Chief Naturalist, Zion National Park). Letter To: Superintendent. [Photocopy] Zion National Park, UT; 1971 Dec 6. 1 p.

Notes: 2 copies

Abstract: The subject of this letter is the fish fauna of Zion National Park.

(United States Geological Survey). [stapled photocopy]. Gates, Joseph S. Water supply for Taylor Creek entrance, Zion National Park, Utah. Salt Lake City, Utah: United States Geological Survey; 1964 11 p.

Abstract: This report examines the possibilities of utilizing ground water from the park to the Taylor Creek entrance area, 20 to 30 gallons per minute. The geology of the area is examined, along with hydrology and water quality concerns. It was determined by this report that this would not be a viable source of water for the Taylor Creek entrance.

@@ ### Gates, Joseph S. 1965. Ground water in the Navajo Sandstone at the east entrance of Zion National Park. Pp 151-160 In Guidebook to the Geology of Utah No. 19. Utah Geol. Soc. And Intermt. Assn. Petroleum Geologists. Abstract: In the process of drilling a well, information was gathered on the geologic layers and their water characteristics. Some information is provided on a few springs in the area as well --full report not available.

SK NOTE: basically looking at a particular aquifer, however also provides some water quality data on ground water in the Navajo Sandstone of the area. The data show basically good WQ, with somewhat elevated iron levels.

@@ ### Gunnell, Roy. 1984. State of Utah 305(B) biennial water quality report. Utah Dept of Health. (estimated 250 pp; full report not available) 18 pp of excerpts from a report of over 200 pp. Abstract: Provides a list of aquatic organisms in the Virgin River at Zion.

SK NOTE: in addition to macroinvertebrate list, presents a limited discussion of some basic chemical WQ parameters.

(University of Nevada). Human induced changes to native fishes in the Virgin River drainage [published paper]. Gregory, Scott C. and Deacon, James E. American Water Resources Association: Effects of Human-Induced Changes on Hydrologic Systems . 1994 Jun; 435-444.

Abstract: This paper examines the impacts, of humans, on the native fishes of the Virgin River drainage; includes graphs and references.

Hamilton, Wayne L. Holocene and Pleistocene lakes in Zion National Park, Utah. in: Linn, R., editor. Proceedings of the First Conference on Scientific Research in the National Parks; New Orleans, LA. Washington, D. C.: US National Park Service; 1979: pages 835-844. extent of whole unknown.

Abstract: This paper examines three lakes in Zion National Park (Mystery Lake, Beatty Lake, and Beartrap Lake) and their deposits and sediments for indicators of their dates of formation.

@---. A Preliminary Hydrological Assessment of Grapevine Spring, Zion National Park, and a Comparison with Other Springs in the Park [Photocopy]. 1975 Jan 107 p.

Abstract: Describes spring, area hydrology, flow characteristics since 1973, chemical analysis with calculated variability of December 17, 1974 and June 20, 1974, and comparison to other Park water resources. Includes five references.

SK NOTE provides some values on pH, alkaline earths, metals, and a few other physical/inorganic chemistry constituents.

(National Biological Survey, Greater Yellowstone Field Station). [stapled photocopy]. Hamilton, Wayne L. Quarternary ponds and lakes in Zion National Park. 1994 Apr 59 p.

Abstract: This paper examines quarternary sediments from lakes and ponds in Zion National Park; includes fossil finds and pollen samples as indicators of past ecological conditions.

Heilwell, Victor M. and Freethey, Geoffrey W. (United States Geological Survey). Hydrology of the Navajo Aquifer in Southwestern Utah and Northwestern Arizona, including computer simulation of ground-water flow and water-level declines that could be caused by proposed withdrawals Harty, Kimm M., Editor. 1992 Field Symposium: Engineering and environmental geology of Southwestern Utah Salt Lake City, UT: Utah Geological Association; 1992 213-223 Utah Geological Association Publication 21.

Notes: Symposium co-sponsored by: The Utah Geological Association and the Utah Section of the Association of Engineering Geologists

Abstract: The paper discusses possible impacts of coal mining on water levels and water discharge rates within Navajo sandstone. Pipe Springs National Monument and Zion National Park are within the area that would be impacted by coal mining. The Navajo sandstone hydrologic system is described including its properties and current ground-water activity. Computer applications are utilized to simulate the ground-water movement of this system; includes maps, tables, and a list of literature cited.

SK NOTE modeling, little WQ

Hereford, Richard, United States Geological Survey. The Role of water in the geomorphic evolution of Zion Canyon [stapled photocopy]. 1993 Apr 193 p.

Abstract: This outline details the age and origin of the canyon system and the fluvial activity and evolution of the alluvial valleys.

(Tree-Ring Laboratory, Pällisades, NY/Laboratory of Tree-Ring Research, University of Arizona). [publication]. Hereford, Richard; Jacoby, Gordon C. Jr., and McCord, V. Alexander S. Geomorphic history of the Virgin River in the Zion National Park area, Southwest Utah. United States Department of the Interior, United States Geological Survey; 1995; US Geological Survey Open-file Report 95-515. 75 p.

Abstract: This report traces the geomorphic development of the alluvial valleys of the Virgin River by identifying, dating, and interpreting the patterns of erosion and deposition that formed these alluvial valleys.

(Northern Arizona University). [stapled photocopy]. Hevly, Richard H. Paleocology of holocene and plesitocene laustrine sediments from Zion National Park, Utah. Flagstaff, AZ: Northern Arizona University, Department of Biological Sciences; Late twentieth century 21 p.

Abstract: This paper traces the paleocology of holocene and pleistocene sediments within Zion National Park.

Horrocks and Associates, Consulting Engineers. Zion wastewater disposal. St. George, Utah: Horrocks and Associates; 1976 Aug 5250 p.

Abstract: The study outlines the most economical and environmentally sound method of waste-water disposal for the Springdale, Rockville, and Zion National Park area. Includes 13 figures, 6 maps and 9 tables.

SK NOTE: DS indicates not so relevant to our project, since wastewater piped out of the park.

Jennings, Daryl Letter To: Schiller, Bob. [Photocopy] Zion National Park, Utah; 1992 Oct. 6 p.
Abstract: This letter discusses Mr. Jennings' trip to Zion National Park on October 21, 1992. He met with Vic Vieira and Sheri Fedorchak to discuss the Virgin River Spinedace and park aquatic ecosystems in general.

Zion water inventory maps [Plotted, topographic]. Jones, Donald A., cartographer. [maps]. 1988.
9 maps; 2' X 2 1/2'; 1:24000.
Abstract: These maps were plotted over USGS topographic maps of Zion National Park. These maps depict over two hundred water sources, found within the park, during the summer 1988 water survey.

[Photocopy]. Kelley, R. Reed, Seasonal Ranger-Naturalist. Untitled. Zion National Park, Utah: National Park Service; 1971 Dec 15 p.
Abstract: This paper reports on the native and exotic fish fauna in Zion National Park.

Kelly, Robert R. (Ranger-Naturalist). Letter To: Chief Park Naturalist. [Photocopy] Zion National Park, UT; 1971 Dec 1. 1 p.
Notes: 2 copies
Abstract: The subject of this letter is the planting of fish in Zion National Park.

Kerr, Robert I. (Superintendent, Zion National Park). Letter To: General Superintendent, Southern Utah Group. [Photocopy] Zion National Park, UT; 1971 Dec 7. 1 p.
Abstract: The subject of this letter is fish planting in the Virgin River.

(United States Geological Survey/National Park Service). [stapled photocopy]. Kimball, Briant A. and Christensen, Paul. Source and residence time of ground water issuing from seeps and springs in the hanging gardens area, Zion National Park, Southwestern Utah (draft) . 1993?25 p.
Abstract: This paper examines the ground water presence in the hanging gardens of the park and how ground water withdrawals around the park effect the gardens. Samples are taken at spring which reveal two distinct water types; a very dilute water and a more mineralized water.

@@## Kimball, Briant A., and Paul K. Christensen. 1996. Residence time of water discharging from the hanging gardens of Zion Park. Water Resources Bulletin. American Water Resources Association. 32(3):531-540. Abstract: Ground-water chemistry used to trace movement of the water.

SK NOTE: a table in the report gives some data on pH, alkaline earths, sulfate, and other values for a number of springs in the park.

Kimball, Dan and Ponce, Stanley L. Letter To: Terri Martin, National Parks and Conservation Association. 1991 Sep. 8 pages. Water Resources Division, Resource Room, Park file.
Notes: Reviews National Parks and Conservation Association study of water resources in Zion National Park with editorial comments inserted on original narrative

@ Lindahl, Alice M., Department of Wildlife Science-Utah State University. Ecological Reconnaissance Grapevine Spring Zion National Park, Utah. Logan, Utah: Department of Wildlife Science, Utah State University; 1976 Summer 12 p.
Abstract: The purposes of this analysis are; (1) Survey the flora and fauna of the Grapevine Spring area of Zion National Park; (2) Identify any rare and endangered plants and animals; and, (3) Identify habitats for the rare and endangered species. Includes 40 references, 5 appendices, 13 figures, 9 tables.

SK NOTE this is the biggest spring in the area.

(Utah State University). [stapled original]. Lindahl, Alice M. Preliminary report: Ecological reconnaissance Grapevine Spring Zion National Park. 197635 p.
Abstract: This document is a checklist of plant and animal species that inhabit the Grapevine Spring area of Zion National Park.

@@ (Utah State University). [photocopy]. Maddox, J. Dain and Hart, George E. The bacterial and chemical inputs to Zion National Park. Logan, Utah: Utah State University; 1977 Dec42 p.
Abstract: The aims of this study were to; examine the bacterial and chemical water quality of the North Fork of the Virgin River as it enters the park, to detail land use practices outside of the park and how these effect water incoming to the park, and to establish a water chemistry baseline data for all stream flows entering the park.

SK NOTE Maddox et al reports are dated, but give good overviews of chemical and bacterial conditions found around the park (note park is collecting more bacterial data at this time).

@@ Maddox, J. Dain; Hart, George E., and Hawkins, Richard H., Department of Forestry and Outdoor Recreation, Utah State University. Bacterial analysis of the water resource of the North Fork of the Virgin River Zion National Park. Logan, Utah: Utah State University; 1977 Apr; RM/VP N-30. 40 p.
Abstract: This study was designed to evaluate the bacterial characteristics of the North Fork of the Virgin River. The study area was the Zion Narrows and its major tributaries. Includes 10 tables, 7 figures.

@@ Maddox, J. Dain; Hart, George E., and Hawkins, Richard H., Department of Forestry and Outdoor Recreation, Utah State University. A water resource inventory of the North Fork of the Virgin River Zion National Park. Logan, Utah: Utah State University; 1977 Apr60 p.
Abstract: The purpose of this report was to provide information for managers to make decisions on maintaining desired levels of water quality and quantity. The study did a general inventory of the water resources of the eastern part of Zion National Park, water chemistry analyses. Flood frequency and flood probability, and hydrologic characteristics of the watershed were studied. Includes 13 figures, and 18 tables.

SK NOTE: compares water quality with the geology of the area and reviews possibilities of impacts from coal mining and other activities.

(University of California, Los Angeles/University of Utah). Flood frequency and the assemblage of dispersal types in hanging gardens of the narrows, Zion National Park [published reprint]. Malanson, George Patrick and Kay, Jeanne. Great Basin Naturalist. 1980 Dec 31; 40(4):365-371.
Abstract: This article looks at probable explanations for heterogeneous distribution of plant communities within the hanging gardens of Zion National Park.

Narrows: photographic water level documentation Mitchell, Jerry. Springdale, Utah: Zion National Park; 1981 Sep 3 144 (4 sets of 36) slides).
Abstract: This set of slides documents the water level in the Narrows of Zion National Park.

@@#### Mangum, Fred A. 1996. Aquatic ecosystem inventory, Dixie National Forest, Cedar City Ranger District. USDA Forest Service and Brigham Young U. Provo. 66 pp. Abstract: shows macroinvertebrate indices for several streams in the Forest, some near Zion or Bryce.

SK NOTE the specific values are not of much interest in the parks; however, the report summarizes the technique and approaches used by the Forest Service locally.

Moore, Ralph Letter To: Vieira, Victor G. [Photocopy] Zion National Park, UT; 1992 Aug 2. 4 p.
Abstract: The subject of this letter is fish surveying on the East Fork of the Virgin River in

Parunuweap.

Moorhead, Bruce B. (Wildlife Ranger). Letter To: Chief Ranger, Zion National Park, Zion National Park, Utah; 1964 Feb 13. 2 p.

Abstract: On January 30, 1964, members of the Park Ranger staff cooperated with local Utah Fish and Game Department men in conducting a fish survey of the Virgin River. An electrical shocking unit was furnished and used by the state men. Includes six black and white photographs.

Mortensen, Vear L. Soil survey of Zion National Park. Riverside, California: Soil Conservation Service; 1971 181 p.

Abstract: This survey of Zion National Park was written by the Soil Conservation Service as a part of the Washington Soil Survey Area. This survey includes an introduction, descriptions of soils, recreational uses of the soils, use of the soils for range, the engineering properties and behavior of soils, uses of the soils for woodland, and a map.

National Park Service. 1964 fish survey. Zion National Park, Utah: National Park Service; 1964 Feb 6 photographs (black and white); 3' x 3'.).

Abstract: These photographs depict the 1964 fish survey.

---. Alien wildlife species Zion National Park. 1994 Jan 131 p.

Abstract: This document lists the alien animal species found in Zion National Park.

---. Amphibians, reptiles, fishes and snails of Zion National Park [Photocopy] 2 p.

Abstract: This manuscript is a checklist of snails, fish, amphibians and reptiles that occur in Zion National Park

[Photocopy]. National Park Service. Checklist of the Amphibians, Reptiles, Fishes, of Zion National Park; 1972 Apr; 2 p.

Abstract: Common name checklist of seven amphibians, twenty-six reptiles, and nine fish species with annotations regarding habitat and abundance.

[Photocopy]. National Park Service. Checklist of the Amphibians, Reptiles, Fishes, of Zion National Park; 1976 Jul; 1 p.

Abstract: Common name checklist of seven amphibians, twenty-six reptiles, and nine fish species with annotations regarding habitat and abundance.

---. [Photocopy] Population monitoring protocol for the Virgin River. 1988? 7 p.

Abstract: The purpose of the Recovery Team monitoring program is to determine the presence of protected or rare fish in the Virgin River, and to assess the current population status.

@@### National Park Service, Environmental Assessment Branch. 1986. Water quality impact analysis (related to coal mining proposed by Zion). EAB report to the Regional Director, NPS. 15 stapled pages. Abstract: summarizes some of the aquatic species that could be threatened by coal mining.

SK NOTE: mainly a T&E type report, but does review some of the potential impacts in the area.

---. Resource Management Projects to Do. 1992 20+ p.

Abstract: Log for identifying needs and status of vegetation, 'office' (observation records, maps, photos), wildlife, soils, cultural, compliance, and photographic documentation protects.

---. Zion Backcountry Management Plan [Photocopy]. 1979 22 p.

Abstract: Describes Zion National Park backcountry topography, vegetation, and wildlife. Analyzes visitor use patterns and impacts. Establishes policies regarding permits, group size,

fire restrictions and control, water quality and use, sanitation, domestic animals, staffing, interpretation, information, signage, maintenance, impact to special status species, backcountry rehabilitation, and backcountry baseline information database for enhanced management planning.

SK NOTE: DS says backcountry mgt plan very dated, but GMP is much better.

---. [Photocopy] Zion National Park - fauna species list. 1992 Jan 2627 p.

Abstract: This document is a checklist of fauna species that occur in Zion National Park.

[Photocopy]. National Park Service. ZION Resource Management Plan. Springdale, UT: Zion National Park; 1977 Jan 600+ p.

Notes: See this database, odd RecNo: 31-43 for appendix.

Abstract: Details Zion resource management needs, goals, and objectives. Natural resource plans concern air quality, weather monitoring, weather modification experiments external to the Park, trespass grazing, development of alternative energy sources (hydro-electric, solar, wind), wildlife inventory and protection, pest management, dog traffic control, development of a fire history for improved management policy, fire weather monitoring, vegetation mapping, cryptogamic floral inventory, vegetation and landscape restoration, development of an exotic flora management plan, land acquisition, use impact (flora, landscape, geologic features), gravel, erosion/floods, geologic hazards, fossils, geologic mapping, paleontological research, Tunnel strain gauge measurements, water rights and quality of streams, watershed, springs, and wells, evapotranspiration monitoring, landscape, visitor management, staffing, air traffic, noise pollution, ground verification of soil recent map, and sewage/refuse disposal. Includes Appendix.

[Photocopy]. National Park Service. ZION Resource Management Plan. Springdale, UT: Zion National Park; 1983 600+ p.

Abstract: Same as the 1977 plan with improved introduction and additional sections regarding habitat degradation study, arthropod inventory, role of beaver, coyote ecology, predator/prey ratios, riparian ecosystems, hanging garden survey, geologic study to quantify rates of accelerated erosion due to development and land use practices on Park boundaries, stream sediment study, and a recreational use capacity study. Includes 7 p. references, updated Appendix.

National Park Service. ZION Resource Management Plan, Project Statements. Springdale, UT: Zion National Park; 1994 107-109 p.

Abstract: Listing of Zion Resource Project Statements. Natural resource projects regard environmental compliance, air quality monitoring, light pollution monitoring and baseline data, weather monitoring, water resources scoping report, inventory and monitoring of aquatic ecosystems, Tinaja map, water rights, GIS mapping of Virgin River floodplain, vegetation management, control of exotic flora, hazardous tree management, riparian protection, inventory and monitoring of Hanging Gardens and rock crevice/ledge communities, relict flora monitoring, special status flora survey, revegetation (bike paths, highway), fire impact study, fuel load map, distribution and ecology special status fauna, assess and monitor wildlife health and disease, ichthofauna microhabitat utilization study, GIS soil survey, geologic inventory and hazards assessment, sound monitoring, backcountry management, climbing management, land protection, IPM/feral animal control, inventory of bats, breeding birds, herpetofauna, invertebrates, and paleontological resources.

