Dist : w/o Enclosures (1) PHL (2) BS (3) SLD (4) DMS (5) KMH (6) CO file

Umetco Minerals Corporation

P.O. BOX 1029
GRAND JUNCTION, COLORADO 81502
☎ (970) 245-3700

March 19, 2001

Honorable Richard W. Dana
Judicial Arbiter Group
1601 Blake Street, Suite 400
Denver, Colorado 80202-1328

Re: **Uravan Remedial Action Plan (RAP)**
Working Copy, Updated

Dear Judge Dana:

Enclosed is an updated copy of the Uravan RAP, reflecting all the approved modifications to date. All approved changes to the RAP are indicated by strikethrough for text deleted, and by bold lettering for additions. To the best of our knowledge, this update is accurate.

This version is intended to be a working document that can be used by decision makers to quickly and accurately assess site remedial activities against RAP requirements. The document is not intended, nor does it replace or supersede the original Consent Decree and Remedial Action Plan approved by Judge Jim Carrigan or any of the correspondence containing or related to RAP modifications.

If you have any questions, please call us.

Sincerely,

John S Hamrick

John S. Hamrick, Manager
Health, Safety and Environmental Affairs

01 MAR 22 PM 6:03 OSP

Enclosure

JSH:edm

01-049.doc

STP-006 Template RIDS Dist SP08 add: K. Kerr paper copy

cc: Umetco:
C. Dudnick, Esq.
H. W. Ipsen, Esq.
C. O. Sealy
RAP Files

State of Colorado:
J. Goad, State Atty. Gen. Office
J. Jacobi, CDPHE (2)
D. H. Simpson, CDPHE (1)
R. Marsh, State Atty. Gen. Office

Federal:
P. Osborne, EPA
D. Sollenberger, NRC
G. Taylor, EPA

Uravan Remedial Action Plan (RAP)

(With tracking of changes 1986 – 2000)

(83-C-2384 Final Consent Decree, Order, Judgment and Reference to Special Master, with Appendices)

Revised March 2001

Umetco Minerals Corporation
Grand Junction, Colorado

PREFACE

This document incorporates all modifications to the Uravan Remedial Action Plan (RAP) from 1987 through 2000. These changes were agreed to by the State of Colorado and Umetco Minerals Corporation and were approved by the Special Master. The document is intended to be a working document that can be used by decision makers to quickly and accurately assess site remedial activities against RAP requirements. The document is not intended, nor does it replace or supersede the original Consent Decree and Remedial Action Plan approved by Judge Jim Carrigan or any of the correspondence containing or related to RAP modifications.

IN THE
UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLORADO

STATE OF COLORADO, Plaintiff, v. UNION CARBIDE CORPORATION, a New York corporation, and UMETCO MINERALS CORPORATION, a Delaware corporation Defendants.	)	No. 83-C-2384 Judge Jim R. Carrigan

CONSENT DECREE, ORDER, JUDGMENT AND
REFERENCE TO SPECIAL MASTER

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and
Umetco Minerals Corporation

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLORADO

Civil Action No. 83-C-2384

STATE OF COLORADO,

Plaintiff,

v.

UNION CARBIDE CORPORATION, a New York corporation, and UMETCO MINERALS CORPORATION, a Delaware corporation

Defendants.

FINAL CONSENT DECREE, ORDER, JUDGMENT AND REFERENCE TO SPECIAL MASTER

RECITALS

WHEREAS, on December 9, 1983, the State of Colorado (hereinafter, "Plaintiff" or "the State"), and certain State departments and agencies, filed a complaint against Union Carbide Corporation, a New York corporation, for natural resource damages pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA"), 42 U.S.C. §9601 et seq., concerning the Uravan Uranium Facility owned and operated by Defendant Union Carbide Corporation;

WHEREAS, on April 8, 1985, the State of Colorado filed its first amended complaint deleting the other named plaintiffs and adding a claim for response costs under CERCLA

together with pendent claims under Colorado law for statutory nuisance, common law nuisance, strict liability in tort, and negligence;

WHEREAS, on March 18, 1986, the State filed with the Court's approval a second amended complaint adding as a Party Defendant Umetco Minerals Corporation, a wholly owned subsidiary of Union Carbide Corporation and current owner and operator of the Uravan Uranium Facility;

WHEREAS, Union Carbide Corporation and Umetco Minerals Corporation have answered the State's complaint and amended complaints, and have denied and presently deny liability in this action;

WHEREAS, Union Carbide Corporation was the holder of Colorado Radioactive Materials License SUA-673; and operated the Uravan Facility under this License from 1968 to April 1984, and, prior to that time, under a license issued by the U.S. Atomic Energy Commission under the Atomic Energy Act of 1954, as amended, and regulations promulgated thereunder;

WHEREAS, Umetco Minerals Corporation is the current holder of Radioactive Materials License SUA-673, and has operated the Uravan Facility under this License since April 1984;

WHEREAS, prior to the commencement of this litigation, an administrative proceeding was initiated before the Colorado Department of Health to renew said License with the new designation 660-02S, but such proceeding has not yet been concluded;

WHEREAS, said License has not been renewed pending the outcome of negotiations herein, and is now issued for public comment herewith;

WHEREAS, the State and the U. S. Environmental Protection Agency ("USEPA") on April 2, 1986, executed a "Memorandum of Agreement" (MOA) by which their roles and responsibilities were established such that the State is acting as lead agency regarding the Uravan Facility;

WHEREAS, the State represents that it has, consistent with its obligations under the MOA, advised USEPA of settlement negotiations herein and has consulted with USEPA on that subject and on the Remedial Action Plan ("RAP") attached hereto and by reference incorporated herein;

WHEREAS, the Parties agree that settlement and entry of this Consent Decree is made in good faith to avoid expensive and protracted litigation and to settle and resolve all claims between the Parties which have been raised by the State's complaint, first amended complaint and second amended

complaint, and Defendants' responsive pleadings, subject, however, to Plaintiff's and Defendants' right to seek relief against non-parties to this Consent Decree for claims arising out of the transactions or occurrences which are the subject of this action;

WHEREAS, the Parties desire to achieve the timely implementation of an adequate and cost-effective remedy at the Uravan Facility that will effectively protect the public health, welfare and the environment;

WHEREAS, all Parties to this Consent Decree consent to the entry hereof as an Order, Judgment, and Reference to Special Master of this court.

NOW, THEREFORE, IT IS HEREBY ORDERED, ADJUDGED AND DECREED AS FOLLOWS:

I. JURISDICTION

This court has jurisdiction over the Parties and the subject matter of this action.

II. PARTIES BOUND

This Consent Decree shall apply to and be binding upon each of the Parties, its agents, employees, successors in interest and assigns. The undersigned representatives of the respective Parties certify that they are fully authorized by the Party or Parties whom they represent to enter into the

terms and conditions of this Consent Decree, to execute this Consent Decree, and to legally bind that Party or Parties.

III. DEFINITIONS

Words used in this Consent Decree are to be taken and understood in their natural and ordinary sense unless this Consent Decree indicates that a different meaning was intended. Whenever the following terms are used in this Consent Decree, together with all documents appended hereto, the following meanings shall apply:

a. "CDH" shall mean the Colorado Department of Health.

b. "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §9601, et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986, Pub. L 99-499, 100 Stat. 1613 ("SARA").

c. "Consent Decree" shall mean this document together with all attachments thereto.

d. "Contractor" means the company or companies retained by or on behalf of the Defendants to undertake and complete the Work. The Contractor and any subcontractors retained by the Contractor shall be deemed to be related by contract to each Defendant within the meaning of 42 U.S.C. §9607(b)(3).

e. "Defendants" shall mean both Union Carbide Corporation and Umetco Minerals Corporation.

f. "Final Submittal" shall mean the plans, specifications, quality control/quality assurance plans and documents, monitoring plans and documents, performance evaluation plans and documents and any other submittals from Defendants to the State required by this Consent Decree, the RAP and any addenda to the RAP, as such submittal has been approved by the State or modified and/or approved by exhaustion of the dispute resolution process pursuant to Sections XIII and XIV herein.

g. "Full Surety" shall mean the completed posting by Defendant(s) of such cash, and/or financial or insurance instruments and/or meeting by Defendant(s) of such financial tests, as are acceptable to the State pursuant to Section XVII herein in an amount which is at least equal to the net present value of the projected cost of all of the remaining Work calculated as though it would be performed by an independent contractor.

h. "Impacted Area" shall mean any area identified in the RAP or by any studies or monitoring programs conducted pursuant to the provisions of this Consent Decree where a hazardous substance released from the Uravan Facility has been deposited, stored, disposed of, placed, or otherwise come to be located.

i. "License" or "SUA 673" or "660-02S" shall mean the Colorado Radioactive Materials License SUA 673 or its successor 660-02S, attached hereto as Appendix II, and issued as of the date of lodging of this Consent Decree.

j. "Memorandum of Agreement" or "MOA" shall mean that document which was executed by the United States Environmental Protection Agency and the State of Colorado on April 2, 1986, to establish their roles and responsibilities with regard to the Uravan Facility.

k. "National Contingency Plan" or "NCP" shall mean the National Oil and Hazardous Substances Pollution Contingency Plan promulgated at 40 C.F.R. Part 300 in accordance with 42 U.S.C. §9605 as the same may from time to time be lawfully amended.

l. "National Priorities List" or "NPL" shall mean that list established pursuant to 42 U.S.C. §9605(8)(b).

m. "On-Site Coordinator" or "OSC" shall mean that individual appointed by the Colorado Department of Health whose duties are described in Section VIII.

n. (the) "Parties" collectively shall mean the State of Colorado, Union Carbide Corporation, and Umetco Minerals Corporation.

o. "Remedial Action Plan" or "RAP" shall mean the plan for implementation of remedial work at the Uravan Facility, set forth in Appendix I together with Final Submittals thereunder, and modifications made in accordance with Section VII.

p. "Scheduled Activity" shall mean an activity which is denominated as such in this Consent Decree or RAP or for which a date certain is prescribed by this Consent Decree, the RAP or Final Submittal made thereunder.

q. "Site Manager" or "SM" shall mean that individual appointed by the Defendants whose duties are identified in Section IX.

r. (the) "State" shall mean the State of Colorado, its agencies, departments, divisions, officers, and employees.

s. (the) "Uravan Uranium Facility," the "Uravan Facility" or the "Facility" shall mean those sites or areas considered to be disposal and source control areas including the Atkinson Creek Crystal Disposal area, the Club Ranch Ponds area, the River Ponds area, the tailings piles, Club Mesa area, Mill areas, the Town and adjacent areas, all as described in the Remedial Action Plan; ancillary areas as described in the Remedial Action Plan; and any other place where Work is planned pursuant to the Remedial Action Plan.

t. "USEPA" shall mean the United States Environmental Protection Agency.

u. (the) "Work" shall mean all remedial, mitigative, corrective, and other actions prescribed by or described in Sections IV, V, VI, and VII herein, the Remedial Action Plan, any schedules or plans established by the terms of this Consent Decree, the terms, conditions and schedules contained in any Final Submittal, and in Radioactive Materials License No. 660-02S.

IV. COMMITMENTS OF PLAINTIFF AND DEFENDANTS

A. The Parties agree and the Court hereby finds that the obligations imposed by this Consent Decree require performance by Defendants of actions which are reasonably designed to protect the public health, welfare, environment and safety from any hazards which may be identified at or from the Uravan Facility. Any enforcement of the obligations imposed by this Consent Decree constitute an action or proceeding by the State to enforce the State's police or regulatory power.

B. Defendants agree to and shall timely finance both the Work and the Surety for Performance. In addition, Defendants agree to and shall timely and properly perform at their own cost the Work, which obligation is more fully set forth in Sections V, VI, and VII herein.

C. The State shall oversee Defendants' performance of the Work for consistency and compliance with the provisions of this Consent Decree and with the RAP, which obligation is more fully described in Section VIII herein.

D. Defendants agree to and shall give preference to local residents for employment or retention as Contractors or subcontractors in connection with performance of the Work at the Uravan Facility to the extent not prohibited by law or existing labor contracts and to the extent local residents are qualified to perform the Work for which they are employed or retained. Defendants agree to and shall require their Contractors and subcontractors to give preference to local residents for employment in connection with performance of the Work at the Uravan Facility to the extent not prohibited by law or existing labor contracts and to the extent local residents are qualified to perform the Work for which they are employed. For purposes of this paragraph, a "local resident" is a person who has resided within or has been on the tax rolls of Montrose, San Miguel, Dolores, or Mesa County for six months preceding his/her employment or retention.

E. Defendants agree to and shall cause all present residents of the Town of Uravan to vacate their residences by December 31, 1986. Defendants shall not, without prior State approval, permit any building or improvement at the Uravan Facility to be constructed for or occupied as a residence.

F. In the event of a conflict between any requirement, term, or provision of this Consent Decree and any requirement, term or provision of the RAP or Final Submittals thereunder, the requirements, terms and provisions of this Consent Decree shall control.

G. Prior to petitioning the Court for termination of this Consent Decree pursuant to Section XXXIII, Defendants shall post a fund for Long Term Monitoring and Maintenance of the Uravan Facility as required by applicable law, such fund to be based upon an assumed real rate of return of 2% per annum provided that Defendants can demonstrate such assumed rate of return is appropriate.

H. Upon payment of Response Costs, Natural Resource Damages and Contributions described in Sections XXII, XXIII, and XXIV herein, and posting of Full Surety, each Defendant shall be released from liability with regard to the Uravan Facility subject to the provisions of Section XIX herein.

V. REMEDIAL ACTION

A. Attached hereto as Appendix I and incorporated by reference herein is the RAP which describes the remedy which shall be implemented at the Uravan Facility. The RAP is by reference incorporated herein as if set out verbatim. The Work to be performed under the RAP shall be performed by Defendants at their expense. Performance of the Work shall be subject to

oversight by representatives of the State as is more specifically described in Section VIII. The Work shall be conducted in a good and workmanlike manner and in accordance with the standards and specifications and within the time periods prescribed in the RAP, Final Submittals and/or applicable licenses.

B. The State and its consultants shall not interfere with the orderly progress of any construction activity, so long as Defendants and their Contractors are proceeding in accordance with the Final Submittals. This shall not preclude the exercise of any Party's options under this Consent Decree.

C. The Defendants shall obtain and comply with all requisite federal and State permits and licenses necessary to perform their collective obligations under this Consent Decree, including, but not limited to, all necessary land use permits, licenses and leases for access to federal land. If Defendants notify the State that in order to discharge their obligations under this Consent Decree it has become necessary to obtain a best efforts within its authority to assist Defendants in obtaining such permits deemed necessary by the Parties.

VI. PERFORMANCE OF THE WORK

Subpart One - Initial Plan Review

A. The Remedial Action Plan requires Defendants to submit for review and prior approval by the State certain construction plans and specifications relating to various project features of the RAP. These plans and specifications shall include a schedule which shall prescribe deadlines for completion of the objectives described in the RAP. The submittals shall be made in accordance with applicable schedules prescribed in the RAP. The State shall review each such submittal for completeness and notify Defendants whether the submittals are in fact complete within sixty (60) days of initial receipt. The Defendants shall cure any incomplete submittal within sixty (60) days or such other period upon which the parties agree. The State shall review each such submittal for consistency with applicable provisions of the Consent Decree and the RAP. Within sixty (60) days after initial receipt of submittals, plus such additional time, if any, as Defendants take to cure any incomplete submittal, relating to the evaporation ponds for hillside seepage, toe berm seepage and tailings liquids pursuant to Paragraphs 4.2.4(1), 5.1.1.4(2), and 5.1.2.4(1) of the RAP and within one hundred twenty (120) days of initial receipt of every other submittal, plus such additional time, if any, as Defendants

take to cure any incomplete submittal, the State shall notify Defendants in writing whether such complete submittals are acceptable, as set forth in Paragraph B below.

B. After review of the submittals, the Parties shall proceed as follows:

1. If the submittals are acceptable, Defendants shall proceed to perform the Work in accordance with the detailed terms and provisions of the Final Submittals.

2. If the submittals are not acceptable to the State, the State shall give the Defendants notice of unacceptable performance, which notice shall contain detailed written findings, and the Parties may proceed in accordance with Sections XIII and XIV.

3. If the State fails to give notice of the acceptability or non-acceptability of the submittal within the time periods described in Paragraph A, the Parties shall immediately be subject to the provisions of Sections XIII and XIV.

Subpart Two - Compliance

A. In the event Defendants learn or have reason to believe that there has been or will be a delay in excess of twenty-four hours in the inception or completion of a Scheduled

Activity in accordance with the schedules set forth in the RAP or in a Final Submittal, Defendants shall promptly notify the OSC orally and shall, not later than five (5) working days after oral notification to the OSC, give the State a written notice of delay specifying in detail the anticipated length and cause of the delay, the measures taken and to be taken to prevent or minimize the delay, and the timetable by which Defendants intend to implement these measures. Unless an event has rendered notification impossible, failure to give the notice required herein shall be deemed a waiver by Defendants of the "force majeure" provisions of Section X.

B. In the event Defendants determine that there has been, is, or may be a failure of a remedial action component, Defendants shall immediately notify the OSC orally and in writing that there has been, is, or may be a failure and the timetable by which Defendants intend to implement the contingency plan required by the RAP, if any, or if the RAP does not require a contingency plan, the steps Defendants have taken, are taking, or plan to take, to correct and/or mitigate the actual or anticipated failure subject to the State's review and approval.

C. The Parties shall modify the applicable schedules of the RAP, License, and any Final Submittal in writing to provide such additional time as may be necessary to allow the

completion of the specific phase of the Work and/or any succeeding phase of the Work affected by a delay, not to exceed the actual duration of the delay, if:

1. The measures taken or to be taken to prevent or minimize the delay, and the timetable by which Defendants propose to implement these measures, are acceptable to the State; and

2. Either of the following:

   (a) the Parties agree that a delay is or was attributable to a "force majeure" event as such is defined in Section X; or

   (b) the Parties agree that the delay was otherwise reasonable under the circumstances.

3. If the Parties disagree that the delay is or was attributable to a "force majeure" event or if the Parties disagree about the measures taken or to be taken to prevent or minimize the delay resulting from a "force majeure" event, or if the Parties disagree about the timetable by which Defendants intend to implement those measures, then the dispute shall be resolved pursuant to the provisions of Sections XIII and XIV.

4. Notwithstanding any other provision of this Consent Decree, absent a "force majeure" event or agreement by the Parties pursuant to Paragraph C(2)(b) of this Subpart Two, Defendants shall not be excused from the consequence of any delay (including any applicable penalties and/or contempt sanctions) or be entitled to unilaterally invoke the dispute resolution procedures under Sections XIII and XIV of this Consent Decree with regard to whether the delay was otherwise reasonable under the circumstances.

D. The State shall not unreasonably delay Defendants' implementation of the Work. In the event the State or any of its consultants unreasonably delays the Work, the time for completion of affected Scheduled Activity(ies) under the RAP shall be extended by the period of unreasonable delay.

E. If the Parties disagree that the State's delay was unreasonable under the circumstances, or if the Parties disagree about the measures to be taken in consequence of that delay, or if the Parties disagree about the timetable by which the time for completion of the RAP shall be extended, then such dispute shall be resolved pursuant to the provisions of Sections XIII and XIV.

F. In the event that the State determines either: (i) that there is an actual or anticipated unsatisfactory performance of the Work by Defendants or their Contractors; or (ii) that there is an actual or anticipated failure of a remedial action component to meet the goals, standards, or requirements set forth for such component in this Consent Decree or in the RAP and/or any applicable license, which unsatisfactory performance and/or failure does not create a condition which may present an imminent and substantial endangerment to public health, welfare, or the environment pursuant to Section XVI, the State shall provide Defendants with a written notice of its determination of unacceptable performance or failure specifying in reasonable detail the nature of such unacceptable performance or failure, and the basis for such determination. Such notice shall include a written demand that Defendants undertake at their expense appropriate mitigative and/or corrective action. Such demand may, at the State's option, either specify the appropriate mitigative and/or corrective actions to be undertaken by Defendants at their expense, or may require Defendants to develop and submit within a reasonable time a plan for implementation of appropriate mitigative and/or corrective action which shall be undertaken by Defendants at their expense upon approval by the State. Defendants shall, within five (5) working days of receipt of such notice, give the State a written response, either:

1. Accepting the State's determination and demand, in which case the Parties shall agree to modify the RAP as provided in Section VII to reflect the agreement reached; or

2. Contesting the State's determination and/or demand. Failure to respond to the State's notice within the specified time period shall be deemed constructive rejection of the State's determination and constructive notice of contest.

If the Defendants give actual or constructive notice of contest, or if, within five (5) days, the State fails to accept the Defendants' proposal to remedy, the Parties shall immediately be subject to the provisions of Sections XIII and XIV. In the event that the Defendants invoke the dispute resolution provisions of this Consent Decree with regard to a notice and/or demand of the State issued pursuant to this paragraph, the final decision resulting from such dispute shall resolve whether the Work was in fact performed satisfactorily and in accordance with this Consent Decree and shall resolve the need for and nature of any mitigative and/or corrective actions to be undertaken in consequence of any noncompliance or unsatisfactory performance. Such action shall be implemented

by the Defendants at their expense or by the State in the event of failure or refusal of Defendants to timely implement such actions. If the State implements said decision, Defendants shall pay to the State all costs incurred or to be incurred by the State in performance of the Work, and/or mitigative or corrective action.

G. In the event that any Party breaches any term or condition of this Consent Decree, the non-breaching Party(ies) may seek imposition of penalties and other appropriate relief pursuant to the contempt powers of this Court through the procedures established in Sections XIII and XIV.

H. When the State determines that an event has occurred which triggers implementation of a contingency plan as specified in the RAP, the State may order Defendants to implement such contingency plan and Defendants shall do so pending final resolution of any resultant dispute unless such implementation shall have been stayed pursuant to Section XIV upon a showing by Defendants that no adverse environmental impact will result from the stay.

Subpart Three - Completion

A. When Defendants believe they have satisfactorily completed a Scheduled Activity of the RAP, they shall give a written notice of completion to the State with all other

reports not previously submitted which are required by Section XI of this Consent Decree and the RAP, as provided in Section XXVI.

B. Within one hundred twenty (120) days following receipt of Defendants' notice of completion, the State shall either:

1. Give a written acceptance of completion to Defendants indicating agreement that a Scheduled Activity has been satisfactorily completed; or
2. Give a written denial of completion to Defendants indicating that the Scheduled Activity has not been satisfactorily completed, and stating the basis for such determination.
3. In the event that the State fails to make written response to Defendants' notice within one hundred twenty (120) days, the Parties shall be immediately subject to the provisions of Sections XIII and XIV.

VII. MODIFICATION OF THE REMEDIAL ACTION PLAN

A. The RAP may be modified by written agreement of the Parties which, in the case of the State, shall require the approval of the Executive Director for CDH or his/her duly

designated representative with the advice and consent of the Attorney General. If such modification is in any way inconsistent with the provisions of this Consent Decree, then the Parties shall proceed in accordance with Section XXVII.

B. Either Plaintiff or Defendants may unilaterally request a modification of the RAP, which may include prospective but not retroactive delays. Such request shall be presented in writing to the other Parties. If the request is denied by a non-requesting Party, the Parties shall be subject to the dispute resolution provisions of Sections XIII and XIV. Any modification of the RAP to which the Parties agree or which has been reached as a result of the dispute resolution provisions of this Consent Decree shall be incorporated into the RAP. If such modification is inconsistent with the provisions of this Consent Decree, the Parties may seek amendment of this Consent Decree pursuant to Section XXVII.

VIII. OVERSIGHT OF REMEDIAL ACTION

A. The State shall oversee the Defendants' performance of the Work for consistency and compliance with the provisions of this Consent Decree and the RAP. The State shall also review the Defendants' performance of the Work for compliance with subsequently enacted, modified, or promulgated statutes or regulations which the State asserts are applicable.

In the event the State asserts that any such statute or regulation is or may be applicable to Defendants' performance of the Work, Defendants shall be entitled to invoke dispute resolution as provided in Paragraph XXIX(B).

B. In addition to any necessary and proper oversight, enforcement, and/or regulatory activities which the State may undertake at the Uravan Facility, the State shall:

1. Coordinate oversight under this Consent Decree with regulatory activities under applicable statutes and regulations to assure that regulatory costs chargeable to Defendants are minimized to the maximum extent practicable.

2. Subject to state and federal radiation control statutes, regulations and rules, conduct all inspections required under the Colorado Radiation Control Act and regulations promulgated thereunder with respect to the Uravan Facility. The cost of such inspections which do not unnecessarily duplicate inspections conducted under this

Consent Decree shall be charged to the Defendants' inspection costs, in accordance with Paragraph XXII(A). State personnel shall exercise their best efforts to minimize such duplication.

3. Coordinate licensing and permitting under state laws and regulations promulgated thereunder so as to minimize duplication of costs and effort by state personnel and to avoid inconsistent requirements.

C. On or before the effective date of this Consent Decree, the State shall designate an On-Site Coordinator (OSC) for the Uravan Facility, and may designate other representatives including counsel for and/or other employees of the State, and consultants, to observe and monitor all progress of any activity and to inspect and copy records of activity undertaken pursuant to this Consent Decree. In addition to the authority necessary and proper to accomplish the foregoing, the OSC shall have the same authority as that vested in a federal "On-Scene Coordinator" under the NCP.

1. The OSC shall be appointed by the Executive Director of CDH or his/her duly designated representative with the advice and consent of the Colorado Attorney General.

2. The State shall have the right to change its OSC from time to time. The State shall notify Defendants in writing at least one (1) week prior to such change, and shall provide the Defendants with the name and title of the individual who will next be serving as OSC.

3. Following appointment of the OSC or his/her successor, the State shall notify the Defendants of the name, title and qualifications of the OSC.

IX. SITE MANAGER FOR REMEDIAL ACTION

A. On or before the effective date of this Consent Decree, the Defendants shall designate one individual to be their Site Manager (SM), and shall notify the State in writing of the name, title and qualifications of the SM.

B. The SM shall oversee Defendants' implementation of the RAP and shall be responsible for Defendants' conduct, direction, and supervision of the Work.

C. Defendants shall have the right to change their SM. Defendants shall notify the State in writing at least one (1) week prior to the change, and shall provide the State with the name, title and qualifications of the individual who will next be serving as SM.

