WORK PLAN

TITLE:

Death Valley Hydrogeology Studies Program

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Work Package No. 7

SUPERSEDES:

APPROVAL

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CONCURRENCE

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19 Nov 1998

Project Quality Assurance Officer **Date**

1.0 INTRODUCTION

This work plan provides the background, scope of work, personnel, and management plan for the Inyo County component of Nye County Nuclear Waste Repository Project Officer Independent Scientific Program's Early Warning Drilling Program. The schedule for each work activity is provided in activity descriptions.

1.1 Abstract

Nye and Inyo Counties have participated in oversight activities for the Yucca Mountain Nuclear Waste Repository since 1987. The purpose of each County's oversight activities is to seek to ensure that repository siting and subsequent repository activities do not adversely impact the public health, safety, or welfare of County residents, including, in the case of Inyo County, Death Valley National Park. Inyo County hydrogeology consultants determined that a linkage between the alluvial and carbonate aquifers at Yucca Mountain and in Inyo County may exist. This Death Valley research program is to evaluate the connection between the Lower Carbonate Aquifer at Yucca Mountain and the biosphere. The Inyo County program consists of four study activities: 1) the geochemical analysis of spring water associated with the Death Valley basin, 2) the determination of evapotranspiration (ET) rates in the saltpan and upland areas of Death Valley, 3) installation and monitoring of stream gauges at Tecopa

and Dumont Dunes, and 4) the determination of infiltration rates into the Death Valley mountain blocks at Gold Valley.

1.2 Background

Yucca Mountain is the site of the only proposed high-level nuclear repository in the United States. The repository concept uses the philosophy of multiple barriers, both engineered and natural, each of which impede the movement of contaminants. The proposed repository would be in the unsaturated zone above the water table in Tertiary tuffaceous rocks. The principal transporting mechanism for radionuclides is moving ground water. Underlying the repository at approximately 2 km (6,000 feet) is an extensive Lower Carbonate Aquifer known to be highly permeable. Several points of potential discharge from this aquifer are the springs on the east side of Death Valley.

Inyo County's Yucca Mountain Oversight Program identified a number of spring sources in the Death Valley Mountain ranges. As part of the 1998 Oversight Program HYRODYNAMICS collected water samples from 23 springs and 2 creeks in Death Valley. Samples were analyzed for concentrations of major cations and anions, and isotopic ratios of strontium, uranium, and oxygen. The results of the analysis are currently being compared to analyses of other available carbonate aquifer and spring samples in the Yucca Mountain project area.

The U.S. Geological Survey (USGS), in cooperation with the National Park Service, is currently conducting ET studies at three locations in Death Valley. The focus of their studies is to determine ET rates from the saltpan areas near Badwater in Death Valley. Approximately 2 years of ET data have been collected, with plans to collect data for another 2 years.

The Tecopa stream gauging station on the Amargosa River was monitored by the USGS for approximately 30 years. This station was removed in 1987. The USGS is currently monitoring stream gauges on the 40 Mile Wash at Yucca Mountain and at Beatty. No other stream gauging stations are operating in the Death Valley drainage basin area.

Alan Flint (USGS) and associates recently developed conceptual and numerical models of infiltration for the Yucca Mountain Area. The current plan is to apply Flint's method of calculating infiltration to all of the Death Valley Drainage area for input into the USGS's numerical ground water model for the Yucca Mountain area.

1.3 Statement Of Problem

The linkages between the alluvial and carbonate aquifers, the recharge and discharge points, and ground water travel time are key to Nye and Inyo County's hydrological concerns about the Yucca Mountain Nuclear Waste Repository. Death Valley is the terminus for surface water drainage from Yucca Mountain and Amargosa Valley. It is also believed that ground water from the Lower Carbonate Aquifer discharges into Death Valley via springs. The relationship between waters in Death Valley and the ground water flowing under Yucca Mountain has yet to be determined.