@#### Peterson, Karen L. 1991. Modeling the stream temperature regime of the East Fort of the Virgin River in Zion National Park. Colorado State University Master of Science Thesis. Dept of Civil Engineering. 242 pp. Temperature was studied to learn more about aquatic organisms' habitat in Zion National Park.

SK NOTE: basic stream information only, mainly just temperature.

[stapled photocopy]. Radant, Randy D. and Coffeen, Randy D., preparer. Virgin River chub population monitoring. 198645 p.

Abstract: This report details the plight of the Virgin River chub; the Virgin River in Utah, Virgin River chub monitoring stations, and juvenile and adult chubs.

Rinne, William E. The Life history of *Lepidomeda mollispinis mollispinis* (the virgin river spinedace) a unique Western cyprinid [stapled photocopy]. Las Vegas, NV: M.S. Thesis, University of Nevada; 1971 Jun23 p.

Abstract: This document is an excerpt from the actual master's thesis with this title (a 109 page document). Topics covered in this copy include; distribution and relative abundance, habitat preference and movement, interspecific relationships, and a list of literature cited.

@@ (State of Utah, Department of Natural Resources). [technical publication]. Sandberg, George W. and Sultz, LaVerne G., Hydrologists, United States Geological Survey. Reconnaissance of the quality of surface water in the upper Virgin River Basin, Utah, Arizona, and Nevada, 1981-82. Salt Lake City, UT: Utah Department of Natural Resources; 1985; Technical Publication No. 83. 66 p.

Abstract: This report examines the quality of surface water in the Virgin River Basin. Geologic formations such as fine-grained clastic and carbonate rocks of the Mesozoic age affect water quality in the basin. This study also details small dissolved solid concentrations from tributary inflow and sodium hazards downstream from LaVerkin hot springs.

SK NOTE: a comprehensive summary of water quality in the area, providing detailed maps.

[Photocopy]. Schumann, Paul B.; Stuenkel, Edward L., and Deacon, James E. Thermal tolerances and preferences of fishes of the Virgin River system (Utah, Arizona, Nevada). September 1986. 26 p.

Abstract: This article examines the critical thermal maxima and thermal preference of common fish within the Virgin River. This study looked both at native and introduced species.

(United States Geological Survey). [stapled photocopy]. Schuster, Robert L. and Wieczorek, Gerald F. Reconnaissance study of the April 12, 1995, landslide in Zion Canyon, Zion National Park, Utah. U.S. Geological Survey; 1995 May 221 p.

Abstract: This USGS administrative report summarizes the damage and results of a landslide that occurred on the west valley wall of Zion canyon, in Zion National Park, on April 12, 1995.

(University of Utah). Ash yellows in velvet ash in Zion National Park, Utah; High incidence but low impact [reprint]. Sinclair, Wayne A.; Griffiths, Helen M.; Treshow, Michael, and Davis, Robert E. Plant Disease. 1994 May; 78(5):486-490.

Abstract: This article examines the possible causes and effects of ash yellows (AshY) disease in velvet ashes in Zion National Park.

@@#### Shakarjian, M. J. and J. A. Stanford. 1997. The effect of trampling by river recreationists on zoobenthos in the North Fork of the Virgin River, Zion National Park. Draft report to Zion National Park from Flathead Lake Biological Station, the University of Montana. Polson, MT. 21pp.

SK NOTE one of the concerns and impacts at the park is recreationist trampling in North Fork. Park feels some continued or expanded monitoring would be valuable. This report also reviews the level of visitation and impacts in particular areas in the park.

@@#### Sharrow, David. 2001. Assessment of bacterial water quality and threats to recreationists in Zion National Park. Annual report on project ZION-N-211.002. Park files. 17 pp. Abstract:

summarizes bacterial levels in the streams sampled around the park.

SK NOTE: provides some fecal coliform and turbidity values (work still underway).

@@### Sharrow, David. 2001. General information on Zion hydrology. Note to the file. 3pp.
Abstract: provides basic data on streams, flows, sediment, and watersheds.

SK NOTE: brief look at the essentials of hydrology in the area.

Sinclair, Wayne A.; Griffiths, Helen M.; Treshow, Michael, and Davis, Robert E. Ash yellows in Zion National Park: impact, identity of pathogen, mode of spread, and prospects for management. 1993 Apr 30; CA-1463-5-0001. 49 p.

Notes: There is a manuscript. ("Ash yellows and defoliating insects related to decline of velvet ash in Zion National Park") prepared for "Park Science" based on this report in the third location.

Abstract: This research was done to determine the amount of damage done to the ash species in Zion by the disease 'ash yellows, (AshY)'; to map the distribution of the disease, to determine how and the rate AshY is spread, to determine the link between the disease and MLOs (mycoplasma-like organisms), and to determine managing possibilities for the disease. Three color plates (containing 21 pictures) with descriptions, forty-six references, and an appendix are included. Research was done at Zion.

Bighorn sheep, habitat analysis project, Zion National Park [GIS]. Smith, Tom S., cartographer.
[map]. late twentieth century. 1 map; 2 1/2' X 3'.

Abstract: This map shows bighorn sheep habitat within Zion; shows forested-non habitat, perennial streams, springs, human activity areas, trails, improved and unimproved roads, cadastral surveys, and park boundaries.

Stevens, Nancy F. and Hansen, William. Investigations of controlled Kolob Reservoir releases during September 8-17, 1993 at Zion National Park, Utah. Fort Collins, CO: U.S. National Park Service, Water Resources Division; 1997 Jan; NPS/NRWRD/NRTR-97/108. 1 volume.

SK NOTE the one reservoir of any size above the park 400-500AF or so... the report provides no WQ info however.

[spiral bound]. U.S. Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources. Virgin River Basin-Utah cooperative study: Wildlife and riparian habitat. 1990 Aug 19 p.

Notes: See also NRBIB's ZION-0535, ZION-0536, ZION-0537, ZION-0538, ZION-0539, ZION-0540

Abstract: This cooperative study examines the Virgin River Basin, of which the East and North Fork run through Zion National Park; includes colored pull-out maps, species descriptions, aquatic habitats, game information, riparian areas, and wilderness areas.

[spiral bound]. U.S. Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources. Virgin River Basin-Utah cooperative study: Summary. 1990 Aug 64 p.

Notes: See also NRBIB's ZION-0534, ZION-0535, ZION-0537, ZION-0538, ZION-0539, ZION-0540

Abstract: This cooperative study contains separate spiral bound documents that examine different aspects of the Virgin River Basin, of which the East and North Fork run through Zion National Park; includes colored pull-out maps, and an overview of the following topics, each of which have their own separate report: socioeconomics, recreation, historical, and archaeological resources; water supply; soil, erosion, sedimentation, and flooding; cropland; range and forest; and wildlife and riparian habitat.

[spiral bound]. U.S. Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources. Virgin River Basin-Utah cooperative study: Water supply. 1990 Aug 48 p.

Notes: See also NRBIB's ZION-0534, ZION-0535, ZION-0536, ZION-0538, ZION-0539, ZION-0540
Abstract: This cooperative study contains separate spiral bound documents that examine different aspects of the Virgin River Basin, of which the East and North Fork run through Zion National Park; includes colored pull-out maps, water supply, water quality, present water use, projected water needs, and water development potential.

[spiral bound]. U.S. Department of Agriculture, Soil Conservation Service and Utah Department of Natural Resources, Division of Water Resources. Virgin River Basin-Utah cooperative study: Soil, erosion, sedimentation, and flooding. 1990 Aug 36 p.

Notes: See also NRBIB's ZION-0534, ZION-0535, ZION-0536, ZION-0537, ZION-0538, ZION-0540
Abstract: This cooperative study contains separate spiral bound documents that examine different aspects of the Virgin River Basin, of which the East and North Fork run through Zion National Park; includes colored pull-out maps, soil descriptions of the area, farmlands, cropland soils, sedimentation, erosion, geologic erosion, and flooding.

@@ Topographic map of Zion National Park showing water sources, backcountry campsites, and petroglyphs [Topographic]. U.S. Geological Survey, cartographer. Zion National Park, Utah: Zion Natural History Association / National Park Service; 1971. 1 map; 4' X 5'; 1:31680.

Notes: ISBN 0-015630-08-7

Abstract: This map shows the water sources, backcountry camping areas, and petroglyphs within Zion National Park.

United States. National Park Service. Water Resources Division. Baseline water quality data: inventory and analysis: Zion National Park. Fort Collins, CO: U.S. National Park Service; 1998 May; NPS/NRWRD/NRTR-98/153. 3 volumes.

Notes: 7 floppy disks. Abstract: summarizes the water quality information available in STORET files in the Zion area.

SK NOTE: this is the HORIZON report.

[spiral bound]. Utah Division of Water Resources. Inventory of reservoirs and potential dam sites in the Virgin River Basin. Salt Lake City, UT: Utah Department of Natural Resources; 1988 Dec 66 p.

Abstract: This report summarizes an inventory of existing reservoirs and previously investigated dam sites and details information on nineteen existing reservoirs along the Virgin River.

[bound copy]. Utah Water Research Laboratory and Bureau of Environmental Health.

Comprehensive water quality management plan for the Virgin River system in the state of Utah: Volume I-the plan. 1974 Dec 39 p.

Abstract: The water resources management plan for the Virgin River includes the following topics; Virgin River water quality standards, stream standards, benthic invertebrates, point waste loads, low flows, population predictions, and wastewater treatment.

SK NOTE: not so useful from the park perspective (DS says) and also dated.

[spiral bound]. Valdez, Richard A. and Masslich, William J. Status of the Virgin spinedace (*Lepidomeda mollispinis mollispinis*) in the Virgin River drainage, Utah: A Report on current distribution, abundance, and threats. 1991 Jan 46 p.

Abstract: This report details the study of the Virgin spinedace at different spots along the Virgin River drainage; examined specifically are distribution, abundance, and habitat utilization of these fish.

[spiral bound]. Virgin River Fishes Recovery Team. Recovery plan for the Virgin River fishes. 1995 May 45 p.

Abstract: This report details recovery plans for the woundfin and Virgin River chub; the woundfin original plan was approved July 9, 1979 and the woundfin first revision was approved March 1, 1985.

@ ### Utah, State Department of Environmental Quality. 1998. Utah water quality assessment report to Congress. Salt Lake City. 163 pp plus 1- 20pp appendix.

SK NOTE good background for working up a NPS monitoring plan. Provides overview of water quality issues and monitoring needs around the state.

@@### Vaughn Hansen Associates. 1977. Water quality phase of 208 waste water quality management program. Report for Five County Association of Governments, funded by EPA. Salt Lake City. 115 pp. Abstract: reviews water quality and impact problems in SW Utah, including grazing, recreation, and sediment loading.

Wallis, Orthello L., Aquatic Biologist, National Park Service. [Photocopy]Provisional list of fishes of Zion National Park, Utah. 1959 Sep2 p.
Abstract: This is a limited checklist of fish found in Zion National Park.

Welsh, Stanley L., Endangered Plant Studies, Inc. Final report: hanging gardens of Zion National Park . Orem, Utah: Endangered Plant Studies, Inc.; 1989 Sep 15; CX 1590-7-0001. 38 p.
Abstract: This paper discusses size versus water relationships, water quality versus plant species numbers, water age and wetness versus plant species numbers. A linear relationship exists between wetness and higher plant species number in the gardens. The use of a linear regression formula allows predictive capacity for varying surface wetness conditions in the hanging gardens.

---. On the distribution of Utah's hanging gardens. The Great Basin Naturalist. 1989 Jan 31; 49(1):1-30; ISSN: 0017-3614.

Abstract: This paper discusses the hanging gardens, the geomorphology and geography of the gardens, aspects of diversity and distribution, and algal and principal vascular plants species. Plant productivity aspects and animal trapping studies are reviewed. The areas studied within Zion National Park are Weeping Rock, Narrows Trail, North Fork of the Virgin River, Parunuweap Canyon; other parks of the Colorado Plateau are included in the article. Among the tables are lists of algal components of the Utah hanging gardens by group as well as distribution of individual species in Zion, Glen Canyon, and Arches.

Welsh, Stanley L., Endangered Plant Studies, Inc. Preliminary report (third quarter): hanging gardens of Zion National Park . Orem, Utah: Endangered Plant Studies, Inc.; 1989 May 10; CX 1590-7-0001. 69 p.

Notes: See also NRBIB: ZION-0141

Abstract: This paper discusses size versus water relationships, water quality versus plant species numbers, water age and wetness versus plant species numbers. A linear relationship exists between wetness and higher plant species number in the gardens. The use of a linear regression formula allows predictive capacity for varying surface wetness conditions in the hanging gardens. Also includes water analysis tables used in this study.

Biotic communities of hanging gardens in Southeastern Utah [published reprint]. Welsh, Stanley L. and Toft, Catherine A. National Geographic Society Research Reports. 1981; 13663-681.

Notes: Grant no. 1109

Abstract: This report examines the biotic communities of southern Utah and northern Arizona; Zion National Park is included in the study area.

Woodbury, Angus M., Park Naturalist, Zion National Park. Snail checklist [Photocopy]. 1927 Aug27 p.
Abstract: Mr. Woodbury covers the fifteen species of snails that had been collected in Zion National Park. Distribution and habitat preferences are also discussed.

Workman, Gar W., Department of Fisheries and Wildlife, Utah State University. Aquatic and riparian ecological relationships of the North Fork of the Virgin River and its Deep Creek-Crystal Creek tributary, Zion National Park, Utah. Logan, Utah: Department of Fisheries and

Wildlife, Utah State University ; 1983; (NPS) CX-1200-08041 (USU) 246 2760 1009 16501. 276 p.

Notes: A research proposal for this project is located in the second location; the file folder also contains correspondence and notes related to this project.

Abstract: The purpose of this project was to obtain baseline data on the riparian zones within Zion National Park. Eleven stations were established on the Virgin River and its tributaries and water samples were taken from each major source. Studies identified a wide variety of fauna and flora at sampling sites and identified to the species level where possible. Chemical analyses of water quality parameters were made multiple times at each site. Includes 7 appendices, 73 tables, and 10 figures.

Workman, Gar W., Department of Fisheries and Wildlife, Utah State University. Aquatic and riparian ecological relationships of the North Fork of the Virgin River and its Deep Creek-Crystal Creek tributary, Zion National Park, Utah (Rough Draft). 1982 Jan 1; (NPS) CX-1200-08041 (USU) 246 2760 1009 16501. 181 p.

Abstract: The purpose of this project was to obtain baseline data on the riparian zones within Zion National Park. Eleven stations were established on the Virgin River and its tributaries and water samples were taken from each major source. Studies identified a wide variety of fauna and flora at sampling sites, and identified to the species level where possible. Chemical analyses of water quality parameters were made multiple times at each site. Includes 13 appendices, 67 tables, and 9 figures.

Workman, Gar W., Gar W. Workman and Associates. An Aquatic survey of the North Fork of the Virgin River and two of its tributaries in Zion National Park, Utah. 1980 May 1; Order Number: PX-1590-0-0106. 53 p.

Abstract: The purpose of this project was to obtain baseline data on the invertebrates and vertebrates present, water chemistry data, and description of the riparian habitat of the North fork of the Virgin River. Stations were established on the Virgin River and water samples were taken from each major source. Studies identified a wide variety of fauna and flora at sampling sites, and identified to the species level where possible. Chemical analyses of water quality parameters were made multiple times at each site. Includes survey sheets and tables.

@@##Yelken, Mary A. 1996. Trace element analysis of selected springs in the Virgin River Basin. M.S. Thesis. Dept of Geoscience. University of Nevada, Las Vegas. 156 pp. Abstract: provides some inorganic chemistry data. Some sites sampled in the Virgin River were in and near Zion NP, in the North Fork and East Fork. The investigator measured major cation and anion chemistry, plus trace element concentrations and stable isotopes (oxygen-18 and deuterium).

SK NOTE: basic background geologic information, useful for understanding hydrology of the area.

Zion National Park. [three-ring binder]Aquatic invertebrate monitoring. 19951 three-ring binder; 9 data sheets.

Abstract: This ring binder contains data sheets on aquatic invertebrate monitoring at Zion National Park; information includes; date, time, sampled by, stream flow, water temperature, duration of sample, number of large rocks, location of sample, and any comments.

[bound copy]. Zion National Park. Development concept plan: Environmental assessment. 1993 Aug 153 p.

Abstract: This plan examines the obstacles preventing park managers from realizing the park's management objectives and goals. Topics include vegetation, soils, geology, threatened and endangered species, water resources, wildlife, wilderness, air quality, visual resources, noise quality, and cultural resources.

—. [stapled photocopy]Draft conservation agreement: Virgin spinedace, *Lepidomeda mollispinis*

mollispinis . 1994 Nov35 p.

Abstract: This conservation plan focuses on; other species involved, involved parties, status and distribution of the Virgin spinedace, problems facing the species, and conservation actions to be implemented.

[bound copy]. Zion National Park. Environmental assessment: Development concept plan. 1980 Dec105 p.

Abstract: This plan examines the obstacles to park management created by human impacts within Zion National Park. Topics include vegetation, soils, geology, threatened and endangered species, water resources, wildlife, wilderness, air quality, visual resources, noise quality, and cultural resources.

[photocopy]. Zion National Park. Environmental assessment: Domestic water supply Zion National Park, Utah. 1981; 100? p.