X. IMPOSSIBILITY OF PERFORMANCE AND "FORCE MAJEURE"

A. In the event that Defendants' performance of any provision of this Consent Decree is rendered impossible by the issuance of any federal enforcement order or the rendering of any federal judicial order, decree or judgment relating to any matter at the Uravan Facility which is addressed in this Consent Decree, any Party shall have the right, upon written notice to the other Parties, to seek a determination from this Court as to the obligations imposed by this Consent Decree.

B. Force majeure shall excuse any Party from performance or timely performance of a particular obligation under the Consent Decree. Force majeure for purposes of this Consent Decree is defined as a reasonably unforeseeable event arising from cause(s) beyond the control of the Party asserting these force majeure provisions which unavoidably delays or prevents the performance of any obligation under this Consent Decree. A force majeure event may include, by way of example but not of limitation, an Act of God, act of war, state or federally caused modification, cessation, or delay of the Work, or act or omission of any non-party to this Consent Decree over whom the Party seeking to invoke these force majeure provisions has no control.

C. Time required to obtain necessary permits and licenses or other land use authorizations or entitlements which are not described in the Final Submittals shall

constitute a force majeure event, provided that the initial application for such permit, license, land use authorization or entitlement was timely made and Defendants have provided all information reasonably required to process such application.

D. Force majeure shall not include increased costs or expenses, except as specifically provided in the RAP, nor failure to apply in a timely manner for any required governmental permit, license, land use authorization or entitlement nor to make timely provision of all required information therefor.

XI. MONITORING AND REPORTING

A. Defendants shall provide written progress reports to CDH and the OSC, as required by this Consent Decree and/or the RAP, and containing the information therein required. At a minimum, these reports shall include:

1. Quarterly progress reports which shall be filed on the tenth day of each calendar quarter and which shall set forth a summary of activities, including at a minimum:
   (a) A summary of the Work performed;
   (b) Any change or modification of scheduled activities;

(c) A summary of the Work planned for the following quarter; and

(d) The raw monitoring data gathered as a part of the Work during the preceding quarter, or as soon thereafter as such data becomes available.

2. A notice of completion which shall be submitted within thirty (30) days of the completion of any Scheduled Activity. Said notice shall include a summary of Work undertaken toward the completion of the Scheduled Activity, any problems encountered, and any modifications of Final Submittals that were necessary for completion.

3. Annual monitoring reports which shall provide annual summaries of all monitoring data gathered as part of the Work, whether or not such data are required to be gathered by this Consent Decree or the RAP. Said reports shall be provided to the State no later than March 31 for the previous calendar year ending December 31.

B. All records, documents, information, and raw data of whatever kind, nature and description within the custody or control of Defendants or Contractors relating to performance of the Work at the Uravan Facility shall be available at all times to the OSC and any other representative of the State designated in writing by the Attorney General of Colorado or by the OSC for inspection and copying.

C. Until completion of the Work and termination of this Consent Decree, the Parties shall preserve, and shall instruct their Contractors to preserve all records, documents and information of whatever kind, nature or description relating to performance of the Work which are not confidential attorney-client communications. Upon completion of the Work and termination of this Consent Decree, copies of all such records, documents and information shall be delivered promptly to the respective Parties.

D. Defendants shall submit to the appropriate authority all reports and required documentation according to the terms of all applicable Colorado and federal environmental statutes, regulations, and licenses in addition to any report required by this Consent Decree. A copy of every such report and document shall be provided to the OSC.

E. In order to comply with Section 121(c) of CERCLA, as added by Section 121(a) of SARA, Defendants shall periodically review the Work undertaken and to be performed pursuant to the RAP to assure that human health and the environment are being protected by the implementation of the RAP. Such review shall be accompanied by a written report summarizing the results of such review. If such review and report indicate, in the judgment of the State, that further or additional remedial action is appropriate at the Uravan Facility to avoid or abate an imminent and substantial endangerment or which is necessary to protect the public health and environment, the State may seek modification of the RAP pursuant to Section VII of this Consent Decree, or, if appropriate, proceed under Section XVI of this Consent Decree. Such periodic review shall be undertaken every five (5) years following commencement of the remedial program described by the Consent Decree and RAP. The report of the first of such reviews shall be submitted to the State on or before January 30, 1992, and reports of subsequent reviews shall be submitted to the State on or before January 30 of every fifth year thereafter until termination of this Consent Decree.

XII. SITE ACCESS AND RESTRICTIVE COVENANTS

A. Defendants agree to and shall provide unrestricted access to all portions of the Uravan Facility, excluding office areas but subject to the requirements of

Paragraph XI(B), within the control of Defendants to the State, its counsel, OSC, and such agents or consultants as the Attorney General and/or OSC may designate in writing for the purpose of overseeing and inspecting any and all activities or conditions which have been or are being conducted and/or addressed pursuant to this Consent Decree. In addition, the Defendants shall use their best efforts to obtain unrestricted access for the OSC to any portions of the Uravan Facility for which the Defendants have noncontrolling access.

B. Nothing herein shall be deemed to preempt, limit or restrict in any way any and all rights to site access at the Uravan Facility, including the right to inspect and copy documents, take samples, and obtain evidence, which the State, or any of its officers, agencies, departments or instrumentalities may have pursuant to any and all applicable laws or rules of procedure.

C. As a condition of entry pursuant to Paragraph A, Defendants may require all visitors to the Uravan Facility to identify themselves, present their credentials, comply with sign-in procedures and to comply with all state and federal statutes, including regulations of the United States Mine Safety and Health Administration (MSHA), and to comply with Defendants' health and safety regulations, plans and procedures, and to acknowledge receipt of an advisement that

certain hazards may exist at the Facility. Such advisement shall not be in a form which waives or otherwise requires the waiver of rights or claims otherwise cognizable under federal or state statutory or common law. The Defendants' right to require compliance with their health and safety regulations, plans and procedures shall not be used to unreasonably impede or interfere with the State's unrestricted right of access granted pursuant to Paragraph A of this Section.

D. No property of the State or its consultants left at the Uravan Facility shall be deemed a fixture and all such property shall remain the property of the State or its consultants.

E. Defendants shall exercise expeditiously their best efforts to obtain title or patents from the United States Bureau of Land Management (BLM) or other federal agency holding title to any property within the Uravan Facility. Additionally, Defendants shall expeditiously apply for any permits necessary for site access or to implement the Work upon any land owned by BLM or other federal agency until such title or patents can be obtained.

F. To the extent access to or easement over property other than those portions of the Uravan Facility over which Defendants hold any legal interest is required for the proper and complete performance of this Consent Decree,

Defendants shall use reasonable efforts to gain access to or easements over such property, and if necessary, the State agrees to use reasonable efforts, consistent with its legal authority, to assist Defendants in obtaining such access.

G. No conveyance of title, easement, or any other legal interest in any portion of the Uravan Facility, specifically but non-exclusively including all portions owned by the Defendants, or either of them, which are more particularly depicted in Appendix III, which is attached hereto and incorporated by reference herein, shall be consummated without a provision permitting the continued, unimpeded operation and maintenance of all components of and all structures and improvements resulting from or related to the Work, the timely performance of any Work to be done pursuant to this Consent Decree, and the unrestricted access to the Uravan Facility granted to the State herein, and all such conveyances of title and/or any legal interest in any portion of the Uravan Facility shall contain a covenant to permit such unrestricted access and the unimpeded operation and maintenance of such structures and improvements and performance of such Work. At least ninety (90) days prior to any conveyance of title or any interest in all or any portion of the Uravan Facility, the person(s) owning such property and/or legal interest shall notify the State by registered

mail of the intent of such person(s) to convey title and/or any legal interest in such property. This notice shall contain a detailed description of the legal interest and property intended to be conveyed, an identification of and current mailing address for the person(s) to whom such legal interest will be conveyed, and an exact copy of the provision(s) of the conveyance instrument permitting the continued operation, maintenance, performance and unrestricted access prescribed herein. The restrictions and obligations set forth in this Paragraph G shall run with the land and shall be binding upon any and all persons who acquire title or any legal interest in all or any portion of the Uravan Facility.

H. Defendants shall file for record, at their cost, a copy of this Consent Decree and Appendices I and II in the office of the Clerk and Recorder of Montrose County, Colorado as an encumbrance upon all parcels comprising the Uravan Facility. No other attachments to the Consent Decree need be so filed, but shall be made available by the Parties for public inspection. Defendants shall execute such instruments and documents and pay such costs, if any, as may be required to entitle the terms of this Consent Decree to be so recorded and to operate as a covenant running with the land. Upon

termination of this Consent Decree, the State shall record a release of encumbrance(s) on the subject parcels.

XIII. DISPUTE RESOLUTION

A. In any dispute arising under this Consent Decree or the RAP, the Parties shall attempt to resolve the dispute by negotiations at first between the OSC and SM; and if unsuccessful, then, with counsel present if any Party so requests, among designated representatives of the Parties having authority to act on behalf of the Parties. If the dispute is resolved informally, the Parties shall modify the RAP in writing and/or jointly move the Court for an amendment of this Consent Decree to reflect the agreement reached. The initial informal dispute resolution period shall be thirty (30) days. The Parties may, by mutual written agreement and for good cause, extend the time for informal dispute resolution by an additional ten (10) days. The total time period for informal dispute resolution shall in no event exceed forty (40) days. However, informal dispute resolution need not be initiated if in the opinion of any Party to do so would be futile, in which event a direct filing of a petition to the Court pursuant to Paragraph B of this Section XIII may be permitted.

B. When a disputed issue cannot be resolved by the process described in Paragraph A of this Section, any Party may elect to file a petition in this Court for mediation or adjudication of the matter in dispute. The petition shall identify the issues in dispute, the reasons that the dispute could not be resolved after reasonable effort or why informal dispute resolution was thought to be futile, and the relief sought by that Party. The other Parties shall file responses or objections to the petition within 10 days of service of the petition or within such greater or lesser time as the Court shall order. All such petitions, responses and objections shall be filed with the Court and served upon the other Parties and the Special Master.

XIV. REFERENCE TO SPECIAL MASTER FOR MEDIATION AND ADJUDICATION OF DISPUTES AND CONTEMPT

A. The Court hereby appoints Richard W. Dana of the Judicial Arbiter Group (2919 Valmont Road, Suite 206, Boulder, Colorado 80301) as Special Master to mediate and/or adjudicate all disputes between the Parties, and motions for stay, applications under Sections VII and XXVII, petitions for abatement orders pursuant to Paragraph XVI(A)(2), and motions for contempt, arising under this Consent Decree or RAP subject to the conditions and limitations established herein.

B. Upon Court Order or application for mediation by either Party to which no timely objection is filed, the Special Master shall promptly facilitate resolution of all petitions for mediation filed pursuant to Paragraph B of Section XIII. If a Party files an objection to mediation, the petition for mediation shall be deemed a petition for adjudication and the Special Master shall proceed pursuant to subparagraph D of this Section. If mediation, once initiated, is determined by any Party to be futile, the matter(s) in dispute shall be referred back to the Court for adjudication by petition of any Party. The Parties may procure the attendance of witnesses before the Special Master by the issuance and service of subpoenas as provided in Federal Rules of Civil Procedure 45.

C. Except where expressly prohibited in this Consent Decree or RAP (e.g., in Paragraphs XVI(A)(1) and (B)), any Party opposing a unilateral determination by another Party under this Consent Decree or RAP shall be entitled to invoke the dispute resolution provisions of Sections XIII and XIV.

D. Upon application of any Party, or upon direction of the Court, the Special Master shall promptly consider and resolve all petitions for adjudication filed pursuant to Paragraph B of Section XIII, motions for stay, motions for contempt, petitions for abatement orders pursuant to

Paragraph XVI(A)(2), and applications under Sections VII and XXVII herein arising under this Consent Decree by conducting hearings on all matters in dispute and making findings of fact, conclusions of law and recommendations to this Court. For this purpose, the Special Master has and shall exercise the power to regulate all proceedings in every hearing before him and to do all acts and take all measures necessary or proper for the efficient performance of his duties under this Order of Reference. Without limiting the foregoing, the Special Master may:

1. Require production before him of evidence upon all matters in dispute, including the production of all books, papers, vouchers, documents, and writings in whatever form stored or recorded applicable thereto;
2. Rule upon the admissibility of evidence;
3. Procure the attendance of witnesses before him and put witnesses on oath and/or himself examine them;
4. Call the Parties and/or their employees and examine them upon oath;

5. Punish as for a contempt and subject to the consequences, penalties, and remedies provided in Federal Rules of Civil Procedure 37 and 45 a subpoenaed witness or a noticed party who, without adequate excuse, fails to appear or give evidence as required.

The Parties may also procure the attendance of witnesses before the Special Master by the issuance and service of subpoenas as provided in Federal Rules of Civil Procedure 45.

E. When a Party to an adjudicatory proceeding so requests, the Special Master shall make a record of the evidence offered and excluded in the same manner and subject to the same limitations as provided in the Federal Rules of Evidence for a court sitting without a jury. The cost of recording and/or transcribing the proceedings shall be part of the costs reimbursable to the Special Master as provided below.

F. Each decision by the Special Master rendered in the course of an adjudicatory proceeding shall be in writing or stated orally on the record, and shall report the relevant findings of fact, conclusions of law and recommendations. The Parties stipulate and the Court hereby orders that the Special Master's findings of fact shall be final and only questions of law arising upon the report shall thereafter be considered.

G. The decisions of the Special Master rendered in the course of an adjudicatory proceeding shall be final and binding upon the Parties and enforceable as an order of this Court unless any Party objects to the Special Master's decision in whole or in part by applying to the Court for judicial review within five (5) days after receiving the Special Master's oral or written decision. Such application for judicial review shall be in writing, served upon all Parties and the Special Master and shall set forth specifically the legal basis supporting the request for judicial review and the relief desired. When a Party has filed a timely application for judicial review, the Special Master shall forthwith file transcripts and exhibits from proceedings with the Court. If, in the decision being reviewed, the Special Master makes a finding that the relief recommended in his decision is appropriate to abate a condition which may present an imminent and substantial endangerment to public health, welfare or the environment, the Special Master's decision shall not be stayed and shall be binding upon the Parties unless and until it is modified or rejected in whole or in part by the Court pursuant to a timely application for judicial review. In all other cases in which either Party has timely requested judicial review, the effect

of the Special Master's decision shall, unless otherwise ordered by the Special Master or the Court, be stayed pending resolution by the Court.

H. Fees and expenses of the Special Master incurred in connection with any adjudicatory proceeding hereunder shall be deemed approved by the Court unless any Party presents an objection to the Court within thirty (30) days following submittal of the Special Master's invoice. Such fees and expenses shall be paid by the Defendants within sixty (60) days following submittal of the Special Master's invoice unless it is finally determined that the State's position in the relevant proceeding was unreasonable, in which case all such fees and expenses not yet paid shall be paid by the State and those which have been paid by Defendants shall be reimbursed to Defendants by the State immediately. When the Party whose duty it is to pay the Special Master's fees and expenses pursuant to this paragraph has failed to do so within sixty (60) days following submittal of the Special Master's invoice, the Special Master shall be entitled to a writ of execution against the delinquent Party.

I. The State's reasonable costs and attorneys' fees incurred in connection with any adjudicatory proceeding hereunder, including any application for reconsideration or judicial review to the District Court, shall be paid to the

State by Defendants within sixty (60) days of the final resolution of such matter unless it is finally determined that the State's position in the relevant proceeding was unreasonable, in which case all reasonable costs and attorneys' fees of all Parties shall be paid by the State. If the State seeks reimbursement for its costs and attorneys fees, it shall first submit to the Special Master and to Defendants a detailed accounting of such costs and fees. At the request of Defendants, the Special Master shall review the State's costs and attorneys fees submittal, and determine the reasonableness of such costs and fees and whether the State's position was unreasonable.

J. Notwithstanding the provisions of Paragraphs H and I of Section XIV, the State shall bear all costs of adjudicatory proceedings if the State invokes the dispute resolution process pursuant to Paragraph B(3) of Section VI, Subpart One, or Paragraph B(3) of Section VI, Subpart Three; or if any Party invokes the dispute resolution process with respect to Paragraph C(4) of Section XXIV unless it is finally determined that the Defendant's position in the relevant proceedings was unreasonable in which case Defendants shall bear their own costs and attorneys fees.

K. In any proceeding involving contempt under this Consent Decree or civil penalties sought by the State under Section XVIII, the prevailing Party shall be entitled to recover its reasonable costs and attorneys fees incurred in connection with said proceeding. If the prevailing Party seeks reimbursement for its costs and attorneys fees, it shall first submit to the Special Master and to the other Party(ies) a detailed accounting of such costs and fees. At the request of any Party, the Special Master shall review such costs and attorneys fees submitted, and determine their reasonableness.

L. The State shall pay half, and the Defendants shall pay half, of the Special Master's fees and costs incurred in any mediation proceedings hereunder and in other appropriate general activities (which shall not include any adjudicatory proceedings for which fees and costs are awarded pursuant to paragraphs H through J of this Section XIV) of the Special Master pursuant to this Order of Reference, which general activities non-exclusively include the Special Master's initial review of this Consent Decree, the RAP and all other attachments to it, and his initial site visit and tour. The Special Master shall submit monthly invoices to the Court, with copies to the Parties, for any month in which mediation and/or other appropriate general activities pursuant to this Order of Reference have occurred. The Parties shall have

10 days from the date a Special Master's invoice is mailed within which to object in writing to all or part of that invoice. If an objection to a Special Master's invoice is received, the Parties' obligations to pay their respective shares of the invoice shall be suspended unless and until the invoice at issue is authorized by the Court.

XV. RELATIONSHIP OF STATE LICENSES AND PERMITS TO THE CONSENT DECREE

A. Upon entry of this Consent Decree, the License 660-02S, which is by reference incorporated herein, shall become final unless appealed by a non-party to this Consent Decree, and Defendants shall be deemed to have waived their rights to administrative and judicial review under state law; provided, however, that if for any reason the conditions of the License are modified at the conclusion of the public comment period provided in Section XXXV, Defendants shall retain all rights of review regarding such modification.

B. Enforcement of the provisions of the License shall, at the option of the State, be under the provisions of this Consent Decree or under applicable provisions of state law; provided, however, that Defendants may elect to invoke the dispute resolution provisions of Sections XIII and XIV with respect to any notice of violation issued pursuant to

§25-11-107, C.R.S. regarding any obligations imposed by the RAP or Consent Decree to determine only whether a violation has occurred. Any subsequent proceedings, at the option of the State, shall be under the provisions of this Consent Decree or under applicable provisions of State law.

C. Any future modification to the License which is not inconsistent with the terms and conditions of this Consent Decree or the RAP, initiated by either the State or the Defendants, shall be subject to administrative and judicial review procedures under state law. The State acknowledges Defendants' right to raise substantive and procedural issues of preemption by this Consent Decree before the state courts. If any proposed modification to the License is inconsistent with any provision of the RAP, then Defendants may invoke the dispute resolution provisions of Sections XIII and XIV with regard to such modification only if a non-party to this Consent Decree has not sought status as a party to such state law proceeding. Such invocation shall be deemed a waiver by Defendants of all rights of review pursuant to state law.

D. If any other permit issued by the State prescribes terms and conditions which are not inconsistent with the terms of this Consent Decree or RAP, then any review of such permits shall be pursuant to state law. The State

acknowledges Defendants' right to raise substantive and procedural issues of preemption by this Consent Decree before the state courts. If the terms or conditions of any such permit are inconsistent with any provision of the RAP, then Defendants may invoke the dispute resolution provisions of Sections XIII and XIV with regard to such terms and conditions only if a non-party to this Consent Decree has not sought status as a party to such state law proceeding. Such invocation shall be deemed a waiver by Defendants of all rights of review pursuant to state law.

E. Notwithstanding the Defendants' right to invoke the dispute resolution provisions of this Consent Decree pursuant to Paragraphs C and D of this Section XV, such right shall not foreclose any rights non-parties to this Consent Decree may have under state law to receive public notice, or to comment on, intervene in, or appeal from such permit proceeding.

XVI. SPECIAL RESPONSE AUTHORITY

A. In the event that a condition at or from the Uravan Facility may present an imminent and substantial endangerment to public health, welfare or the environment, the State may:

1. Order Defendants to perform the Work in compliance with this Consent Decree, and/or implement actions appropriate to eliminate, correct or mitigate the endangerment. No stay of Defendants' obligation under this Paragraph XVI(A)(1) shall be granted unless Defendants establish that their failure to perform any such obligation will not pose an imminent and substantial endangerment to the public health, welfare or environment. If Defendants fail or refuse to perform such Work and/or implement such actions in accordance with the schedule contained in the State's order, the State may, with prior or contemporaneous notice to Defendants, perform the Work and/or implement such actions. In the event the State performs such Work or implements such actions pursuant to this paragraph, the State shall be entitled to obtain the monies determined necessary by the State to perform the Work and/or implement such actions from the Defendants, or if

Defendants fail or refuse to timely provide such monies, then from the Construction Fund or instrument(s) pursuant to Section XVII. Upon receipt of the State's order or notice pursuant to this paragraph, the Defendants may invoke the Dispute Resolution provisions of Sections XIII and XIV to examine only whether the activity taken and/or whether the amount determined and/or expended by the State was in fact necessary and reasonable under the circumstances. If the activity and expenditure are finally determined to have been reasonable under the circumstances, the Defendants shall have no recourse against the State and shall, within thirty (30) days of the determination, replace any funds removed from the construction fund or posting established pursuant to Section XVII herein so as to maintain the amount of surety then required by Section XVII. If the activity or expenditure is

finally determined to have been unreasonable under the circumstances, the only relief available to Defendants under this Consent Decree shall be the reimbursement to Defendants of those monies unreasonably taken or expended by the State, together with any unexpended monies and the reasonable costs of restoring any portion of the Uravan Facility to its condition prior to the State's mitigative and/or corrective action, if appropriate. Such sums shall be paid to the Defendants within thirty (30) days of the final determination. Nothing in this subparagraph (1) shall be construed to authorize any action prohibited by Paragraph B of this Section; or

2. Seek, with notice to Defendants, upon a forthwith hearing before the Special Master or before this Court pursuant to Paragraph D of this Section XVI, an order compelling compliance with the Defendants' obligation to perform the Work in

compliance with this Consent Decree, and/or to implement corrective and/or mitigative actions necessary to abate the imminent and substantial endangerment.

B. Whenever the State undertakes any part of the Work, and/or corrective or mitigative action pursuant to Section VI or Section XVI(A), Defendants shall not interfere with, impede, or otherwise hinder or delay the State's performance of such Work and/or actions. In the event that the State undertakes any such performance, Defendants shall have available only that relief which is specified in Section XVI(A) and shall not be entitled to seek or obtain any other order which interferes with, impedes or otherwise hinders or delays the State's performance or access to the monies described in Paragraph A of this Section. Nothing in this Paragraph B shall be construed to limit or impair any rights Defendants may have under federal or state law to seek, following the final conclusion of the dispute resolution process authorized by Paragraph A(1) of this Section, appropriate relief based on activities or expenditures undertaken by the State pursuant to this Section XVI.

C. Whether or not an "imminent and substantial endangerment" may exist in a particular case shall be determined from an analysis of the facts and circumstances prevailing in that case and applicable law. However, for purposes of this Consent Decree only, the following acts, omissions, or circumstances shall be conclusively presumed to constitute and present an "imminent and substantial endangerment."

1. Failure or refusal of the Defendants to comply with the requirements of any of the following paragraphs of the RAP:
   a. 5.0.1
   b. 5.0.2
   c. 5.1.1.2(3)
   d. 5.1.2.2(2)
   e. 5.4.3.2.1(7); or
2. Any failure of the structural integrity of the Tailings Piles or the crystal repository in the Burbank Quarry.

D. In the event that the State determines that a condition has arisen which may present an imminent and substantial endangerment to the public health or welfare or the environment because of a failure of a remedial action component or an actual or threatened release of a hazardous

substance from the Uravan Facility, the State may directly petition, with notice to Defendants and without need to invoke or exhaust any dispute resolution provision of this Consent Decree, any court of competent jurisdiction for such relief as may be necessary to immediately abate the danger or threat. If the State so elects, it may in its petition seek direct review by this Court and, in that event, the matter raised in that petition shall not be deemed referred to the Special Master without further specific Order of this Court.

E. Subject to the provisions of Section XV(B), the State may also take other action within its authority under Colorado or federal statutes, rules and regulations.

F. Absent a substantial breach of this Consent Decree, the State shall not seek or solicit federal participation or consultation in the implementation of the remedy at the Uravan Facility pursuant to this Consent Decree, which solicitation will operate to impose an additional liability under CERCLA to Defendants for response costs.

XVII. SURETY FOR PERFORMANCE

A. Within 90 days of the effective date of this Consent Decree, Defendants shall establish a restricted, single-purpose construction fund or account to be managed by the Defendants for the sole purpose of providing to the State

financial surety for the Work. The sums to be maintained in the fund may be invested by Defendants in Eligible Investments as defined in Appendix IV, or in other investments previously approved by the State. The fund shall be subject to audit by the State for compliance with the restrictions and conditions established pursuant to this Section XVII. Defendants' payments into the construction account shall be on an incremental basis, described below. For purposes of the following subparagraphs, the projected costs referred to therein shall be projected by Defendants and shall be subject to review and approval by the State.

1. On or before April 10, 1987, following entry of this Consent Decree, initial funding shall occur in an amount equal to the projected cost of the required Work for the remainder of 1987, and the first quarter of 1988;

2. On or before April 10, 1988, a sum shall be added to the fund equal to the projected cost of the required Work for the last three quarters of 1988, calendar year 1989, and the first quarter of 1990;

3. On or before April 10, 1989, a sum shall be added to the fund equal to the projected cost of the required Work for the last three quarters of 1990 and the first quarter of 1991;

4. On or before April 10th of each succeeding year, a sum shall be added to the fund equal to the projected cost of the required Work in the next succeeding twelve calendar months for which the cost of Work has not yet been funded. This funding procedure shall be followed until the aggregate amount of the construction fund equals the net present value of the projected cost of remaining Work. At that point, Defendants may cease their annual contribution to the fund, and may make withdrawals from the fund as provided below, so long as the amount retained therein provides Full Surety to the State.

B. On and after April 10, 1989, Defendants must post and maintain Full Surety by: (i) compliance with Paragraphs A and C of this Section; or (ii) compliance with Paragraph D of this Section; or (iii) compliance with Paragraph E of this Section.