Specifically, HYDRODYNAMICS' hydraulic model of the Amargosa River system indicates a negative water balance. Measured stream flows exceed what would be expected for published ET rates and precipitation. This suggests a significant contribution to Amargosa river flows from ground water storage. Winograd (USGS) and other researchers suggest that ground water in the Yucca Mountain area are hydraulically connected by the Lower Carbonate Aquifer. Discharge from the major springs in Death Valley may be fault controlled and hydraulically connected to the Lower Carbonate Aquifer. The USGS's numerical ground water model of the Yucca Mountain is based on limited data on the hydrology of the Death Valley system. Major data gaps exist in:

1. ET values for Death Valley,
2. inflow into Death Valley from the Amargosa River,
3. infiltration into the Death Valley mountain ranges,
4. the source of spring waters in Death Valley
5. water level data,
6. hydraulic parameters, and
7. hydraulic boundary conditions in Death Valley.

1.4 Goal and Objectives

This project has four objectives. A description of the overall goal and objectives of this study program is provided below.

The overall goal of this study is the evaluation of far-field issues related to potential transport by ground water of radionuclides into Death Valley, and evaluation of connection between the Lower Carbonate Aquifer and the biosphere. Death Valley is believed to be the discharge point for regional ground water aquifers below Yucca Mountain.

The objective of the geochemical analysis of spring waters is to help further characterize the ground water in the Death Valley mountain blocks, and to determine the source of these waters. The results of the analysis will be compared to HYDRODYNAMICS and USGS collected water chemistry data from springs and wells at and near Yucca Mountain.

The objective of our ET studies is to more accurately estimate the mean annual ground-water discharge by ET from Death Valley. These estimates will be beneficial for improving estimates of ground-water discharge across the valley and are the first step in determining the magnitude of water discharge from Death Valley. Refining ET rates will also benefit ground-water flow models which currently rely on less rigorous estimates of the water budget components.

The purpose of the stream gauge installation and monitoring is to determine Amargosa River discharge into Death Valley. The stream gauging stations are to be monitored for at least a three year period.

The objective of the Gold Valley infiltration rate study is to calculate net-infiltration rates at Gold Valley to 1) establish a reference infiltration rate to estimate recharge into the Death Valley mountain ranges, and 2) evaluate the applicability of Alan Flint's (USGS) method of determining infiltration, developed for the Yucca Mountain, area in Death Valley.

2.0 WORK PLAN ACTIVITIES

Our Work Plan for Death Valley hydrogeology studies consists of the following four work activities:

Activity 1: Spring Water Sampling and Analysis
Activity 2: Death Valley ET Studies
Activity 3: Installation and Monitoring of Stream Gauging Stations
Activity 4: Gold Valley Infiltration Study

A description of each work activity is provided below.

2.1 Activity 1: Spring Water Sampling and Analysis

This activity is a continuation of HYDRODYNAMICS spring water sampling program for Inyo County. The sampling and characterization of springs will be by HYDRODYNAMICS. The interpretation of results of analysis will be by HYDRODYNAMICS supported by the USGS.

Spring water samples are to be collected, preserved, and shipped to designated laboratories by HYDRODYNAMICS personnel in accordance with U.S. Geological Survey Yucca Mountain Program ground water sampling protocols under the direction of Zell Petermen (Senior Geologist, U.S. Geological Survey, Yucca Mountain Project Branch). Each spring source is to be sampled once in this study. This study should not have an impact on natural and cultural resources, on park visitors, and on park staff. A summary of our methods follows:

Sample Collection: Hydrodynamics

Analysis:
- USGS
  - Strontium isotopes
  - Uranium $^{234}U/^{238}U$ isotopes
  - Oxygen/Deuterium
- Hydrodynamics
  - Major anions/cations

Protocols: Yucca Mountain protocols using USGS sampling equipment (0.2u filters).
Field data:
- GPS location
- Data and time of sample collection
- Temp., pH, cond., TDS, dissolved oxygen, turbidity
- Spring flow rate measurements
- Site photos & videos
- Site geology map & site plan
- Field Activities Log
- Field calibration records

USGS provides chain-of-custody forms & shipping instructions

Sample Bottles:
- USGS & Huffman Laboratory provide bottles
- One archival sample from each spring
- USGS provides sample numbers

Spring water samples will be sent to two separate laboratories for analysis. Each laboratory will require, at a minimum, one liter of water sample, for a total of three liters of water to be extracted from each spring. The samples will be consumed during analysis. The USGS will archive one sample from each spring for a six month period. Archive samples will be disposed of or returned to Death Valley Park personnel at their request.