Abstract: This document examines the alternatives for domestic water development within Zion National park and Springdale, Utah; includes, a statement of the problem, eleven alternatives, and possible impacts of each alternative.

---. Grapevine Spring folder [folder]. 19722 folders; 53 p.; 55 color slides; 9 black and white negatives.

Abstract: This folder contains information on Grapevine Spring, specifically; the history of attempts to acquire water from the spring, a physical and biological overview of the spring, the setting and geology of the area, black and white negatives of the new hydrobiid snail, and general legislation and laws effecting the spring.

---. [file folder]Significant resource problem proposals. 19833 file folders; 75? p.

Abstract: These file folders contain proposals that address issues that the park labels, significant resource problems. These include; air quality, exotics and pests, extirpated and reintroduced species, threatened and endangered species, fire management, stressed plant communities, endangered geologic features, stream erosion and deposition, water quality, noise pollution, archaeological resources, and backcountry carrying capacity.

---. [three-ring binder]Virgin River data. early to middle twentieth century1 three-ring binder; 75 p.

Abstract: This ring binder contains water temperature data for the Virgin River for the year 1929 and the years between the 1950's and 1970's.

---. [file folder]Water analysis report forms. 19791 file folder; 21 p.

Abstract: These report forms contain the following information for sites including; West Rim Springs, Volcano Springs, Hop Valley, and Weeping Rock: date, a description of the sample source, characteristics, and chemical analysis.

[original copy]. Zion National Park. Water resources study. 6 p.

Abstract: This brief report details a study in which water quality and biological data were collected from streams, springs, and the Virgin River.

---. [file folder]Water source reports for Zion National Park, Utah. 19631 file folder; 75? p.

Abstract: These water source reports (forms) include the following information; name of water, location, access, terrain, flow, length of flow, existing development, wildlife/human utilization, and recommendations.

---. [index cards]Zion National Park Water Inventory. 1988100? index cards.

Abstract: These water inventory cards include the following information; site, name, date, flow, elevation, and the geology of the area.

@@### Zion National Park. 2001. Final general management plan/ environmental impact statement (visitor management and resource protection plan). Abstract: among other topics, reviews natural resource conditions and issues, with maps and other background

information presented.

SK NOTE: not so much on water per se, but provides good background maps and summaries for understanding the park and drainage basins in general.

6.2. PIPE SPRING LITERATURE

= new items added in by SK (Sam Kunkle) on 6/20/01

SK NOTES = SK comments to Colorado State University colleagues working on the Northern Colorado Plateau water quality project in 2001-2

@ = indicates copy of some pages made for CSU use

@@ = indicates copy of bulk of the article or all the article made for CSU use

OTHER ITEMS RELEVANT TO THE WQ MONITORING PROJECT, JUNE 2001

Author unknown? (no author included in original record). Natural resource preservation program proposals [Photocopy]. In. Resource Project Proposals. Moccasin, Arizona: National Park Service; 19958 p.

Abstract: The project proposals under Natural Resource Preservation Program Proposals are a baseline vegetation inventory, and a baseline aquatic biology inventory.

Barrett, Donald C. and Owen Williams. 1986. An evaluation of the decline in spring flow at Pipe Spring NM. WRD inhouse technical report. Water Resources Division, National Park Service. Fort Collins. 13 pp. Abstract: Reviews yields of the spring, quantifying the decreasing yields in recent years, meaning potential long-term problems and the possibility that the spring could dry up.

SK NOTE: The report also provides a basic overview of the geology of the Pipe Spring area, with maps to describe the aquifer and its function.

Geerdes, Raymond J. (NPS area manager, Pipe Spring). Letter To: General Superintendent, Southern Utah Group National Park Service. [photocopy] Moccasin, Arizona; 1970 Jan. 71+ pages.

Notes: "The ownership of Pipe Spring: a legal and historical brief"

Hasty, Gary M., Superintendent, Pipe Spring National Monument. Natural resource inventory priorities [Photocopy]. 1992 Nov 21 p.

Abstract: This document lists inventory components and their priorities.

[Photocopy]. Hasty, Gary M., Superintendent, PISP. Statement for Management, Pipe Spring National Monument. Moccasin, AZ: Pipe Spring National Monument; 1990; Draft. 20 p.

Abstract: Inventory and assessment of Pipe Springs legislative mandates and resources. Natural resource issues regard landscape restoration and maintenance, protection of special status flora (pincushion cactus), control of exotic flora (russian thistle, cheat-grass, coyote gourd), flood control, hydrology, earthquakes, water legislation and protection, urban impact, air quality, hydrology, recreation impact, visual resources, roads and utilities. Includes cover letter, 5 maps, 1 chart.

Heilwell, Victor M. and Freethey, Geoffrey W. (United States Geological Survey). Hydrology of the Navajo Aquifer in Southwestern Utah and Northwestern Arizona, including computer simulation of ground-water flow and water-level declines that could be caused by proposed withdrawals. Harty, Kimm M., Editor. 1992 Field Symposium: Engineering and environmental geology of Southwestern Utah. Salt Lake City, UT: Utah Geological Association; 1992 213-223 Utah Geological Association Publication 21.

Notes: Symposium co-sponsored by: The Utah Geological Association and the Utah

Section of the Association of Engineering Geologists

Abstract: The paper discusses possible impacts of coal mining on water levels and water discharge rates within Navajo sandstone. Pipe Springs National Monument and Zion National Park are within the area that would be impacted by coal mining. The Navajo sandstone hydrologic system is described including its properties and current ground-water activity. Computer applications are utilized to simulate the ground-water movement of this system; includes maps, tables, and a list of literature cited.

SK NOTE: DS notes that the ground-water modeling work in the paper is relevant to the Zion NP area.

Inglis, Richard, Jr. Spring flow trends at Pipe Spring. Highlights of Natural Resources Management. 1989; NPS/NRPO/NRR-90/0217.

Abstract: This article discusses how much the spring yields have declined over a twelve year time period.

@@ Inglis, Richard, Jr. Water resources data of the Pipe Spring National Monument Area, Arizona, 1977-1989. Fort Collins, CO: United States Department of Interior, National Park Service; 1990 Oct; Technical Report NPS/NRWRD/NRTR-90/02. 33 p.

Abstract: The Water Resource Division is conducting this study to determine if ground water pumping is causing the decline of spring flow at Pipe Spring National Monument. The purpose of this report is to summarize the information obtained to date from Pipe Springs spring flow study and to evaluate whether the present approach will provide the information necessary to determine the cause of spring flow decline.

Johns, Alice. Date unknown. (Correspondence with several pages of hand sketches describing the flow and piping related to the spring). 9pp.

[Photocopy]. National Park Service, Park Technician, PISP. Cultural Resources Management Plan, Pipe Spring National Monument. Moccasin, AZ: Pipe Spring National Monument; 1985 Feb; Third Revision Draft. 63 p.

Abstract: Inventory of Pipe Springs National Monument cultural resources and protection plan. Related natural resource issues regard impact of historic grazing, earthquake monitoring and preparedness, collection development, flood control, IPM, climate, prehistoric agriculture, hydrology, ethnohistorical flora and fauna. Includes review letters, Appendix A-B (bibliography and 5 maps).

National Park Service. [Photocopy] NPFAUNA database. 1994 Mar 288 p.

Notes: Three copies located in the Visitor Center

Abstract: Mammal, amphibian, fish, reptile, and bird species are listed in this NPFAUNA database list for Pipe Spring National Monument. Presence, status, and origin are given for each species.

[Photocopy]. National Park Service. Pipe Spring National Monument Draft Resource Management Plan. Moccasin, Arizona: National Park Service; 1976 35 p.

Notes: Five copies located in the Administrative Clerk's office

Abstract: This document is a draft of the Resource Management Plan for Pipe Spring National Monument. The plan is designed to guide the protection and management of natural, historical, and archaeological resources in this monument in northern Arizona. Subjects treated in the plan include preservation of historic artifacts and structures; maintenance of historic grounds; the living history ranch; fire and flood control; and geological, wildlife, water, and archaeological resources.

[Photocopy]. National Park Service. Pipe Spring National Monument Resource Management Plan. Moccasin, Arizona: National Park Service; 1976 Jul 1422 p.

Notes: Two copies located in the Administrative Clerk's office

Abstract: This document is the Resource Management Plan for Pipe Spring National

Monument. The plan is designed to guide the protection and management of natural, historical, and archaeological resources in this monument in northern Arizona. Subjects treated in the plan include preservation of historic artifacts and structures; maintenance of historic grounds; the living history ranch; fire and flood control; and geological, wildlife, water, and archaeological resources.

National Park Service. Resource Management Plan, Pipe Spring National Monument. Moccasin, AZ: Pipe Spring National Monument; 1977?; Draft. 50+ p.

Notes: The document in the second location is a nineteen page version of this paper. Abstract: Management action evaluation, proposed actions, and monitoring plans for preservation and protection of Pipe Springs National Monument resources. Natural resource plans concern landscape restoration, fire and flood control, seismographic monitoring and structural reinforcement for earthquake preparedness, IPM, water quality, irrigation and pond maintenance, and flow monitoring. Includes review letter.

National Park Service, Chief Ranger, PISP. Resource Management Plan, Pipe Spring National Monument. Moccasin, AZ: Pipe Spring National Monument; 1993; Draft. 200+ p. Abstract: Project statements for Pipe Springs National Monument resource projects. Natural resource projects, statements N001-N011, are to: provide flora water resource management, provide for wildlife management, provide for general land protection and boundary issues, provide for exotic plant management, conduct study of geological resources, provide for air quality management, provide for historic scenic vista management, provide for pest management, provide for soils management, develop weather and climate records, and to provide for threatened and endangered species survey. Interdisciplinary projects related to resource management, Statements I004-I007, are: to enter resource data into GIS, establish hazard tree management program, examine overflight issues, and to conduct hydrological study of Pipe Springs National Monument.

@@ ### Sharrow, Dave. 1999. Addition and removal of water from main spring and spring room spring. Correspondence to the Superintendent, Pipe Spring NM. NPS Zion. 9 pp.

SK NOTE:\ looks at drawdown and recovery of well.

Superintendent, Pipe Spring National Monument (Pipe Spring National Monument). Letter To: Regional Director, Rocky Mountain Region. Moccasin, Arizona; 1990 Nov 29. 3 p. Abstract: This memorandum provided information to help in the protection of the water resources of Pipe Spring. The main problem was a hazardous waste incinerator being located close to the monument.

@@ ### Truini, Margot. 1999. Geohydrology of Pipe Spring National Monument area, northern Arizona. U.S. Geological Survey Water-Resources Investigations 98-4263. Tucson. 25 pp. Abstract: Describes the physical hydrology and hydrogeology of the spring, investigating the patterns of ground-water flow and ages of water in the aquifers. The report also presents a detailed table of chemical data for the spring, with comparison to other springs in the area..

SK NOTE: The table of chemical data helps provide some relatively recent information on the spring's basic chemistry.

University of Arizona. 2000. Report of analysis for oxygen and deuterium isotopes from two wells surrounding Pipe Spring. 1 page.

6.3.CEDAR BREAKS LITERATURE

= new items added in by SK (Sam Kunkle) week of 6/18/01

SK NOTES = SK comments to Colorado State University colleagues working on the Northern Colorado Plateau water quality project in 2001-2

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OTHER ITEMS RELEVANT TO THE WQ MONITORING PROJECT, JUNE 01

Author not included when this record was created. Cedar Breaks Waterline Project [file folder]. 198655? p.

Abstract: This folder contains information on a waterline project at Cedar Breaks National Monument of 1986-1987. Contains correspondence and maps relating to Cedar Breaks rehabilitation and repair for spring box and water system, (contract number CX-1590-5-0001). Archaeological resources, as they might be affected by this project, are mentioned; contains maps.

[spiral-bound]. Bingham Engineering. Evaluation of water supply, water demand, and water development opportunities for Cedar City. Salt Lake City, UT: Bingham Engineering; 1993 Mar250? p.

Abstract: This report, completed by an outside consulting firm, examines the water demands present in the Cedar City area, the evaluation of the existing water supply, the treatment of potential water surface supplies, and plan formulation and cost for surface water development alternatives. The project area includes Cedar Breaks National Monument.

@@ ### National Park Service. Resources Management Plan, Cedar Breaks National Monument. 1994. Statement for management, Cedar Breaks NM. 13 pp. In-park document for managers.

SK NOTES: general overview material, without any significant details on water resources.

[Photocopy]. National Park Service. Resources Management Plan, Cedar Breaks National Monument. Cedar City, UT: Cedar Breaks National Monument; 1992 113 p.

Abstract: Summary overview of Cedar Breaks resources. Establishes mitigating actions and evaluation plan. Natural Resource Project Statements regard; survey of geologic formations including caves, soils survey, identification and rehabilitation of use impacted areas, trail management plan, lands, exotic flora research and management, infestation and disease in forests, fire, visual resources, survey for special status fauna, water resource inventory, fishery management, quaternary studies, tree hazard mitigation, and Geographic Information Systems (GIS). Includes Appendices A-B.

Fisheries and water-related wildlife/water-related recreation/Federal water planning and development [spiral-bound]. Utah Division of Water Resources and Utah Department of Natural Resources. Utah State Water Plan: Cedar/Beaver Basin: Public Review Draft. Salt Lake City, UT: Utah Board of Water Resources; 1994 Nov300? p.

Abstract: This report details the Utah State Water Plan, for the Cedar/Beaver Basin area; Cedar Brakes National Monument is mentioned specifically in sections 14-(fisheries and water-related wildlife), 15-(water-related recreation), and 16-(federal water planning and development).

@@### Sumsion, C.T. 1971. Spring discharge at Cedar Breaks National Monument and Zion National Park, southwestern Utah. U.S. Geological Survey Administrative Report. Salt Lake City. 18 pp.

SK NOTE: Sunset View Spring in CEBR and Sawmill Spring in ZION were analyzed for discharge and chemistry. Tables provide data on discharge rates, basic inorganic chemicals, and

temperature

6.4.BRYCE CANYON LITERATURE

= new items added in by SK (Sam Kunkle) on 6/20/01

SK NOTES = SK comments to Colorado State University colleagues working on the Northern Colorado Plateau water quality project in 2001-2

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TWO "PROJECT STATEMENTS" BELOW, IN ADDITION TO THE LITERATURE LIST:

###@@ PROJECT STATEMENT BRCA-N-180.000, updated 1996, "Develop Water Resource Mgt Plan." 3 pp. Abstract: The park does not have the basic document, a "water resources management plan." Among other information such plan would provide, the project statement points out that three perennial streams and numerous intermittent water surces in the park are important for wildlife, recreation, aesthetics, etc, but water quality information is not available to support these values. Issues and concerns include: livestock impacts, lack of monitoring on springs routinely used by hikers, questions about the water quality coming from the park, which serves to supply towns with drinking water.

###@@ PROJECT STATEMENT BRCA-N-084.000, updated 1996, "Protect and rehabilitate spring areas." 2 pp. Abstract: Springs in the backcountry provide drinking water for hikers and wildlife. Cattle impact the springs. The proposal calls for fencing and other measures to protect these water sources.

LITERATURE BELOW

Author unknown (or not included when record was created). Research proposals [file folder]. late twentieth century1 file folder.

Abstract: This file folder contains various research proposals for projects within Bryce Canyon National Park. Some subjects include; ground and surface waters, air pollution, plant communities, geohydrology, nesting bird surveys, and distribution of bighorn sheep.

Bingham Engineering. 1987. Navajo Aquifer investigation in portions of Kane and Garfield Counties, Utah. File report. A report prepared by Bingham Engineering for Alton Coal Project Utah International, Inc. 48 pp text plus 11 maps, foldouts, and charts. Note from BRCA & WQ perspective: This report is relevant to Zion, covering the Navajo formation, but not directly relevant to BRCA.

@@ Czarnowski, Kenneth. 1991. Hydrologic characterization and inventory of water rights, uses and requirements at Bryce Canyon National Park. Water Resources Division NPS field report. Fort Collins. 21 pp plus 4 annotated topographic foldout maps. Note from a WQ perspective: This is a water rights report; however, it does provide an overview of springs, surface waters, and aquifers in general in the BRCA area.

@@ Doremus, Llyn and David Kreamer. 1999. Bryce Canyon water resource study report. Park file copy. Report by Waterworks Consultants, Seattle, and Water Resource Management, University of Nevada, Las Vegas, NV. 35 pp plus 40 pp appendices with data. Abstract: This report describes spring flows and discharge rates, and also provides an overview of water chemistry for the springs. Some springs show high sulfates. Most show

alkaline earth levels expected from the limestone. Comparisons are made to the earlier USGS report on chemistry in 1963. Flow of the Tropic Ditch is described.

- @@ (University of Arizona). [stapled original]. Dorr, Brian S. and Weiss, Steven Joseph. Aquatic macro-invertebrate survey of the upper Paria River basin in Bryce Canyon National Park. Tucson, AZ: University of Arizona; 1994 Jan 10 p.
Abstract: Aquatic macro-invertebrates were collected and identified from the Paria River in Bryce Canyon National Park, in order to inventory their distribution and diversity within the park.

SK NOTE: above report provides some baseline on macroinvertebrates.

- [publication]. Marine, I. Wendell. Ground-water resources of the Bryce Canyon National Park area, Utah. Washington, D.C.: United States Government Printing Office; 1963; Geological Survey Water-supply Paper 1475-M. 45 p.
Abstract: This paper documents the ground-water resources available at Bryce Canyon National Park; includes a section on the drilling of a test well and a 2' X 3' map showing the physiographic features and the location of springs and wells within the park.