C. In addition to the requirements of Paragraph A, the Defendants, or either of them, shall, on or before April 10, 1989, furnish to the State a Securities and Exchange Commission Form 10-K if filed by the Defendants, or either of them, or, if not, a certified financial statement for either company's most recent fiscal year prepared by a licensed auditor and the unqualified opinion of an independent certified public accountant that the Defendants or either of them meet either the financial test described in subparagraph 1 below or the financial test described in subparagraph 2 below:

1. Either of the Defendants must have:

(a) Two of the following three ratios: a ratio of total liabilities to net worth less than 2.0; a ratio of the sum of net income plus depreciation, depletion and amortization to total liabilities greater than 0.1; and a ratio of current assets to current liabilities greater than 1.5; and

(b) Net working capital and tangible net worth each at least 6 times the current net present value of the remaining projected cost of Work; and

(c) Tangible net worth of at least Ten Million Dollars ($10,000,000.00); and

(d) Assets in the United States amounting to at least 90% of its total assets or at least 6 times the current net present value of the remaining projected cost of Work.

2. Either of the Defendants must have:

(a) A current rating for its most recent bond issuance of AAA, AA, or A as issued by Standard and Poor's or Aaa, Aa, or A as issued by Moody's; and

(b) Tangible net worth at least 6 times the current net present value of the remaining projected cost of Work; and

(c) Tangible net worth of at least Ten Million Dollars ($10,000,000.00); and

(d) Assets located in the United States amounting to at least 90% of its total assets or at least 6 times the sum of the current net present value of the remaining projected cost of the Work.

3. The accounting terms used in this Paragraph XVII(C) are defined in Appendix IV, which is attached herewith and incorporated by reference herein.

4. To maintain the agreement in effect, the Defendants, or either of them, shall, within 100 days after the end of each fiscal year, provide the most recent form 10-K or certified financial statement, and, in either case, an independent certified public accountant's opinion of continued compliance with the requirements of Paragraph XVII(C)(1) or XVII(C)(2).

5. If a Defendant files a Securities and Exchange Commission Form 8-K (change in financial condition) with the Securities and Exchange Commission, a copy shall be provided forthwith to the State. If neither Defendant is required to file Form 8-K, either Defendant shall report immediately to the State any change in financial condition which would be required to be reported by a company filing a form 8-K. If the State has reason to believe

that neither Defendant no longer meets the requirements of Paragraphs XVII(C)(1) or XVII(C)(2), it shall require the Defendants to submit an updated independent certified public accountant's opinion at the end of the most recent fiscal quarter.

6. If, based upon the information described in Paragraph XVII(C)(5), the State determines that neither of the Defendants complies with the requirements of Paragraph XVII(C)(1) or XVII(C)(2), the State shall notify the Defendants by certified mail, which notice shall contain reasonably detailed written findings, and the noncomplying Defendants, or either of them, shall have thirty (30) days from receipt of notice in which to substitute an acceptable alternative surety arrangement, unless granted more time by the State for good cause or unless the Defendants have invoked the dispute resolution provisions of Sections XIII and XIV and obtained a stay of their obligations under this Paragraph C(6).

7. The provisions of this Paragraph C shall not apply when under Paragraph A(4) of this Section XVII, the amount of the construction fund contains the amount required to maintain Full Surety.

D. In the alternative to Paragraphs A and C, on or before April 10, 1989, the Defendants, or either of them, shall submit to the State a surety arrangement in the form of an irrevocable letter of credit, surety bond, certificate of insurance, other financial surety arrangement acceptable to the State, or combination thereof for the amount required to maintain Full Surety.

E. The Defendants, or either of them, may propose to the State, on April 10, 1989, or at any time thereafter, but not more frequently than once per twelve calendar month period, as an alternative to Paragraphs XVII(A) and (C), or as an alternative to Paragraph XVII(D), to attain and maintain Full Surety, a surety arrangement which may consist of any combination of the provisions of Paragraphs XVII(A), (C) and/or (D). The State shall respond to any such proposal with reasonably detailed findings not later than ninety (90) days from receipt of Defendants' proposal.

F. If the Defendants, or either of them, elect to furnish the surety arrangements described in Paragraph XVII(D) or (E) which are acceptable to the State, the provisions of

Paragraphs XVII(A) and XVII(C) shall be rendered null and void and of no effect. The State, within thirty (30) days of notice from Defendants, shall confirm liquidation to the bank or other financial institution(s) holding the construction fund, with a copy to Defendants, to enable Defendants to liquidate the construction fund described in Paragraph XVII(A).

G. The amount necessary to attain Full Surety, and the adequacy of the financial assurance instruments under this Section XVII, shall be determined by CDH within one hundred twenty (120) days of the State's approval of plans and specifications submitted by Defendants pursuant to Section VI, Subpart One of this Consent Decree and annually thereafter following review by the State of proposed changes to cost estimates which shall be submitted to the State by the Defendants by June 30 of each year (commencing in 1989). The State shall complete its review and shall respond to such cost estimates within sixty (60) days of its receipt of such estimates. Cost estimates may be annually adjusted upward or downward as current circumstances, including, but not limited to, inflation and technology, require. Each such determination by CDH of the amount necessary to attain Full Surety and of the adequacy of the financial assurance instruments shall, together with the underlying calculations

and rationale, be served upon Defendants. Each such determination shall be final and binding upon the Parties and Defendants shall have sixty (60) days in which to adjust the appropriate financial instruments, unless Defendants invoke the dispute resolution provisions of this Consent Decree within ten (10) working days after service by certified mail of such determination upon them.

H. The State shall be entitled to obtain monies from the construction fund and/or instruments established by this Section XVII upon tendering to Defendants and/or their surety(ies) a written demand for a sum certain signed by the Attorney General and the Executive Director of CDH, which demand asserts that (i) a condition at or from the Uravan Facility may present an imminent and substantial endangerment to the public health, welfare, or the environment and that Defendants have failed or refused to timely implement corrective actions deemed appropriate by the State; (ii) the Defendants have failed or refused to timely provide the demanded sum certain; and, (iii) the demanded sum is necessary to the State's performance of the Work and/or appropriate corrective or mitigative actions. The existence of a condition which may present an imminent and substantial endangerment may be the subject of dispute resolution between the Parties as provided in Paragraph XVI(A); however, the

actual existence of such a condition shall not be deemed or construed as a condition precedent to the surety's obligation to honor the State's demand for the sum certain. Monies obtained by the State prior to expenditure shall be retained in an escrow account as provided in Paragraphs J and K of this Section XVII.

I. Following the conclusion, favorable to the State, of any dispute resolution proceeding in which the State alleges that Defendants have failed to comply with any of their obligations imposed by this Consent Decree, the State shall be entitled to an order authorizing the State to obtain the sums determined necessary to the State's performance of all or part of the Work and/or appropriate corrective or mitigative actions from the construction fund and other instruments established by this Section. Monies obtained by the State prior to expenditure shall be retained in an escrow account as provided in Paragraphs J and K of this Section XVII.

J. If any portion of Full Surety being provided to the State is through a cash construction fund managed by Defendants and (i) neither Defendant makes deposits to such fund as and when required by this Section, or (ii) neither Defendant tenders to the State the amount demanded within fifteen (15) days following receipt of a demand by certified

mail which complies with Paragraph H of this Section, then the Defendants shall transfer, unless a stay of such obligation has been granted through the dispute resolution provisions of Sections XIII or XIV, all monies in such construction fund into an escrow account with an independent third party agent selected by the Defendants and approved by the State, and shall add to the account the amount required to achieve Full Surety. Defendants shall give preference to a third party agent in Colorado, provided such agent is rated in one of the two highest categories by a nationally-recognized rating service. Administration of such escrow account shall be subject to the terms and conditions of this Consent Decree. In the event the Defendants fail or refuse to transfer the construction fund as and when required by this paragraph, the State shall be entitled, upon filing of a sworn certificate of such failure with this Court, to a Writ of Execution for the entire amount required to achieve Full Surety pursuant to Paragraph C(7) of this Section, which amount shall be deposited into an independent escrow account selected by the State.

K. In the event that an escrow fund is created pursuant to this Section XVII, the independent escrow agent shall invest and reinvest the principal and income of the fund and keep invested as a single fund, without distinction

between principal and income in Eligible Investments as described in Appendix IV, or in other investments approved in advance by the Parties. In investing, reinvesting, exchanging, selling and managing the fund, the agent shall discharge his duties with respect to the fund solely in the interest of the Parties and with the care, skill, prudence and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims. The agent shall provide quarterly statements to the parties regarding the status of the escrow fund.

L. All letters of credit, surety bonds, certificates of insurance and other financial instruments posted pursuant to this Section shall contain a provision requiring direct payment to the State of the amount demanded up to the face amount of each such financial instrument within 15 days following (i) receipt of a demand by certified mail on the financial institution and on the Defendants which complies with Paragraph H of this Section or (ii) presentation by certified mail to Defendants and the financial institution of an order obtained pursuant to Paragraph I of this Section authorizing the State to obtain a sum certain and the State's certification that the Defendants have failed to pay to the

State such sum certain as ordered. In the event that some or all of the Full Surety being provided to the State is in the form of financial tests pursuant to Paragraphs C or E of this Section, and the amount demanded by the State exceeds the surety available in other (i.e., non-financial test) forms pursuant to Paragraphs A, D, or E of this Section, then Defendants shall pay to the State within 15 days following the receipt of a written demand as provided by Paragraph H or I of this Section the full amount demanded less any amounts paid by other surety instruments. In the event the Defendants fail or refuse to pay such amount as and when required by this paragraph, the State shall be entitled, upon filing of a sworn certificate of such failure with this Court, to a Writ of Execution for the unpaid amount.

M. So long as Full Surety as annually determined pursuant to Paragraph G of this Section meeting the provisions of Paragraphs A and C, D, or E is maintained, Defendants shall be entitled to the withdrawal of funds or the reduction of the amount of any financial instrument in excess of Full Surety. If an escrow account has been established pursuant to this Section XVII, whenever the funds in such amount exceed Full Surety, Defendants, upon written notice to the State and the independent third party agent, may obtain the release of any funds in excess of Full Surety. Whenever under this

Paragraph M the Defendants seek the withdrawal or release of funds, or a reduction in any financial instrument, the State shall, within thirty (30) days of notice from the Defendants, take any and all actions necessary to effect such withdrawal, release, or reduction in excess of Full Surety.

N. In the event the State obtains monies from the construction fund or other instruments established in accordance with Paragraph J to perform all or part of the Work and/or appropriate corrective or mitigative actions, the State three (3) months after initiation of the Work, and for every three (3) month period thereafter until completion, shall provide the Defendants with an accounting of expenditures and shall, upon completion, provide the Defendants with all unexpended monies, if any.

O. In projecting costs of the Work for purposes of this Section, Defendants shall include costs of mill decommissioning.

P. Upon determination by the State that the Work has been satisfactorily completed in accordance with Subpart Three of Section VI and Section XXXIII of this Consent Decree, and the License, and upon transfer of the site to the State or to the United States pursuant to the Uranium Mill Tailings Radiation Control Act of 1978, PL 95-604, 92 Stat. 3021, the Defendants shall be immediately released from their

obligations to provide Surety for Performance as described in this Section, and the State shall take any and all actions necessary to effect the withdrawal, release, transfer, or liquidation of any outstanding surety arrangement.

XVIII. STIPULATED PENALTIES

A. In the event Defendants, or either of them, violate the following provisions of this Consent Decree, the violator(s) shall pay to the State of Colorado a stipulated civil penalty for each day of each such violation in the following specific amounts:

1. Twenty-five hundred dollars ($2,500.00) for the first calendar day, five thousand dollars ($5,000.00) per day for calendar days two (2) through seven (7) inclusive, and ten thousand dollars ($10,000.00) per succeeding calendar day in which there is a violation of Paragraph 5.0.1 or 5.0.2 of the RAP;
2. Five thousand dollars ($5,000.00) per day for calendar days one (1) through seven (7) inclusive, and ten thousand dollars ($10,000.00) per succeeding calendar day in which there is a violation of Paragraph 5.0.3(1) of the RAP;

3. Five thousand dollars ($5,000.00) per day for calendar days one (1) through seven (7) inclusive, and ten thousand dollars ($10,000.00) per succeeding calendar day in which there is a violation of Paragraph 5.0.3(2) of the RAP.

B. The stipulated penalties set forth in Paragraph A of this Section shall be paid within ten (10) days of Defendants' receipt of a written demand from the State for payment of such penalties unless Defendants shall have invoked in writing the dispute resolution provisions of Sections XIII and XIV prior to the deadline for payment. The demand required by this paragraph shall be served upon Defendants by certified mail and shall describe the provisions allegedly violated, the facts constituting the violation and the date(s) on which such violation allegedly occurred. Payment of the penalties set forth in this Section shall be by certified check made to the order of "Treasurer, State of Colorado" tendered to the Office of the Colorado Attorney General for payment into the "Hazardous Substance Response Fund" established by Colorado Revised Statutes §25-16-104.6.

C. In the event that the State demonstrates a pattern of violations by the Defendants of other provisions of the Consent Decree or Remedial Action Plan and Final

Submittals thereunder, the State may petition the Court for establishment of a schedule for stipulated future penalties, or any other sanctions which the Court may deem appropriate.

D. The Parties agree and the Court hereby finds that the provisions of this Section, which are designed to protect the public health, welfare and environment by deterring significant violations of this Consent Decree, are integral and essential to both the Parties' desire and the Court's Order that the provisions of this Consent Decree be to the maximum extent achievable self-executing and self-enforcing. The Parties agree and the Court hereby Orders that the stipulated penalties described in Paragraph A of this Section are not to be suspended in whole or in part. The Defendants agree and the Court hereby finds that the Defendants have waived all rights they may have to contest the amount or imposition of the stipulated penalties described in Paragraph A of this Section, subject only to the affirmative defense that the event(s), conduct, or circumstance(s) giving rise to the violation described in the State's demand did not in fact occur, which affirmative defense may be raised only by filing with the Court and Special Master and serving upon the State, a written petition for adjudication pursuant to Sections XIII and XIV of this Consent Decree within ten (10) days of service of the State's demand pursuant to Paragraph B

of this Section. Defendants' petition shall set forth the factual basis upon which their assertion of the affirmative defense provided herein rests. If Defendants timely file such a petition, all stipulated penalties not specifically rejected by the dispute resolution process shall be paid on or before the tenth (10th) day following final resolution of the dispute pursuant to Sections XIII and XIV of this Consent Decree.

E. Upon tender of any stipulated penalty pursuant to this Section and acceptance thereof by the State, Defendants shall be deemed to have been subject to a civil enforcement action for that violation and shall not thereafter be subject to any additional civil penalty or other sanction for that violation. However, nothing herein shall be deemed to limit or preclude the State from seeking or any court of competent jurisdiction from granting appropriate injunctive relief to compel remedial or corrective action or compliance with the provisions of this Consent Decree and applicable law.

F. Failure to pay the penalties as and when due pursuant to this Section shall entitle the State to a Writ of Execution for the full amount then due and owing.

XIX. MUTUAL RELEASE AND COVENANT NOT TO SUE

A. Except as specifically provided hereafter in subparagraph B of this paragraph, upon compliance by Defendants with Sections XXII, XXIII, and XXIV hereof and

posting of Full Surety by Defendants, the State hereby releases and covenants not to sue Defendants as to all: (i) common law claims; (ii) civil, state and federal statutory claims and causes of action under provisions of CERCLA and other environmental statutes and/or regulations and/or other environmental laws administered and enforced by the State or available to be asserted by the State; and (iii) claims by the State for natural resource damages within the state which have been, or could have been asserted against Defendants as of the effective date of this Consent Decree, arising out of all matters which were raised relating to or arising from the Uravan Facility. Upon the release and covenant not to sue by the State described above, Defendants hereby release and covenant not to sue the State as to all: (i) common law claims; (ii) claims for monetary damages; and (iii) civil, state and federal claims and causes of action under provisions of CERCLA and other environmental statutes and/or regulations available to be asserted by Defendants which have been, or could have been asserted against the State as of the effective date of this Consent Decree, arising out of all matters which were raised relating to or arising from the Uravan Facility. This Paragraph XIX(A) shall not be construed as a release of any Defendant who does not make all payments and postings required by this Consent Decree or as a release or covenant not to sue any other person or entity not a party to this Consent Decree.

B. This Mutual Release and Covenant Not to Sue shall not apply to the following:

1. Failure to perform the Work or failure to meet the requirements of this Consent Decree or the RAP; or

2. Any liability under common law and/or state and federal statutes and regulations arising from the off-site disposal of waste materials taken from the Uravan Facility; or

3. Complaints, cross-claims, counterclaims, and/or third-party complaints between and among the State and/or Defendants in, or arising out of, any private action brought by any private (nongovernmental) person or entity not a party to this litigation; or

4. Any costs incurred by the State as a result of the exercise of their response authority under federal or state statutes due to a release or substantial threat of a release at or from the Uravan Facility or the Impacted Area as a result of the failure of Defendants to perform the Work or meet the requirements of this Consent Decree and the

RAP whenever the Defendants have failed to undertake such response after reasonable notice; or

5. Any damages incurred by the State as a result of any release or substantial threat of release of hazardous substances at or from the Uravan Facility or the Impacted Area which results from failure(s) of the Defendants to perform the Work or meet the requirements of this Consent Decree and the RAP; or

6. Defendants' rights under state law to administrative and/or judicial review of State action relating to the issuance, denial or modification of any license or permit, except as such rights have been waived as provided in Paragraphs XV(A), (C) and (D) of this Consent Decree; or

7. The right of Defendants to seek contribution from the State in the event of the filing of a suit by the United States for natural resource damages under CERCLA. Nothing herein shall be deemed a waiver of

the State's rights, if any, under the Eleventh Amendment to the United States Constitution.

8. Nothing within this Consent Decree shall be construed to limit the authority of the State to undertake any action against either Defendant or both of them in response to or to recover the costs of responding to conditions at or from the Uravan Facility or Impacted Area which may present an imminent and substantial endangerment to the public health, welfare or the environment resulting from or in connection with:

   (a) Either the occurrence and/or discovery after execution by the Parties of this Consent Decree of (i) previously unknown or undetected conditions at or from the Uravan Facility; or (ii) other previously unknown or new facts; or (iii) scientific knowledge regarding the toxicity of conditions at the Uravan Facility; or

(b) Conditions caused by the implementation of the Remedial Action Plan or this Consent Decree;

provided, however, that the State has first made a good faith effort to provide Defendants, or either of them, with the opportunity to implement a response to the conditions, which response is both timely and appropriate in the opinion of the State.

XX. RESERVATION OF RIGHTS

The Parties reserve the right to assert claims and defenses against any non-parties to this Consent Decree including the United States and, without limitation, the right to seek payment, reimbursement or contribution from non-parties to this Consent Decree for actions taken or to be taken under the RAP or this Consent Decree.

XXI. INDEMNIFICATION

Defendants agree to indemnify the State from all claims by non-parties to this Consent Decree which arise from the acts or omissions of Defendants, their agents, Contractors, consultants, and employees in carrying out

activities at the Uravan Facility required by or undertaken pursuant to any provision of this Consent Decree. For purposes of this Section only, "non-parties to this Consent Decree" shall be deemed to include officers, agents and employees of the State. This indemnification does not extend to that portion of any such claim or cause of action attributable to the negligent acts or omissions of the State or its officers, agents, contractors, consultants or employees.

XXII. RESPONSE COSTS

A. In accordance with the payment schedule prescribed in Section XXV, the Defendants shall reimburse the General Fund of the State through the "Hazardous Substance Response Fund" created pursuant to C.R.S. §25-16-104.6, Seven Hundred Twenty-five Thousand Dollars ($725,000.00) for its costs of response and remedial action relating to the remedial investigation, development of the RAP, and any other activities conducted prior to, and during the course of, this litigation, excluding License renewal and inspection fees, in increments as specified in Appendix V, Allocation of Monetary Payments, attached hereto and incorporated by reference herein. The amount due pursuant to this paragraph shall be

reduced by Two Hundred Sixteen Thousand, Four Hundred and Eighty Dollars ($216,480.00) as a credit for sums already paid by Defendants to the State and its Contractors pursuant to the Memorandum of Understanding of December 5, 1985, and shall be further reduced by Eight Thousand Five Hundred and Twenty Dollars ($8,520.00) as a credit for sums paid by Defendants to contractors for costs incurred in the development of the joint groundwater investigation program.

B. In accordance with the payment schedule prescribed in Section XXV, the Defendants shall pay the State Five Hundred Thousand Dollars ($500,000.00) for deposit to the "Hazardous Substance Response Fund" created pursuant to C.R.S. §25-16-104.6 for the State's response costs to be incurred at the Uravan Facility after date of entry of this Consent Decree in connection with the State's oversight of the Work, excluding License renewal and inspection fees, in increments as specified in Appendix V. Response costs to be incurred for which payments shall be made as described herein do not include License amendments and inspection fees to be charged by CDH in connection with Defendants' Radioactive Materials License, monitoring costs incurred by the Defendants, nor the Long Term Care Fund which is required by regulations of the United States Nuclear Regulatory Commission and Colorado

Department of Health. The obligation for all such costs remains with the Defendants and is not limited by this Consent Decree.

C. Any amount paid by Defendants to the USEPA or any other federal agency for response costs incurred or to be incurred with regard to the Uravan Facility pursuant to an administrative or court order under CERCLA, the liability for which response costs are attributable to a failure by the State to conduct appropriate oversight of Defendants' implementation of the RAP, shall be credited against Defendants' obligation to pay future response costs pursuant to Paragraph B of this Section.

XXIII. NATURAL RESOURCE DAMAGES

In accordance with the payment schedule prescribed in Section XXV, the Defendants shall compensate the State for damage to natural resources, including the costs of assessment of such damages by payment to the State for deposit in the "CERCLA Recovery Fund" created pursuant to C.R.S. §25-16-201 the amount of One Million Dollars ($1,000,000.00) in increments as specified in Appendix V.

XXIV. CONTRIBUTIONS

A. In accordance with the payment schedule prescribed in Section XXV, the Defendants shall contribute to the "Hazardous Substances Response Fund" created pursuant to C.R.S. §25-16-104.6 a total sum of Five Hundred Twenty-five Thousand Dollars ($525,000.00) to be paid in increments as specified in Appendix V. The amount due pursuant to this paragraph shall be reduced by Two Hundred Twenty-five Thousand Dollars ($225,000.00) as a credit for sums already paid by Defendants to Contractors for costs incurred in development of the joint groundwater investigation program. This credit is in addition to the credits recited in Paragraph XXII(A) of this Consent Decree.

B. Within 90 days following entry of this Consent Decree, Defendants shall convey to the State of Colorado, Department of Natural Resources, Colorado Natural Areas Program, in fee simple, certain mineral patents located in secs. 1, 2, 11, 12, and 13, T47N, R17W, N.M.P.M., all in Montrose County, Colorado. The State, through the Department of Natural Resources, shall convey said property for preservation as a natural area to The Nature Conservancy, a non-profit corporation organized for the purpose of preserving, protecting, and enhancing certain lands, waters, and other natural features as natural areas. Within 60 days

of the transfer to The Nature Conservancy and upon the Department of Natural Resources' acceptance of the Articles of Designation required under C.R.S. §36-10-108, the property shall be designated as a Colorado Natural Area pursuant to C.R.S. §36-10-108. The Defendants shall indemnify the State from all liability under the common law, doctrines of public nuisance, strict liability, toxic tort, and ultrahazardous activities, and all State and federal statutes and regulations, including CERCLA, which liability directly or indirectly arises out of, is related to, is connected with, or is attributed to Defendants' operations on, or discharges and/or releases from, to or through the subject land.

C. Defendants shall make an area of the Uravan Facility selected by the State which is within Defendants' ownership available to the State at no cost for disposal of some or all of the low-level radioactive waste materials located at the Denver Radium Site and the Colorado School of Mines, at any time during the ten (10) years following entry of this Consent Decree. Appendix VII, which is attached hereto and is by reference incorporated herein, lists the location of these sites. Management of those waste materials, including transportation, disposal, operation and maintenance, shall be at no cost to Defendants. As a precondition to allowing the disposal of such waste materials at the Uravan

Facility, Defendants shall only be entitled to: (i) receipt of written notice of the State's election to Defendants; (ii) an opportunity for consultation on the governmental plans for disposal of the waste and operation and maintenance of the resulting facility; (iii) receipt of all Requests for Proposal and an opportunity to bid on all work relating to such waste materials including the transportation and disposal of such waste materials, and the operation and maintenance of any resulting facilities; (iv) the execution of a Covenant Not to Sue Union Carbide Corporation and Umetco Minerals Corporation by the United States and the State in regard to the transportation and disposal of the named waste materials (but such Covenant Not to Sue shall not govern releases or discharges caused by an affirmative act or acts of Defendants, or either of them), and Defendants' acceptance of such a Covenant shall not be unreasonably withheld; and (v) indemnification for any liability related to such materials, except to the extent such liability is caused by or results from an affirmative act or acts of Defendants, or either of them. If such election by the State is made:

1. The State and/or such other entities as the State may designate shall, at their expense, design and conduct the construction, operation and maintenance of

a permanent disposal unit which will not allow the commingling of the radioactive wastes from the Denver Radium Site and Colorado School of Mines with the waste materials at the Uravan Facility. Such disposal unit shall meet or exceed the requirements of all applicable Colorado and federal statutes, rules, and regulations.

2. The State and such other entities as the State may designate shall, at their expense, transport and dispose of the radioactive wastes from the Denver Radium Site and Colorado School of Mines in accordance with applicable State and federal statutes, rules, and regulations.

3. The State shall not assess Defendants for the regulatory costs associated with any License amendment or part thereof or for the cost or any portion of the cost of any regulatory inspections or oversight which is attributable to the disposal of the radioactive wastes from the Denver Radium Site and Colorado School of Mines.

4. Disposal of the waste materials from Denver Radium Site and Colorado School of Mines shall be planned and accomplished in a manner and timeframe so as to avoid interference with operations of the Uravan Facility, or implementation of the remedial measures or schedules defined by the RAP. If interference does occur, the Defendants shall be entitled to a revision of the RAP to the extent that a revision is necessary on account of the interference. If agreement cannot be reached as to such revision, the Parties shall be subject to the dispute resolution provisions of Sections XIII and XIV of this Consent Decree.