Each spring site visited will be documented by photographs, video, site sketch, and a rock sample, as permitted by NPS. A descriptive narrative will be prepared for each spring site visited.

2.2 Activity 2: Death Valley ET Studies

Evapotranspiration rates are to be determined at several locations in Death Valley, and results will be used to estimate the annual evaporative ground-water discharge. This research is a continuation of the USGS's current ET studies in Death Valley. Evapotranspiration rates will be determined using energy-budget and energy-combination models using meteorological data (air temperature, windspeed, relative humidity, surface and subsurface soil temperatures, vegetation temperature, soil heat flux, and net radiation) as model input. This approach combines field measurements with remote sensing techniques that make it possible to extend the estimate of evaporative discharge to larger areas of Death Valley where complexity and diversity of terrain preclude the constructing of field sites.

Micro-meteorological data will be collected at each ET station for 3 years. These data will be used to calculate ET rates and develop relations between annual evapotranspiration of water from Death Valley, and various hydrologic variables. Remotely-sensed data (Landsat, TIMS, and aerial photography) will be used to delineate spatial regions of evaporative discharge based on land-surface characteristics such as vegetation cover, mineral deposits, and openwater locations. These delineated regions denote specific ET characteristics and are referred to as ET units. Soil and water samples at ET stations will be collected and analyzed for major anions and cations. This data will be used in demonstrating the relation between salts (types and/or concentrations), surface characteristics (determined using remotely-sensed data), and ET rates in delineating ET units. As discussed, ET rates will be determined using the energy-budget approach with solutions sought using the Bowen-ratio method, and energy-combination model, the Penman-Montieth method, and possibly the Eddy-correlation method.

The USGS will install and monitor two additional ET measurement stations for a three year period. The ET stations are located at a site near the Saratoga spring, and in the Mesquite Flats area. These two sites are located where remotely-sensed data indicate that evaporative discharge is likely to be significant. A photograph of an ET station in Death Valley is shown in Plate 1. Data to be collected at each ET station include air temperature, windspeed, relative humidity, surface and subsurface soil temperatures, vegetation temperature, soil heat flux, and net radiation. Data will be recorded using a Campbell Scientific data logger. Field equipment is to be calibrated by the manufacturer and field checked every six months. Solar photovoltaic panels will provide power to each ET station. Ground water monitoring wells are to be installed at each station to depths of approximately 1.5 and 2.5 meters below ground surface. HYDRODYNAMICS will assist the USGS with the installation of the ET stations. HYDRODYNAMICS will collect ground water samples from the monitoring wells at each ET station, at the direction of the USGS. The samples will be sent to Zell Petermen (USGS) for radioactive isotope analysis according to the previously described spring water sampling protocols. The USGS indicate they will be collecting data from the 3 existing ET stations near Badwater during our study.

ET station data will be collected approximately every two weeks by USGS personnel. The data will be summarized quarterly in a data report delivered to HYDRODYNAMICS by the USGS. Remote sensing data will be provided as developed. ET calculations will be made once adequate data has been collected each year to make reasonable estimates of rates. The USGS has determined that one year of data is adequate for ET calculations. At a minimum, calculated ET rates will be provided to HYDRODYNAMICS in the USGS's annual report. HYDRODYNAMICS will further calibrate its HYMET hydraulic model of the Death Valley area using newly calculated ET data, additional Amargosa River stream flow data, and infiltration data for Gold Valley.

The USGS has a Death Valley Research Permit for the installation and operation of their three ET Stations. The USGS will submit an addendum to their current research permit for the installation and operation of the Saratoga spring and Mesquite Flat ET stations.