- @@ [publication]. Marine, I. Wendell. Ground-water resources of the Bryce Canyon National Park area, Utah. USGS Water Supply Paper 1475-M. Salt Lake City, UT: United States Geological Survey-Ground Water Branch; 1963 64 pp.
Abstract: This paper documents the ground-water resources available at Bryce Canyon National Park; includes water use of the area, stratigraphy, water resources (surface water, springs, ground water in alluvium, ground water in bedrock, and the author's conclusions.

SK NOTE: Valuable overview report, with map and descriptions of springs, creeks, and other features, plus discussion of concern over water in the area.

- [plastic binder]. Nakashima, R. Steven, park volunteer. A Water quality survey of the back-country in Bryce Canyon National Park. 1981 Summer 48 p.
Abstract: This report documents a study of the bacteria content of major backcountry water sources; specifically fecal coliform (*Escherichia coli*) and fecal streptococci (Group D Lancefield).

- ### @@ Nakashima, R. Steven. 1981. A water quality survey of the backcountry in Bryce Canyon National Park. Volunteer in Parks Program report. Park reference copy. 14 pp.

SK NOTE: Valuable report, where summer intern sampled 16 spring and creek sites around the park to gather at least a snapshot of bacterial levels at the time. See Ott report for some followup work.

- ### National Park Service. 1999. Baseline water quality data inventory and analysis, Bryce Canyon National Park. Technical Report NPS/NRWWRD/NRTR-99/227. October, 1999. Water Resources Division, NPS, Fort Collins. 455 pp plus ~ 80 pp appendices. Abstract: This is the "Horizon Report" summarization of STORET water quality data from the EPA for the area in and around the park (appears that the STORET data probably does not include the spring water quality information in the file reports of Ott, Nakashima, or Doremus and Kremer (all in BRCA files), presumably because the data were not in STORET.

- [stapled]. National Park Service. Statement for Management: Bryce Canyon National Park. United States Department of the Interior-National Park Service; 1989 Sep 34 p.
Notes: There is a 1993, 48 page version of this plan available at Chief Resource Management Specialists Office, first wooden shelving unit, first shelf.
Abstract: This management plan covers; legislation, resources, land use, air quality, fire management, resource management, water use, natural and cultural resources, and

visitor/recreation development within Bryce Canyon National Park.

SK NOTE: The park's Statement for Management or the General Mgt Plan do not contain anything significant on water.

@@ Ott, Amy 1996. Natural spring inventory Bryce Canyon National Park. File report from seasonal staff member to the Resource Management Division, Bryce Canyon NP. 6 pp text plus 31 pages of lab result forms and 1 foldout chart. Abstract: Provides a water quality snapshot of 9 springs in July, 1996, with results for the individual samples for pH, EC, flow, temp, TDS, DO, carbonate, hardness, Ca, Mg, Na, K, Mn, F, B, Br, Cl, I, CN, Al SiO₂, Fe, nitrate, nitrite, sulfate, S, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Ag, and Zn..

SK NOTE foldout chart gives values of chemistry at 9 springs (goes with the report by Ott, 1996)

@@ Utah State Division of Health. 1981. Water quality testing contract report. Purchase Order form with two pages of data on fecal coliforms and fecal streptococci at 16 camp site and trail springs in the park, plus proposal for "backcountry water quality survey." 8pp. Other data from the Nakashima work in 1981, with some data summary.

6.5.CAPITOL REEF LITERATURE

= new items added in by SK (Sam Kunkle) on 6/20/01

SK NOTES = SK comments to Colorado State University colleagues working on the Northern Colorado Plateau water quality project in 2001-2

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@@ = indicates copy of bulk of the article or all the article made for CSU use

OTHER ITEMS RELEVANT TO THE WQ MONITORING PROJECT, JUNE 01

LIST OF GIS LAYERS (from park GIS specialist, Dave Worthington showing about 130 layers of point and line features, e.g., roads, streams, park boundary, etc)

@@ PROPOSAL ON "WATER QUALITY AND FISH HABITAT IMPROVEMENT PROJECT" (unknown date or author, presumably park staff). 2 pp. Briefly reviews the turbidity and nutrient problems found in the river, caused by livestock, irrigation, and other land-use impacts.

@@ PROPOSAL ON "SEAL LIVESTOCK CORRALS AWAY FROM THE FREMONT RIVER." (unknown date or author, presumably park staff). 2 pp. Briefly describes need to protect streams from livestock, also showing some turbidity data for the Fremont River area and at watershed sampling sites in creeks, the irrigation canal, and springs around the park.

@@ PROPOSAL ON FREMONT RIVER "WATER QUALITY IMPROVEMENT PROJECT" (unknown date or author, presumably park staff). 4 pp. Describes the high nutrient levels observed in the river.

@@ PROJECT STATEMENT CARE-N-015.005, 1999. "Water resources management plan." 9 pp. This project statement provides an overview of water problems in the park for the river, creeks, washes, tinajas, etc and is an excellent summary of a large range of water issues, including water quality impacts.

@@ PROJECT STATEMENT CARE-N-15.004, 1999. "Water resources management: Halls Creek Watershed evaluation." 5 pp. This project statement describes the special water quality concerns on this creek, impacted by recreationists, and outlines the need for base-line water information on the creek, including some water quality monitoring.

@@ MEETING NOTES FROM COLORADO PLATEAU MEETING IN 1991, "Impacts of cattle on water quality of potholes within Capitol Reef National Park." 5 pp. Describes grazing impacts on water quality of potholes and tinajas in the park.

LITERATURE BELOW

Database: MAIN\COMMON NAME LIST\PLANTLIST. Microsoft Access ed. 896 records.

Abstract: This database is a checklist of the plant species known to exist at Capitol Reef National Park. The records contain the scientific name and the common name for each plant species.

Database: MAIN\GRAZING\Table: STOCKIMP. Microsoft Access ed. 423 records.

Abstract: This database is a list of all the stock improvements, including ranching developments that have been made in Capitol Reef National Park; these include stock ponds, water supply, and fencing.

Database: MAIN\Table-WILD. Microsoft Access ed. 2462 records.

Notes: See also NRBIB: CARE-0545 and NRBIB: CARE-0548

Abstract: This database is a list of animal observation records for Capitol Reef National Park. The animals observed are fish, birds, reptiles, amphibians, and mammals. For each record, information on class name, species name, common name, scientific name, number seen, location description, date, and observer are provided.

Miscellaneous boundary survey and work maps[folder]. no date included in original record. 32 sheets; mostly 23 x 18 inches; mostly 1:24,000.

Abstract: This folder contains topographic maps from a boundary survey, water, and miscellaneous work maps for Capitol Reef National Park.

Streams, springs, seeps, and tinajas: Capitol Reef National Park [Topographic]. late twentieth century. 17 sheets; 18 x 14 inches (some larger); 1:62,500.

Abstract: United States Geological Survey maps with markings showing the locations of perennial streams, semi-perennial streams, springs, seeps, tinajas, ponds, tanks, reservoirs, and wells in Capitol Reef National Park. Some of the maps appear to have been used during a survey in 1985, 1986, and 1987 while others appear older and have no dates.

Tinaja survey [Topographic]. 1993 Fall-1994 Spring. 2 sheets; 23 x 18 inches; 1:24,000.

Abstract: United States Geological Survey maps with markings showing tinajas located during a survey of the Waterpocket Fold in Capitol Reef National Park.

Author unknown? (no author included in original record). 12. Weather. 1981 64 color slides; 2x2.).

Abstract: This collection of slides shows scenes of the Fremont River flood, flash flood damage in the Fruita area, Capitol Gorge, and the Burr Trail, and flood effects like erosion and rockfalls in Capitol Reef National Park.

[folder]. Author unknown? (no author included in original record). 1962 water and sewage. 1962 33 sheets; mostly 34 x 21 inches.).

Abstract: This folder contains; sketch drawings of the Gifford House water line at Capitol Reef National Park, 1/2 size incomplete water and sewage plans from 1962 for areas within the Park, a diagram from 1962 showing the schematic wiring for a water treatment plant at the Park, and two sets of plans from 1962 showing the water and sewage system at the Park.

[folder]. Author unknown? (no author included in original record). 1969-83 campground and picnic improvements. 1969 7 sheets; different sizes.).

Abstract: This folder contains; incomplete plans from 1969 for a waste disposal system at Capitol Reef National Park, a sketch drawing from 1976 of the sewage and water system

around the campground at the Park, and a set of plans from 1983 for a picnic area Comfort Station and leach field at the Park.

Author unknown? (no author included in original record). 5.60 Water studies. 1986 35 color slides; 2x2.).

Abstract: This collection contains slides showing water quality sampling for the study of coliform bacteria along Halls Creek, at tinajas, a stock pond, and other sites in Capitol Reef National Park.

Author unknown? (no author included in original record). 5. Water other than for stock. 1969 31 color slides; 2x2.).

Abstract: This collection contains slides showing the Fremont River, Deep Creek, Oak Creek, lower Halls Creek, tinajas, and drainage runoff (watershed) at Capitol Reef National Park.

Author unknown? (no author included in original record). 8. Grazing. 1982 154 color slides; 2x2.).

Abstract: This collection contains slides showing grazing exclosures, cattle, a cattle drive, cattle fences, vegetation destruction, springs, reservoirs, wells, and stock ponds at Capitol Reef National Park.

Author unknown? (no author included in original record). Bighorn sheep habitat assessment: Geographic Information Systems analysis. 17 overhead projector transparencies).

Abstract: Geographic Information System (GIS) analysis was used to assess bighorn sheep habitat in Capitol Reef National Park and adjacent areas. Subjects covered: land ownership, elevation ranges, escape terrain, cliffs, core habitat, horizontal visibility, grazing allotments, fences, human activity zones, perennial water sources, Navajo Formation, potential bighorn habitat, and core habitat.

---. Capitol Reef National Park flash flood - July 24, 1992 [VHS]. 1992. 1: 15 min. videocassette.

Abstract: Video footage of a flash flood at Capitol Reef National Park.

Author unknown? (no author included in original record). Electroshocking in Fremont River, irrigation water into Fremont River, runoff into Fremont, and malaise traps. 1992 Jun 24 color slides; 2x2.).

Abstract: Slides showing electroshocking (electrofishing) activities and fish samples from a project to assess the impact of a rotenone spill on the fish in the Fremont River in Capitol Reef National Park, slides showing Malaise traps for trapping dance flies in the park, and slides showing excess irrigation water in Cuts Wash which flows into the Fremont River upstream from the park.

Author unknown? (no author included in original record). Fish - Fremont River, Sulphur Creek, Pleasant Creek: Electroshocking. 1993 May 36 color slides; 2x2.).

Abstract: Slides showing fish sampled in electroshocking (electrofishing) projects in the Fremont River, Sulphur Creek, and Pleasant Creek at Capitol Reef National Park; species include, leatherside chub, flannelmouth sucker, bluehead sucker, and speckled dace.

Author unknown? (no author included in original record). Fremont River and diversions - Garkane and Torrey canals. 1989 Sep 34 color slides; 2x2.).

Abstract: Slides showing the Fremont River and some of its diversions for agricultural purposes, including irrigation, upstream from Capitol Reef National Park at the following sites; Garkane Canal, the Garkane Diversion Dam, and the Torrey Canal.

Author unknown? (no author included in original record). Lion kills: Fremont River sampling sites, tinajas, and cattle at Blue Flats. 1991 Feb 13 color slides; 2x2.).

Abstract: Slides showing evidence of mountain lion kills, including drag marks and deer carcasses at Capitol Reef National Park. Slides also include sampling sites on the Fremont River in the park and specimen sampling of aquatic invertebrates at tinajas in the park.

Author unknown? (no author included in original record). Rotenone - potassium permanganate incident in Fremont River. 1991 Nov 23 color slides; 2x2.).
Abstract: Slides documenting the Utah Division of Wildlife Resources's spill of 27 gallons of rotenone into the Fremont River upstream from Capitol Reef National Park. Both the spill and subsequent detoxification with potassium permanganate proved to be toxic to aquatic life. The treatment serves to eradicate whirling disease, a protozoan-borne disease which is specific to fish of the salmonid family.

Author unknown? (no author included in original record). Tinaja inventory proposal slide presentation. 1990s? 14 color slides; 2x2.).
Notes: See also NRBIB: CARE-0422
Abstract: Slides for a presentation on a proposal to conduct an inventory of the tinajas at Capitol Reef National Park. The proposed survey would determine the extent of tinaja wetlands in the park, determine the variability in physical, biological, and chemical characteristics of the wetlands, and to provide park management with information they need during the General Management Plan revision process for evaluating developments or activities.

Author unknown? (no author included in original record). Tinaja sampling (3-9-91); Lower South Desert range (2-21-91). 1991 43 color slides; 2x2.).
Abstract: Slides showing specimen sampling of aquatic invertebrates at tinajas in Capitol Reef National Park and slides showing the range condition of the lower South Desert in the park.

Author unknown? (no author included in original record). Tinaja survey. 1993 154 color slides; 2x2.).
Abstract: This collection contains slides showing tinajas, tinaja drainages, and watersheds located during a survey of the Waterpocket Fold in Capitol Reef National Park. The survey took place during Fall 1993 and Spring 1994.

Author unknown? (no author included in original record). Tinajas studied - 5.51/Cottonwood tinajas [#0-#5]. 1984 287 color slides; 2x2.).
Abstract: This collection contains slides showing the Cottonwood Tanks (tinajas) and the Cottonwood Tanks drainage (watershed) located in Capitol Reef National Park.

Author unknown? (no author included in original record). Tinajas studied - 5.52/Willow tinajas [#0-#5]. 1986 132 color slides; 2x2.).
Abstract: This collection contains slides showing the Willow Tanks (tinajas) and the Willow Tanks drainage (watershed) located in Capitol Reef National Park.

Author unknown? (no author included in original record). Tinajas studied - 5.53/Fountain tinajas [#0-#5]. 1984 56 color slides; 2x2.).
Abstract: This collection contains slides showing the Fountain Tanks (tinajas) located in Capitol Reef National Park.

Author unknown? (no author included in original record). Tinajas studied - 5.53/Miaheyan tinajas [#0-#5]. 1985 85 color slides; 2x2.).
Abstract: This collection contains slides showing the Miaheyan Tanks (tinajas) located in Capitol Reef National Park.

Author unknown (or not included when record was created). Capitol Reef National Park coliform sampling data sheets [three-ring binder]75 p.
Abstract: This binder contains documents pertaining to the quality of water resources at Capitol Reef National Park: (1) a summary of fecal coliform culturing and fecal coliform water collecting procedures, (2) instructions for plankton and chlorophyll sampling, (3) coliform sampling data sheets from 1988 to 1990 for Sulphur Creek, Sand Creek, water sources in the North District, water sources in the South District, Oak Creek, Pleasant Creek, and water sources outside the park, and (4) notes on coliform samples.

- . Capitol Reef National Park: Riparian species below c. 6500' (excluding those known from gardens/tinajas); species found in the willow and cottonwood tinajas; species known from hanging gardens⁴ p.
Abstract: Lists of plant species found in riparian zones below 6500 feet, in willow and cottonwood tinajas, and in hanging gardens at Capitol Reef National Park; includes scientific names.
- . Capitol Reef National Park, science and resource management division: Land protection plan update. 1991 Apr 1 p.
Notes: See also NRBIB: CARE-0580
Abstract: A short amendment to the Land Protection Plan for Capitol Reef National Park. The purpose of the update is to document the external land use practices occurring adjacent to the park that have an effect on park resources. Topics are resources to be protected including, Pleasant Creek, Oak Creek, and Fremont River, land use for agriculture, the proposed dam on Fremont River, and water quality monitoring.
- . Capitol Reef National Park water quality data [three-ring binder]. 1992 150 p.
Abstract: This binder contains documents pertaining to water resources at Capitol Reef National Park; including Fremont River daily and peak heights data sheets, water sampling data sheets, water quality sampling field sheets, quality control/assurance spike results, and distilled water analyses.
- . Capitol Reef National Park water quality data [three-ring binder]. 1993 50 p.
Abstract: This binder contains documents pertaining to water resources at Capitol Reef National Park: water sampling data sheets, quality control and assurance spike results, and distilled water analyses.
- . Capitol Reef National Park water quality data [three-ring binder]. 1994 50 p.
Abstract: This binder contains documents pertaining to water resources at Capitol Reef National Park; including water sampling data sheets, and a distilled water analysis.
- . Capitol Reef National Park water quality sampling field sheets [three-ring binder]. 1991 150 p.
Abstract: This binder contains water quality sampling data sheets for water resources at Capitol Reef National Park.
- . Capitol Reef National Park water sampling data sheets [three-ring binder]. late twentieth century 150 p.
Abstract: This binder contains documents pertaining to the water resources at Capitol Reef National Park; including water quality sampling data sheets from 1990, coliform sampling data sheets from 1988 to 1990, and Fremont River turbidity and conductivity data sheets from 1987 and 1988.
- . Capitol Reef National Park: Wildlife observations through 1993 200 p.; within a binder.
Notes: See also NRBIB: CARE-0785
Abstract: Computer printout pages from a computer database on animal observations; fish, birds, reptiles, amphibians, and mammals at Capitol Reef National Park. For each record, information on class name, species name, common name, scientific name, number seen, location description, date, and observer are provided.
- . Discharge data from Capitol Reef National Park⁵ notebooks.
Abstract: This set of notebooks contains discharge data collected from the Fremont River and Pleasant Creek at Capitol Reef National Park.
- . Floodplain correspondence [folder]. 1980 1 folder.
Abstract: This folder contains documents on floodplains at Capitol Reef National Park; including correspondence from 1980 to 1985, illustrations showing flash flood hazard areas in the campground, and guidelines for establishing flash flood hazard areas.