D. Defendants shall convey to the Water Conservation Board, Department of Natural Resources, State of Colorado, within ninety (90) days of entry of this Consent Decree, the right of appropriation for power purposes decreed for The San Miguel River Ditch No. 222, in the amount of 240 c.f.s., priority No. 286 in Water District 60, decree dated October 22, 1926, with a historic date of appropriation of April 28, 1914.

E. In addition to the foregoing, in order to assure that present and future water users in the San Miguel River Basin are protected during the course of remedial activities, Defendants shall establish a trust consisting of surface and groundwater rights. This trust, which is created by the Uravan Water Trust agreement attached hereto as Appendix VI, and incorporated by reference herein, will be administered for the benefit of those lawful users of valid water rights on the San Miguel River System (including tributary groundwater) who, in the determination of the trustees, have demonstrated that the Defendants' operations, disposal practices or remedial activities at the Uravan Facility have created water quality conditions which materially impair the ability of those users to put those rights to their decreed use(s). Upon final termination of mill operations and completion of remedial activities, the Defendants will convey these water rights to the State.

F. Defendants shall join with the State in any necessary change of use proceeding as a coapplicant relating to the water rights described in the preceding Paragraphs D and E. If any of the water rights described in Appendix VII are subsequently judicially decreed abandoned or listed as abandoned by the Division Engineer for Water Division No. 4, Defendants shall employ reasonable efforts to have such decree or listing reconsidered or rescinded.

XXV. PAYMENT SCHEDULE

The sums to be paid by Defendants for response costs incurred by the State as described in Paragraph XXII(A), response costs to be incurred by the State as described in Paragraph XXII(B), natural resource damages as described in Section XXIII, and contributions as described in Section XXIV are to be paid by certified check made to the order of "Treasurer, State of Colorado" tendered to the Office of the Colorado Attorney General for distribution into the fund(s) designated in this Consent Decree. The total amounts and schedules for payment as described in those Sections recited hereinabove are as follows:

A. One Million Seventy-five Thousand Dollars ($1,075,000.00) to be paid on or before December 1, 1986, or thirty (30) days following the entry of this Consent Decree, whichever is later.

B. Six Hundred Thousand Dollars ($600,000.00) to be paid on or before December 1, 1987, less a credit of Four Hundred Fifty Thousand Dollars ($450,000.00).

C. Three Hundred Fifty Thousand Dollars ($350,000.00) to be paid on or before December 1, 1988.

D. Five Hundred Twenty-five Thousand Dollars ($525,000.00) to be paid on or before December 1, 1989.

E. Ninety Thousand Dollars ($90,000.00) to be paid on or before December 1, 1990.

F. Fifty-Thousand Dollars ($50,000.00) to be paid on or before December 1, 1991.

G. Fifty Thousand Dollars ($50,000.00) to be paid on or before December 1, 1992.

H. Ten Thousand Dollars ($10,000.00) to be paid on or before December 1, 1993.

XXVI. WORK RELATED COMMUNICATIONS AND NOTICES

A. The OSC shall notify each of the following agencies of his/her appointment as OSC and liaison role between these agencies and Defendants with respect to the Work at the Uravan Facility. Communications between each of these agencies listed herein and Defendants with respect to the Uravan Facility shall be made so as to include the OSC.

Office of Health Protection
Colorado Department of Health

Water Quality Control Division
Colorado Department of Health

Radiation Control Division
Colorado Department of Health

Air Quality Control Division
Colorado Department of Health

Wildlife Division
Colorado Department of Natural Resources

Mined Land Reclamation Division
Colorado Department of Natural Resources

Colorado Geological Survey
Colorado Department of Natural Resources

Board of Land Commissioners
Colorado Department of Natural Resources

Colorado Natural Areas Program
Colorado Department of Natural Resources

Division of Water Resources
Colorado Department of Natural Resources

Water Conservation Board
Colorado Department of Natural Resources

Bureau of Land Management
United States Department of Interior

United States Environmental Protection Agency

Mine Safety & Health Administration
United States Department of Labor

United States Department of Energy

United States Nuclear Regulatory Commission

and any other governmental agency which becomes involved pursuant to the provisions of Paragraph B of this Section.

B. Whenever Defendants receive a notice of an administrative action regarding environmental matters at the Uravan Facility which notice does not, on its face, indicate

delivery to the OSC, Defendants shall provide the OSC with a copy. The OSC shall contact the sending agency to notify it of his/her role pursuant to this Consent Decree.

C. Whenever, under the terms of this Consent Decree, notice is required to be given, notice shall be deemed complete upon mailing, as evidenced by postmark or date of hand delivery.

D. Nothing in this Consent Decree is intended to, or shall, preempt the notification requirements of any applicable Colorado or federal statute, regulation, license or permit.

E. Whenever, under the terms of this Consent Decree notice is required to be given, a report or other document is required to be forwarded by one Party to another, or service of any papers or process is required, it shall be directed to the following individuals at the addresses specified below until further written notice:

As to the State of Colorado.

(a) Office of the Colorado Attorney General
CERCLA Litigation Section
1560 Broadway, Suite 250
Denver, Colorado 80202

(b) Colorado Department of Health
Director, Radiation Control Division
4210 East 11th Avenue
Denver, Colorado 80220

(c) Uravan On-Site Coordinator
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220
(or other address as specified in writing)

As to the Defendants.

(a) Union Carbide Corporation
Law Department
Old Ridgebury Road
Danbury, Connecticut 06817
Attention: Carol L. Dudnick

(b) Holme Roberts & Owen
1700 Broadway, Suite 1800
Denver, Colorado 80290
Attention: Henry W. Ipsen

(c) Umetco Minerals Corporation
1600 Ute Avenue
P. O. Box 1029
Grand Junction, Colorado 81502
Attention: J. F. Frost

XXVII. AMENDMENTS TO THIS CONSENT DECREE

The Parties may jointly petition the Court for amendment of this Consent Decree. Absent agreement by and among the Parties, no disputed application for amendment of this Consent Decree shall be presented by the Parties or any of them to the Court for consideration unless such action is authorized under Section VII(B) and/or such application has been in the first instance presented to the Special Master for dispute resolution and his decision and recommendation has been received by the Court, or unless the Court's de novo consideration of an application for amendment is recommended

by the Special Master. No amendment to this Consent Decree (not including the RAP) shall be granted unless such amendment is reasonably necessary to effectuate the purposes of the negotiated settlement; or, to protect the public health and welfare or, unless performance of any requirement of this Consent Decree has been rendered impossible by any subsequently enacted, modified or promulgated federal or state law, regulation or permit. Any proposed amendment determined by the State to be major shall be submitted for the appropriate public comment prior to its entry as an order of the Court. Every amendment to this Consent Decree shall be in writing and approved by Court Order and shall have as its effective date the date on which such amendments are approved by the Court.

XXVIII. COMPLIANCE WITH APPLICABLE LAW

A. Defendants shall comply with all pertinent requirements of 40 C.F.R. Part 192, Subpart D as specified in Sections 4.2.2(9) and 5.4.3.2.2 and Figure 4.2.2-1 of the RAP.

B. For purposes of determining compliance with Paragraph A of this Section and the regulations referenced herein, the Court hereby finds that the concentration limits of hazardous constituents for groundwater protection as

required by 40 C.F.R. §192.32(a)(2) [as that Section incorporates 40 C.F.R. §§264.92, 264.93, 264.94] are those which are set out in Table 5.4.3.2-2 of the RAP.

C. For purposes of determining compliance with Paragraph A of this Section and the regulations referenced herein, the Court hereby finds that the compliance point described in and required by 40 C.F.R. §192.32(a)(2) [as that Section incorporates 40 C.F.R. §§264.92 and 264.95] is as defined in Paragraph 5.4.3.2.2(1) of the RAP.

D. Following State approval of design, construction and installation of evaporation ponds, as described in Paragraphs 4.2.2(9) and 5.1.1.2(4) of the RAP, any subsequent leak from the evaporation ponds shall not be used as evidence of an inadequate design, construction, or installation. However, nothing herein shall be construed to limit the State, where otherwise authorized by this Consent Decree, from undertaking appropriate corrective action, or to require the Defendants to undertake appropriate corrective action to prevent the migration of hazardous constituents or hazardous substances to adjacent subsurface soils or groundwater or surface water, or to ameliorate the consequences of such migration. Nothing herein shall be construed to limit the obligation of Defendants to pay stipulated penalties as described in Section XVIII in the event of a failure to undertake appropriate corrective action to stop or prevent the

migration of hazardous constituents or hazardous substances to adjacent subsurface soils or groundwater or surface water.

E. The Parties agree, and the Court hereby finds that the remedial action described in the RAP requires a level or standard of control for all hazardous substances or pollutants or contaminants which will attain all legally applicable or relevant and appropriate standards, requirements, criteria, or limitations, including standards, requirements, criteria and/or limitations under the following statutes, and regulations promulgated thereunder:

Clean Air Act, 42 U.S.C. §7401, et seq.

Federal Water Pollution Control Act, as amended by the Clean Water Act, 33 U.S.C. §1251, et seq.

Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act and the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. §6901, et seq.

Uranium Mill Tailings Radiation Control Act of 1978, Pub. L. No. 95-604, 92 Stat. 3021 (1978) (codified as amended at 42 U.S.C.§2014 and scattered sections thereafter and at 42 U.S.C. §7091-42)

Atomic Energy Act, 42 U.S.C. §2011, et seq.

Safe Drinking Water Act, 42 U.S.C. §§300f-300j-10, as amended by Pub. L. No. 99-339, 100 Stat. 642 (1986)

Toxic Substances Control Act, 15 U.S.C. §2601, et seq.

National Environmental Policy Act of 1969, 42 U.S.C. §4321, et seq.

Rivers and Harbors Appropriation Act of 1899, 33 U.S.C. §401, et seq.

Endangered Species Act of 1973, 16 U.S.C. §1531, et seq.

Fish and Wildlife Coordination Act, 16 U.S.C. §§661-666c

National Historic Preservation Act, 16 U.S.C. §470, et seq.

Hazardous Materials Transportation Act, 49 U.S.C. §1801, et seq.

Surface Management regulations under General Mining Laws, 43 C.F.R. Subpart 3809

Colorado Air Quality Control Act, Colo. Rev. Stat. §25-7-101, et seq.

Colorado Water Quality Control Act, Colo. Rev. Stat. §25-8-101, et seq.

Colorado Hazardous Waste Act, Colo. Rev. Stat. §25-15-101, et seq.

Colorado Radiation Control Act, Colo. Rev. Stat. §25-11-101, et seq.

Colorado Solid Wastes Disposal Act, Colo. Rev. Stat. §30-20-101, et seq.

Colorado Groundwater Management Act, Colo. Rev. Stat. §37-90-101, et seq.

Historical, Prehistorical, and Archaeological Resources, Colo. Rev. Stat. §§25-80-401 to -410

Colorado Mined Land Reclamation Act, Colo. Rev. Stat. §34-32-101, et seq.

F. The Parties acknowledge and the Court finds that the Consent Decree was lodged within thirty (30) days immediately following enactment of the Superfund Amendments and Reauthorization Act of 1986, Pub. L. 99-499, 100 Stat. 1613 (SARA). The Court finds that, if the provisions of Section 121 of CERCLA, as added by

Section 121(a) of SARA, are applicable to this Consent Decree, then the provisions of Section 121(b)(2) of SARA are also applicable to this Consent Decree. To the extent Section 121 of CERCLA is applicable to this Consent Decree, the remedial action to be undertaken by Defendants pursuant to the provisions of the Consent Decree and RAP shall comply to the maximum extent practicable with the cleanup standards of Section 121 of CERCLA, to the extent such standards are legally applicable or relevant and appropriate under the circumstances presented by any release or threatened release from the Uravan Facility.

G. The Parties agree and the Court finds that the provisions of Section 121(b)(1)(A)-(G) of CERCLA, as added by Section 121(a) of SARA, were taken into account in the assessment of alternative remedial actions which preceded the selection of the remedial action prescribed in the RAP. The Court further finds that the remedial action selected will attain a degree of cleanup of hazardous substances, pollutants and contaminants at or released from the Uravan Facility which assures protection of human health and the environment.

H. The Parties agree and the Court hereby finds that, in the context of presently existing technologies and their costs and availability, the remedial action described in the RAP is designed to limit radiation exposures to a level which is as low as is reasonably achievable.

XXIX. EFFECT OF SUBSEQUENTLY ENACTED OR PROMULGATED STATUTES OR REGULATIONS

A. Any reference to a statute or regulation which is made in this Consent Decree is to said statute or regulation in effect as of the date of entry of this Consent Decree.

B. In the event that any Party asserts that a subsequent enactment, amendment, or promulgation of any federal or state statute or regulation is applicable and if any Party determines that such statute or regulation may directly or indirectly impose an obligation which differs from or is inconsistent with any obligation imposed by this Consent Decree or RAP, any Party may seek appropriate modification of any Party's obligation(s) pursuant to Sections VII and/or XXVII. Any modification requested pursuant to this Section shall be subject to the dispute resolution provisions of Sections XIII and XIV.

C. In the event any Party seeks a modification of the RAP or amendment of the Consent Decree, pursuant to Paragraph B of this Section, Defendants shall proceed in compliance with the RAP, but may seek a stay of any obligation under the Consent Decree or RAP affected by or relating to the requested modification, provided, however, that no stay shall

be granted unless Defendants establish that their failure to perform any scheduled obligation will not pose an imminent and substantial endangerment to the public health, welfare or environment.

XXX. CERCLA AND THE NATIONAL CONTINGENCY PLAN

A. The Court finds that the site investigation and analysis of remedial alternatives undertaken by the Parties has complied with and is consistent with the requirements of 40 C.F.R. §§300.68 and 300.71(a)(2)(A) of the NCP.

B. The Court finds that the scoping of response actions during the remedial investigation and development and initial screening of alternatives, detailed analysis of alternatives, and selection of remedy has complied and is consistent with the requirements of 40 C.F.R. §§300.68 and 300.71(a)(2)(B).

C. The Court finds that the Remedial Action provided for in the RAP and Consent Decree is the "appropriate extent of remedy" as defined and required by 40 C.F.R. §§300.68(i)(1) and 300.71(a)(2)(ii)(C).

D. The Court finds that the response costs expended or to be expended by the State and/or Defendants at or relating to the Uravan Facility are recoverable under CERCLA as amended and are consistent with, and are not inconsistent with, the NCP.

E. The Court finds that all actions taken or omitted by Response Action Contractors as defined in §119(e) of CERCLA, as added by Section 119 of SARA, pursuant to the RAP or Final Submittals are to be afforded the protection provided in §119(a) of CERCLA, as added by Section 119 of SARA. For purposes of this paragraph (E), the term "Response Action Contractor" specifically excludes the Defendants unless the Defendants, or either of them, act as a Response Action Contractor for purposes of Paragraph XXIV(C) of this Consent Decree.

XXXI. NATIONAL PRIORITIES LIST

Upon successful completion of the Work, the State agrees to use its best efforts to obtain deletion of the Uravan Facility from the National Priorities List.

XXXII. USE OF DECREE

This Consent Decree has been negotiated and executed by the State and Defendants in good faith to avoid further expensive and protracted litigation and to assure the protection of the public health, welfare and the environment at and near the Uravan Facility. This Consent Decree is a settlement of claims which were vigorously contested, denied and disputed as to validity and amount. Execution of this Consent Decree is not an admission of liability or fault as to

any issue which has been or could have been raised in this litigation. Except as provided in Section XVIII herein, the payments and contributions made herein by Defendants are not and do not constitute penalties, fines, or monetary sanctions of any kind.

XXXIII. TERMINATION

A. When Defendants believe that their obligations under this Consent Decree have been satisfied and that the Work has been completed, they shall petition this Court for termination of this Consent Decree, which shall then terminate, subject to the exceptions stated below, one hundred eighty (180) days thereafter unless the State objects within that period of time. Any such objection shall be subject to the dispute resolution provisions of Sections XIII and XIV.

B. Termination of this Consent Decree shall not affect the provisions of IV(G), XII(G), XIX, XX, XXI and XXIV(C); provided however, that the provisions of Paragraph XIX(B)(8) shall terminate with respect to those areas or sites within the Uravan Facility which are transferred to the United States or to the State pursuant to the provisions of the Uranium Mill Tailing Radiation Control Act of 1978, PL 95-604, 92 Stat. 3021 (1978), and regulations promulgated thereunder.

XXXIV. RETENTION OF JURISDICTION

Subject to the provisions of Section XXXIII, this Court shall retain jurisdiction over the Parties and this Consent Decree for purposes of ensuring compliance with its terms and provisions, to consider amendments under Section XXVII, and to adjudicate disputes as provided in Section XIV of this Consent Decree.

XXXV. EFFECTIVE DATES

This Consent Decree, together with all appendices, is to be submitted for public comment immediately upon execution by the Parties in accordance with the State's Community Relations Plan. This Consent Decree shall not become effective until a thirty (30) day comment period expires, all comments received have been duly considered by the Parties and jointly submitted to the Court together with responses and/or mutually agreed amendments to this Consent Decree, RAP, and License. This Consent Decree shall become effective upon the date of its entry by the Court; provided, however, that if the State elects to effect a major modification to the License pursuant to any public comment submitted during the thirty-day comment period provided for in this Section, Defendants shall have the right to withdraw from this Consent Decree.

THE PARTIES HERETO ENTER INTO THIS FINAL CONSENT DECREE, ORDER, JUDGMENT AND REFERENCE TO SPECIAL MASTER, AND SUBMIT IT TO THE COURT FOR ITS APPROVAL.

DATED this 19th day of December 1986.

FOR THE PLAINTIFF:

RICHARD D. LAMM
Governor, State of Colorado

THOMAS VERNON, M.D.
Executive Director,
Colorado Department of Health

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Union Carbide Corporation

FRANK V. McMILLEN
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(12/19/86)

ORDER, JUDGMENT AND REFERENCE TO SPECIAL MASTER

THIS MATTER having come before the Court upon the Parties' request for entry of this Consent Decree, and the Court having fully reviewed this matter, the public comments submitted, and the Parties' responses thereto, it is hereby

FOUND that the terms and provisions of this Consent Decree in their entirety, and all documents appended hereto which are incorporated by reference in this Consent Decree, represent a fair, reasonable, and equitable settlement of all matters which have been raised between the Parties to this litigation, including all matters pertaining to Radioactive Materials License 660-02S; and it is therefore

ORDERED that the foregoing CONSENT DECREE together with all Appendices and all their terms and conditions are adopted by the Court and made an Order, and Judgment of this Court and disputes are referred to the Special Master of this Court as further detailed herein.

DONE this 23 day of Feb., 1987, NUNC PRO TUNC TO Feb. 12, 1987

BY THE COURT:

Jim R. Carrigan
United States District Judge
For the District of Colorado

I, the undersigned, Clerk of the United States District Court for the District of Colorado, do certify that the foregoing is a true and correct copy of the original thereof.
23 February 1987
By Deputy

UNITED STATES DISTRICT COURT
DISTRICT OF COLORADO

JAMES R. MANSPEAKER, CLERK
C-145 U.S. Courthouse
1929 Stout Street
Denver, Colorado 80294
(303) 844-3433

Date: February 23, 1987 Case No.: 83-C-2384

The undersigned hereby certifies that on the above date a copy of Finald Consent Decree, Order, Judgment and Reference to Special Master signed by Jim R. Carrigan, Judge on Feb. 23, 1987 was mailed to the following:
nunc pro tunc Feb. 12, 1987

Howard Kenison, Esq
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HAND DELIVERED TO COUNSEL.

James R. Manspeaker, Clerk

By: _____
Deputy Clerk

APPENDIX I

REMEDIAL ACTION PLAN

State of Colorado vs.
Union Carbide Corporation and
Umetco Minerals Corporation
83-C-2384

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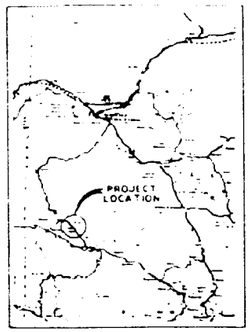
1.0 INTRODUCTION

1.1 BACKGROUND

The existing Union Carbide Corporation/Umetco Minerals Corporation (UCC/Umetco) Uravan Facility is located on the valley floor of the San Miguel River and on two benches of Club Mesa to the west of the San Miguel River canyon, approximately fifty (50) miles southwest of Grand Junction along State Highway 141 (Figure 1.1-1). Since UCC/Umetco began operations at the Uravan Facility, the mill has processed over ten million tons of uranium-vanadium ore. During this time, operations have produced in excess of ten million tons of tailings, millions of gallons of waste liquid raffinate, raffinate crystal residue (primarily hydrated ammonium sulfate), and other milling wastes containing radioactive materials (uranium, radium, thorium), metals (selenium, aluminum, arsenic, cadmium, zinc and others) and other inorganic contaminants (ammonia, nitrate, sulfates and others). Table 1.1-1 shows the chemical composition of the solid waste materials and Table 1.1-2 shows the chemical composition of the liquid waste at Uravan.

Since approximately the 1950's, aspects of the Uravan operations have been partially regulated by federal and State government permits and licenses. Additionally, until 1970, Union Carbide produced uranium pursuant to contracts with the United



VICINITY MAP

TOWN DUMP

ATKINSON CREEK

ATKINSON CREEK CRYSTAL DISPOSAL AREA

CLUB RANCH PONDS AREA

HIGHWAY 141

SAN MIGUEL RIVER

TOWN

N

CONTOUR INTERVAL 2 feet

BONE YARD

RIVER PONDS AREA

ELK CLAIM SITE

PROPOSED BORROW AREA

TAILINGS PILE 2

TAILINGS PILE 1

"A" PLANT

MAJOR SEEP LOCATIONS

"B" PLANT

EXISTING CLAYEY TOCKPILE

CLUB MESA SPRAY AREA

ORE STORAGE PILE
BARREL STORAGE PILE
HEAP LEACH SITE

NEUTRALIZED SLUDGE

TAILINGS PILE 3

STORAGE PONDS

HIEROGLYPHIC CANYON

CHEN AND ASSOCIATES, INC

RECLAMATION OF EXISTING FACILITIES
URAVAN MILL

Fig. 1.1-1

TABLE 1.1-1 CHEMICAL COMPOSITION OF SOLID URAVAN WASTE MATERIAL

		Tailings Pond 2		Tailings Pond 3				
PARAMETER, mg/kg	NEUTRALIZATION POND SLUDGE STNO1	SLIMES STT02A	BEACH STT02B	SLIMES STT03C	BEACH AVE STT3A,B	SPRAY AREA 2 CRYSTALS	SPRAY AREA 4 CRYSTALS	SPRAY AREA 8 CRYSTALS
Al	51800	1470	406	2270	301	50700	50100	30000
As	360	51	39	83	15.5	180	112	470
Ba	52	241	222	235	141	8.4	1.1	13
B	<2	1.8	0.5	<2	0.85	<0.4	<0.4	<2
Cd	27	5.2	3	4	2.25	2.1	0.9	9
Ca	140000	39300	6100	72500	2545	11300	2620	30200
Cr	<2.5	<0.5	<0.5	<2.5	<0.5	55	62	<2.5
Co	46	2.3	1.1	6	0.45	1.4	0.4	9
Cu	383	30	178	29	14	49	19	249
Fe	32100	1560	1080	2800	538	18900	8790	88700
Pb	52	259	142	264	108	14	<2.5	91
Mg	14000	1700	260	2970	97	173	139	1330
Mn	620	34	14	66	<0.5	5.4	<0.5	46
Mo	33	81	31	144	32.5	58	43	125
Ni	450	12	4	18	<1	<1	<1	15
P	1180	93	<6	<30	<6	330	62	1450
K	2330	850	290	1130	295	8120	6030	22800
Ag	4	3.3	1.3	6	0.85	1.2	0.3	4
Na	10500	530	92	800	40.5	162	92	300
SR	148	141	34	261	23.5	80	16	250
Ti	71	235	64	520	75	49	25	130
V	1200	831	235	1490	193.5	529	145	1750
Zn	931	134	199	92	88.5	9.2	3.4	69

TABLE 1.1-1 cont.

