Field Methods for Quantifying Irrigation Return Flow in Basins

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FLINT CREEK RETURN FLOW STUDY

1997 – DNRC Water Resources Division
irrigation return flow study

- SURFACE WATER
  - Hydrologist: Terry Voeller

- GROUND-WATER
  - Hydrogeologist: Kirk Waren
- Describe the study area

- Basic approach used to evaluate irrigation return flow

- Existing data

- Study design

- Results (expected products)

- Comments on results and conclusions (time permitting)
EVALUATING RETURN FLOW

RETURN FLOW = BASIN OUTFLOW – BASIN INFLOW
RETURN FLOW = BASIN OUTFLOW – BASIN INFLOW
RETURN FLOW =

BASIN OUTFLOW – BASIN INFLOW….
RETURN FLOW = 

BASIN OUTFLOW – BASIN INFLOW + BASIN DIVERSEIONS
RETURN FLOW =

BASIN OUTFLOW – BASIN INFLOW + BASIN DIVERSEIONS
RETURN FLOW = BASIN OUTFLOW - BASIN INFLOW
Website Information Sources

- Natural Resource Information System – NRIS
  Montana State Library
- Water Resources Division – Montana Department of Natural Resources and Conservation (DNRC)
- US Geological Survey (USGS)
- Montana Bureau of Mines and Geology (MBMG) State Geologic Mapping Program – and publications
- Ground-Water Information Center (GWIC) – Montana Bureau of Mines and Geology
- Google Earth
Flint Creek Main Canal

Flow at Flint Creek Divide (cfs) vs. Flow at Headgate (cfs)
STUDY DESIGN:

ASSEMBLE AVAILABLE DATA

DEFINE HYDROLOGIC UNITS

DETERMINE STREAM GAGE LOCATIONS

EVALUATE THE SUBSURFACE

MONITOR GROUND-WATER LEVELS
Headwater Unit

Flow (cfs)

Date

01APR94 01JUL94 01OCT94 01JAN95 01APR95 01JUL95 01OCT95 01JAN96
VALID RESULTS:

ACCURATE AND DEFENSIBLE MEASUREMENTS OR ESTIMATES OF INFLOW AND OUTFLOW FOR EACH UNIT

EVALUATE THE SUBSURFACE WATER STORAGE CAPACITY

CALCULATE SURFACE WATER GAINS AND LOSSES WITHIN EACH UNIT

CALCULATE GROUND-WATER GAINS AND LOSSES WITHIN EACH UNIT
IMPORTANT CONCLUSIONS OF THE FLINT CREEK STUDY

RETURN FLOW CHARACTER OF EACH HYDROLOGIC UNIT WAS QUANITIFIED AND CHARACTERIZED – AND VARIED

RESERVOIRS HAVE A DRAMATIC IMPACT ON WATER AVAILABILITY IN THE BASIN, EVEN FOR NON-PROJECT IRRIGATORS

FLOOD TO SPRINKER CONVERSIONS

ADDITIONAL EARLY SEASON ONLY IRRIGATION POTENTIALLY BENEFICIAL
The Gallatin Valley
Geology and Ground-Water Resources of the Gallatin Valley, Gallatin County, Montana

• COMPREHENSIVE STREAM FLOW GAGING OR MEASUREMENT STRATEGY
• PRECIPITATION MEASURED WITH RAIN GAGES
• INVENTORY OF NEARLY 800 WELLS AND SPRINGS
• 20 DRILLED TEST WELLS, 5,966 FEET OF DRILLING ranging from 25 to 1000 feet deep
• SEISMIC STUDIES
• MULTIPLE WELL AQUIFER TESTS
• WATER QUALITY SAMPLING AND ANALYSIS FROM WELLS, SPRINGS, TEST HOLES, AND STREAMS
The Gallatin Valley
Geology and Ground-Water Resources of the Gallatin Valley, Gallatin County, Montana

- USED CORRELATIONS TO EXTEND EXISTING DATA TO PREVIOUS YEARS, DEVELOPING A WATER BUDGET FOR 1931 TO 1951
- CALCULATED MONTHLY WATER BUDGET FOR THE STUDY AREA, WITH AMOUNTS OF WATER LOST TO ET AS THE CALCULATED UNKNOWN
- MANY FIRM CONCLUSIONS THAT ARE STILL VALID TODAY. USED CONJUNCTIVELY, SURFACE WATER SHORTAGES COULD BE OVERCOME, AND ADDITIONAL WATER USE COULD BE REALIZED
CONCLUSION