- . Fremont River Dam analyses: Dam and reservoir [folder]1 folder.
Abstract: A 1986 analysis of the proposed Torrey Reservoir in the Fremont River by the State of Utah - Division of Wildlife Resources. This folder also includes; a 1986 application to the Federal Energy Regulatory Commission for a license for the Fremont River Water Power Project by the Wayne County Water Conservancy District.
- . Fremont River Dam: Blue Valley Project [folder]1 folder.
Abstract: Correspondence, planning reports, and photocopied articles from 1988 and 1993 related to a plan to construct a reservoir and hydroelectric project on the Fremont River near Torrey in Wayne County, Utah. The site is upstream from the Fremont River in Capitol Reef National Park.
- . Fremont River Dam: (Briefing statements; State Engineer hearing, Loa, UT, 6/11/92) [folders]2 folders.
Abstract: Briefing statements from 1986 and 1990 describing the positions of both the Wayne County Water Conservancy District and Capitol Reef National Park regarding the proposal to build a reservoir and dam on the Fremont River near Torrey, Utah. Also, correspondence from 1992 related to a State Engineer's hearing concerning the application by the Wayne County Water Conservancy District for an extension of time to prove water appropriation of 50,000 acre feet of the Fremont River.
- . Fremont River Dam: (Funding; Water rights) [folder]2 folders.
Abstract: Correspondence from 1989 regarding the funding for studies of the Lower Fremont River Development Project. Also, correspondence from 1986 to 1992 regarding water rights for the Fremont River. The documents relate to the proposed Torrey Dam and Reservoir (Fremont Power Project) on the Fremont River just upstream from Capitol Reef National Park.
- . Fremont River Dam: (National Park Service recommendations; Comments, protests, etc.) [folders]2 folders.
Abstract: Correspondence, comments, and protest from 1986 to 1993 regarding the proposed Torrey Dam and Reservoir (Fremont Power Project) on the Fremont River just upstream from Capitol Reef National Park.
- . Fremont River Dam: Reviews of studies, reports, etc. [folder]1 folder.
Notes: See also NRBIB: CARE-0225 and NRBIB: CARE-0226
Abstract: Reviews of "Macroinvertebrate fauna of the Fremont River, Wayne County, Utah" and "Botanical environmental assessment, Wayne County Water Conservancy District Fremont River Water Power Project, Wayne County, Utah,". Also, correspondence from 1987 to 1991 regarding the possible effects that construction and operation of a reservoir and hydroelectric plant on the Fremont River would have on Capitol Reef National Park. The site is upstream from Capitol Reef National Park.
- . Fremont River Dam: Six-month progress reports, WCWCD [folder]1 folder.
Abstract: Six-month progress reports from 1987 to 1991 by the Wayne County Water Conservancy District for the proposed Fremont River Dam and Power Project regarding progress of studies and planning under a Preliminary Energy Regulatory Commission for Project No. 10026. The proposed project is the construction and operation of a reservoir and hydroelectric plant on the Fremont River. The site is upstream from Capitol Reef National Park.
- . Fremont River Gorge water well information: Memos - correspondence - plans and specifications, etc. [three-ring binder]. 1992200 p.
Abstract: This binder contains documents related to a water well in the Fremont River Gorge of Capitol Reef National Park; memos, correspondence, construction plans, a proposal for a photovoltaic water pumping system, a summary of background information and development needs for the water well construction, and other items.

- . Fremont River Gorge water well information: Water quality test plus contracts and regulations [three-ring binder]. 1993 150 p.
Abstract: This binder contains documents related to a water well in the Fremont River Gorge of Capitol Reef National Park; correspondence, results from water quality tests for volatile organic compounds and coliform bacteria, and bid schedules for construction.
- . Fremont River: Water power project [three-ring binder]. 1986 300 p.
Abstract: This binder contains documents related to the Fremont River Water Power Project, a proposal to build a reservoir and dam on the Fremont River upstream from Capitol Reef National Park; includes correspondence, a draft FERC (Federal Energy Regulatory Commission) licence application, notes, reviews of planning reports, and comments.
- . Fremont River watershed - mgmt (CUP-federal aid) [folder]. 1993 1 folder.
Abstract: Correspondence, proposals, meeting minutes, and other documents related to a project to improve watershed conditions as well as stream, wetland, and riparian habitats in the Fremont River drainage.
- . Fremont River - wild and scenic [folder]. 1990? 1 folder.
Abstract: This folder contains documents related to the determination of "National Wild and Scenic Rivers System" eligibility for rivers within Capitol Reef National Park. Documents include; correspondence, reports of eligibility findings for the Fremont River, Pleasant Creek, and Halls Creek, and a wild and scenic values report for the Fremont River.
- . General procedures and equipment use: Capitol Reef National Park [three-ring binder]. 1986 40 p.
Abstract: This binder contains summaries on procedures and equipment use for measuring water quality at Capitol Reef National Park. The summaries are on operation of the pH meter, measuring the pH of precipitation, use of the Bamstead water still, measuring Fremont River turbidity and conductivity, use of the UV sterilizer, procedures for fecal coliform filtering and culturing, procedures for collecting data at grazing enclosure sites, procedures for tinaja sampling, and procedures for using the conductivity meter.
- . Grazing Management: Allotments [folder]. late twentieth century 17 folders.
Abstract: These folders contain documents on grazing allotments in Capitol Reef National Park; including allotment summaries, stock improvement project & water source locations, range trend plot location data, and maps. The names of the allotments are Hartnet, Cathedral, Sandy I, Sandy II, Sandy III, Torrey Town, Sleeping Rainbow, Waterpocket, Rock Springs, Muley Twist, Circle Cliffs, Moody, Wagon Box Mesa, Thousand Lake, Solomon, Chimney Canyon, Dry Bench, Miners Mountain, Meeks Mesa, and River; items are from the 1970s and 1980s.
- . Grazing management: Environmental Assessment for reservoir maintenance [folder]. 1985 1 folder.
Notes: See also NRBIB: CARE-0650
Abstract: This folder contains documents related to "Capitol Reef reservoir maintenance"; including correspondence, comments, analyses, and a decision record rationale document and finding of no significant impact. The items concern a decision to reconstruct two reservoirs and one spring in Capitol Reef National Park to supply water for livestock and wildlife.
- . Grazing Management: General information [folder]. 1981 1 folder.
Abstract: This folder contains documents related to grazing allotments in Capitol Reef National Park; including a summary of allotments, supplementary items for allotment maps, charts and a list describing water sources and stock projects, range management data, and general information.
- . Grazing management: Locations - stock projects, water resources, trend plots [folder]. 1986 2

folders.

Abstract: These folders contain documents related to grazing management in Capitol Reef National Park; including a 1988 list of stock improvement projects and water source locations and stock improvement and trend plot forms from 1986.

---. Grazing management: Range improvements [folder]. 19851 folder.

Abstract: This folder contains memos on range improvements, including reservoirs, springs, water trough, and fencing in Capitol Reef National Park.

---. Macroinvertebrates and vertebrates observed in Cottonwood and Willow tanks7 p.

Abstract: A list of the macroinvertebrates and vertebrates in the Cottonwood and Willow tanks at Capitol Reef National Park. Information includes scientific name, common name, functional feeding group, aquatic community, habit, and other information are provided for each species.

---. North District water monitoring project [three-ring binder]. 1986100 p.

Abstract: A water monitoring project for the North District of Capitol Reef National Park is described. The objectives of the project are to establish a pattern of water availability for nine water sources, including; springs, creeks, reservoirs, establish a pattern of use by livestock and/or wildlife, and after five years of monthly comparisons, establish a pattern of availability of water at any of the given sites. Water site monitoring forms contain information on the condition of each site, the character of the water, usage, and observations.

---. Organic matter data sheets [three-ring binder]. 199150 p.

Abstract: This binder contains organic matter data sheets for water resource sites at Capitol Reef National Park.

---. Questionnaire - threats to the parks. 1980 May 513 p.

Abstract: Questionnaire about threats impacting Capitol Reef National Park's resources. Sections include: air pollution, water quality pollution, aesthetic degradation, physical removal of resources, exotic encroachment, visitor physical impacts, and park operations.

---. Report for the National Park Service on the Capitol Reef National Park expansion: Attachment no. 9 - Richfield District [three-ring binder]. 1972 Jan 31400 p.

Abstract: This report examines livestock grazing privileges, grazing permits, grazing agreements, rest rotation system for Hartnet Grazing Allotment, resource conservation and development projects, and Bitter Creek watershed study area. Attachment Number 10, Kanab District, includes range management and related agreements in the Kanab District portion of Capitol Reef National Park extension.

---. Resource management: Briefing - CARE [folder]. 19881 folder.

Abstract: This folder contains documents pertaining to resource management issues at Capitol Reef National Park; including a 1993 list of livestock grazing effects studies, a 1993 list of potential water resources projects, a review of funding needs, specifically grazing management and GIS for 1993, a 1991 summary of a project to monitor the quality of waters within the Fremont River watershed, a 1989 statement for management update, lists of research projects being conducted in 1988, and a summary on the status of resource management issues in 1988.

---. Resource management: Committee meetings 1988-1990 (folder)1 folder.

Abstract: This folder contains the minutes from Resource Management Committee meetings at Capitol Reef National Park from 1988 to 1990. The topics focus on animals, plants, land, water, and other resource management issues. Mostly natural resources issues but some cultural resources issues.

---. Resource Management: Interpretive handouts/education programs [folder]1 folder.

Abstract: This folder contains documents regarding resources management at Capitol Reef National Park: Resource Management and Science Division News for 1993, lists and descriptions of macroinvertebrate, invertebrate, vertebrate, and zooplankton life observed in tinajas, and a list of topics for educational science programs from 1994.

- Resource Management: Issues - Fremont River Dam proposal [folder]1 folder.
Abstract: This folder contains documents related to the proposal to build a reservoir and dam on the Fremont River near Torrey, Utah: a draft FERC, licence application, a review of proposed environmental studies, letters, newspaper articles, and a Wayne County Water Conservancy District progress report. Items range in date from 1988 to 1991.
- Resource Management: Proposals for funding (PRAM, etc.; NRPP, Challenge Cost Share, etc.) [folder]2 folders.
Abstract: These folders contain documents regarding funding for resource management projects at Capitol Reef National Park: research topics for 1986, descriptions of Resource Management Project Proposals for 1991, descriptions of Water Resources Program proposals for 1991 and 1992, proposals for a Challenge Cost-Share Program application for 1992 and 1993, Natural Resource Infrastructure Initiative Request proposals for 1993, and Preservation, Restoration, and Mitigation (PRAM) proposals for 1992, 1993, and 1994.
- Soil Testing Laboratory, Colorado State University: Domestic water analysis report. 19871 p.
Abstract: Chemical analysis results and recommended limits for the domestic water at Capitol Reef National Park.
- UDWR - Whirling disease / Rotenone [folder]1 folder.
Abstract: Correspondence, pesticide use proposals, and other documents related to a 1993 rotenone treatment project for the Fremont River. The treatment serves to eradicate whirling disease, a protozoan-borne disease which is specific to fish of the salmonid family. The poisoning would be an attempt to remove trout, the disease host, for three years or more in order to interrupt the life cycle of the disease agent.
- Utah Division of Water Quality: Collected samples [three-ring binder]. 199450 p.; within 3-ring binder.
Abstract: This binder contains summaries of water quality monitoring sample runs from Halls Creek, Oak Creek, Pleasant Creek, Sulphur Creek, and Polk Creek in Capitol Reef National Park.
- Vegetation: General - misc. notes about CARE plants [folder]1 folder.
Abstract: This folder contains documents related to vegetation at Capitol Reef National Park: notes on relict areas, annotated plant lists, annotated lists of threatened and endangered plant species, an annotated list of plant communities, a list of aquatic plants, and correspondence. The items range in date from 1981 to 1993.
- Water inventory [three-ring binder]. 1985 Jul250 p.
Abstract: This binder contains water inventory data sheets for water sources such as springs, tinajas, seeps, wells, and reservoirs within Capitol Reef National Park. The sheets contain information on the location of each source and its condition.
- Water Management: Inventory of park water sources [folder]1 folder.
Abstract: This folder contains documents from an inventory of the water resources at Capitol Reef National Park. Information includes location, current use, and background information on dams, a well, seeps, reservoirs, springs, a river, and creeks in the park. Folder also contains some chemical analysis forms and map reproductions showing water resource locations.
- Water Resources: Aquatic invertebrates - inventory and monitoring [folder]1 folder.
Abstract: This folder contains documents related to aquatic invertebrate monitoring of the

Fremont River in Capitol Reef National Park: correspondence from 1994 and riparian/macrobenthic field data sheets from 1993.

- Water Resources: Proposed rotenone treatments [folder]. 1992 folder.
Abstract: This folder contains documents related to the Utah Division of Wildlife's proposed rotenone treatments on the Fremont River upstream from Capitol Reef National Park: comments on the proposal, correspondence, and an explanation of safeguards to protect downstream aquatic resources. The treatment serves to eradicate whirling disease, a protozoan-borne disease which is specific to fish of the salmonid family. Items date from 1992 and 1993.
- Water Resources: rotenone incident (i.e. spill) - documentation/conversations/WQ reports [folder] 1 folder.
Abstract: This folder contains documents related to the Utah Division of Wildlife Resources's spill of 27 gallons of rotenone into the Fremont River upstream from Capitol Reef National Park: water quality analyses, correspondence, notes, newspaper articles, a case/incident record, and notes. Both the spill and subsequent detoxification with potassium permanganate proved to be toxic to aquatic life. The treatment serves to eradicate whirling disease, a protozoan-borne disease which is specific to fish of the salmonid family. Items date from 1991 and 1992.
- Water Resources: Tinaja wetlands - chemical data [folder] 1 folder.
Abstract: Chemical data and field notes from a sampling project of the tanks in Cottonwood and Willow Washes of Capitol Reef National Park in 1993.
- Water Resources: tinaja wetlands - (Fecal coliform bacteria study; Fecal coliform bacteria study/data analysis and graphics) [folder] 2 folders.
Notes: See also NRBIB: CARE-0530
Abstract: These folders contain documents regarding a study to assess the impacts of cattle on the water quality of tinajas within Capitol Reef National Park: illustrations of the study areas, proposals to study and monitor fecal coliform bacteria in tinajas associated with cattle, photographs, a summary on the impacts of cattle, and data analysis figures. Items range in date from 1986 to 1991.
- Water Resources: Tinaja wetlands - riparian vegetation study - 1988 [folder]. 1988 folder.
Abstract: This folder contains documents related to a study, "Ecology of riparian communities adjacent to tinajas: impacts of livestock in Capitol Reef National Park." The folder includes; sampling origin, photo point, and soil moisture data, proposal, and other items.
- Water Resources: tinaja wetlands (Tinaja inventory 1993-1994; Inventory proposals 1993-1994) [folder]. 1993 folders.
Notes: See also NRBIB: CARE-0528
Abstract: These folders contain correspondence, notes, proposals, and other documents related to a proposed survey to determine the extent of tinaja wetlands in Capitol Reef National Park as well as to determine the basic physical, biological, and chemical characterization of each one found. Items date from 1993 and 1994.
- Water Resources: (Tinajas - potential studies; Tinaja ecology - correspondence) [folder] 2 folders.
Abstract: Notes, correspondence, and two proposals related to potential water resources research projects on tinajas in Capitol Reef National Park. The items date from 1986 to 1994.
- Water resources: Water well—1994: Water quality concerns (e.g. sulfates) [folder] 1 folder.
Abstract: Correspondence concerning water quality, reducing sulfates and other dissolved solids, in Capitol Reef National Park's water supply well.

- . Water resources: Well development - misc. info. [folder] 1 folder.
Abstract: Correspondence, documents describing well locations, information on water well construction at Capitol Reef National Park, and other items from 1992-1994.
- . Waterpocket ecology project: Taja field sampling procedures [folder] 1 folder.
Notes: See also NRBIB: CARE-0419)
Abstract: This folder contains notes and lists of procedures regarding the sampling techniques for Galal's study, "Waterpocket ecology/macrobenthic research - Capitol Reef National Park." Items date from 1986 and 1987.
- . Watershed - Remote sensing [folder]. 19917 p.
Abstract: Correspondence, comments and a manuscript describing the background goals and objectives for a potential videography and GIS project on the Fremont River Watershed.
- . Wildlife: Fisheries [folder] 1 folder.
Abstract: Contains information on sampling efforts for fisheries surveys (April 30-May 5, 1993) in Capitol Reef National Park. Surveys were done of Pleasant Creek and Sulphur Creek.
- . Wildlife: General [folder] 1 folder.
Abstract: Items relating to Capitol Reef National Park: a wildlife observations species listing (fish, amphibians, reptiles, birds, mammals, insects, arachnids), a completed questionnaire from 1991 for a survey of animal diseases and related issues in the National Park System, a memorandum on wildlife management research from 1978 (invertebrates, amphibians, lizards, birds, rodents, small game, large game, deer, plants, weather), and a list of common birds of Fruita.
- . Wildlife Management: Exotic and feral animals [folder]. 19771 folder.
Abstract: This folder contains completed forms from a survey of feral/exotic vertebrates in Capitol Reef National Park. Species reported include starlings (*Sturnus vulgaris vulgaris*), house sparrows (*Passer domesticus domesticus*), and Asiatic chukars (*Alectoris graeca*); bluegills (*Lepomis macrochirus*), black bullheads (*Ictalurus melas*), reddsides (*Richardsonius balteatus*), brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), and leathersides minnows (*Gila copeii*).
- . Wildlife Management: Park checklists [folder] 1 folder.
Abstract: This folder contains checklists for bird, reptile, mammal, fish, and amphibian species at Capitol Reef National Park. No dates are recorded, although habitats are often described.
- @@ Barth, Richard C. and McCullough, Edgar J., Soil-Plant Systems, Golden, CO. Livestock grazing impacts on riparian areas within Capitol Reef National Park: Final report. 1988; National Park Service Contract Number CT1200-4-A065. 154 p.
Notes: See also NRBIB: CARE-0173
Abstract: This report addresses these objectives: 1) characterize the historical composition and structure of riparian areas, 2) locate riparian areas and determine current water quality, vegetation, aquatic life, and erosion, 3) assess the impact of livestock grazing on riparian areas, and 4) suggest and evaluate management strategies to minimize livestock impact in riparian areas; includes appendix, figures, and tables.