	Tailings Pond 2			Tailings Pond 3				
PARAMETER, mg/kg	NEUTRALIZATION POND SLUDGE STNO1	SLIMES STT02A	BEACH STT02B	SLIMES STT03C	BEACH AVE STT3A,B	SPRAY AREA 2 CRYSTALS	SPRAY AREA 4 CRYSTALS	SPRAY AREA 8 CRYSTALS
SO_4						180000	410000	330000
Cl						--	27	84
NH_3						8800	9300	6200
NO_3						0.6	6	0.6
NCO_3 + CO_3						ND	ND	ND
Gross alpha, pci/g	1080	3200	1320	4600	830	520	120	1040
Gross beta, pci/g	360	3000	1050	4400	620	290	100	560
Th-230, pci/g	890							
U-nat, pci/g	22	21	45	73	64	1.6	1.9	4.7

Data from ERI 1986 Baseline Study

TABLE 1.1-2 CHEMICAL COMPOSITION OF URAVAN LIQUID WASTE AND CONTAMINATED GROUNDWATER

PARAMETERS	RAFFINATE 1974-1980[1]	RAFFINATE 1984[2]	CLUB RANCH PONDS 1972-1974[3]	CLUB RANCH PONDS 1974-1980[4]	CLUB RANCH PONDS 1984[2]	PRECIPITATES @ CR PONDS 1986[5]	ATKINSON CREEK @ CR PONDS 1986[6]	CLUB RANCH DITCH 1986[7]	CLUB RANCH WELL #9 1978[8]	CLUB RANCH WELL #10 1978[9]	CLUB RANCH WELL #5 25' 1984[2]	CLUB RANCH WELL #2A 56' 1984[2]	CLUB RANCH WELL #2 100' 1984[2]
METALS, mg/l													
Al	5611		2893	4806		17320	2.87	564	1.0	4200			
As	25			45		63	<0.05	0.8	<1.0	<1.0			
Ba		<0.2			0.2	34.2	0.07	<0.01	0.10	0.07			
B						2.6	0.168	0.19					
Cd		2.8			7.0	10.5	0.008	0.51	0.4	4.8			
Ca	546		674	623		14113	79.7	82.9	640	660	475	395	439
Cr		21			4.0	6.0	<0.005	0.17	0.14	38			
Co						35.9	0.016	1.16					
Cu	21		30.8	44.5		168	0.097	4.33	0.13	57			
F		410			190				46	2			
Fe	3183		4008	4465		8037	0.12	15.1	0.38	230	56.4	0.33	10.8
Pb		1.3			1.1	32.7	<0.25	<0.05	0.68	2.3			
Mg	6722		7291	10932		51051	133	1500	6600	15800	3600	1806	1808
Hg			0.17	<0.095									
Mn	131		145.8	246.5		964	0.96	44.8	119	350	186	17.2	5.53
Mo		0.019			5.5	18	<0.005	<0.01					
Ni						17.9	0.12	7.2					
P						397	<0.3	2.3					
K		910			1100	2507	14.2	12.3	272	480	67.7	238	368
Ag		0.076			0.091	1.5	<0.003	<0.006	0.05	0.11			
Na	2747		1958	4747		18153	102	610	2050	5650	3540	768	753
Se		1.8			7.7				<0.1	0.2	2.62	0.39	<0.01
SR						57	2	0.43					
Ti						36	<0.002	<0.004					
V			82			244	0.003	0.43	<0.02	21			
Zn	141	0.19	5803	230	300	630	0.231	20.2	21	174	81.9	3.08	0.32
MACRO CHEMISTRY, mg/l													
TDS	114536		93099	141949					45626	153028			
pH	2.1-3.1		2.19	1.7-3.3		~2			6.51	3.48			
SO_4	82008		62851	100343		375000			32301	76249	49660	15940	16760
Cl	2455		2236	4633		10919			1700	7863	3400	1260	1630
NH_3	2625		6436	4015		15895			57	145	2390	1220	2030
NO_3	724		939	807							140	27	10
NCO_3 + CO_3									2000	<1.0	<1.0	1590	2180
RADIOLOGICALS, pCi/l													
Ra-226	678	66		631	270				54.47	45.96	2.6	0.49	0.4
Th-230	114000	35300		165000	16200	148			3.0	1152	115	6.5	9.3
U-nat	4750	1500		8780	16000	30.6			961	11.170	2700	530	530
Pb-210		3530			1340						8.2	2.8	2.6
Po-210		44			1250								
Gross Alpha						344							
Gross Beta						245							

[1] International Engineering Company, 1982. Average of data collected between 12/31/74 and 1/8/80.
[2] UCC, Annual Environmental Monitoring Data Review, 1985. Fresh Raffinate, Sampled 6/6/84.
[3] Jones, Environmental Operating and Reporting Requirements, 12/1/78. Club Ranch Pond Liquid, average of data from six ponds collected between March, 1972 and December, 1974.
[4] International Engineering Company, 1982. Average of data for six ponds collected between 12/31/74 and 1/8/80.
[5] ERI Logan, 1986. Average of 11 precipitate samples taken adjacent to or on six Club Ranch Ponds, January, 1986. Sample sites STR01-10.
[6] ERI Logan, 1986. Single grab sample. Atkinson Creek flowing only adjacent to Club Ranch Ponds, January 1986. Sample site AAC01.
[7] ERI Logan, 1986. Single grab sample. Flowing ditch adjacent to Pond 5, January, 1986. Sample site SAR01.
[8] Dames and Moore, 1978. Monitor well between road and Club Ranch Ponds.
[9] Dames and Moore, 1978. Monitor well between Club Ranch Ponds and San Miguel River.

States. Mining, milling and waste disposal practices have resulted in:

- Wind and surface water dispersal of the tailings materials and the uncontrolled release of radon from the Tailings Piles.
- Seepage of contaminated liquids into soils and groundwater from several areas in the mill complex and waste disposal areas.
- Concentrations of large quantities of wastes in locations which pose a risk to public health and the environment, based on considerations of the potential for release of hazardous materials to the environment.

The impact of Uravan operations on the natural resources of the State of Colorado (State) precipitated the filing of Civil Action 83-C-2384 against UCC/Umetco by the State. The State and UCC/Umetco subsequently assigned representatives to attempt to develop an agreement regarding remedial actions at Uravan. The joint group developed a Remedial Action Plan (RAP) on the basis of (1) a review and reassessment of previous reclamation and other studies performed for UCC/Umetco and reviewed by the State, and (2) analysis of additional data from recent field work.

Remedial activities pertaining to removal of contaminated solids from certain discrete areas on the site and to the tailings disposal areas are substantially based upon previous UCC/Umetco commitments in the 1984 Colorado Radioactive Materials Licensing proceedings. Additional action requirements pertain

to: (a) contaminated solids on Club Mesa and in the town of Uravan and adjacent areas, a borrow area on Club Mesa, and the Burbank Quarry, an area designated to be a permanent raffinate crystal repository; and (b) contaminated liquids, including hillside and toe berm seepage, tailings liquids and groundwater.

This document presents the developed Remedial Action Plan (RAP) for cleanup and reclamation of the Uravan Facility.

1.2 SCOPE

The scope of this RAP is to describe the remedial activities to be conducted by UCC/Umetco. The remedial activities must comply with the State's prescribed permitting, inspection, monitoring and certification requirements. This RAP does not include Final Plans and Specifications, which will be developed by UCC/Umetco and submitted to the State for approval prior to construction.

The following major areas (Figure 1.1-1) which contain contaminated solids shall be subject to remedial action:

- ATKINSON CREEK CRYSTAL DISPOSAL AREA: This is a covered, unlined repository containing raffinate crystals, adjacent to Colorado Highway No. 141.

- CLUB RANCH PONDS: These are six (6) unlined evaporation ponds containing primarily raffinate

crystals and ponded liquids located adjacent to and above the San Miguel River.

- RIVER PONDS: These are seven (7) settling ponds, containing settled solids and tailings, constructed adjacent to the San Miguel River.

- TAILINGS PILES: These are three (3) Tailings Piles containing over 10,000,000 tons of tailings located on Club Mesa.

- CLUB MESA AREA: This area includes two (2) clay-lined storage ponds, a neutralized sludge storage area, an area which was used for the spray evaporation of raffinate liquid and an adjacent area of soils contaminated by spray from the evaporation procedure.

- MILL AREAS: These areas consist of the A- and B- Plant areas, an ore stockpile area, a barrel storage area, a heap leach site, a yard (bone yard) for scrap equipment, and adjacent contaminated materials.

- TOWN AND ADJACENT AREAS: These areas consist of the Uravan town, town dump, adjacent drainageways (Atkinson Creek, San Miguel River, Hieroglyphic Canyon, and dry washes) and remnant waste materials previously used in near-site construction activities.

Ancillary areas which will be impacted by the remedial activities include:

- THE BURBANK QUARRY: This is a borrow pit for rock and random fill to be used during cleanup and reclamation activities, and is the designated final repository site for raffinate crystals.

- BORROW AREA ON CLUB MESA: This is the primary borrow source for clayey soils and random fill.

The cleanup and disposal of contaminated liquids shall also be subject to remedial actions. Contaminated liquids subject to remedial actions include tailings seepage (hillside and toe

berm), tailings dewatering liquids, ponded liquids, surface runoff, and groundwater.

The description of remedial activities includes:

- A brief discussion of UCC/Umetco's operations at each contaminated area and observed impacts on the environment.
- A description of remedial activities and cleanup criteria. Remedial activities include cleanup and reclamation of affected areas where applicable.
- A description of requisite assessments and engineering activities.
- Schedule for implementation of the RAP.
- Requisite quality control/quality assurance (QC/QA), monitoring, performance evaluation and inspection.

In accordance with the schedule in this RAP, UCC/Umetco shall provide prior to construction Final Plans and Specifications for all remedial activities and a Quality Control/Quality Assurance, Monitoring and Performance Evaluation Plan for approval by the State. The State will develop an Inspection and Certification Plan for remedial activities at Uravan. UCC/Umetco shall perform all remedial activities in accordance with the plans, specifications and procedures prescribed by these documents. Where the RAP is silent on specific matters routinely addressed by applicable licenses and permits, implementation will be according to the licenses and permits. However, the terms and conditions of such licenses and

permits shall be consistent with the provisions of the RAP.

Immediately after UCC/Umetco completes remedial activities at each area, UCC/Umetco shall prepare and submit to the State a Final Construction Report. This document shall include as-built drawings, quality control surveys and test results, and construction surveillance information. State approval of the Final Construction Report for a given area shall signify completion of construction activities in accordance with Approved Final Plans and Specifications.

Prior to termination of the Consent Decree, UCC/Umetco shall prepare and submit to the State a Certification Report. The Certification Report shall contain an explanation and assessment of cleanup and reclamation activities conducted in accordance with the provisions of the RAP and with statutes, rules and regulations, licenses and permits rendered applicable under the RAP or Consent Decree. State approval of the Certification Report shall signify UCC/Umetco's completion of remedial activities in accordance with the RAP and Consent Decree, and statutes, rules and regulatory licenses, and permits rendered applicable under RAP or Consent Decree.

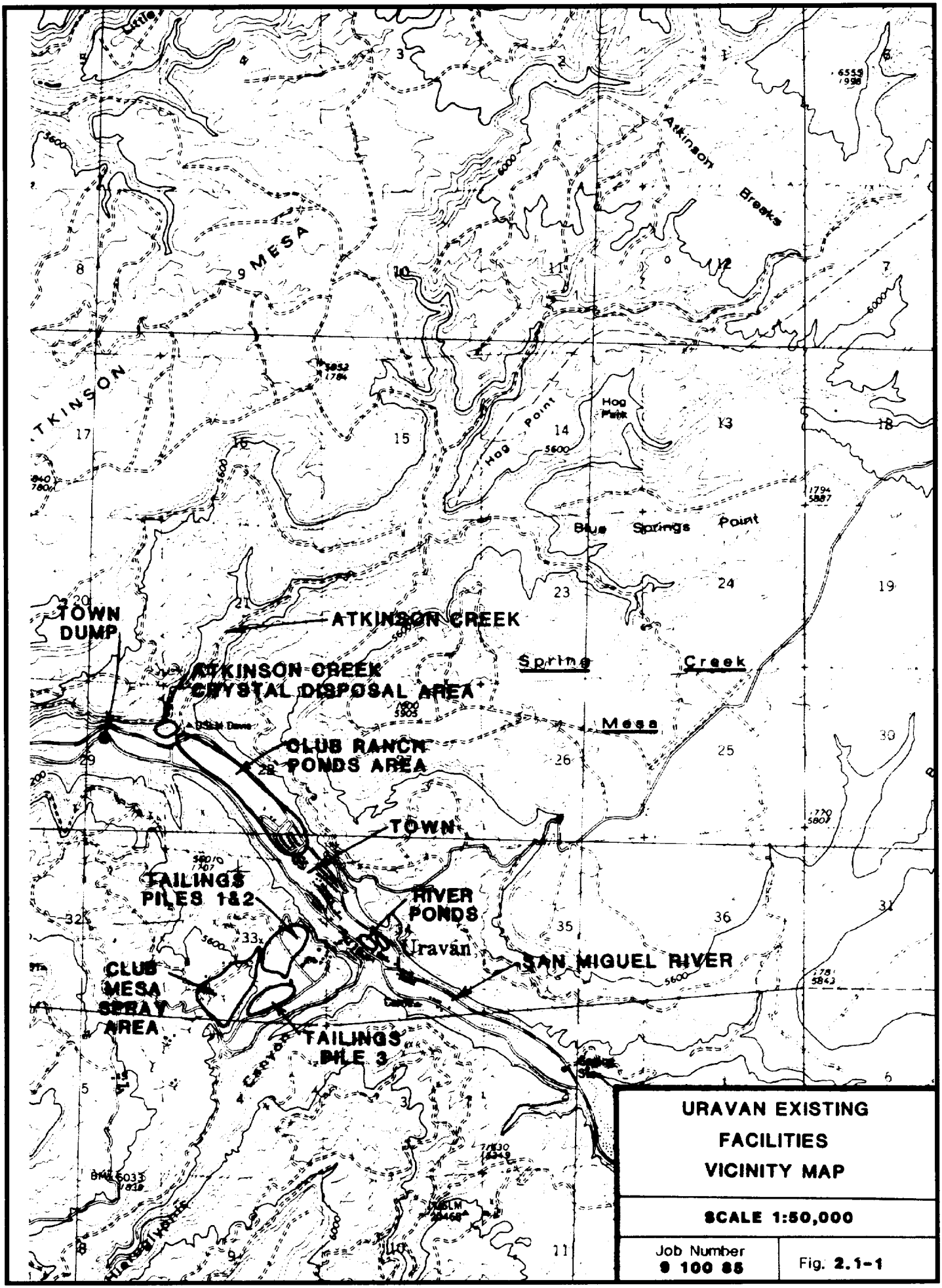
2.0 REGIONAL SETTING

2.1 PHYSIOGRAPHY

The existing UCC/Umetco Uravan Facility is located in the Club Mesa area to the west of the San Miguel River Canyon and along the river canyon floor as shown on the vicinity map on Figure 2.1-1.

Uravan is in the eastern part of the Canyonland section of the Colorado Plateau Physiographic Province (See Figure 2.1-2). The topography of this region is primarily canyons and mesas. This landscape is the result of downcutting of the principal streams which drain the region and accompanying lateral cliff retreat along the canyon rims. Resistant sandstone units which cap the mesas in the Uravan area are the Dakota and Burro Canyon formations and the Salt Wash member of the Morrison Formation. Principal streams in the immediate area of Uravan have formed the mesa and canyon topography and include the San Miguel River, Spring Creek, Atkinson Creek, and Tabeguache Creek.

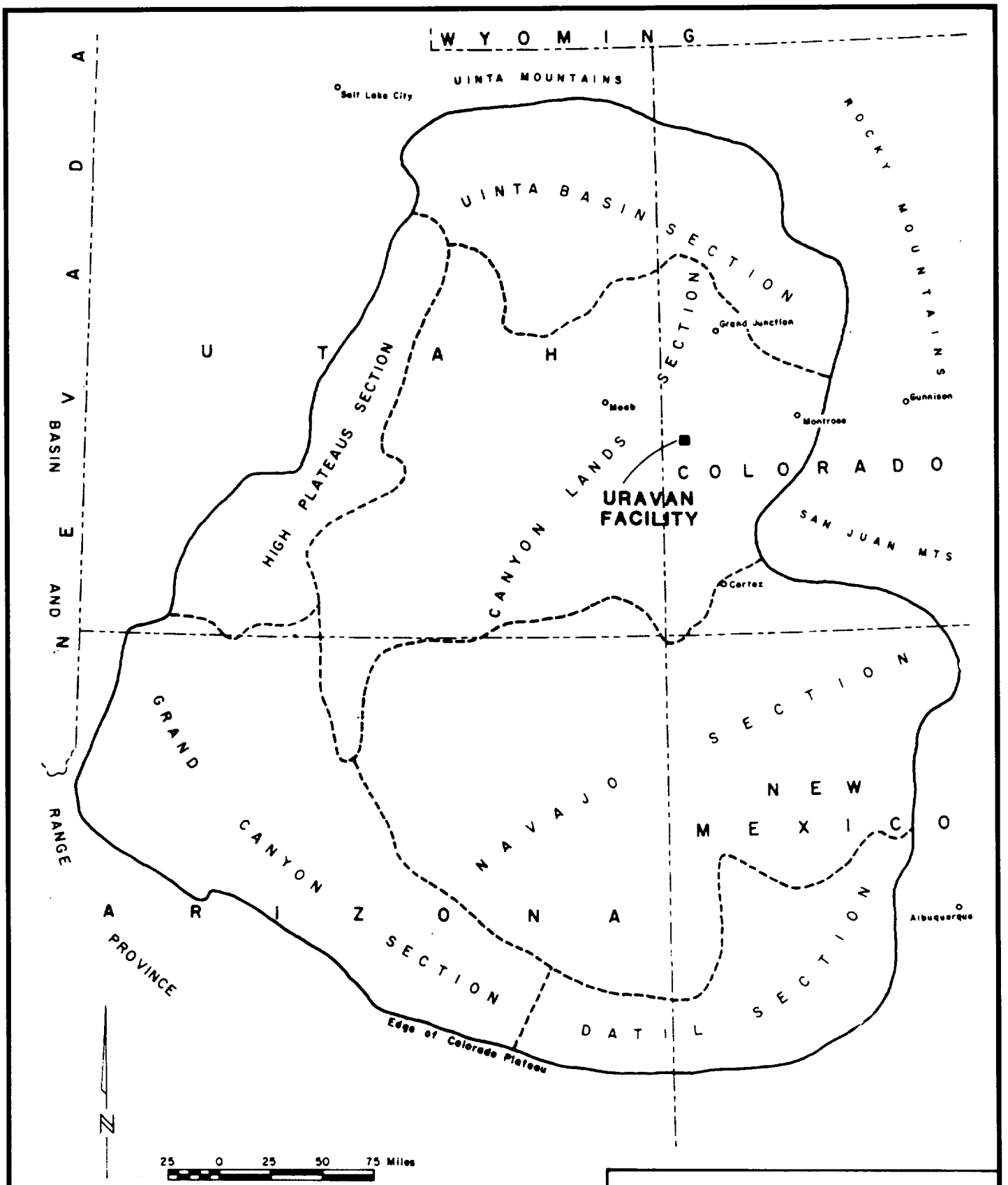
Geomorphic processes that have led to the present day landscape started as the result of regional uplift during the Miocene or Pliocene ages, about 10 to 25 million years ago. River downcutting has resulted in local relief between the San



URAVAN EXISTING FACILITIES VICINITY MAP

SCALE 1:50,000

Job Number	Fig.
9 100 85	**2.1-1**



SOURCE: HUNT (1956), modified

COLORADO PLATEAU
PHYSIOGRAPHIC PROVINCE

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Fig. 2.1-2

Miguel River and the bordering mesas of about 900 feet. Downcutting has been more or less continuous. However, several episodes of river aggradation, associated with Quaternary glacial periods, have also occurred, but have been relatively minor and short-lived in comparison with continued river downcutting.

2.2 METEOROLOGY

Meteorological conditions in the Uravan area are described in detail in Section 2.7 of the Environmental Report by Dames and Moore (1978) and in Section 2.8 of the Report by Gibbs and Hill (1982). Additionally, weather observations at Uravan have been performed by UCC/Umetco personnel since August 1972. Data records include daily maximum and minimum temperatures, daily precipitation, and continuous records of wind direction and wind speed. These records and data may be consulted if additional detail is needed.

The monthly mean and extreme temperatures recorded at Uravan are indicated in Table 2.7-1 of the report by Dames and Moore (1978). The annual mean temperature during the period of record was 52.2°F (11.2°C). The annual mean maximum temperature at Uravan was 68.4°F (20.2°C) and the annual mean minimum was 36.1°F (2.30°C). Extreme temperatures recorded at Uravan during the period of record show a minimum of -10°F (-23.3°C) which occurred in January 1974 and a record maximum of 106°F (41.1°C) which occurred in July 1976.

Annual and monthly mean and monthly and daily extreme precipitation values from Uravan are listed in Table 2.7-2 of the report by Dames and Moore (1978). The annual average total

precipitation received at Uravan from 1973 through 1977 was 10.1 in. (25.6 cm). An annual maximum of 12.2 in. (31.1 cm) of precipitation was recorded in 1975, and an annual minimum of 8.0 in. (20.4 cm) was recorded in 1976. The maximum monthly precipitation recorded at Uravan was observed in October 1972 when 5.9 in. (14.9 cm) of precipitation was recorded, and the minimum monthly precipitation was received in June 1974 when only 0.03 in. (0.07 cm) was recorded. During the period of record, the greatest single daily precipitation amount was 1.25 in. (3.2 cm), occurring on July 24, 1977.

Winds at Uravan are strongly influenced by the San Miguel River Valley. The highest frequency wind directions generally parallel the river valley and are from the southeast. Winds from this general quadrant were observed 59 percent of the time during the period of record (Dames and Moore, 1978). These winds represent the drainage flow of air that occurs generally during the night and early morning hours. Winds flowing up the river valley from the northwest were observed 24.9 percent of the time. These winds generally occur during the late morning and afternoon or after a frontal passage. The annual mean wind speed is approximately 4.4 mph (1.95 m/s).

Studies in the Uravan area have shown the net evaporation rate for the entire year to be approximately two (2) gallons per

minute per acre (gpm/acre) or approximately 36 inches per year (91 cm/year).

Severe weather in the area is usually in the form of intense rainfall or hail, both resulting from thunderstorms. The ten-year storm is estimated to be 1.3 to 1.5 inches of rainfall within six hours and the 100-year storm consists of 2.9 to 3.3 inches of rainfall within 24 hours (Gibbs and Hill, 1978, Table 2.8-5). The thunderstorm season occurs during late spring and summer. Probable maximum precipitation (PMP) for a local six-hour event is estimated to be 9.7 inches. Strong winds and hailstorms may accompany thunderstorm activity.

2.3 REGIONAL GEOLOGY

Regional geology and geologic history of the Uravan area are described in detail by Dames and Moore (1978), International Engineering Company, Inc. (1981) and Chen & Associates, Inc. (1983). These reports may be consulted if more detailed information is desired than is presented in the following summary.

Stratigraphy: About 18,400 feet of relatively flat-lying Paleozoic and Mesozoic-age sedimentary rocks underlie the Uravan area. A stratigraphic column of the formations present at Uravan is shown on Figure 2.3-1. This sedimentary section consists of

Age	Stratigraphic Unit	Thick. (ft.)	Characteristics
JURASSIC	Morrison Formation	±400	MORRISON FORMATION, BRUSHY BASIN MEMBER: Clay (bentonitic) shale with some interbedded sandstone and conglomerate lenses. Some thin limestone beds. White, gray, rusty-red and buff sandstone and varigated shale.
		±300	MORRISON FORMATION, SALT WASH SANDSTONE MEMBER: Predominantly sandstone with some interbedded shale. Colors as above.
	San Rafael Group	80-100	SUMMERVILLE FORMATION: Thin-bedded mudstone and shale. Red, gray, green and brown.
		80-110	ENTRADA SANDSTONE/CARMEL FORMATION: Fine-grained, massive, crossbedded sandstone, orange, buff and white underlain by sandstone and mudstone, red.
MESOZOIC		10-30	NAVAJO SANDSTONE: Discontinuous outlier lenses of fine-grained, crossbedded sandstone. Buff and gray.
	Glen Canyon Group	±180	KAYENTA FORMATION: Irregularly bedded shale, siltstone, and fine to coarse-grained sandstone, red, buff, gray and lavender.
		±200	WINGATE SANDATONE: Massive, crossbedded, thick-bedded, fine-grained sandstone, reddish brown.
TRIASSIC		±800	CHINLE FORMATION: Silstone with interbedded lenses of sandstone, shale, and limestone-pebble, clay-pellet conglomerate, lenses of quartz-pebble conglomerate at base, reddish color.
		350-800	MOENKOPI FORMATION: Upper Unit: ripple-bedded shale. Middle Unit: arkosic sandstone and conglomerate. Lower Unit: indistinctly-bedded mudstone. Gypsum occurs in seams and veins and in beds near base, brown.

Age	Stratigraphic Unit	Thick. (ft.)	Characteristics
PERMIAN			MOENKOPI FORMATION (continued).
		8000 - 10,000	CUTLER FORMATION: Mostly arkosic conglomerate and sandstone, some sandy mudstone and limestone, maroon, red, and purple.
PALEOZOIC		±2000	HERMOSA FORMATION, LIMESTONE MEMBER: Fossiliferous thick-bedded limestone with beds of shale and minor arkose, gray.
PENNSYLVANIAN		2500-4800	HERMOSA FORMATION, PARADOX MEMBER: Interbedded gypsum, anhydrite, halite, limestone, sandstone an shale, white, gray and dark gray.
M,D,C		±1000	OLDER PALEOZOIC ROCKS: Sandstone, limestone and dolomite.
PC			PRECAMBRIAN CRYSTALLINE ROCK

NOTES:

1. M - Mississippian
2. D - Devonian
3. C - Cambrian
4. PC - Pre-Cambrian

URAVAN AREA
REGIONAL
STRATIGRAPHY

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Fig. 2.3-1

about 1,700 feet of Mesozoic rock which is primarily comprised of sandstone, mudstone and shale of continental origins. The Mesozoic rocks are underlain by about 16,700 feet of Paleozoic rocks consisting of nonmarine sandstones and marine carbonates, evaporites and shales. This thick sedimentary section rests on Precambrian-age crystalline rocks.