2.3 Activity 3: Installation and Monitoring of Stream Gauging Stations

The USGS will install stream gauging stations on the Amargosa River at Tecopa and Dumont Dunes, California. Stream discharge rates will be calculated using a methodology developed and used by the U.S. Geological Survey for waters of the United States. A gauging station consists of a stream staff gauge and a nitrogen compensated air line to measure depth of water in a stream bed. A topographic profile of each gauging site will be surveyed. Stream discharge rates are calculated from depth of water data and the known profile of the stream bed. The Tecopa station will utilize existing gauging station equipment at the site (e.g. equipment housing structure). Gauging station data will be recorded on a data logger and transmitted to the U.S. Geological Survey by a satellite transmitter. Each site will be periodically visited (approximately every 2 weeks) by Survey personnel to calibrate field equipment and make any necessary repairs. A summary of stream flow rates at each station will be provided quarterly by the Survey over the three year study period. The USGS will obtain necessary environmental permits from the Bureau of Land Management for each station.

2.4 Activity 4: Gold Valley Infiltration Study

Net-infiltration rates will be determined for Gold Valley using an approach to water-balance calculations development by Alan Flint (USGS) and associates for the Yucca Mountain area. Flint's methodology and results of his analysis of the Yucca Mountain area will be published by the USGS (Open-File Report) in his paper entitled *Development of Conceptual and Numerical Models of Infiltration For The Yucca Mountain Area, Nevada.* Flint states in his draft paper that determination of net-infiltration rates using water-balance calculations requires very precise and accurate measurements of the components of the water-balance equation. The dominant physical processes in the water-balance equation, to be measured in the field, are precipitation, ET, overland flow, infiltration, and redistribution of soil moisture. HYDRODYNAMICS, in cooperation with the USGS, will measure these physical processes in Gold Valley for a 2 year period. The USGS, with support from HYDRODYNAMICS, will then determine net-infiltration rates for Gold Valley and establish a data base for estimating infiltration in the Death Valley basin area. The results of this study will be compared to Flint's analysis for Yucca Mountain. Measured results will be compared to estimated results at Yucca Mountain.

Gold Valley is located on the eastern flank of the Black Mountain Range just east of Mormon Point in Death Valley. Gold Valley is in the approximate North-South center of the Black Mountain Range. The valley floor is at an average elevation of 1,200 meters (3,937 feet) above sea level. Gold Valley has a surface area of approximately 9.6 square kilometers (4.5 mi^2) (Plate 2).

Gold Valley was selected for this study because of its location in the Black Mountain range, and because it is a well defined drainage basin that appears to be hydraulically isolated from adjacent drainage basins. The basin is a pie shaped bowl defined by relatively steep bedrock valley walls that extend below a broad colluvium/alluvium filled valley. The water-bearing bedrock materials are fractured metamorphic rocks. The water-bearing characteristics of these materials are dependent on the degree of weathering and the presence of fractures. The matrix permeability is so small as to be negligible. The movement and storage of ground water is controlled by secondary fracture permeability.

Surface water discharge from the valley is through Willow Creek into Death Valley. Willow spring is the discharge point for drainage from Gold Valley at the head water of Willow Creek (Plate 2). Willow Spring is a perennial (Blue Line) spring.

This Gold Valley infiltration study involves the following work activities:

1) Willow Spring discharge monitoring
2) Geological and geophysical characterization
3) Water-balance field measurements
4) ET rate evaluation

2.4.1 Willow Spring Discharge Monitoring

Willow spring is situated at the head waters of Willow Creek. The spring is defined by approximately 100 meters by a 15 meter grouping of willows in Willow Creek canyon. There is no identifiable single spring orifice. The up-gradient boundary of the spring is about a 10 meter wide gap in the canyon between a prominent bedrock outcrop and valley wall to the north. Unconsolidated soil type materials in the spring area are limited to the willow growth in the valley. The thickness of unconsolidated materials is estimated to be less than 1 meter. Willow spring is a perennial spring, with essentially all free surface water being captured by the willows in the summer and late fall months. No water was observed in Willow Creek down-gradient of the spring. HYDRODYNAMICS observed water flow in the organic material in the spring willows near the ground surface in June of 1998.

Discharge from Willow spring will be measured and recorded for a two year period. The measurement of discharge from this spring is complicated because 1) the spring is located in a wilderness protection area, and 2) the capture of free water by the willows in the spring area. A temporary weir well be constructed in the spring. The weir will consist of a notched metal plate that extends through the unconsolidated materials in the spring area, and will be set in-place by hand digging. The weir will be held in-place with sand bags that will extend across Willow creek canyon. A topographic map at a 1 to 2 meter contour interval will be prepared for the Willow spring area by a licensed surveyor. The selected contour interval will depend on the range of elevations and the desired site detail. A profile of the spring channel at the weir will be prepared. A pressure transducer will be placed behind the weir to measure water levels, which will be recorded on a data logger.