SK NOTE considers fecal coliforms levels as well as macroinvertebrate indices on two creeks.

- @ ### Baumann, Richard W. 1989. Macroinvertebrate fauna of the Fremont River, Wayne County, Utah. Report from Dept of Zoology, Brigham Young University to Water Conservancy District, Teasdale, UT. 38 pp. Abstract: one of the earlier studies listing the macroinvertebrates found in the Fremont River, in the park area.

SK NOTE above report also reviews some of the basic needs for monitoring in the park.

Berghoff, Kevin, hydrologist, Glen Canyon National Recreation Area. 1994 Water quality summary: Capitol Reef National Park. 1995?6 p.

Abstract: This study examines water quality for Capitol Reef National Park in 1994. Samples were taken at five separate sites and analyzed at the Utah water quality lab.

SK NOTE: It's particularly important that BERGHOFF would like to cooperate with us (CSU & NCPN) on the project, and is available and ready for questions or discussions on WQ and monitoring, particularly ideas re: CARE or other parks in the southern Utah area where he has worked (see Sam's list of contacts & telephones on this).

Berghoff, Kevin, hydrologist, Resource Management Division, Capitol Reef National Park. Capitol Reef National Park tinaja wetland survey: Summary report. 1994 Jul 11 p.

Notes: See also NRBIB: CARE-0308

Abstract: This survey examines the presence and extent of tinajas in Capitol Reef National Park. These are wetland or rock pools located in the Navajo sandstone formation along the Waterpocket Fold. A total of four hundred and sixty individual tinajas were discovered in eighty drainages along the Waterpocket Fold south of the Burr Trail; includes figures.

Berghoff, Kevin, hydrologist, Resource Management and Science Division, Capitol Reef National Park. Capitol Reef National Park tinaja wetland survey - summary report. 1995 Apr 120 p.

Abstract: This project proposes to locate major tinaja drainages within the Waterpocket Fold and enter them into a GIS program and to group these tinajas by physical and biological traits. The determination of these physical and biological features can be used to predict the presence of larger drainages and permanent tinajas.

—, hydrologist (Capitol Reef National Park). Capitol Reef National Park tinaja wetland survey summary report. U.S. National Park Service, Capitol Reef National Park; 1995 Apr 96 pages.

Berghoff, Kevin, hydrologist, Resource Management and Science Division, Capitol Reef National Park. Floodplain delineation at Fruita - Capitol Reef National Park. 1995 Apr 12 p.

Abstract: This report summarizes the floodplain survey for the Fruita area in Capitol Reef National Park. Topographic cross sections of Sulphur Creek were collected along two stream reaches, near the visitor center/administration area, and near the residential area. Cross sections were also taken of the Fremont River; includes figures.

SK NOTE: some good work, but not wq

Biologist (Capitol Reef National Park). Letter To: Superintendent, Capitol Reef National Park. [memo] 1976 Mar 19. 6 p.

Abstract: This memo is a summary of information on the subject "Agriculture: soils, fertility, fertilizers, gardening, crops, etc.." The author has assembled his/her notes on the above topic and has made inferences relating to agricultural management at the Capitol Reef National Park based in part on the results from orchard soil tests. Section topics include nitrogen, potassium, phosphorus, pH and soil acidity, water sources, and pertinent comments regarding management.

Bjorklund, L. J., hydrologist, United States Geological Survey. Reconnaissance of the ground-water resources of the upper Fremont River Valley, Wayne County, Utah. U.S. Geological Survey and Utah Department of Natural Resources, Division of Water Rights, preparer; 1969; State of Utah, Department of Natural Resources Technical Publication No. 22. 54 p.

Abstract: This investigation examines; the source and occurrence of groundwater, its availability, approximate quantity, and chemical quality. The relation of groundwater to streamflow is discussed, as well as if and where additional studies are needed. Specifically, the report focuses on ground water in the valley fill and adjacent volcanic rocks and the general hydrology of the upper Fremont River valley drainage basin; includes illustrations

and tables.

Borthwick, Sandy. Slides of rotenone incident: Capitol Reef National Park. 1991 11 color slides; 2x2.
).

Notes: See also NRBIB: CARE-0526

Abstract: Slides documenting the Utah Division of Wildlife Resources's spill of twenty-seven gallons of rotenone into the Fremont River upstream from Capitol Reef National Park. Both the spill and subsequent detoxification with potassium permanganate proved to be toxic to aquatic life. The treatment serves to eradicate whirling disease, a protozoan-borne disease which is specific to fish of the salmonid family.

@@ Borthwick, Sandy and Henderson, Norman R., Capitol Reef National Park, Torrey, Utah. A proposal to monitor the quality of waters within the Fremont River watershed - Capitol Reef National Park, Utah. 1991 ?56 p.

Abstract: The objectives of this project include; the establishment a water quality baseline for the Fremont River watershed, the evaluation of land use practices which may effect this system, and to develop a georeferenced database for water resources within Capitol Reef National Park; includes an appendix.

SK NOTE: Henderson spent many years in park (prior to Berghoff) so presumably has some ideas of value. This is a "monitoring plan" for an area in the park (note, he's now at Glen Canyon).

Boyle, Terrence P., Water Resources Lab, Colorado State University, Fort Collins, CO.

[folder]Research: RSP-108 Waterpocket ecology (Boyle) 1986 (Correspondence and more). 19864 folders.

Notes: Project status: terminated.

Abstract: Correspondence, investigator's annual reports, data, and an application for permission to collect algae, invertebrates, and amphibians. The project title is "Ecological characterization/biological assessment of the aquatic ecosystems of the Waterpocket Fold, Capitol Reef National Park, Utah."

Brammer, Colin A. 1997. A survey of the aquatic insect fauna of Pleasant Creek, a pristine Utah stream. MS Thesis, Purdue University Dept of Entomology. 87 pp. Abstract: Benthic insects were collected and identified along Pleasant Creek, and the collections used to calculate stream indices for water quality

SK NOTE this report provides an inventory list of the macroinvertebrates. (the correspondence copied shows contacts at Purdue, with people who have worked in the park).

Bureau of Land Management. Draft environmental impact statement on the Circle Cliffs combined hydrocarbon lease conversion. 1984 Nov 175 p.

Notes: See also NRBIB: CARE-0487

Abstract: This statement assesses the environmental consequences of developing the Circle Cliffs tar sand deposit in accordance with a plan of operation submitted by W. C. Kirkwood Oil & Gas Company. It addresses the impacts of the proposed action, a restricted development alternative, a worst case analysis, and a no action alternative. The major areas of environmental concern relate to air quality in Capitol Reef National Park, changes in existing water use, socioeconomic factors, and effects on governmental plans and policies for the Boulder to Bullfrog road, Burr Trail; includes a glossary and appendix.

Bureau of Land Management, Richfield District. Henry Mountain Coordinated Resource Management Plan - environmental assessment: Draft. 1988 42 p.

Abstract: This draft environmental assessment analyzes a proposal developed to assist in the funding and management of resources in part of the Bureau of Land Management's Henry Mountain Planning Area, including land within and to the east of Capitol Reef National Park. The purpose of the proposed action is to: 1) increase ground cover to reduce soil erosion and improve watershed conditions, 2) increase forage to provide for

current big game (particularly bison) and livestock use levels, and 3) reduce salinity of the Colorado River; includes appendices.

Capitol Reef National Park, Resource Management Division. Capitol Reef National Park: Grazing summary - 1986. 1988 Mar54 p.

Abstract: The purpose of this report is to provide a summary of grazing activities in Capitol Reef National Park for the period Fall 1986 to Summer 1987. Included in this report is information on permittee status, allotment summaries, and existing and proposed stock improvement projects and water sources in each allotment; includes figures and appendices.

Capitol Reef National Park, Resource Management Division. Capitol Reef National Park: Grazing summary - 1987. 1987 Oct67 p.

Abstract: The purpose of this report is to provide a summary of grazing activities in Capitol Reef National Park for the period Fall 1986 to Spring 1987. Included in this report is information on permittee status, allotment summaries, and existing and proposed stock improvement projects and water sources in each allotment; includes figures and appendices.

@@ Capitol Reef National Park, Resource Management Division. Water quality of the Fremont River from Bicknell Bottoms through Capitol Reef National Park, 1988-1989. 1990 Mar50 p.

Abstract: Water quality data for the Fremont River from 1988-89, taken from sites within Capitol Reef National Park and upstream. Temperature, turbidity, conductivity, and fecal coliform bacteria were all monitored. Recommendations for revising the water quality monitoring program at the park are provided. Figures and tables.

SK NOTE: this report provides some overviews of turbidity, conductance, and bacteria, with insights into ideas for monitoring in the park.

Capitol Reef Natural History Association. Reptiles, amphibians, and fishes checklist: Capitol Reef National Park. 1984 Feb2 p.

Abstract: List of the reptile, amphibian, and fish species identified in or near Capitol Reef National Park as well as species whose range includes the park. The types of reptiles listed are turtles, lizards, and snakes. The types of amphibians listed are salamanders, fish, frogs, and toads.

Christiana, David and Rasmussen, Todd C. 1989. Hydrologic assessment for Capitol Reef National Park. Draft Scoping Report from the Dept of Hydrology and Water Resources, University of Arizona to the park. Tucson. 89 pp. Abstract: An overview of water resources in the park, describing basic hydrology, water supply, dam impact concerns, water rights, and impacts from grazing, floods, exotic vegetation, and recreation.

@@ ##Christiana, David. 1989. Draft scoping report: hydrologic assessment for Capitol Reef National Park. Report to the park from Dept of Hydrology & Water Resources, Univ. of AZ. 69 pp. An overview of water resources in the park, describing basic hydrology, water supply, dam impact concerns, water rights, and impacts from grazing, floods, exotic vegetation, and recreation

SK NOTE: one of the best, more comprehensive summaries of water issues for the park.

Christiana, David G. and Rasmussen, Todd C., Department of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona. Hydrology and water resources of Capitol Reef National Park, Utah. Henderson, Norman R., National Park Service, Capitol Reef National Park; 1991 Aug126 p.

Notes: See also NRBIB: CARE-0221

Abstract: This report examines the hydrology and water resources of capitol Reef National Park, the chemical quality of water resources, and the park's water uses and water

budget; includes tables, figures, and appendices.

Cooperative Park Studies Unit, Northern Arizona University. Text slides for tinaja presentation. 1991 Jul 17 color slides; 2x2.).

Notes: See also NRBIB: CARE-0420

Abstract: Slides for a presentation on the impacts of cattle on the water quality of tinajas within Capitol Reef National Park. Fecal coliform bacteria in the tinajas was studied as well as turbidity, conductivity, and pH of the tinajas.

Dubiel, Russell F., United States Geological Survey. Sedimentology of the Upper Triassic Chinle Formation, southeastern Utah: Paleoclimatic implications [reprint]. Journal of the Arizona-Nevada Academy of Science. 1987; 2235-45.

Abstract: This article examines the possibility of abundant lakes, streams, and marshes with high water tables for the upper Triassic Chinle formation, as supported by interpretations based on sedimentology and paleontological investigations. Locations in or near Capitol Reef are referred to in the text.

Dubiel, Russell F.; Blodgett, Robert H., and Bown, Thomas M. Lungfish burrows in the Upper Triassic Chinle and Dolores Formations, Colorado Plateau - reply [reprint]. Society of Economic Paleontologists and Mineralogists. Journal of Sedimentary Petrology. 1988 Mar; 58(2):367-369.

Notes: See NRBIB: CARE-0100 and NRBIB: CARE-0102

Abstract: The authors review the criteria used to interpret the Triassic lungfish burrows they documented from the Upper Triassic Chinle and Dolores Formations on the Colorado Plateau. They also address specific points raised by McAllister as to the credibility of their findings. Capitol Reef National Park is one of disputed lungfish burrow localities.

—. Lungfish burrows in the Upper Triassic Chinle and Dolores Formations, Colorado Plateau [reprint]. Society of Economic Paleontologists and Mineralogists. Journal of Sedimentary Petrology. 1987 May; 57(3):512-521.

Notes: See also NRBIB: CARE-0101 and NRBIB: CARE-0102

Abstract: Trace fossils that occur in the Upper Triassic Chinle and Dolores Formations on the Colorado Plateau are interpreted to be the casts of lungfish burrows. The widespread occurrence of the lungfish burrows in the Chinle and Dolores Formations attests to the extensive habitat that supported lungfish in the Late Triassic and to conditions favorable for burrow preservation. Capitol Reef National Park is a lungfish burrow locality.

Eisenberg, Len, South Pacific Chevron Co., Brisbane, Queensland, Australia. [folder]Research: RSP-138 A Jurassic flash flood, Navajo Sandstone, Capitol Reef N.P., Utah 1 folder.

Abstract: Correspondence, investigator's annual reports, photographs, and other documents related to the project, "Jurassic flash flood, Navajo Sandstone, Capitol Reef National Park, Utah." The objectives are to describe the unusual debris flow deposit within the Navajo Sandstone and to describe the depositional setting.

Envirosphere Company. Draft report - National Park Service, Rocky Mountain Regional Office: water quality studies at Capitol Reef National Park and Dinosaur National Monument. Golden, Colorado: Envirosphere Company; 1980 Oct 67 p.

Abstract: This report describes the first phase of a National Park Service program to assess the quality of water resources and to identify sources of water quality problems in and around Dinosaur National Monument and Capitol Reef National Park. The primary purpose of this phase is the design of a water quality monitoring program. Maps and charts.

Envirosphere Company. Final report: National Park Service - Rocky Mountain Regional Office water quality studies at Capitol Reef National Park and Dinosaur National Monument. 1981 May 74 p.

Abstract: This report describes the first phase of a program to assess the quality of the water resources at Dinosaur National Monument and Capitol Reef National Park. The

primary purpose of this phase is the design of a water quality monitoring program to assure protection of the the water resource and to satisfy requirements to Section 208 of the Federal Water Pollution Control Act (Public Law 92-500); includes tables and figures.

Envirosphere Company, preparer. Water quality studies at Capitol Reef National Park and Dinosaur National Monument: final report. National Park Service, Rocky Mountain Regional Office; 198134 p.

Abstract: These proposals for monitoring programs at Dinosaur National Monument and Capitol Reef National Park were developed on the basis of information gathered in an intensive short term evaluation of the water resources. The primary purpose is the design of a water quality monitoring program to assure protection of the water resource and to satisfy requirements to Section 208 of the Federal Water Pollution Control Act.

@@ ### Frye, Bradford J. 1998. From barrier to crossroads: An administrative history of Capitol Reef National Park, Utah. Cultural Resources Selections. Intermountain Region, National Park Service. Vols. I & II. 638 pp. Abstract: Reviews the park's history, mostly in administrative terms, however, also provides some insight into natural resource problems, including in water, that have have occurred related to mining, grazing, water rights struggles, and other issues.

Galat, David L., Arizona State University, Department of Zoology, Tempe, Arizona. Research proposal: Waterpocket ecology/macrobenthic research - Capitol Reef National Park, Utah. 1987 Aug 25; submitted to National Park Service, Capitol Reef National Park: Solicitation No. RFP-1350-7-0001. 35 p.

Notes: See also NRBIB: CARE-0421

Abstract: Objectives: 1) characterize the physical, chemical, and biological limnology and macroinvertebrate ecology of tinajas in the Halls Creek region of Capitol Reef National Park, 2) determine temporal and spatial variability in that ecology with emphasis on natural stressors and disturbance events, and 3) determine the impact of non-natural livestock disturbance on that ecology.

Graf, William L. (Arizona State University, Department of Geography, Tempe, AZ). Fluvial processes in the lower Fremont River basin [photocopy]. UGA - 1980 Henry Mountains Symposium; 1980: Pages 177-184.

Abstract: This paper examines eighty-eight sites for arroyo cross sections for depth and width. These vary allometrically and are effected, over the last ten years, by the proximity of the Fremont River and its discharge. In the case of the ten-year flooding, the Fremont River's tributaries possess a more powerful force than the river itself.

—, Arizona State University, Department of Geography, Tempe, AZ. Location of the Escalante - Hall's Crossing Road [folder]Research: RSP-92 Location of the Escalante - Hall's Crossing Road (Graf). 19761 folder.

Abstract: This folder contains a one-page description for the location of an historic road. A letter and an application for permission to collect stream sample sediments for the study of movement and storage of sediments in Capitol Reef National Park is also included.

—, Spatial variation of fluvial processes in semi-arid lands. from within: Thorn, George, editor. Space and time in geomorphology: Allen and Unwin Publishers; 1982; pp. 193-217.

Notes: See also NRBIB: CARE-0193

Abstract: This paper examines the spatial variation of energy as an explanation of fluvial processes. Data was collected from the from the Henry Mountains area to test this hypothesis; includes figures, tables, and photographs comparing the Fremont River in the 1930s and in the 1980s.

H. D. Smith and Associates. Technical report: terrestrial vertebrates of the proposed Fremont River Water Power Project. 1989 Nov64 p.

Abstract: A pre-manipulation study of the factors and organisms likely to be influenced by

the proposed Fremont River Water Power Project. This study was undertaken to document avian and terrestrial vertebrates present in the project area and address the possible impacts of the water power project; includes an appendix.