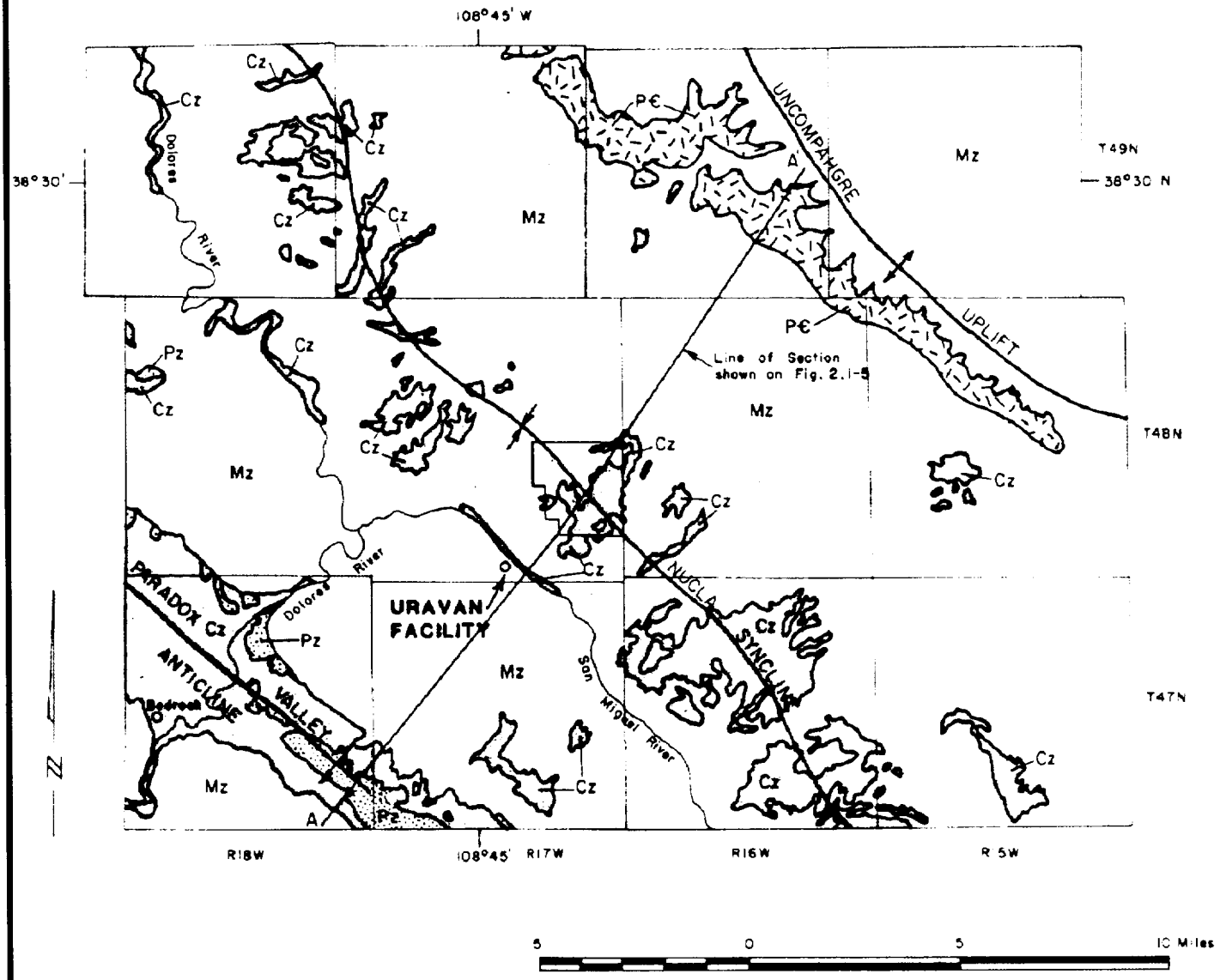
Surficial deposits are usually thin and are primarily colluvial, residual and eolian deposits which are interspersed with bedrock outcrops along the canyon sides and on the mesa tops. Stream alluvium and small alluvial fans are present along the San Miguel River and its principal tributaries. Modern flood plain deposits are limited. In the Uravan area, these deposits are present upstream of the town. Downstream of the town for several miles, the San Miguel has incised a narrow canyon into the Kayenta Formation and underlying Wingate Sandstone and Chinle Formation. At Uravan, there is evidence of three former flood plain levels as indicated by thin terrace gravels. The three former flood plains lie about 10, 25, and 60 feet above the present incised river channel. These flood plain surfaces have been modified considerably by subsequent colluvial deposition from the adjacent canyon sides.

Structure: The principal structural elements in the Uravan area are shown on Figure 2.3-2 and a regional geologic cross-

section is shown in Figure 2.3-3. Uravan is located on the southwest limb of the northwest trending Nucla Syncline. This syncline is a relatively simple structure downwarp which lies between the structurally more complex Uncompahgre Uplift and the Paradox Valley Anticline. The Mesozoic strata at Uravan are gently inclined at about 2° towards the northeast. Folding of these major structural elements may have occurred during the late Cretaceous or Eocene Laramide orogeny, about 40 to 70 million years ago.

Faults with large displacements in the Mesozoic sedimentary rock are not present in the Nucla Syncline and major faults have not been recognized at the existing tailings or mill effluent disposal sites. Northwest-trending faults which may have been active in the Quaternary (Kirkham and Rogers, 1981) are present along the western flank of the Uncompahgre Uplift. Several northwest-trending normal faults which displace Quaternary deposits are present along the collapsed crest of the Paradox Valley Anticline.

Seismicity: The Uravan region is in an area which has experienced a relatively low level of seismic activity for about the last 125 years. Epicenters of earthquakes with magnitudes greater than 4.0 or modified Mercalli intensities greater than V, within 200 miles of Uravan, are shown on Figure 2.3-4 (Figure



Cz — **CENOZOIC SEDIMENTS**
Quarternary Soil Deposits

Mz — **MESOZOIC SEDIMENTARY ROCKS**
Dakota, Burro Canyon, Morrison, Summerville, Entrada Sandstone, Navajo Sandstone, Kayenta, Wingate Sandstone, Chinle, Moenkopi Formations

Pz — **PALEOZOIC SEDIMENTARY ROCKS**
Cutler, Hermosa Formations

P€ — **PRECAMBRIAN ROCKS**

ANTICLINAL AXIS

SYNCLINAL AXIS

SOURCE: WILLIAMS (1964), modified

GENERALIZED REGIONAL GEOLOGY AND STRUCTURE

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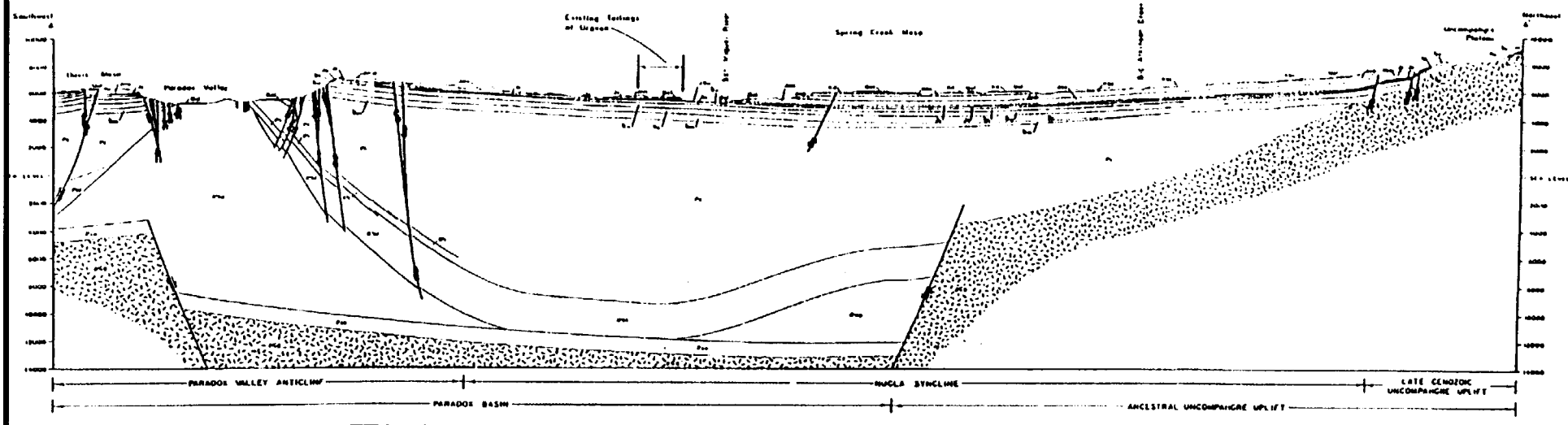
Fig. 2.3-2



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REGIONAL GEOLOGIC CROSS-SECTION

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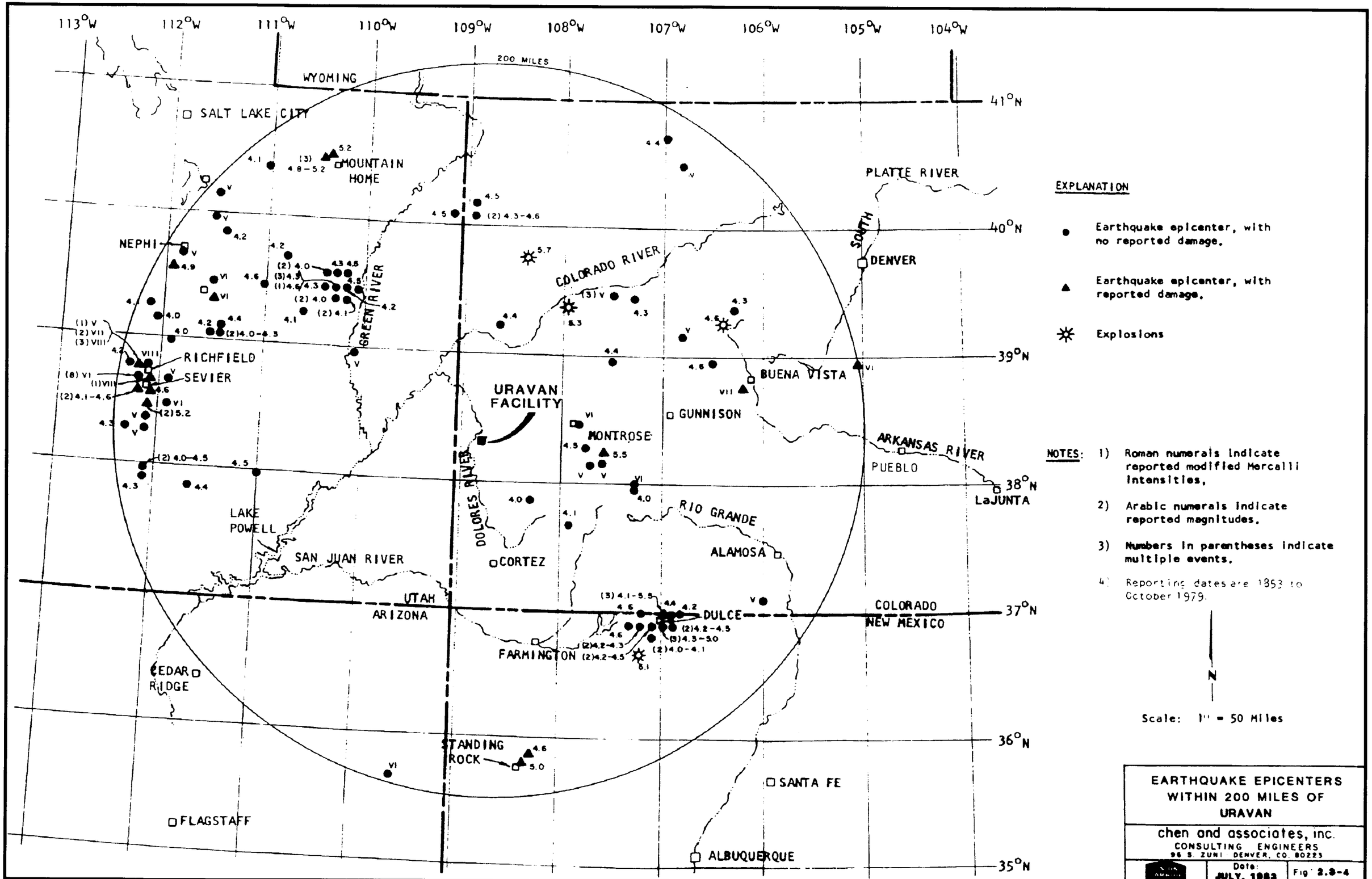
Fig 3.3-3



EARTHQUAKE EPICENTERS WITHIN 200 MILES OF URAVAN

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Fig. 2.3-4

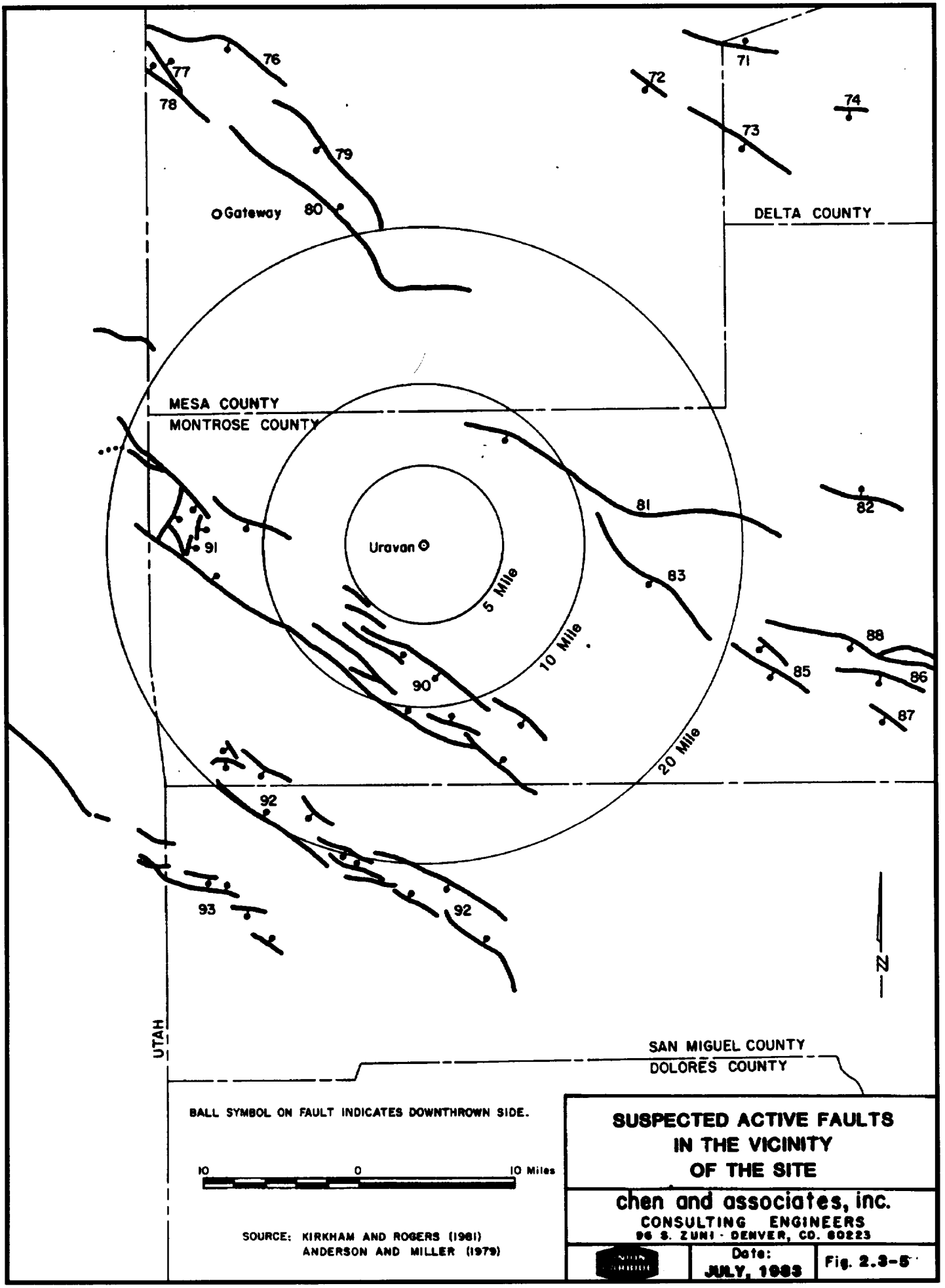
2.2-1, Chen & Associates, Inc., 1983). The more frequent and larger earthquakes in the region have occurred in the intermountain seismic zone which generally coincides with the Wasatch Mountain range in Utah. This zone of major seismic activity is located about 170 miles to the west of Uravan. Because of its distance from the site, the intermountain seismic zone will not have a major impact at Uravan. The historic seismicity from this zone probably has not caused site intensities at Uravan greater than IV and peak bedrock accelerations likely have not exceeded 0.02g.

Active Faults: Studies done by Kirkham and Rogers (1981) indicate that there are several faults in the region which are suspected to be active faults. The locations of these faults are shown on Figure 2.3-5. Historic earthquake activity has not been associated with any of these faults, but geologic conditions indicate that fault movement may have occurred as recently as the Quaternary, within the last 1.8 million years. The suspected active faults are located either along the flanks of the Uncompahgre Uplift or along the flanks of the collapsed Paradox Valley Anticline and other salt anticlines to the southwest. The Paradox Valley Faults and other salt anticline faults are suspected to be actively moving at the present. However, because their movement is caused by salt flowage, they are not considered by researchers to be capable of generating moderate to large

earthquakes.

The other potentially active faults northeast of Uravan are along the southwestern or northeastern flank of the Uncompahgre Uplift. Detailed studies of the Uncompahgre faults would be required to establish if they actually have moved recently enough to be classified as capable faults in accordance with Nuclear Regulatory Commission criteria. Since such studies have not been made, these faults have been assumed to be capable faults and were considered in assessing the seismic risk at Uravan.

Design Earthquake: Two levels of seismic exposure, one for the short-term operational phase of the project and the other for the long-term post-reclamation phase of the project, have been determined for the Uravan area by Dames and Moore (1978). Their seismic source model accounted for both background seismic activity based on historic seismic records and potential seismic activity which could be expected if the faults bordering the Uncompahgre Uplift were actually active. For the short-term operational phase of the facility, earthquake exposure with an average annual recurrence interval of 1,000 years was considered. For the long-term post-reclamation phase of the facility, an earthquake exposure with an average annual recurrence interval of 10,000 years was considered. Analysis indicates that a peak bedrock acceleration of 0.12g is expected to be associated with a



SUSPECTED ACTIVE FAULTS IN THE VICINITY OF THE SITE

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Fig. 2.3-5

1,000 year recurrence interval and a peak bedrock acceleration of 0.23g is expected to be associated with a 10,000 year recurrence interval.

Geomorphic Processes: Studies of geomorphic processes in the Uravan area have been made by Smith (1980) and by Chen & Associates (1982 and 1983). The following is a summary of those studies.

Geomorphic features along the Colorado River and its principal tributaries in the Colorado Plateau, such as the San Miguel and Dolores Rivers, indicate that the Colorado River system has been downcutting during at least the last 10 million years. Long-term average rates of river incision, from a variety of localities within the Colorado Plateau, range from 0.005 feet per thousand years to 1.4 feet per thousand years and average about 0.5 feet per thousand years.

Hunt (1956), Larson et. al. (1975), and Keend (1969), state that canyon widening has also accompanied river downcutting during this period. Canyon widening primarily results from mesa rim retreat and mass wasting along the mesa flanks. Mesa tops are formed by resistant sandstone units and remain relatively unchanged during erosional processes. Slow erosion, primarily by mass wasting of the underlying weaker rock units, results in slow

retreat of the rims. Although the regional geomorphology indicates that river downcutting and mesa rim retreat have been the predominant geomorphic processes, several episodes of river aggradation associated with Quaternary glacial periods have also occurred (Richmond, 1962).

The past geomorphic processes of river downcutting and aggradation, along with canyon widening, have shaped the present landscape and these processes are expected to continue into the future. Future long-term geomorphic rates are expected to be similar to those in the past. Since part of the existing facilities are on Club Mesa, which is about 400 to 700 feet above the San Miguel River, long-term impacts were assessed. The resistant sandstone cliffs which make up the mesa rims are actively retreating. Maximum rate for rim retreat adjacent to the San Miguel River is estimated to be about 1.0 to 4.0 feet per thousand years. Retreat rates for the mesa rims adjacent to tributary drainages range from 0.4 to 4 feet per thousand years.

2.4 HYDROGEOLOGY

The regional ground water hydrogeology of the Uravan area has been described in studies done for Union Carbide by Dames and Moore (1978), International Engineering Company (1981) and Envirologic Systems, Inc. (1983b). These reports may be referred to for additional discussion. This summary includes a description of water-bearing zones, aquitards or confining layers, and their characteristics and interrelationships and draws upon the geologic descriptions given in Section 2.3.

Aquifers in the Uravan area are generally limited to the hydrostratigraphic units which have sufficient permeability to transmit ground water. These sandstone units generally have variable permeabilities due to grain size, fracturing, sorting and secondary cementing. Ground water in the region is transmitted via secondary (joint) permeability and primary (intergranular) permeability. Secondary permeability in the region tends to be directional and highly variable. Mesozoic Formations capable of transmitting water in economic amounts include the Dakota and Burro Canyon Formations, the Salt Wash member of the Morrison Formation, and the Entrada, Kayenta, and Wingate Sandstones (Figure 2.3-1). Mesozoic strata which are not capable of transmitting water in economic amounts and which are therefore considered aquitards include the Brushy Basin member of

the Morrison Formation, the Summerville, Chinle, and Moenkopi formations (Figure 2.3-1).

The Chinle Formation, which underlies the Kayenta-Wingate aquifer, is the first hydrogeologic unit of concern in the Uravan area (Figure 2.3-1). All geologic units below this aquitard, which underlies the deepest water-bearing zone of concern, should not be impacted by the migration of contaminated liquids. A description of the Chinle Formation and the hydrogeologic units above this formation follows:

Chinle Formation: The Chinle Formation is about 400 feet thick and consists predominantly of soft red siltstone. The Chinle does not produce water in the Grand Junction area (Lohman, 1965) and most likely will not produce water in the Uravan area. Because of its lithology, the permeability is probably very low and it acts as an aquitard to vertical ground water movement. The upper part of the Chinle in the Uravan area contains sandstones of low permeability and probably is in hydraulic connection with the overlying Wingate sandstones.

Wingate Sandstone: The Wingate Sandstone is about 200 feet thick in the Uravan area and is composed of very fine to fine-grained sand with minor interstitial clay and calcite cement. Portions of the Wingate are water-bearing in the region, despite

its relatively low permeability. Laboratory tests on Wingate Sandstone samples for the coefficient of permeability indicate that the Wingate has a similar permeability to the Entrada except near its base (Table 2.4-1). It has been reported that in the Uravan area, the aquifer is capable of producing up to 500 gallons per minute and well yields of over 100 gallons per minute are common. These high yields are probably due to high fracture permeability, rather than primary permeability of the formation (Dames and Moore, 1978). However, the Bishop, Brogden, and Rumph study in 1986 indicated the Wingate at Uravan to be predominantly unfractured and low permeability.

Regionally, Wingate ground water is sodium bicarbonate water of relatively good quality, similar to that of the Entrada Sandstone. In the past this groundwater has been used as the Uravan water supply.

In the Uravan vicinity, recharge to the Wingate Sandstone probably occurs in two primary areas: 1) west of Uravan along the Dolores River and the flanks of the Paradox Valley and 2) northeast of Uravan along its exposed margin, bordering the Uncompahgre Uplift. Recharge occurs from both direct infiltration to Wingate outcrops and from vertical infiltration from overlying units. The Wingate is not exposed in the immediate area around Uravan, so discharge is either northwest

TABLE 2.4-1

HYDROLOGIC PROPERTIES OF PRINCIPAL
WATER BEARING ZONES AND AQUITARDS

Formation	Position in Formation	Permeability (feet/year) Horiz.	Vert.	Storativity	Reference
Wingate	Near top	220	55		1
	Near middle	1	0.4		1
	Above base	40	1		1
	Average	26			4
Kayenta		740	6		2
		300			3
		5.3			4
		2.4			3
Entrada	Slick Rock	30	20		1
	Moab-base	275	55		1
	Moab-top	1200	715	5×10^{-5}	1
Summerville	No data available				
Salt-Wash		55		3×10^{-5}	1
Brushy Basin		.62 to .01			2
Burro Canyon		827			

References:

1. Lohman (1965)
2. Envirologic Systems (1983b)
3. Dames and Moore (1978)
4. Bishop, Brogden & Rumph, 1986 Drilling Program

along the trend of the synclinal axis (near the confluence of the San Miguel and Dolores Rivers) and/or upward into the Kayenta through connecting fractures. Data are not adequate to quantify recharge and discharge rates in this system.

Kayenta Formation: The Kayenta Formation is approximately 180 to 200 feet thick in the Uravan area. The formation consists of lenticular to irregularity-bedded layers of fine to medium-grained sandstone, irregular lenses of siltstone and shale, and a few lenses of conglomerate or conglomeratic sandstone. The sandstones are generally harder and coarser grained then the underlying Wingate, particularly the lower beds of the Kayenta (Lohman, 1965).

Regionally, the Kayenta is not considered to be an aquifer. Locally, the Kayenta contains water and is hydrologically connected with the underlying Wingate and overlying Navajo and Entrada formations (Lohman, 1965). Permeabilities are generally very low, but in the Uravan area Dames & Moore (1978) state laboratory values of horizontal and vertical permeabilities of 740 and 690 feet per year, respectively, for an upper sandstone. They also state a porosity of 26.9 percent. Recharge probably occurs along the flanks of the Dolores River and Paradox Valley, west of Uravan, where the Kayenta is exposed. Northeast of Uravan, recharge may also occur along the exposed edge of the

Kayenta on the margins of the Uncompahgre Uplift. Flow probably is towards the San Miguel River Canyon where the Kayenta is at its lowest exposed elevation. Therefore, flow is generally toward the San Miguel from both the northeast and southwest.

Navajo Formation: The Navajo formation in the Uravan area is an outlier of the main formation body which lies further to the west (Cater, 1970). The Navajo is 30 feet thick or less in this area and is composed of massive, fine-grained, very well-sorted, clean, nearly white sandstone. Because the areal extent of the Navajo in the vicinity of Uravan is small, ground water information is not available; however, it is thought to allow vertical hydraulic connection between water-bearing zones above and below it.

Entrada Formation: The Entrada Formation is 80 to 110 feet thick in the Uravan area and is predominantly a fine to very-fine grained sandstone with small amounts of medium-grained sand and from less than 10 percent to as high as 30 percent silt (Lohman, 1965). Some beds, particularly those near the base, contain a small proportion of well-rounded, frosted and iron-stained, coarse-grained sand.

Regionally, the Entrada is considered the most productive of the various bedrock water-bearing zones. Locally, however, the

Entrada may be relatively dry due to dissection by various canyons. Flow tests made on the Entrada wells have yielded transmissivity values of 150 gallons per day per foot (gpd/ft) and storativity of 5×10^{-5} (Lohman, 1965).

Water quality tends to be good and the water is a sodium bicarbonate type that becomes increasingly soft at greater distances from the recharge area due to natural base exchange (Lohman, 1965). Recharge probably occurs west and southwest of Uravan where the Entrada is exposed and northeast along the flanks of the Uncompahgre Uplift. Discharge probably occurs along the San Miguel River and in Hieroglyphic Canyon.

Summerville Formation: The thinly bedded Summerville Formation consists mainly of alternating beds of siltstone and sandstone with shale and mudstone near the top. In the Uravan vicinity, the Summerville is 40 to 60 feet thick and is considered to be an acquitard in this region. This formation generally does not yield water to wells, due to its low permeability. The Summerville Formation effectively confines water in the Entrada and lower units; however, the Summerville Formation is not an aquiclude.

Morrison Formation-Salt Wash Member: The Salt Wash Member ranges in thickness from 0 to 300 feet in this area and is

comprised of alternating beds or lenses of siltstone or mudstone and highly lenticular sandstone, and near the base, a few thin limestone beds (Lohman, 1965). The sandstone beds which are the dominant lithology consist mostly of fine, medium, and coarse-grained quartz sand.

Because of the lithology and lenticular nature of the Salt Wash Member, permeabilities tend to be relatively low and water availability highly variable. Flow tests on wells in the region completed in the Salt Wash yield a transmissivity and storativity of 47 gpd/ft and 3×10^{-5}, respectively.