The boundary of the willow growth area in the spring will be marked by a series of stakes, which will be noted on the topographic map. Seasonal changes in the boundary of the willow growth area in the spring will be marked with additional stakes. The spring area will be re-surveyed at the end of the study showing the locations and data where each stake was placed. Spring water discharge captured by the willows will then be estimated from the surface area coverage of the willows and estimated water consumption rates for willows.

The weir and stakes will be removed from the spring area at the end of the project. Any depressions in the ground surface left by the weir will be filled with native materials at the site.

2.4.2 Geological and Geophysical Characterization

The surface geology of the Gold Valley basin will be field mapped at a scale of 1:24,000. The 1:250,000 scale geological map of Death Valley and Harald Drewes' 1963 Geology of the Funeral Peak quadrangle map will be used as base maps for our field mapping. Geological mapping will be conducted according to published geological field mapping procedure manuals, which will be incorporated into our QA/QC procedures manual.

The shape of the bedrock surface below the colluvial/alluvial materials and definition of the general stratigraphy of the unconsolidated materials over the bedrock will be determined by a resistivity survey of the valley. The resistivity surface will also provide information on the characteristics and degree of weathering of the subsurface bedrock. The resistivity survey will consist of approximately 30 to 32 soundings conducted using the Wenner and/or Schlumberger arrays. Approximately 10 to 20 readings will be made for each sounding using electrode spread lengths ranging from a few feet to approximately 305 meters. The spread length and number of readings will be modified as needed to determine the depth to bedrock and define the geo-electrical properties of the subsurface materials.

The survey will be conducted using a Sting portable resistivity instrument. The data will be modeled using a horizontal layer model to convert the apparent resistivity field measurements into geo-electrical models of layer thickness and resistivity. The models will be correlated into cross-sections showing the vertical and lateral changes in resistivity across the site.

The resistivity survey will be conducted along existing roads, either immediately adjacent to the roads or with the equipment hand carried to the survey site, because of the wilderness designation of the Gold Valley. The resistivity sounding will be conducted by pushing four steel electrodes about six inches into the ground. The electrodes are approximately 3/8 inch in diameter and will not require any excavation or soil preparation. The electrodes will be moved concentrically outward from the center of sounding location staking readings at about 10 to 20 electrode separations, with a total spread length of 305 meters for each sounding. The electrodes are connected to the resistivity instrument using light gauge wire. The resistivity instrument passes a weak current (approximately 10 to 500 mA) across the two electrodes and measures the generated potential across the other two electrodes. All equipment is removed when the sounding is completed.

2.4.3 Water-balance Field Measurements

Water-balance equation parameters of precipitation and soil moisture will be measured at two locations in Gold Valley. Instrumentation at these two data measurement stations will consist of Campbell Scientific's meteorological stations and soil moisture probes. The meteorological stations will measure precipitation, temperature, barometric pressure, wind speed and direction. Four soil moisture probes will be installed at each meteorological station to measure changes in soil moisture. The probes have a relatively small diameter (about 5 centimeters) and will be set to an approximate depth of 20 centimeters. All instruments will be calibrated by the manufacturer and checked against field measurements during each site visit. Instruments will be recalibrated as necessary. Data will be recorded on a Campbell Scientific data logger. A volumetric rain gauge will also be placed at each site. Data will be collected from the data loggers approximately every two months. Power to the system will be provided by a solar panel. All equipment will be removed from the site at the end of the project.

2.4.4 ET Rate Evaluation

ET values for Gold Valley will be estimated by the USGS from soil type and vegetation mapping of the valley, climate data, and a comparison with similar valleys for which ET values have been calculated. Pam evaporation tests will be conducted during selected site visits to better estimate ET values.

A Death Valley research permit will be required for this Gold Valley infiltration study. A research permit application will be submitted to Richard Anderson, Environmental Specialist, National Park Service. The focus of the permit is the benefit of our research to the understanding of Death Valley, and impacts on wilderness areas of the park. An approximate 30 day review period will be necessary for approval by the National Park Service.