(Utah State University, Department of Biology, Logan, UT). Haefner, James W. and Lindahl, Alice M. The ecology of small pools in Capitol Reef National Park, Utah: Final report for phase 1. 1988 Sep 15; USDI/NPS Contract No. PX-1350-7-0259. 70 p.
Abstract: This study examines the effects that livestock grazing may have on rock pool habitats and the aquatic systems of these habitats; includes a bibliography and appendices.

SK NOTE: water quality limited to field test kits mostly, but does provide comparison of sites.

@@ Haefner, James W. and Lindahl, Alice M., Utah State University, Department of Biology and Ecology Center, Logan, UT. The ecology of small pools in Capitol Reef National Park, Utah: final report - phase II. 1991 Feb 5; PX-1350-8-0187. 172 p.
Abstract: This report examines tinajas in Capitol Reef National Park. Topics include seasonal community dynamics, abiotic factors effecting these natural tanks, impacts by carnivore predation on lower trophic levels, and the impacts on the tinajas community dynamics by backswimmers (*Notonecta kirbyi*); includes figures, tables, and appendices.

SK NOTE: water quality limited to field test kits mostly, but does provide comparison of sites.

—, Utah State University, Department of Biology, Logan, UT. [folder]Research: RSP-117 The ecology of small pools in Capitol Reef National Park (Progress reports). 19883 folders.
Notes: See also NRBIB: CARE-0214
Abstract: Proposals, progress reports, draft reports, and other documents relating to the study, "The ecology of small pools in Capitol Reef National Park, Utah." The purpose of the research is to elucidate major mechanisms of community organization in aquatic rock pool habitats and to assess any effects livestock may have on the aquatic system by use of the pools.

Hardy, Thomas B., ichthyologist, Twelve-Nine, Inc., Logan, UT. [folder]Research: RSP-120 E.I. analyses for Fremont River Power Project 1988 - Hardy, Thomas B.: Correspondence. 19901 folder.
Abstract: Correspondence, annual reports, a proposal, and other documents relating to the project, "Fisheries analysis of the proposed Fremont River Hydropower Project." The objectives are to determine the status of existing fisheries population and to assess the potential impacts to the fisheries of the Fremont River associated with altered flow regimes.

Hardy, Thomas B.; Bartz, Brent A., and Carter, Wendy, Twelve-Nine, Inc., Logan, Utah. Impact analysis of the proposed Fremont River Hydropower Project. 1989 Oct 27 120 p.
Abstract: This study examines possible impacts to Capitol Reef National Park fisheries on the Fremont River, due to the proposed Fremont River Water Power Project. This project found no significant impacts found to park fisheries; includes appendices and tables.

Henderson, Norman R., Resource Management Specialist, National Park Service, Capitol Reef National Park, Torrey, UT. [folder]Research: RSP-113 Coliform bacteria in tinajas of the Waterpocket Fold (livestock effects) (Henderson, 1986). 19871 folder.
Abstract: A resource study problem (RSP) for the project "Coliform bacteria in tinajas of the Waterpocket Fold: changes correlated with the presence of cattle in CARE."

SK NOTE: Henderson is now at Glen Canyon.

Hepworth, Dale K.; Ottenbacher, Michael J., and Archer, Donald L., Utah Department of Natural Resources, Division of Wildlife Resources. An evaluation of native fishes of the Fremont River in or near Capitol Reef National Park. 1993 May; Publication No. 93-5. 17 p.
Abstract: Surveys of fish populations in the Fremont River in Capitol Reef National Park were

conducted as a result of chemical reclamation projects conducted upstream from the park. Specific objectives were to see if the chemical reclamation project had greatly reduced or eliminated any native fish species, and to compare fish abundance by species with previous survey data. Native suckers and a native minnow were found to be abundant at all locations sampled within the park.

Hoddenbach, Gerard A., Research biologist, National Park Service, Southwest Regional Office, Santa Fe, NM. Preliminary biological evaluation of Halls Creek [folder]Research: RSP-04, Preliminary evaluation of Hall's Creek (National Park Service, Hoddenbach). 19771 folder. Abstract: Preliminary biological evaluation of Hall's Creek (1975) considers the following topics: reptiles, amphibians, fish, mammals, potential nesting sites for peregrine falcons and habitats for spotted bats, vegetation in canyons, historical and cultural resources, wilderness characteristics and implied isolation, fragile character of the area, access routes, and suggestions. Hall's Creek Survey (1977) has more observations.

Huntoon, Peter Wesley, University of Wyoming, Wyoming Water Resources Research Institute, Laramie, WY. Ground water test drilling sites in the Hartnet, Fremont River, and Hall Creek areas, Capitol Reef National Park, Utah. 1978 Nov17 p. Abstract: Navajo Sandstone was found to be the best source of groundwater within Capitol Reef National Park; three areas within the park were examined with water quality and water amounts considered in the study; includes figures.

Jewel Cave National Monument. Natural Resource Project Funding: folder. N2219. 50+. Abstract: Contains project funding information, a report "Biological and chemical characterization of representative tinajas of Capitol Reef National Park, Utah" by Jill Baron, David M. Swift, and Boris Kondratieff (June 1993, 12 pages), a study plan "Wetland restoration in the Colorado River Watershed, Rocky Mountain National Park, Colorado" by David J. Cooper (1993, 5 pages), study plan "Water resources management plan Bighorn Canyon National Recreation Area" by James T. Peters (Feb. 1993, 13 pages), a study plan "Analysis of contaminants of cave water supplies and determination of their origin Wind Cave National Park/Jewel Cave National Monument" by James A. Nepstad and Michael E. Wiles (1993, 5+), and a project "Water resource inventory and monitoring - instream flow Glen Canyon Recreation Area, Utah-Arizona, Project years 1993-1994" by Charles W. Wood (1993, 3 pages).

[three-ring binder]. Kehrer, Ken, Jr., North District ranger, Capitol Reef National Park. Water sources and developments in the North District of Capitol Reef National Park and closely surrounding areas. 75 p. Abstract: This report consists of location, current use, and background information on water sources at Capitol Reef National Park. The sources include reservoirs, ponds (stockponds), springs, a water pipe, seeps, a well, the Fremont River, and creeks. Photographs accompany the description of each water source; some chemical analyses are included.

Kelly, Charles. Climate, flora and fauna. 2 p. Abstract: This document details the climate of the Capitol Reef region; arid, with an average rainfall of about 5 inches, mainly rain which falls in August during the cloudburst season. This short report briefly describes flash floods, erosion, air temperatures, vegetation, and animals in the Capitol Reef National Park area.

Kelly, Charles. Distribution of glacial debris in Capitol Reef National Monument. 8 p. Abstract: This report provides an explanation for the distribution of glacial debris, basaltic boulders, at Capitol Reef National Park. Floods caused by melting glaciers at the end of the last ice age transported the basaltic boulders through the valley of the Fremont River.

Kelly, Charles. Wild-life of Capitol Reef National Monument. 1948?6 p. Abstract: A historical report of the animals in Capitol Reef National Park [then Monument]. Common names are used with animals reported including; birds, reptiles, fish, and

mammals (rodents, ungulates, carnivores).

Kirby, John M. and James McAllister. 2001. Fish and benthic macroinvertebrate survey of the Fremont River and selected sites on Pleasant Cree and Sulphur Cree within the boundaries of Capitol Reef National Park. Progress report to the park from the Biology Dept, Mansfield University, Mansfield, PA and Biology Dept, Dickinson State U., Dickinson, ND. 46 pp. Abstract: report provides graphs, tables, and other summaries of fish species and macroinvertebrate species collected on the river in the 2000 season.

SK NOTE a good summary of macroinvertebrate species in the area.

Lafrancois, Toben. Biology and ecology of rock pools in Capitol Reef National Park, Utah. Fort Collins, CO: M.S. Thesis, Colorado State University; 1995 Fall 64 p.
Abstract: This thesis examines the biological and chemical systems of rock pools within Capitol Reef National Park. Both basic biological traits and environmental and ecological effects to rock pools are also discussed; includes tables, figures, and an appendix.

Lafrancois, Toben, Colorado State University, Department of Entomology, Fort Collins, CO. The effects of flooding upon rock pool communities in Capitol Reef National Park, Utah. 1994 Jan 17 p.
Abstract: This study examines flooding in Capitol Reef National Park, and its impact on the temporary lentic systems and their invertebrate communities in the park. Flood impacts on the community, species diversity, life histories of aquatic communities, and recovery times are all discussed.

Lindahl, Alice M., Utah State University, Logan, UT. A faunal survey of Hall's Creek, Capitol Reef National Park, Glen Canyon National Recreation Area. 1977 Summer 37 p.
Notes: See also NRBIB: CARE-0128 and NRBIB: CARE-0139
Abstract: A documentation of birds, lizards, mammals, and some aquatic insects are listed with species, genus, family, or phylum.

MacDonald, John F., associate professor, Purdue University, Department of Entomology, West Lafayette, IN. [folder] Research: RSP-151 Field work pertaining to study of aquatic dance flies (MacDonald, 1992) 1 folder.
Abstract: Correspondence, a proposal, progress reports, lists of insects, notes, and other documents related to the project, "Aquatic insects associated with lotic habitats of Capitol Reef National Park." The objective is to conduct a faunistic survey of the aquatic insects of Pleasant Cree and Sulphur Cree.

@@### Mangum, Fred A. 1993. Aquatic ecosystem inventory: macroinvertebrate analysis, Fremont River. Utah Dept of Environmental Quality annual report 1991-92. 32 pp. Abstract: describes samples taken and results for the year's work and provides interpretations from a water pollution view.

SK NOTE: Mangum has many years of experience with macroinvertebrates in Utah in general, presently working with many agencies. This report also provides index evaluations of the macroinvertebrates.

Marine, I. Wendell. Water-supply possibilities at Capitol Reef National Monument, Utah. Washington, D. C.: United States Government Printing Office; 1962; Geological Survey water-supply paper 1475-G. 8 p.
Notes: prepared in cooperation with the National Park Service
Abstract: This report examines the possible water supply resources available at Capitol Reef National Park. An estimation of fifty gallons per minute (GPM), is estimated to be an accurate account of park needs. Possible sources for this supply include Coconino sandstone from the Permian age; includes illustration and tables.

McAllister, James A. Discussion: lungfish burrows in the Upper Triassic Chinle and Dolores Formations, Colorado Plateau - comments on the recognition criteria of fossil lungfish burrows [reprint]. Society of Economic Paleontologists and Mineralogists. Journal of Sedimentary Petrology. 1988 Mar; 58(2):365-366.

Notes: See NRBIB: CARE-0100 and NRBIB: CARE-0102

Abstract: The author reviews the characteristics of undisputed fossil lungfish burrows and compares them with the Triassic lungfish burrows described by Dubiel, Blodgett, and Bown. Dubiel, Blodgett, and Bown interpreted trace fossils in the Upper Triassic Chinle and Dolores Formations on the Colorado Plateau to be the casts of lungfish burrows. Capitol Reef National Park is one of the localities with disputed lungfish burrows.

@ ### Millennium Science and Engineering, Inc. 2001. Draft Fremont River watershed water quality management plan. Report prepared for Utah Division of Water Quality by Millennium Science and Engineering, Inc. Salt Lake City. 86 pp. Abstract: provides details on total maximum daily loads for the Fremont River as well as an overview of the concepts of water quality monitoring now employed by the State of Utah

SK NOTE: copied some pages of this new report because it reviews Utah's present approach to assessments of WQ. The lead person on this is John Christensen (801) 461-0888

Meyer, Susan Elizabeth. Tentative plant community classification for Capitol Reef in relation to substrate characteristics and groundwater regime - Tentative plant community classification for Capitol Reef dominant plant species - Important variables influencing plant distributions in Capitol Reef 5 p.
Abstract: A classification scheme for plant communities in relation to the water table and rock/soil types; a list of habitat types and associated plant species for use in the classification of plant communities; and, an outline of variables (climate, groundwater regime, substrate type, biotic factors) influencing plant distribution.

Murdock, Robert J. and District Manager. A study of the flows of the lower Fremont River and the factors that affect them as they relate to fish habitat values and the Fremont River Water Power Project of the Wayne County Water Conservancy District. 1987 Apr 175 p.
Abstract: The purpose of this report is to organize information regarding the historic flow conditions of the Lower Fremont River. The lower section of the river heads at the outlet of the Bicknell Bottoms and the flow is characterized by gradual sustained changes. These flows are critical to fishery habitat and reservoir and hydroelectric plant proposals for the Fremont River; includes appendices.

Capitol Reef National Park: Well location Naser Engineering, cartographer. 1995 Jul. 2 sheet; 16 x 10 inches; 1 inch = 200 feet.
Abstract: This engineer's drawing (survey) shows the location of a culinary well at Capitol Reef National Park in reference to the northeast corner of section 22, T 29 S, R 6 E, SLB and M as well as points TA-3 and TA-4.

National Park Service. Draft: Resources management plan: Capitol Reef National Park, Utah. 1991 Sep 187 p.
Abstract: The primary objectives of the Capitol Reef National Park Resource Management Plan are the following: 1) develop an organized program to identify, evaluate, monitor and resolve the resource management issues and threats that now face the park, 2) provide long-term guidance to park management on how to manage and protect the resources of the park, 3) enhance public awareness of the resource management problems and issues that face Capitol Reef National Park and provide a mechanism for public participation in the identification and resolution of these issues, 4) provide an organized framework to justify the request and expenditure of the funds to resolve significant resource management issues, and 5) define the resource management responsibilities within the park to ensure that programs can be effectively implemented.

National Park Service, Rocky Mountain Region. Valve box and wet well rehabilitation. 1986 Jun 4 sheets; 34 x 21 inches.).

Abstract: This set of plans for wet well improvements at Capitol Reef National Park includes a construction drawing and drawings of the profile of the wet well plan, details of the wet well, and drawings of the replace valve vaults.

National Park Service, Water Resources Division. Baseline water quality data - inventory and analysis: Capitol Reef National Park. 1994 Oct; Technical Report NPS/NRWRD/NRTR-94/32. 400 p.

Abstract: This document contains water quality data for Capitol Reef National Park; including a complete water inventory, seasonal trends, comparison of Capitol Reef water quality to that of Environmental Protection Agency criteria, and an Inventory Data Evaluation and Analysis form. Report includes disks containing digital copies of all data used in the report, as well as all components of the report; including tables and figures.

Patterson, Glenn, team leader. Capitol Reef Reservoir Maintenance: Environmental assessment. Wood, Doug and Reed, Gene, participating staff; 198525 p.

Notes: See also NRBIB: CARE-0651

Abstract: This environmental assessment proposes the maintaining of two existing reservoirs and one spring in the Hartnet Allotment, within the Capitol Reef National Park. These reservoirs would consist of an earth dam around a cone shaped pit; includes photographs.

Phillips, Arthur Morton, III and Aitchison, Stewart W., Museum of Northern Arizona. Plant species noted at Fountain Tanks, Capitol Reef National Park; Plant species noted in lower Brimhall Arch Canyon (from Hall Creek to Lower Falls, Capitol Reef National Park); Plants collected in Capitol Reef National Park, Utah. 1977 Nov 84 p.

Abstract: Three lists of plant species observed and/or collected at Capitol Reef National Park. Common name and scientific names are provided. The third list contains the names of the plant species collected and deposited in the Museum of Northern Arizona's herbarium.

Rasmussen, Todd C. and Christiana, David G., hydrologist, Department of Hydrology and Water Resources, University of Arizona, Tucson, AZ. [folder]Research: RSP-124 Water resources assessment for CARE (Rasmussen, 1988, U of A)3 folders.

Notes: See also NRBIB: CARE-0768

Abstract: Correspondence, progress reports, water resources management plans, a proposal, and other documents related to a project, "Water resources management plan for Capitol Reef N.P." The objective is to identify and assess water resources issues and hydrologic hazards and to develop a management plan to resolve them.

Reichert, Michael, Bureau of Water Pollution Control, Department of Health, Salt Lake City, UT. Research: RSP-111 Macroinvertebrates and water chemistry of the Fremont River (Bureau of Water Pollution Control - 1978) (folder)1 folder.

Notes: Project status: active

Abstract: Correspondence, progress reports, and other documents relating to a project to monitor macroinvertebrates (benthos) in Utah to determine biological water quality conditions of the Fremont River.

Rentschler, Paul E.; Workman, Gar W., and Bunch, Thomas D., Research biologist; project leader; project advisor. The ecology of a reintroduced population of desert bighorn sheep (*Ovis canadensis nelsoni*) at Capitol Reef National Park. 19853 quarterly reports.

Notes: A brief quarterly report for January 1987 is in the same folder--the study was continuing, but there was little to report at the time.

Abstract: The quarterly reports provide details of a study of desert bighorn sheep reintroduced to Capitol Reef National Park. By the fourth report in October, only three of the eight sheep with operational collars remained in that park. Five had moved to Glen Canyon National Recreation Area. The study objectives were to determine sheep natality and mortality, habitat and feeding preferences, movements and extent of home ranges,

and the extent of range overlap with both mule deer and cattle. The quarterly reports give details for observations of individual sheep.

Rollins, Brown and Gunnell, Inc. Torrey Dam and Reservoir: Preliminary design report. 1986 Mar 60 p.
Abstract: This report details the geology of the Torrey Dam site and the surrounding region, tests for possible embankment materials, flood hydrology, and dam design possibilities. The proposed Torrey Dam site is located just upstream from Capitol Reef National Park.