Salt Wash ground water tends to be sodium bicarbonate-sodium sulfate water of relatively good quality (Lohman, 1965). Pyrite is suspected as the source of the sulfate. High sodium levels suggest that water in the Salt Wash has undergone more natural base exchange than water in any of the other water-bearing units (Lohman, 1965).

The Salt Wash Member is exposed over a wide area southwest of Uravan and is probably one area of recharge. As are the other formations, this member is also exposed along the flanks of the Uncompahgre Uplift and receives water at that location. The San Miguel River Canyon and Atkinson Creek are areas of natural discharge.

Morrison Formation-Brushy Basin Member: The Brushy Basin Member is about 400 feet thick and composed dominantly of variegated mudstone with lesser amounts of sandstone, conglomeratic sandstone, and limestone (Cater, 1970). This unit is considered to be an aquitard for the underlying water-bearing zone in the Salt Wash Member. Packer tests in the upper part of the Brushy Basin on Spring Creek Mesa showed permeabilities ranging from 0.62 foot/year to less than 0.01 ft/year (Chen and Associates, 1984). Very small yields have been reported from wells completed in sandstone layers in this unit, but water availability is highly variable and for the most part poor to nonexistent.

Burro Canyon Formation: The Burro Canyon Formation is up to 200 feet thick in this area and is composed of as much as 85 percent sandstone with individual sandstone beds up to 100 feet thick. Green shale or siltstone, red or purple shale, and locally, thin gray nodular limestone are also present in the formation (Lohman, 1965).

Because the sandstones of the Burro Canyon are generally lenticular and tightly cemented, intergranular permeability is very low. However, locally, fracture permeability may provide fresh water to wells. Aquifer tests on well SCM-1 on Spring

Creek Mesa showed a permeability of 827 foot/year (Chen and Associates, 1984).

South of the San Miguel River on Club Mesa, the Burro Canyon exists as isolated erosional remnants, whereas north of the river it caps much of the area. The erosional remnants are most likely unsaturated. North of the river on Spring Creek Mesa, the lowest portion of the formation is saturated. Recharge occurs along the flank of the Uncompahgre Uplift, exposed areas on the mesa tops, and possible through the overlying Dakota Sandstone. Discharge is through the walls of the various canyons which dissect the mesas and possibly by vertical leakage.

Water quality in the Burro Canyon Formation on Spring Creek Mesa is somewhat variable. For example, Total Dissolved Solids (TDS) measured in various monitoring wells on Spring Creek Mesa show a TDS range from 640 to 3,500 milligrams per liter (mg/1).

Dakota Sandstone: The Dakota Sandstone is up to 150 feet thick in the Uravan area and is composed of fine to medium-grained sandstone which ranges from non-cemented to well-cemented. Interbedded with the sandstone are carbonaceous shales and low-grade coals, and mudstone.

In the Uravan area, the Dakota may be water-bearing only

locally. Generally, the erosional remnants of the Dakota in the Uravan area are unsaturated, but may allow recharge to the Burro Canyon.

2.5 SOILS, VEGETATION, AND ENDANGERED SPECIES

2.5.1 Description of Soils

Little site-specific information is available for soils in the vicinity of Uravan. The USDA Soil Conservation Service Soil Survey is not complete for this area. Some general information is available from the working papers of the SCS office at Norwood, Colorado (USDA-SCS 1985).

Soils on the steep and extremely steep side slopes of the canyons are classified as the Rock outcrop-Torriorthents complex. Rock outcrop and Torriorthent components are intricately intermingled. Rock outcrop components consist of barren escarpments, ridge caps, and sandstone points. Torriorthent components may be shallow or deep and formed in residuum and colluvium derived from sandstone and shale. The surface layer is commonly light bouldery clay loam. Permeability is moderately slow, available water capacity is moderate, runoff is very rapid, and hazard of water erosion is very high.

Bench areas are covered primarily by the very bouldery clay loams of the Bodot-Torriorthents complex. The Bodot soil composes 45 percent of the map unit, with 40 percent Torriorthents, 10 percent Rock outcrop, and 5 percent Pinon and Bowdish soils. The Bodot soil is moderately deep and formed in

residuum derived dominantly from shale. The surface layer is very bouldery clay loam. Permeability is slow, water capacity is moderate, runoff is rapid to very rapid and hazard of water erosion is slight to very high. The Torriorthents soil is described above.

Soils on the mesa tops are composed primarily of a combination of Pinon-Bowdish-Rock outcrop complex and Barx-Progresso complex. Pinon soils are shallow and formed in residuum derived from sandstone and shale. The surface layer can be gravelly loam, gravelly sand loam, sandy loam, or cobbly loam. Permeability is moderate, available water capacity is very low, runoff is medium to very rapid, and hazard of water erosion is slight to very high. Bowdish soils are moderately deep and derived from interbedded sandstone and shale. The surface layer may be sandy loam, sandy clay loam, gravelly sandy loam, or cobbly sandy loam. Permeability is moderate, available water capacity is low, runoff is medium to very rapid, and the hazard of water erosion is slight to very high.

The Barx soil is deep and formed in alluvium derived dominantly from sandstone. The surface layer is typically fine sandy loam. Permeability is moderate, available water capacity is high, runoff is medium to rapid and the hazard of water erosion is slight to very high. Barx soil composes 45 percent of the Barx-Progresso complex.

Forty percent of the Barx-Progresso complex consists of Progresso loam. The Progresso soil is moderately deep and formed in sandstone-derived alluvium. Permeability is moderate, available water capacity is moderate, runoff is medium to rapid, and the hazard of water erosion is slight to very high.

In the riparian zone, Fluvaquents are the predominant soil type. These are deep, poorly drained soils that formed in stratified alluvium from mixed sources. The surface layer is commonly silt loam. Permeability is moderately rapid to very slow to medium, and the hazard of water erosion is slight to high.

Further information concerning soils in the Uravan vicinity is availability from soil type descriptions from the SCS office in Norwood, Colorado (USDA-SCS 1985), and the Amendment to the Environmental Report from the Proposed Spring Creek Mesa Tailings and Effluent Impoundment (Gibbs and Hill, 1984).

2.5.2 Description of Regional Vegetation

Vegetation in the area surrounding the Uravan Facility is divided into three major community types: pinon-juniper woodland; sagebrush-grass community; and riparian zone. Small areas of mountain brush vegetation also occur where slopes are very steep and rocky. These vegetation types are described

below.

Pinon-Juniper Woodland: This vegetation is a very widespread plant community type in the area around Uravan. It occurs on the canyon slopes, the mesa tops, and at higher elevations on the ridges than the sagebrush community (Dames and Moore 1982). About 40 percent of the pinon-juniper woodland in this area occurs on moderate to steep slopes with sandstone outcrops. These steep slopes are areas of shallow soils and low productivity, producing 10 to 30 trees per acre. The other 60 percent of the pinon-juniper woodland occurs on gentler slopes with deeper soils. These stands are more productive with an average of 140 to 190 trees per acre (Gibbs and Hill, 1984).

The major canopy species in the pinon-juniper woodland are pinon pine (Pinus edulis) and 2 species of juniper (Juniperus scopulorum and Junipers osteosperma). About 75 percent of the canopy is composed of junipers. Shrub species expected to be a part of the potential vegetation in this area include serviceberry (Amelanchier utahensis), four-wing saltbrush (Altriplex canescens), snowberry (Symphoricarpos oreophilus), mountain mahogany (Cercocarpus spp.), bitterbrush (Purshia tridentata), cliffrose (Cowania mexicana), and Mormon tea (Ephedra virdis) (Gibbs and Hill, 1984). Understory species are primarily grasses with a few forbs present. Potential plant species likely to be found in pinon-juniper woodland areas are

named in Table 2.5.2-1.

Sage - Grass Community: This vegetation is found in canyon bottoms, on mesa tops, and on gentle, lower slopes of ridges. This vegetation generally occupies finer, deeper soils than the pinon-juniper woodland (Dames and Moore, 1982; Gibbs and Hill, 1984). It often occurs as open parks within pinon-juniper vegetation where the two vegetation types intergrade.

Sagebrush forms about 10 percent of the plant cover. Perennial grasses and forbs form 50 percent and 5 percent of the plant cover, respectively (Gibbs and Hill, 1984). Big sagebrush (Artemisia tridentata), fringed sagebrush (Artemisia frigida), and winterfat (Ceratoides lanata) are the major shrub species (Dames and Moore, 1982; BLM, 1984). Major grass and forb species typically found in sagebrush-grass communities are named in Table 2.5.2-1.

Riparian Community: This vegetation dominates in canyon bottoms near the San Miguel River Major. The species include tamarisk (Tamarix pentandra), narrowleaf cottonwood (Populus angustifolia), willows (Salix spp.), alders (Alnus tenuifolia), and birch (Betula spp.) (Dames and Moore, 1982; BLM, 1984). Understory vegetation includes sedges (Carex spp.) and rushes (Juncus spp.). In the town of Uravan, introduced Chinese elms (Ulmus parviflora) are present.

TABLE 2.5.2-1

POTENTIAL PLANT SPECIES PRESENT IN THE VICINITY OF URAVAN URANIUM MILL IN SOUTHWESTERN COLORADO (Dames and Moore 1982; Gibbs and Hill 1984).

Grasses	Scientific Name
Galleta	Hilaria jamesii
Western wheatgrass	Agropyron smithii
Slender wheatgrass	Agropyron trachycaulum
Streambank wheatgrass	Agropyron riparium
Quackgrass	Agropyron repens
Crested wheatgrass	Agropyron desertorum
Indian ricegrass	Oryzopsis hymenoides
Muttongrass	Poa fendleriana
Alkali bluegrass	Poa juncifolia
Kentucky bluegrass	Poa pratensis
Big bluegrass	Poa ample
Bulbous bluegrass	Poa bulbosa
Sandberg bluegrass	Poa sandbergii
Needle-and-thread grass	Stipa comata
New Mexico feathergrass	Stipa neomexicana
Bottlebrush squirreltail	Sitanion hystrix
Cheatgrass	Bromus tectorum
Alkali sacaton	Sporobolus airoides
Sand dropseed	Sporobolus cryptandrus
Creeping wildrye	Elymus triticoides
Great Basin wildrye	Elymus cinereua
Canada wildrye	Elymus canadensis
Saltgrass	Distichlis sticta
Redtop	Agrostis alba
Bluejoint reedgrass	Calamagrostis canadensis
Nuttail alkaligrass	Puccinellia airoides
Foxtail barley	Hordeum jubatum
Mountain muhly	Muhlenbergia montana
Scratchgrass	Muhlenbergia asperifolia
Junegrass	Koeleria cristata
Three-awn	Aristida fendleriana
Blue grama	Boutelous gracilis
Six-weeks fescue	Festuca octoflora
Sedges	Carex spp.
Baltic rush	Juncus balticus

Forbs	Scientific Name
Prickly-pear cactus	Opuntia polyacantha
Ragweed	Ambrosia spp.
Dogbane	Apocynum canabimum
Milkweed	Asclepias spp.

Forbs	Scientific Name
Rocky Mountain bee plant	Cleome serrulate
Horsetail	Equisetum arvense
Wild licorice	Glycyrrhiza lepidota
Gumweed	Grindelia squarrosa
Sunflower	Heliantus annuus
Povertyweed	Iva axillaris
Prickly lettuce	Lactuca serriola
Daisy	Erigeron spp.
Aster	Aster spp.
Stickseed	Hackelia floribunda
Sandwort	Arenaria hookeri
Morning bride	Chaenactis douglasii
Butterweed	Senecio mutabilis
Buckwheat	Eriogonum spp.
Goldenweed	Haplopappus spp.
Phlox	Phlox spp.
Gilia	Gilia acerosa
Penstemon	Penstemon spp.
Sagewort	Artemisia ludoviciana
Mentzelia	Mentzelia spp.
Scarlet globemallow	Sphaeralcea coccinea
Lambsquarter	Chenopodium album
Kochia	Kochia spp.
Sweetclover	Melilotus spp.
Dock	Rumex spp.
Balsamroot	Balsamorhiza sagittata
Lupine	Lupinus spp.
Yarrow	Achillea lanulosa
Salsify	Tragopogon spp.
Prince's plume	Stanleya pinnata
Mesa milk vetch	Astragalus shortianus
Spotted locoweed	Astragalus lentiginosus
Tansy mustard	Descurainia pinnata
Low larkspur	Delphinium nelsonii
Spined iron plant	Machaeranthera pinnatifida
Scarlet paintbrush	Castilleja miniata

Shrubs	Scientific Name
Mountain mahogany	Cercocarpus montanus
Tamarisk	Tamarix pentandra
Big sagebrush	Artemsia tridentata
Black sagebrush	Artemisia nova
Fringed sagebrush	Artemisia frigida
Wormwood	Artemisia dracunculoides
Rubber rabbitbrush	Chrysothamnus nauseosus
Douglas rabbitbrush	Chrysothamnus viscidiflorus
Snakeweed	Xanthocephalum sarothrae
Shadscale	Atriplex confertifolia

Shrubs	Scientific Name
Fourwing saltbrush	Atriplex canescens
Winterfat	Ceratoides lanata
Rose	Rosa spp.
Russian thistle	Salsola kali
Antelope bitterbrush	Purshia tridentata
Utah serviceberry	Amelanchier utahensis
Mormon tea	Ephedra viridis
Horsebrush	Teradymia spp.
New Mexico olive	Forestiera neomexicana
Chokecherry	Prunus virginiana var. melanocarpa
Greasewood	Sarcobatus vermiculatus
Silver buffaloberry	Shepherdia argentea
Cliffrose	Cowania mexicana
Virgin's bower	Clematis ligusticifolia
Virginia creeper	Parthenocissus spp.
Skunkbush	Rhus trilobata
Golden currant	Ribes aureum
Snowberry	Symphoricarpos oreophilus
Elderberry	Sambucus spp.
Yucca	Yucca glauca

Trees	Scientific Name
Pinyon pine	Pinus edulis
Rocky Mountain juniper	Juniperus scopulorum
Utah juniper	Juniperus osteosperma
Narrowleaf cottonwood	Populus angustifolia
Willow	Salix spp.
Chinese elm	Ulmus parviflora

Mountain Brush Community: Small areas of mountain brush vegetation occur on areas of severe topography. Shrub species in this type include serviceberry, four-wing saltbrush, skunkbush sumac (Rhus trilobata), mountain mahogany, bitterbrush, snowberry, chokecherry (Prunus virginiana) and elderberry (Sambucus candensis) (Gibbs and Hill, 1984).

2.5.3 Description of Threatened, Endangered, and Sensitive Species

Several threatened, endangered, and sensitive plant species are found or have potential habitat in the area around Uravan. These species and a description of their necessary habitat are listed in Table 2.5.3-1.

The Uravan Environmental Report, 1978 by Dames and Moore, identified wildlife species listed by the U.S. Department of Interior as endangered or threatened wildlife, Turec, the Peregrine Falcon, Bald Eagle, and the Black-footed Ferret in the vicinity of Uravan. The Black-footed Ferret has not been definitely sighted in the Uravan vicinity, but its habitat is present.

Peregrine Falcons (Peregrinus anatum) may hunt waterfowl along the San Miguel River but more probably occur as migrants along the Dolores River where prey such as waterfowl, shore birds and passerine birds are more numerous. Sightings indicate that an eyrie occurs in the area but its location is unknown.

TABLE 2.5.3-1 THREATENED, ENDANGERED, AND SENSITIVE PLANT SPECIES AND THEIR NECESSARY HABITATS (BLM 1984)

Species	Habitat
Endangered, known to occur	
Spineless hedgehog cactus, (Echinocereus triglochidiatus)	Rocky soils in open pinon-juniper stands, flat aspects, mesa tops
Endangered, no known occurrence	
Knowlton hedgehog cactus, (Pediocactus knowltonii)	Gravelly hilltops within open pinon-juniper stands
Threatened, no known occurrence	
Uinta Basin hookless cactus, (Sclerocactus glaucus)	Gravelly flats, low hills, sparse vegetation
Mesa Verde cactus, (Sclerocactus mesae-verdae)	Low clay hills, mesa sides, sparse vegetation
Sensitive, known to occur	
Lupinus crassus	Loose shale soils
Phlox, (Phlox caryophylla)	Sagebrush slopes and flats, often on Mancos shale
Sensitive, no known occurrence	
Grand Junction milk-vetch (Astragalus linifolius)	Dry, clayey slopes and gullies in pinon-juniper
Mancos saltbrush (Atriplex pleiantha)	Barren clay mesa slopes
Penstemon parviflorus	Pinon-juniper, sagebrush, mountain brush communities

The Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus) hunts fish and feeds upon carrion along the rivers of the Dolores River Basin. The Northern Bald Eagle (Haliaeetus leucocephalus alascanus) winters in the basin. The only difference between the subspecies seems to be that the Northern Bald Eagle is larger and heavier than the Southern Bald Eagle, but ranges in wing measurements and weights overlap.

2.6 SURFACE WATER HYDROLOGY

2.6.1 General

The San Miguel River provides the primary drainage of the project area. Headwaters of the San Miguel originate in the San Juan Mountains from which the river flows northwest to its confluence with the Dolores River, about four miles downstream from Uravan. The San Miguel is perennial with pronounced seasonal fluctuations exhibited by its hydrograph. This streamflow pattern is characteristic of rivers whose flow is derived primarily from snowmelt runoff. Peak discharges on the San Miguel generally occur in late spring or early summer.

The San Miguel exhibits a seasonal flow pattern typical of streams in the region. Major flows occur from May to late June with moderate peaks, large volumes, and long flow durations. Average flow is 345 cubic feet per second (cfs) with a range of 12 to 6,690 cfs. The San Miguel flows are influenced by upstream diversions, storage and irrigation (Dames and Moore, 1982).

Principal tributaries to the San Miguel River in the vicinity of Uravan include Spring, Atkinson, Tabeguache, and Hieroglyphic Creeks. All are intermittent streams which peak following rainfall events. Peak flows occur most frequently in

spring and summer. Flows are generally low in fall and winter and may reach zero flow (Gibbs and Hill, 1984). A summary of streamflow values for the San Miguel River and its major tributaries is contained in Table 2.6.1-1.

2.6.2 Flood Forecast

A flood study for the Uravan Facility was conducted in 1982 (Dravo Engineers, 1982). This study did not include an analysis of flood erosion mechanisms such as bank erosion rates during floods. The study encompassed the stretch of river upstream of Hieroglyphic Canyon to downstream of Atkinson Creek. The 10-, 50-, 100-, and 500-year frequency floods were calculated using the Army Corps of Engineers HEC-2 model. Peak calculated flows for the San Miguel River and Atkinson Creek for the 10-, 50-, 100- and 500-year return periods are listed in Table 2.6.2-1.

The 500-year frequency flood would reach the level of the River Ponds and a few houses in Uravan. This flood would not overtop the Club Ranch Ponds, Atkinson Creek Disposal area, or impact the A-Plant mill facility. The River Ponds would not be overtopped by the 100-year frequency flood (Dravo Engineers, 1982).

TABLE 2.6.1-1 SUMMARY OF STREAMFLOW VALUES FOR THE SAN MIGUEL RIVER AND MAJOR TRIBUTARIES IN THE VICINITY OF URAVAN (Gibbs and Hill, 1984).

Stream Name	Gage Location	Drainage Area (mi^2)	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)	Period of Record
San Miguel River	Uravan Colo.	1,499	315	6,690	9.4	1954-1962 1973-Present
Atkinson Creek	Upper	12.5	0.44	3.7	0	1981-1982
Atkinson Creek	Lower	33.3	0.40	3.2	0.01	1981-1982
Atkinson Creek	Below Ponds	35.5	0.37	3.0	0.01	1981-1982
Tabeguache Creek	Upper	126	70	275	0	1981-1982
Tabeguache Creek	Lower	154	59	275	0.01	1981-1
Spring Creek	Upper	15.6	1.12	7.9	0	1981-1982
Spring Creek	Lower	21.6	1.10	6.8	0	1981-1982

Note: 1 mi^2 = 2.59 km^2
1 cfs = 0.028 m^3/sec

TABLE 2.6.2-1

PEAK FLOWS FOR THE SAN MIGUEL RIVER AND ATKINSON CREEK FOR FLOOD FREQUENCIES OF 10, 50, 100, AND 500 YEARS (Dravo Engineers, 1982).

San Miguel River

Frequency (years)	Peak Flow (cfs)
10	7,700
50	11,700
100	13,500
500	18,700

Atkinson Creek

Frequency (years)	Peak Flow (cfs)
10	880
50	1,230
100	1,430
500	2,000

Results of flood analyses conducted for Union Carbide using the probable maximum flood (PMF) for the Uravan area are reported in Dames and Moore (1978). This flood is estimated to reach flows of 85,600 cubic feet per second (cfs), have a peak time of 45 hours, and runoff volume of 190,000 acre-feet at Club Ranch Ponds based upon a runoff to rainfall ratio of .32. At peak flows, Club Ranch Ponds 2, 3, and 5 would be submerged. In the town of Uravan, trailer housing, Block-A, -B, -C, -E and -J, and the A-Plant facility would be subject to flooding.

The maximum potential inflow to the Tailings Piles on Club Mesa is calculated as being equivalent to the maximum probable flood added to an antecedent flood equivalent to 40 percent of PMF as well as preceded or followed by a 100-year flood (Dames and Moore, 1978). This inflow would equal 20.7 inches of precipitation or 85 to 87 acre-feet of water to Tailings Piles 2 and 3 respectively. These volumes would be within the available storage capacity of the ponds (Dames and Moore, 1978).

2.6.3 Surface Water Chemistry

The San Miguel River water quality changes significantly as it flows from the Telluride valley to the mouth below Uravan. The seasonal water quality varies in response to snowmelt and storms, as well as to natural and mining loadings at various

locations within the watershed. Best water quality for major ions is observed during spring runoff while fall and winter baseflow periods show increased concentrations of contaminants.

Historical data (1969-1981) on the concentrations of major cations (calcium (Ca), magnesium (Mg), sodium (Na), potassium (K)) and anions (sulfate (SO_4) and chloride (Cl)) above and below Uravan illustrate the seasonal variability as well as the changes caused by the Uravan mill (ERI, 1986).

During January 1986, a network of river and stream stations was designed to identify the various natural and anthropogenic inputs to the San Miguel and Dolores Rivers. As shown in Table 2.6.3-1, the locations of these stations were selected to detect water quality changes along various reaches. At each river station, water quality samples were taken in conjunction with samples of sediments and aquatic biota. Data collected during 1986 (ERI, 1986) showed average concentrations relative to the 1969-1981 data set (Table 2.6.3-1 and Table 2.6.3-3).

Significant chemical changes were noted in the study sections of the San Miguel River from Naturita to its confluence with the Dolores River. Table 2.6.3-2 shows that there is a nearly continuous rise in conductivity. In Table 2.6.3-3, the dominant parameters for downstream station ASM01 and upstream

station ASM06 are compared. Increases in Ca, Mg, K, Na, C1, SO_4, ammonia (NH_3) and nitrate (NO_3) are shown.

TABLE 2.6.3-1 SIGNIFICANCE OF SAMPLE STATION LOCATIONS FOR WATER QUALITY, SEDIMENTS AND AQUATIC BIOLOGY IN THE SAN MIGUEL AND DOLORES RIVERS

River Reach	Significance
Above ASM08	Control Section above General Electric Site, below Dry Creek
ASM08 to ASM07	Impact of General Electric Site
ASM07 to ASM06	Control Section for Tabeguache Creek inputs
ASM06 to ASM05D	Impact of Ball Field and Dry Wash inputs
ASM05B to ASM05C	Use for comparison to UCC Control Station
ASM05C to ASM05B	River Pond and Hieroglyphic Canyon inputs
ASM05B to ASM05A	River Ponds and Wall Seeps inputs
ASM05A to ASM05	Miscellaneous Seeps and Dry Wash inputs
ASM05 to ASM04	Club Ranch Pond and Dry Wash inputs
ASM04 to ASM03	Atkinson Creek and indirect Club Ranch Pond inputs
ASM03 to ASM01	Possible groundwater flow from Mesa disposal areas
Above ADR04	Control section for Dolores River
ADR03 to ADR04	Impact of San Miguel Inputs on Dolores

TABLE 2.6.3-2 MACROCHEMISTRIES FOR SAN MIGUEL AND DOLORES RIVERS, JANUARY 1986.

Station	Conductivity (umhos/cm)	C1 (mg/1)	SO (mg^4/1)	NH (mg^3/1)	NO (mg^3/1)
ASM01	989	18	366	1.2	1.0
ASM03	973	16	365	1.1	0.4
ASM04	947	15	354	0.7	0.2
ASM05	932	15	353	0.5	0.2
ASM05A	827	13	292	0.5	0.6
ASM05B	832	13	311	0.5	0.3
ASM05C	818	13	293	<0.1	0.4
ASM05D	927	n.a.*	n.a.	n.a.	n.a.
ASM06	793	10	274	<0.1	0.4
ASM07	764	11	377	<0.1	0.5
ASM08	764	11	377	<0.1	0.5
ADR03	2420	528		0.8	
ADR04	6620	1990		<0.1	

*n.a. = no analysis performed

The mean of two samples are presented for ASM01 and ASM06.

TABLE 2.6.3-3 CHANGES IN MACROCHEMICAL PARAMETERS BETWEEN SM06 AND SM01, JANUARY 1986.

Parameter	ASM06	ASM01	Units
Ca	84.9	103	mg/1
Mg	33	47.4	mg/1
Na	29.3	41.1	mg/1
K	1.6	2.5	mg/1
Cl	10	18	mg/1
SO_4	285	366	mg/1
NH_3-N	<0.1	1.2	mg/1
NO_3-N	0.1	1.0	mg/1
Conductivity	793	1010	umhos/cm
Total Alk	156	148	mg/1 as $CaCO_3$
pH	8.08	8.17	- - -

Data from ERI 1986 Winter Baseline Study.
mg/1 = milligrams per liter
umhos/cm = micromhos per centimeter

3.0 URAVAN SITE CHARACTERISTICS

The Uravan Facility is divided into two distinct areas for the purpose of describing the geology and hydrogeology. These two areas are the San Miguel River Valley Area and Club Mesa Area. The San Miguel River Valley Area is defined as the valley bottom from the Town of Uravan downstream to the Atkinson Creek Crystal Disposal Area (Figure 1.1-1). Located in this area are portions of the mill facilities (A-Plant), the River Ponds, the Club Ranch Ponds, the town of Uravan and adjacent areas, and the Atkinson Creek Crystal Disposal Area. Club Mesa is directly southwest of Uravan and includes the upper portion of the mill (B-Plant), the ore storage and barrel storage area, the heap leach site, Club Mesa Tailings Piles and the Club Mesa Spray Area (Figure 1.1-1). Regional geologic and hydrogeologic descriptions of these two areas are in Sections 2.3 and 2.4, respectively.