3.0 PROJECT PERSONNEL

Research personnel for these Death Valley studies are from The HYDRODYNAMICS Group and USGS. Key personnel are as follows:

HYDRODYNAMICS	Dr. John Bredehoeft, NAE	Principal-In-Charge
	Michael King, R.G., C.E.G., C.HG.	Project Manager
	Victor Wright, R.G., C.E.G.	Project Geologist
	Dr. John Jenson, P.G.	Project Geophysicist
	Art Ramirez	Project Technician
USGS	Dr. Guy DeMeo	ET Project Manager
	Dr. Alan Flint	Infiltration Project Manager

Dr. Bredehoeft recently retired as head of Water Research for the USGS after 30 years of service. He is a nationally recognized expert on the hydrogeology of the Yucca Mountain area. Mr. King is Registered Geologist and Certified Hydrogeologist in California with over 22 years of ground water project experience. Mr. King has been a consultant for the Yucca Mountain Repository project for Inyo County since 1995. Mr. Wright has over 25 years of project experience conducting geological field mapping studies in California. Dr. Jenson is a recognized expert in conducting geophysical studies, and has conducted research in the application of numerical ground water models to geophysical data interpretation. Mr. Ramirez has over 10 years of experience collecting water samples from springs in California for water quality analysis, and has collected water samples in Death Valley.

Dr. Guy DeMeo is currently conducting ET studies in Death Valley for the USGS. Dr. DeMeo has been conducting ET studies in Death Valley for the past 2 years. Dr. Flint recently completed a three year study of infiltration rates at Yucca Mountain for the USGS. He is a principal investigator of the Death Valley area for the USGS.

It is anticipated that our two-man field teams can work independently of Death Valley Park personnel. We will work with Park Rangers in selecting the best access route to each spring, in locating housing (camping and hotel) facilities within the Park, and shipping water samples from the Park. We will notify Park Rangers when we enter and exit the Park.

4.0 MANAGEMENT PLAN

The objective of our management plan for this project is to ensure technical proficiency, quality data collection, documentation, and timely, cost-effective execution of the project. These objectives are accomplished through managing projects with experienced professionals applying sufficient planning and foresight to avoid major technical, schedule and resource problems.

Key features of this approach include:

- Regular close coordination, consultation, progress reporting, and problem identification with principal scientists
- The use of qualified and experienced technical staff
- Strong line management and well defined organizational responsibilities
- Clearly defined scopes of work for the project team and subcontractors as established in Work Plans developed for each project task and step
- Effective cost planning/control and monitoring systems that provide appropriate information on cost and progress status
- Continuous direct lines of communication and feed back between project team members, subcontractors and the project manager, and
- Constant, direct technical review according to QA/QC procedures by senior staff for all deliverables.

Michael J. King, R.G., C.E.G., C.HG. will serve as HYDRODYNAMICS project manager. He will maintain full time control of the team's involvement and will have overall responsibility for contractual issues, coordination and direction of in-house staff. He will also manage subconsultants and subcontractor performance, schedules, budgets, progress reporting and ongoing communications. He will provide general oversight and coordination on the technical aspects of the project, calling upon technical specialists as necessary to meet project needs. Mr. King will serve as the primary contact person with Nye and Inyo Counties. He will be responsible for administration of QA/QC procedures under the direction of Nye County's QA/QC officer.

4.2 Project Initiation

Mr. King's project management approach will be based on controlling project execution through a strong centralized project organization. The first step is the establishment of a baseline budget and schedule for our scope of work. Mr. King will coordinate the input of our technical staff and subcontractors with the scope, schedule and budget process.

4.3 Schedule Goals

Our baseline goals will be to meet the established schedule by setting milestones for completion of work activities. Monthly progress reports will be compared to the project schedule to monitor progress of each work activity. Meetings will be held with team leaders whose work activities may be behind the established project schedule to determine the cause in the delay. Nye and Inyo Counties will be notified of changes in the project schedule as necessary.

4.4 Work Plan Approval

Prior to the start of technical work, a work plan will be presented to Nye County's QA/QC Officer for review, revision, comment and approval. The approved work plan will be used as the baseline to track and control technical elements, cost, and schedule.