Spence, John R., VIP, Capitol Reef National Park. Fremont Gorge vegetation study, Capitol Reef National Park, Utah. 1990 Mar 289 p.
Abstract: Description of a potential project to study the vegetation of Fremont Gorge. The study aims to produce a list of plant species at the gorge, a map of this vegetation, the documentation of rare and endangered species, the development of permanent transects for future study, and photographic documentation of the site.

Titlow, Budd; Root, Ralph, and Fleet, Harvey, National Park Service, Geographic Information Systems Field Unit, Denver, CO. Resource mapping and establishment of geographic information system data base for Capitol Reef National Park Research: RSP-005. 1982 1 folder.
Notes: Project status: discontinued
Abstract: Investigator's annual reports describe a project: "General vegetation, riparian vegetation, and geology mapped for entire park and entered into digital database." The manuscript included is entitled: "Tentative plant community classification for Capitol Reef in relation to substrate characteristics and groundwater regime".

Fremont River from within: U.S. Forest Service, Intermountain Region. Aquatic ecosystem inventory - macroinvertebrate analysis: Annual progress report - Bureau of Land Management, Richfield Utah District, 1988-89. 1991 Jul 2726 p.
Abstract: This report documents stream sampling activities at three stations in June, August, and September of 1988. Macroinvertebrate communities, at each sampling station, were usually dominated by taxa tolerant to sediment and organic enrichment. Grazing and agricultural return flows impacted reaches that were sampled.

Utah Department of Natural Resources, Division of Wildlife Resources. An aquatic inventory of streams flowing across lands administered by the Bureau of Land Management: Part IV - Richfield District. 1980?; BLM Contract Number UT-910-CTO-006. 70 p.
Abstract: These surveys examine the chemical and biological traits in order to assess management procedures. Certain streams have been designated priority by the Bureau of Land Management district offices, including Pleasant Creek and Carcass Creek in Wayne County and Bullfrog Creek and Sandy Creek in Garfield County.

Utah Division of Water Resources and Palmer-Wilding, Consulting Engineers. Water resource development in the lower Fremont River. 1979 Dec 150 p.
Abstract: This study examines possible water resource development for the lower Fremont River. Plans to use water resources for agricultural purposes, as well as other potential uses, are listed in terms of economic feasibility. The study area is located downstream from Capitol Reef National Park and includes parts of Caineville, Hanksville, and desert areas to the southeast Hanksville.

Utah Division of Water Resources, Department of Natural Resources. Fremont River study. 1975 Apr 72 p.
Abstract: This report examines the geology, climate, hydrology, and use, and economy of the river basin. Goals for the areas development are listed and broken down by local, regional, state, and national opinions. Alternative water development plans and resource management directions are included, along with the hypothesized impact of each plan.

Utah Division of Wildlife Resources. Environmental assessment of plans to chemically treat waters in the Fremont River and Otter Creek drainages as part of a statewide whirling disease

containment program. 1993 Jul74 p.

Abstract: This report documents the long-term monitoring and treatment of the Fremont River and Otter Creek drainages with rotenone for whirling disease, with the removal of the host organism, trout. The life cycle of *M. cerebralis* would be broken by keeping the waters 'trout-free' for a number of years, as well as combating the spread of the parasite.

Fremont River Water Power Project maps [topographic]. Wayne County Water Conservancy District, cartographer. no date included in original record. 5 sheets; 35 x 20 inches; 1:24,000.

Abstract: These maps include; a 1986 map showing the boundaries, the penstock/pipeline, the dam, the transmission line, and the reservoir for a proposed dam on the Fremont River, a 1989 map showing an existing diversion dam and canal in the project area, a 1988 map of plant communities in the project area, a 1989 map showing soil types in the project area, and a 1989 map showing wetland areas in the project area.

Wetland inventory map: Torrey Reservoir-Fremont River Project [blue and white aerial photograph with notes]. Wayne County Water Conservancy District and Wood, William W., cartographers. 1990 Nov 30. 2 sheets; 34 x 25 inches; 1 inch = 400 feet.

Abstract: An inventory of wetlands in the area of the proposed Torrey Reservoir on the Fremont River near Torrey, Utah. Twelve wetland types were identified inside the proposed flood pool area. Soil samples, vegetative constituents, and seasonal hydrologic conditions were assessed.

Weiss, Emanuel, United States Geological Survey, Denver, Colorado. Ground-water flow in the Navajo Sandstone in parts of Emery, Grand, Carbon, Wayne, Garfield, and Kane counties, southeast Utah. 1987; Water-Resources Investigations Report 86-4012. 41 p.

Abstract: This report examines the ground-water flow in Navajo sandstone in Capitol Reef National Park. The Navajo aquifer in southeast Utah, is part of the ground-water system, and was selected for study.

Williams, John Dana, Utah State University, Department of Range Science. Influence of microphytic crusts on selected soil hydrologic and erosional properties in the Hartnet Draw in and near Capitol Reef National Park, Utah. 1989 Oct 2637 p.

Notes: See also NRBIB: CARE-0574

Abstract: An examination of the impacts that microphytic crusts have on wind, water, and hydrologic processes. Study sites included an area within the boundaries of Capitol Reef National Park, the other is on Bureau of Land Management Lands; includes figures.

---. Influence of microphytic crusts on selected soil physical and hydrologic properties in the Hartnet Draw, Capitol Reef National Park, Utah: Ph.D. Dissertation, Utah State University, Department of Range Science; 1993; c1993. 156 p.

Notes: See also NRBIB: CARE-0179

Abstract: This study examines microphytic crusts and their influences on selected physical and hydrologic soil properties in the Hartnet Draw of Capitol Reef National Park; includes appendices, tables, and figures.

Winget, Robert N., Brigham Young University, Provo, UT. Aquatic habitat evaluation of the Fremont, Muddy and Dirty Devil rivers and Caine Springs. 1975 Dec 3; Report to Westinghouse Corporation P.O. ESD-428-75. 81 p.

Abstract: Baseline aquatic surveys were conducted at preselected sites on the Fremont, Muddy, and Dirty Devil rivers plus the Caine Springs in Salt Wash. Measurements included stream profile, discharge, water and air temperature, specific conductance, salinity, pH, and dissolved oxygen. Samples were also taken of periphyton, zooplankton, phytoplankton, macrophytes, macroinvertebrates, and fisheries; includes tables.

@@ Woodbury, Angus M. and Musser, Jean, University of Utah, Division of Biological Sciences, Institute of Environmental Biological Research. A limnological study of the Fremont River, Capitol Reef National Monument, Utah. 1963; Order No. R033-555 . 55 p.
Notes: U.S. National Park Service, Regional Office No. 3, Santa Fe, New Mexico
Abstract: In the field, stations were selected to represent different aspects of the aquatic habitat. Certain physical characteristics were studied and samples of aquatic invertebrates were taken at each of the stations. Fish and amphibians were collected and water samples were analyzed.

SK NOTE: old report with some chemical data from the 60s.

Water-related Citations: Colorado National Monument

Development of springs: Colorado National Monument[Photocopy]. National Park Service, Branch of Plans and Design; c1938? 1 sheet; 18 x 12 in.

Abstract: This map shows the location of springs at Colorado National Monument including catch basin, pipe lines, and fencing around the springs. It also shows a longitudinal and a cross section of typical sections of spring development and cross sections of the catch basin.

Map collection (second record: holder five, Studies); Late 20th century? 1 map holder.

Notes: This map section includes the typed report by Rick Nolan on trails (NRBIB: COLM-0114).

Abstract: There are also handwritten notes and about six marked maps showing trails and springs (some or all by L. Gelatt). One map is labeled 'Air Pollution, Sensitive Plants Research, Vegetation Transect Locations,' and has a key to the symbols. Several others appear to show water sources, one labeled only 1986-9. One has only a few markings (for trees?), another shows trails, and a group of three show the watershed at Colorado National Monument.

Author unknown? (no author included in original record). Devil's Canyon desert bighorn sheep transplant. Fruita, CO: Colorado National Monument; 1977 Jul 730 p.

Abstract: The report describes management alternatives with regard to reintroducing desert bighorn sheep to Colorado National Monument. The Devil's Canyon site was considered suitable habitat partly because of its remoteness and low incidence of human activity. The living and nonliving components of the potential habitat area are described. Photos (poor photocopies), maps, list of representative plant and animal species, and an attached 1977 report, 'Ecological Monitoring of the Reintroduction of Desert Bighorn Sheep to Colorado National Monument,' (Bauer--evidently missing several pages of its bibliography).

Author unknown? (no author included in original record). Environmental Assessment, Restoration of Desert Bighorn Sheep, Colorado National Monument. Fruita, CO: Colorado National Monument; 1976 Jul25 p.

Abstract: The assessment was preliminary to reintroduction of bighorn sheep at Colorado National Monument, and determined that the monument area was the most suitable of western Colorado habitats considered. It includes detailed descriptions and lists of the vegetation, geology, water resources, climate, and existing wildlife. Attached is a Memorandum of Understanding between the National Park Service and the Colorado Division of Wildlife about the reintroduction.

Author unknown? (no author included in original record). [Photo (pos.) file]. 2 file drawers).

Abstract: These drawers contain about 1000 positives of black and white photographs pertaining to Colorado National Monument. Sections include: birds, bison, cats, cattle, elk, sheep, reptiles, rock formations, overlooks, springs, water/flood, canyons, trails, geology, paleontology, plants, and weather.

Author unknown? (no author included in original record). Resource management-general (folder). Fruita, CO: Colorado National Monument; 1993 May1 folder.

Abstract: The folder contains general documents about managing the natural resources in a national park, with a few specifically about Colorado National Monument. Most are from 1993-5, with a few from 1980-1. One of the latter is a description of research proposals on air quality, bighorn sheep, and the limnology of the park. There is also a 1994 completed questionnaire about the park's natural resources, including such information as geographic components; roads, trails, and disturbed areas; native species known (568 terrestrial plant and 127 terrestrial vertebrate species), along with details on exotics; paleontological resources; air quality; aircraft overflights; and other general management data.

Author unknown (or not included when record was created). Environmental impact statements concerning NPS areas, L7617 (folder)1 folder.

Abstract: This folder contains, among other items, a 1985 'Water-line rehabilitation - east entrance complex, Colorado National Monument, Colorado: Environmental assessment,' a 1980 finding of no significant impacts for the drilling of a test well in the west entrance area of the monument, and a 1975 environmental assessment of sewage line construction in the monument.

---. GAP Analysis (folder)1 folder.

Abstract: This folder contains, among other items: 1) a sample quad mosaic of land cover (8/20/92) and explanation of land cover classification (level 1) at Colorado National Monument, and 2) 'Watershed Classification Project: Proposed Land Cover/Land Use Classification' list and map for headwater Colorado and plateau sub-basin.

---. Water matters and Water matters: water docket #1, east entrance (both are L54 folders)2 folders.

Abstract: These folders contain, for Colorado National Monument, correspondences on funding for water rights protection, Colorado Division of Water Resources artesian well forms and correspondences, drawings that show the piping and valves connecting the wells with the pump station, memorandums and notes on well water and pumping, 1972 water quality analyses, and results from a 1984 archeological survey investigation brought about by a proposal to excavate for a water pipeline.

Water-related Citations: Colorado National Monument

---. Water matters: west end wells - permits, L54 (folder)1 folder.

Abstract: This folder contains, for Colorado National Monument, a 1982 completion report for a well hook up in the Saddlehorn area, a 1980 completion report for drilling of a test water well in the monument, water quality and chemical tests for wells, 1988-1990 monthly readings, permits, and related documents.

---. Water rights: COLM, L54 (folder)1 folder.

Abstract: This folder contains a listing of springs within Colorado National Monument claimed by the National Park Service. The listing includes location and estimated flow. The folder also contains two documents, United States Reserved Right Appurtenant to Colorado National Monument, Water Division No. 4 and No. 5, which describe water rights and uses.

Lohman, Stanley William. Geology and artesian water supply: Grand Junction area, Colorado. Colorado Water Conservation Board. Washington, D.C.: United States Government Printing Office; 1965; Geological Survey Professional Paper 451. 149 p. For sale by the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402.

Notes: The Resource Management Library also has an original, typewritten, unedited copy

Abstract: Colorado National Monument is represented in both photographs and text within these sections: Geography, Geologic formations and events and the water-bearing properties of the rocks, and Geologic structure.

National Park Service. [Photocopy]NPFAUNA database. 1994 Mar 288 p.

Notes: Three copies located in the Visitor Center

Abstract: Mammal, amphibian, fish, reptile, and bird species are listed in this NPFAUNA database list for Pipe Spring National Monument. Presence, status, and origin are given for each species.

Soil & moisture conservation National Park Service, Engineering Division, cartographer. [Photocopy]. United States Department of the Interior; c1951? 1 sheet; 18 x 12 in. Part of the Master Plan of Colorado National Monument.

Abstract: This map shows where seeding, contouring, diversion dams, dikes, and checks have been used in Colorado National Monument as a deterrent to erosion.

Spry, Linda. Bedrock influence on basin morphometry and basin response to brief precipitation events. 1989 Dec 15; Geomorphology term project. 50 p.

Abstract: This report describes a study in which the effect of bedrock composition on basin response was evaluated to determine the particle size carried by runoff from the same storm event in two different basins in Colorado National Monument. The maximum probable runoff for 1989 and 1985 storm events was calculated based on rainfall records and compared to the runoff from the greatest rainfall of 1978, a year with flooding in one of the canyons. Contains graphs and a short bibliography.

Water Resources Division, Water Rights Branch letter To: Superintendent, Colorado National Monument. [Photocopy]Fort Collins, CO; 1994 Aug 12. 3 p.

Abstract: The documents from the chief of the Water Rights Branch include two newspaper articles about the wasting of water at Colorado National Monument by opening wells monthly for the purpose of maintaining water rights. The memorandum notes that there apparently were not any water rights at the time, and that the wells could be plugged or not operated without loss of water rights.

Water-related Citations: Timpanogos Cave National Monument

Cudlip, Lynn S.; French, Ronald D., and Hickman, Don, aquatic and terrestrial biologists (Bio-Environs). Blue Mesa Reservoir, Colorado: a historical review of its limnology, 1965-1985. Denver, CO: U.S. Bureau of Reclamation; 1987 Jun59 pages.

Eisenberg, Len, seasonal interpreter. Dipping Stream Sediments in Timpanogos Cave, Utah. TICA Information Sheet. 1.

Notes: Research done inside park

Abstract: Stream sediments inside TICA range from cobble-sized to clay-sized particles. Attitudes taken on thin, distinct clay layers in these stream sediments yield an averaged strike of North 75 West and dip of 25 down in a South 15 West direction. Attitudes were taken in the clay layers across from Hidden Lake, in the Coronary Bypass and along the western side of the stairway passage up to the Imagination Room.

Jensen, T. M. Hydrology study update. 1990 Jul 254.

Notes: Research done inside park

Abstract: Many of the interpreters have asked about the hydrology study and specifically about what we are finding out. I have answered questions individually, but now I attempt to do so collectively. Much of the geochemical analysis is dependent upon funds that we hope to receive by October; however, I have developed hydrographs that show some interesting trends in the seasonal variation of drip rates and lake levels. Information is given for Hansen Cave, Middle Cave, and Timpanogos Cave as well as the watershed geomorphology.

100 and 500 year Floodplain Map. NPS, cartographer. 1982 Dec. 1; 19 X 10; 1" = 400'.

Notes: Contour interval = 100 feet. Research done inside park.

Floodplains, Timpanogos Cave National Monument - UtahNPS, cartographer. 1992. 1; 8 1/2 X 14.

Notes: Research done inside park

Abstract: This is a map showing the historic floodplains and the buildings in the monument

Palmer, Art and Palmer, Peg. Comments on cave origin and mineral stability in Timpanogos Cave. Oneonta, NY: State University of New York; 1990 Jul 35.

Notes: Research done inside park

Abstract: The following comments are based on only a few hours of observation in the cave on July 2-3, 1990, during a visit encouraged by Superintendent Mike Hill and Chief Ranger Mike Tranel. These comments are designed mainly as a guide to future research and should not be considered definitive. They are based on extensive geologic, geochemical, and hydrologic experience in other caves, so the comparison with other cave areas is particularly pertinent. Goes on to talk about cave origin and mineral stability.

[Photocopy]. Schumann, Paul B.; Stuenkel, Edward L., and Deacon, James E. Thermal tolerances and preferences of fishes of the Virgin River system (Utah, Arizona, Nevada). September 1986. 26 p.

Abstract: This article examines the critical thermal maxima and thermal preference of common fish within the Virgin River. This study looked both at native and introduced species.

St. Clair, Larry L. and Rushforth, Samuel R. The diatoms of Timpanogos Cave National Monument, Utah. American Journal of Botany. 1976 Jan; 63(1):49-59.

Notes: Research done inside park

Abstract: The diatom flora of the cavern system of Timpanogos Cave National Monument was investigated. Diatoms were found throughout the cave system and were distributed according to moisture and natural openings. Twenty-six species were identified and described, including eight not previously collected from caves and four new records for the state of Utah.

Tranel, Michael J. Hydrology Study Proposal. 1990.

Notes: Research done inside park. Unpublished manuscript.

United States National Park Service. Water Resources Division. Baseline water quality data: inventory and analysis: Timpanogos Cave National Monument. Fort Collins, CO: U.S. National Park Service; 1999 Mar; NPS/NRWRD/NRTR-99/194. 1 Volume.

Notes: Includes 2 disks

unknown. Hydrology Study of Timpanogos Cave. General Outline. 6.

Notes: Research done inside park. Includes maps and geology

Abstract: The purpose of this study is to assess water quantity and quality in the cave system and to identify actual or potential effects on the watershed which may threaten cave resources. These threats could come from land use above the cave system, the effects of air pollution on water quality, cave water pumping and use, and heavy visitation through the caves.