4.5 Budget and Schedule Control

The project manager will assemble cost and schedule information on a continuous basis and provide immediate feedback to project staff, subcontractors and Nye and Inyo Counties concerning deviations from plan, actual versus budget results, cost escalation or schedule extension. Any difficulties or problems will be identified and corrective measures taken to avoid major impacts to the overall project. Monthly budget reports will be prepared with each monthly billing statement.

4.6 Progress Reporting

The project manager will prepare monthly progress reports identifying technical and contractual accomplishments, problems, deviations from baseline schedule and budget, corrective actions taken, present and future staffing projections, as well as any other pertinent issues.

4.7 Additional Subcontracting Requirements

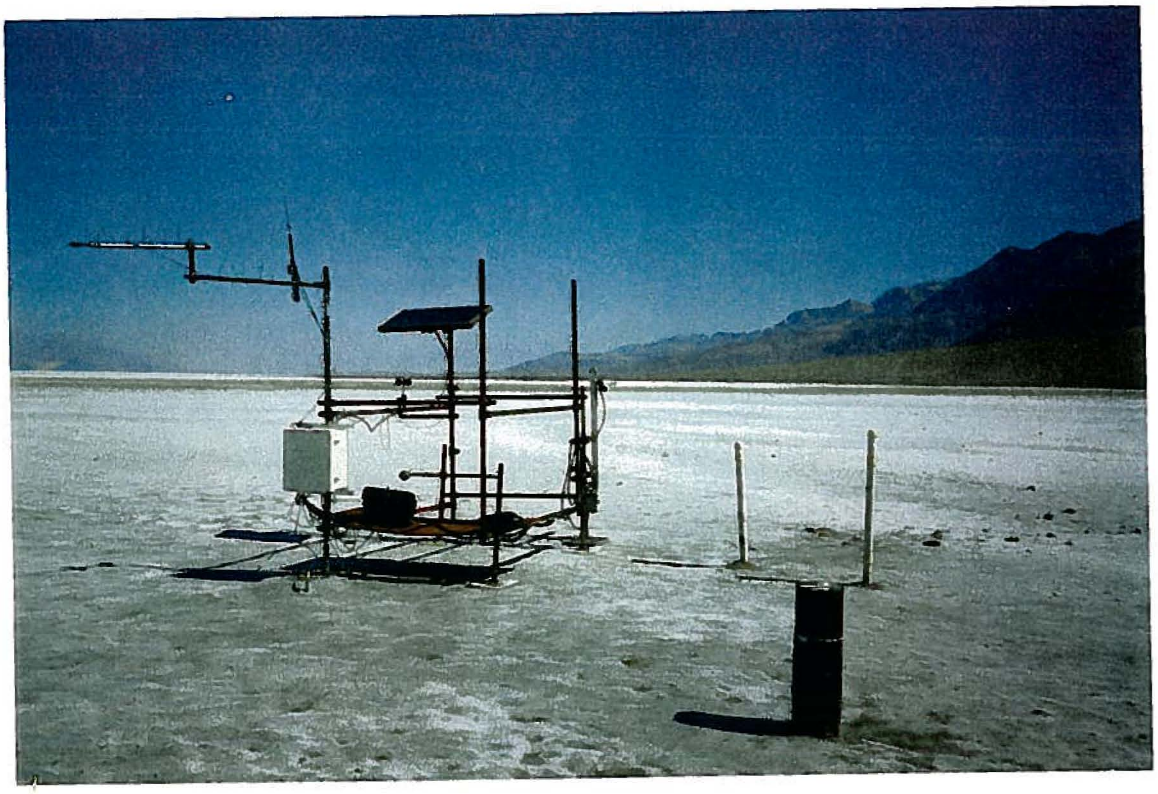
This project will require the services of Huffman Laboratory, a Certified Land Surveyor, and other contractors. We have not identified the provider of these services at this time due to the lack of definition of the required services. A list of known service companies will be provided to Nye and Inyo Counties. The technical qualifications of each service company will also be provided. Additional subcontractors will be engaged as needed.

4.8 Quality Assurance and Quality Control

Quality Assurance and Quality Control for this project will be according to the procedures defined in Nye County Nuclear Waste Repository Project Office Quality Assurance Plan, Rev. 1, 6-30-98. In general, technical quality control will be managed through a rigorous process of documentation and of internal and external review. Initial preparation of graphics, tables, and engineering plans with factual data will involve an extensive cross-checking system. Reports and documents produced by technical staff will be reviewed by senior technical staff for completeness, accuracy, technical judgment and compliance. Prior to publication, all reports will be reviewed for clarity of communication, grammatical correctness and logical consistency by our technical editing staff.

5.0 PRODUCTS

The HYDRODYNAMICS Group will prepare an annual report presenting the results of their Death Valley springs and Gold Valley infiltration research. The USGS will prepare an annual report on their ET research. Nye and Inyo Counties will be provided a copy of HYDRODYNAMICS report to the U.S. Department of the Interior, National Park Service, Death Valley National Park following approval of the report by Nye and Inyo Counties. Monthly progress reports will be prepared. Data collected will be provided quarterly. A final report will be prepared for each project research activity.

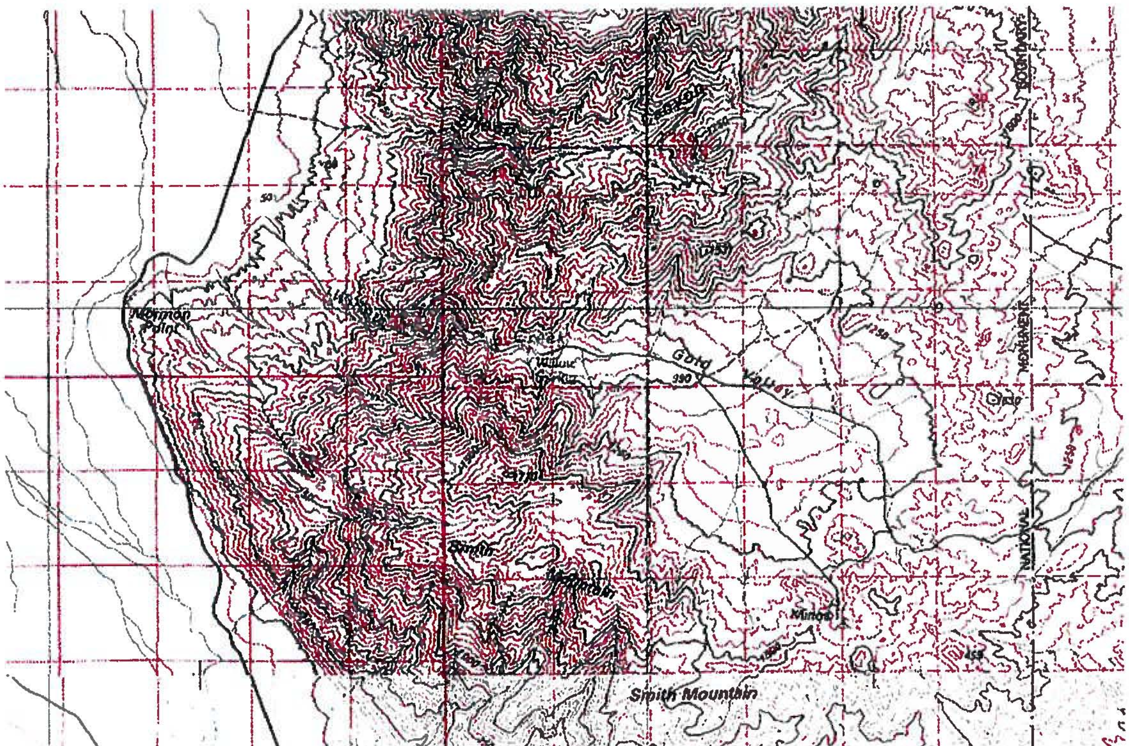


The HYDRODYNAMICS Group

Nye County Nuclear Waste
Repository Project Office

Typical USGS ET Station
Death Valley, California

Plate 1



The HYDRODYNAMICS Group

Nye County Nuclear Waste
Repository Project Office

Gold Valley Drainage Basin
Death Valley, California

Plate 2