3.1 SAN MIGUEL RIVER VALLEY

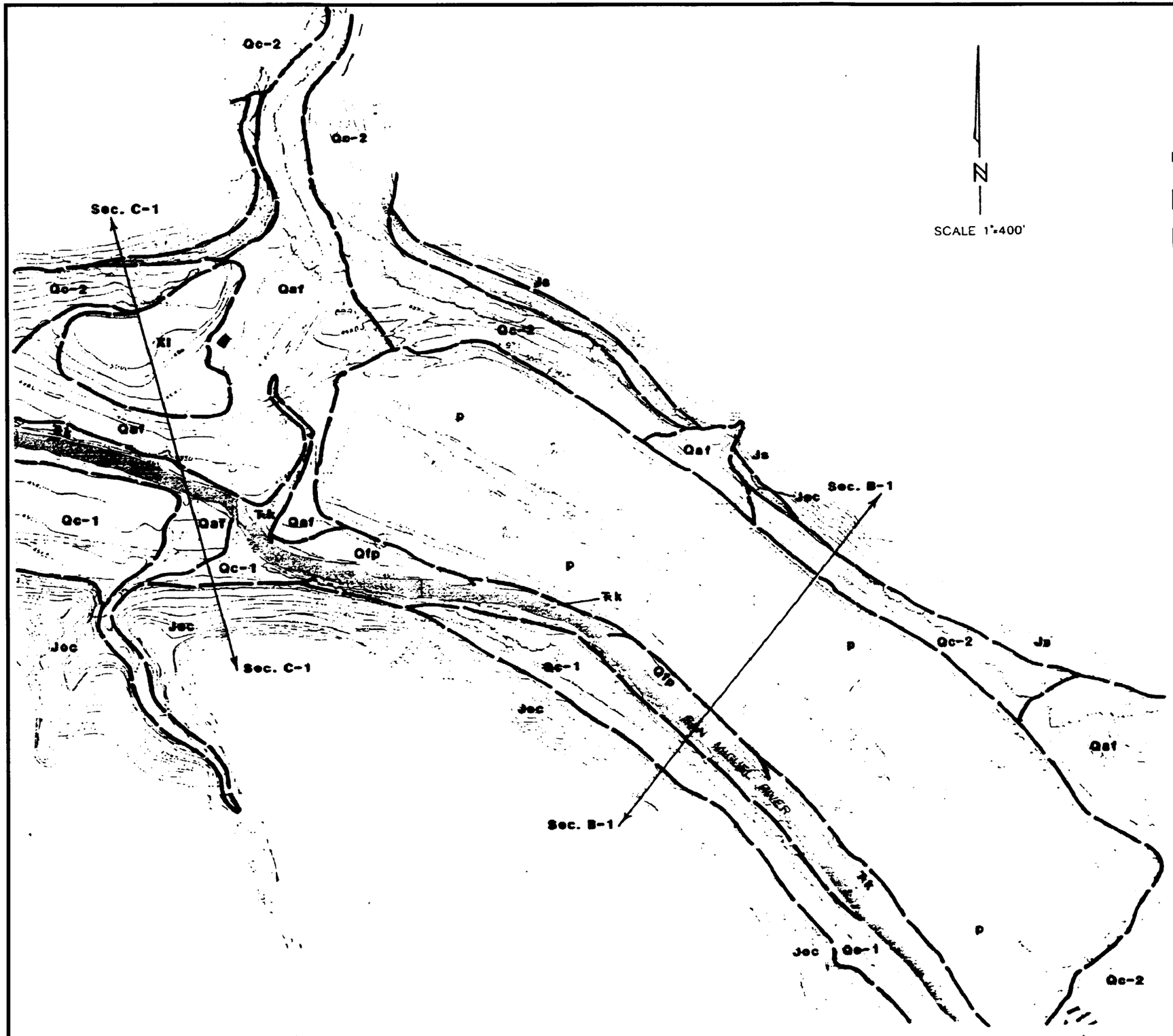
3.1.1 Geology

Bedrock and surficial geology of the San Miguel River are shown on Figure 3.1.1-1 and companion cross-sections, B-1, B-2, and C-1 (Figures 3.1.1-2, and 3.1.1-3). At Uravan and for several miles downstream, the San Miguel River has downcut into the beds of the Kayenta Formation. In this area, the rim of the river channel is about 10 to 30 feet above the river level. Overlying the Kayenta Formation is the Navajo and Entrada/Carmel Formations. These units form the lower-most part of the canyon walls.

Formations in the San Miguel River Valley are inclined slightly (approximately 2º) toward the northeast. No faults have been identified in the area; however, joints are present in the Kayenta Formation and other sandstone units. The Kayenta Formation is cut by three prominent orthogonal joint sets. The two nearly vertical joints strike north 45º west and north 45º east. In the Kayenta, these joints are spaced about 1 to 2 feet apart. This jointing probably provides secondary permeability in the bedrock units.

The valley bottom is mantled with relatively thin flood plain alluvium, terrace gravels, and colluvium. These units are shown on the geologic maps (Figures 3.1.1-1 and 3.2.1-1) and companion cross-sections. The flood plain alluvium is restricted to the present river channel. Terrace gravels representing previous river flood plains are present within the valley bottom at elevations of about 10, 25, and 60 feet above the San Miguel River. These terrace deposits are rounded gravel, cobbles and small boulders in a relatively clean sand matrix. A wedge of colluvium and fan alluvium overlies these terrace deposits. The colluvium consists of angular rock fragments ranging from gravel to boulder size material in a sandy clay matrix. The alluvium is made up of subrounded boulders, cobbles, and gravel in a clayey sand matrix. Both these deposits are thin near the river but increase in thickness toward the valley walls where over 50 feet of material is present.

The surficial deposits are the result of geological processes such as river aggradation and lateral migration, canyon erosion and widening, cliff retreat, and debris flooding. Some of these processes are still active. It is likely that slow downcutting into the Kayenta Formation will continue along the San Miguel River, at a rate not expected to greatly exceed 1.4 feet per thousand years. This downcutting will be accompanied by valley widening, although the river course will continue to



SCALE 1"=400'

EXPLANATION

- P — Club Ranch Ponds
- Xl — Atkinson Creek Crystal Pile
- Qfp — Flood Plain Alluvium
- Qc-1 — Lower Level Colluvium
- Qaf — Alluvial Fan
- Qc-2 — Middle Level Colluvium
- Js — Summerville Formation
- Jec — Entrada Sandstone and Carmel Formation
- Tk — Kayenta Formation
- Contact, approximate contact of map units

SAN MIGUEL RIVER VALLEY
NEAR URAVAN
GEOLOGY MAP

chen and associates, inc.
CONSULTING ENGINEERS
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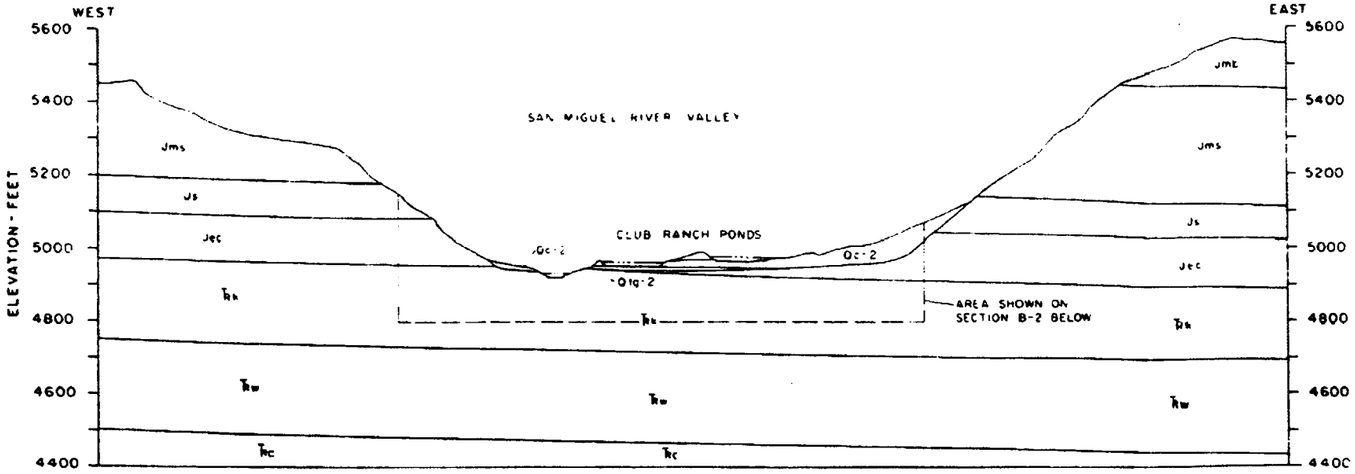
Date: JULY, 1983

Fig 2.1.1-1



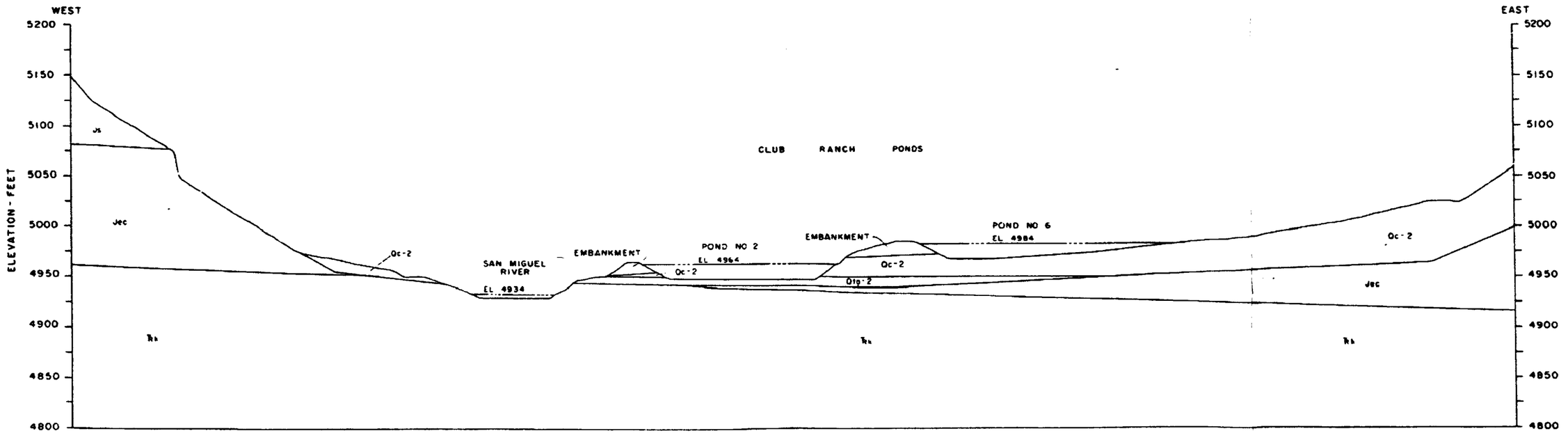
SECTION B-1

SCALE 1"=400' HORIZ & VERT

EXPLANATION

- Oc-2 — Middle Level Colluvium
- Qtg-2 — Middle Level Terrace Gravels
- Jmb — Brushy Basin Member } Morrison Formation
- Jms — Salt Wash Member } Morrison Formation
- Js — Summerville Formation
- Jec — Entrada Sandstone & Carmel Formation
- Trk — Kayenta Formation
- Trw — Wingate Sandstone
- Trc — Chinle Formation

NOTE: Subsurface geology is approximate and is based on test hole data and inferences from outcrop geology.



SECTION B-2

SCALE 1"=100' HORIZ & VERT

GEOLOGIC CROSS-SECTIONS CLUB RANCH POND AREA

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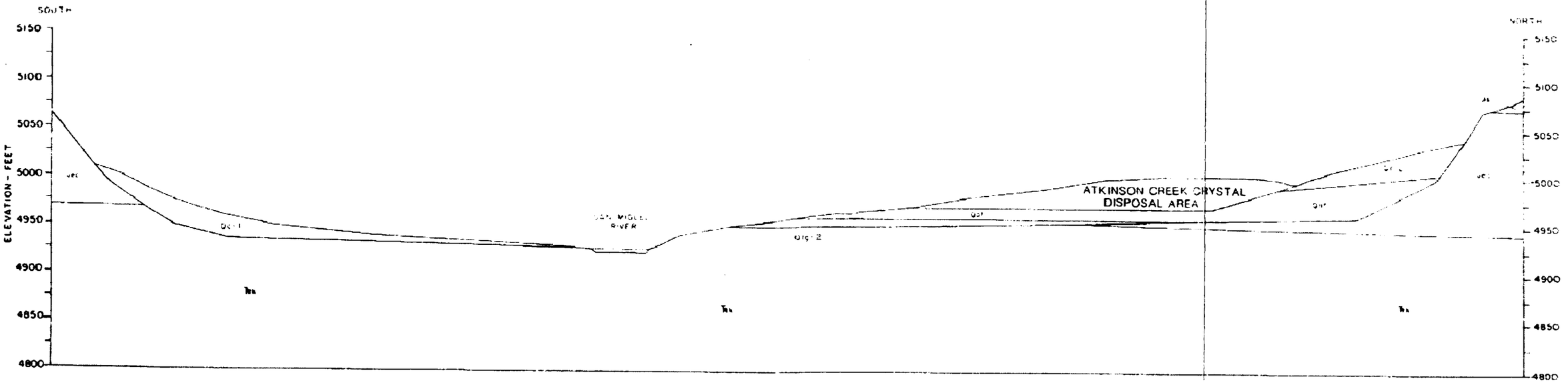
[illegible] SOUTH [illegible] STREET · DENVER, COLORADO [illegible]

JULY 1983

[illegible]

Fig. B.1.1-2



SECTION C-1

SCALE 1"=100' HORIZ & VERT

EXPLANATION

- Qc-1 — Lower Level Colluvium
- Qc-2 — Middle Level Colluvium
- Qtg-2 — Middle Level Terrace Gravels
- Js — Summerville Formation
- Jec — Entrada Sandstone & Carmel Formation
- Tkk — Koyenta Formation

NOTE: Subsurface geology is conjectured and is based on test hole data and inferences from outcrop geology

GEOLOGIC CROSS-SECTIONS ATKINSON CRYSTAL PILE AREA

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CONSULTING GEOTECHNICAL ENGINEERS
[illegible] SOUTH 2ND STREET · DENVER COLORADO [illegible]

JULY 1983

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Fig. 3.1.1-3

occupy the same general course on the valley floor. Deepening of the San Miguel River will also result in a corresponding downcutting of tributary valleys such as Atkinson Creek and Hieroglyphic Canyon. In the event that the San Miguel River aggrades, the river could possibly migrate laterally across the valley bottom. There would also be a corresponding rise in the ground water table. Regardless of river incision or aggradation, other geologic processes that include mainstream flooding, debris flows, cliff retreat, and canyon widening will remain active.

There are three main areas in the San Miguel River valley that have been used for disposal of waste from milling operations: River Ponds, Club Ranch Ponds, and Atkinson Creek Disposal Area. Geologic conditions vary slightly in each of these areas and are discussed as follows:

River Ponds: The River Ponds consist of seven small ponds constructed along the San Miguel River. Five of the ponds are on the west side of the river and two ponds are located on the east side of the river (Figure 1.1-1). These Ponds were constructed within old tailings piles by excavating into and, in some cases, through the tailings. The River Ponds are located on the lower river terrace adjacent to the San Miguel River. Thin gravels may underlie the ponds or they may rest directly on the Kayenta Formation. In either case, permeability of the underlying

materials is estimated to be moderate to high.

Club Ranch Ponds: The Club Ranch Ponds consist of six ponds located downstream from Uravan (Figure 3.1.1-4). These ponds are adjacent to the San Miguel River, which has eroded a 10 foot deep cut into the Kayenta Formation at this location. General geologic conditions in this area are shown on Figures 3.1.1-1 and 3.1.1-2.

The Club Ranch Ponds are underlain by middle level colluvium and terrace gravels that have a combined thickness ranging from 8 to 30 feet. These deposits probably have relatively high primary permeabilities. Beneath these surficial deposits are the sandstones of the Entrada/Carmel and Kayenta formations. Water movement in these formations results from both primary and secondary (fracture) permeability.

Atkinson Creek Crystal Disposal Area: The Atkinson Creek Crystal Disposal Area is downstream from the Club Ranch Ponds and is adjacent to Atkinson Creek (Figure 3.1.1-4). This is the current site for raffinate crystals that were excavated from the Club Ranch Ponds. The general geologic conditions in this area are shown on Figure 3.1.1-3. The Atkinson Creek Crystal Disposal Area is not lined beneath the crystals, resulting in direct crystal contact with alluvial fan sands and gravels and terrace

ATKINSON CREEK

N

Scale: 1"=400'

ATKINSON CREEK CRYSTAL DISPOSAL AREA

POND 4

HIGHWAY 141

POND 3

POND 6

POND 2

SAN MIGUEL RIVER

POND 1

POND 5

PLAN OF CLUB RANCH PONDS AND ATKINSON CREEK AREA

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Job Number	Date:	Fig. 8.1.1-4
25,998	JULY, 1983	

gravels. These materials are relatively thin (10 to 20 feet in thickness) and may have moderate to high permeabilities. The surficial materials are underlain by the Entrada/Carmel and Kayenta formations having both primary and secondary (joint) permeability.

3.1.2 Hydrogeology

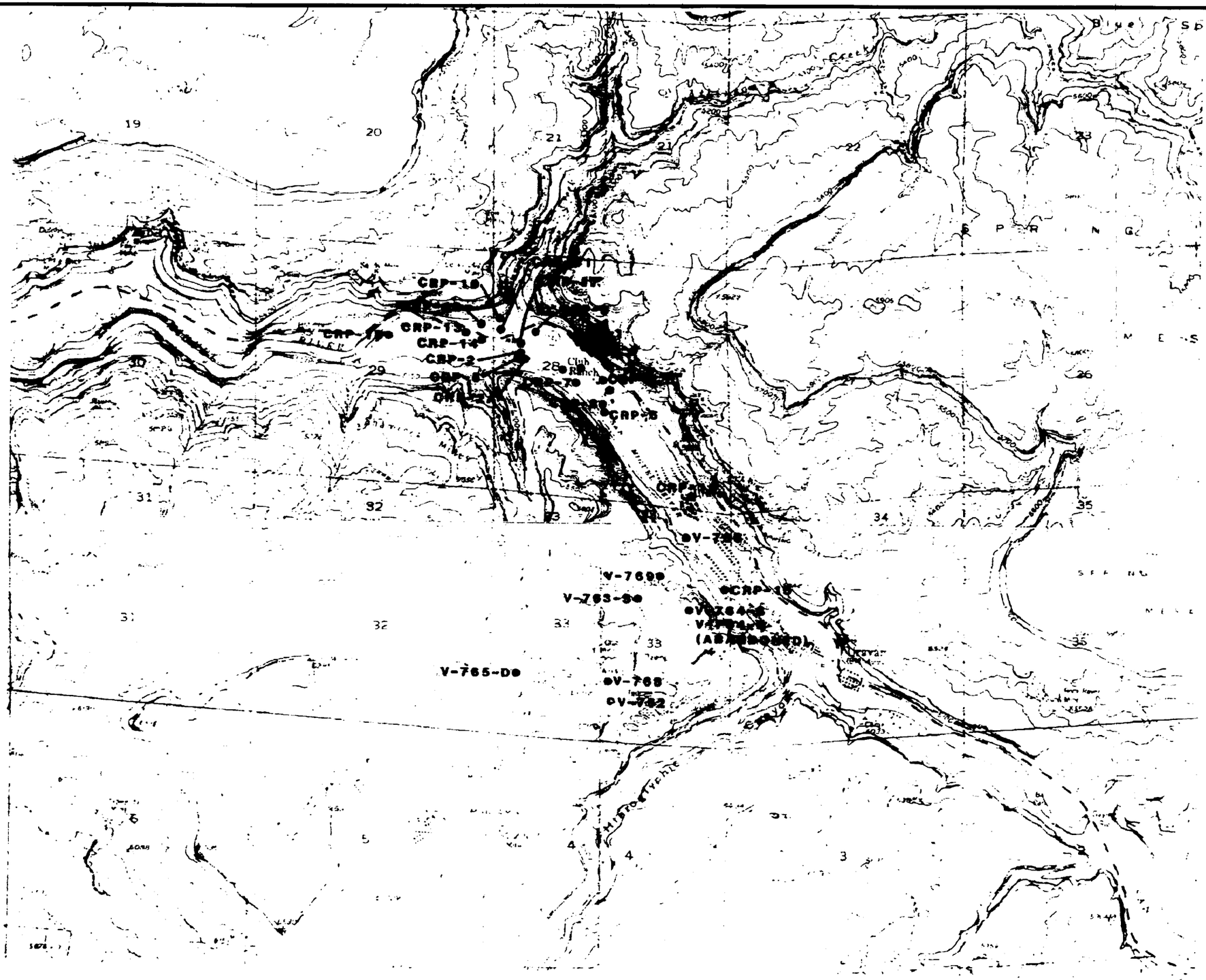
Uranium and vanadium have been mined and milled in the Uravan area for about 75 years. In the past, industry was not required to determine the background or pre-mining/milling condition of resources, including ground water. As a result of this situation, it is not possible to determine pre-operational conditions at areas that are presently contaminated or impacted. Therefore, the regional description of the hydrogeology presented in Section 2.3 will be considered as the general background condition and data collected from specified on- and off-site wells will be used to represent background conditions of currently contaminated areas. The approximate locations of observation wells at the Uravan Facility are depicted in Figure 3.1.2-1.

Water-bearing zones beneath the San Miguel River occur in the bedrock formations and the unconsolidated sediments. Bedrock formations containing water include the Kayenta and Wingate

formations, although some water may be present in the Entrada/Carmel Formation. The unconsolidated sediments are relatively thin in the Uravan area and include three gravel terraces and associated colluvium. Ground water in these sediments is recharged from the underlying bedrock or from the sides of the canyon and discharges to the river.

Club Ranch Ponds and Atkinson Creek Disposal Area: The Kayenta Formation beneath the San Miguel River is approximately 200 feet thick and is thickest at the confluence of Hieroglyphic Canyon and the San Miguel River. The underlying contact between the base of the Kayenta and the top of the Wingate Sandstone is exposed to the surface on the San Miguel River approximately 1.5 miles below the confluence of Atkinson Creek and the San Miguel River.

The Wingate Sandstone occurs beneath the Kayenta Formation. The Wingate Sandstone in the Uravan area is approximately 200 feet thick and is a massive sandstone containing thin interbeds of shales. The Wingate is not fractured as extensively as is the Kayenta although it is in hydrologic contact with the overlying Kayenta. With the Chinle Formation as an aquitard beneath the Wingate, the Wingate Sandstone effectively forms the base of the aquifer system in the River Valley. The base of the Wingate Sandstone is exposed to the surface near the confluence of the



NOTE: Actual location of wells may be found in May, 1984 PELRS prepared by Colorado DOH.

APPROXIMATE LOCATION OF URAVAN OBSERVATION WELLS

FIGURE 3.1.2-1

San Miguel and Dolores rivers.

There seems to be little distinction between ground water in the upper Kayenta-Wingate and the unconsolidated material. These units appear to act as a single aquifer in the subject area. Past analysis of monitoring well water level data by UCC/Umetco showed ground water to be moving southwest toward the river from beneath the terrace material and/or from the sides of the canyon. Seepage from the evaporation ponds influences the shape of water table surface, but does not significantly alter the general flow direction. Ground water moves in a down-valley direction and toward the river. Some contaminated groundwater discharges into the lowest reach of the Atkinson Creek.

River Ponds: The River Pond area has not been monitored for ground water quality or quantity, and therefore, little is known about the site. Dames and Moore (1978) reported for Union Carbide that seepage from the ponds is on the order of 10 to 40 gallons per minute. Since the ponds are on the south side of the river, ground water flow is most likely from the south side of the canyon through the unconsolidated material to the river. There may also be a significant component of shallow water movement in the same direction as river flow, depending on depth to bedrock and the degree of hydraulic connection with the river.

3.2 CLUB MESA AREA

3.2.1 Geology

Club Mesa is directly southwest of Uravan and is about 400 feet above the San Miguel River. Bedrock and surficial geology of Club Mesa is shown on Figures 3.2.1-1 and 3.2.1-2. Bedrock units in the area are, from youngest to oldest, the Brushy Basin and Salt Wash Members of the Morrison Formation, Summerville, Entrada/Carmel, Navajo, and Kayenta formations.

A description of these units is included in Figure 2.3-1. Most of these formations are dominated by thick sandstone sequences. Two of these units are predominantly shale units; the Brushy Basin Member and the Summerville Formation. All of the units are inclined gently toward the northeast at about 2° to 3°. Faulting on Club Mesa has not been identified but an orthogonal joint set is present. One joint set parallels bedding and the other two sets are nearly vertical. These vertical joints strike north 45° west and north 45° east. The trend of these joints parallels the trend of the San Miguel River Canyon or its major tributaries. Secondary permeability is probably provided by this jointing.

Surficial materials are very thin on Club Mesa, generally

SCALE 1"=800'

EXPLANATION

- f — Fill
- t — Tailings Piles
- p — Effluent Ponds and Evaporation Sites
- Qfp — Flood Plain Alluvium
- Qc-1 — Lower Level Colluvium
- Qc-2 — Middle Level Colluvium
- Qc-3 — Upper Level Colluvium
- Jmb — Brushy Basin Member, Morrison Formation
- Jms — Salt Wash Member, Morrison Formation
- Js — Summerville Formation
- Jec — Entrada Formation and Carmel Formation
- TrJn — Navajo Sandstone
- Trk — Kayenta Formation

Contact, approximate contact of map units

Saltwash Sandstone Mesa Rims

Undermined Areas

CLUB MESA AREA
GEOLOGY MAP

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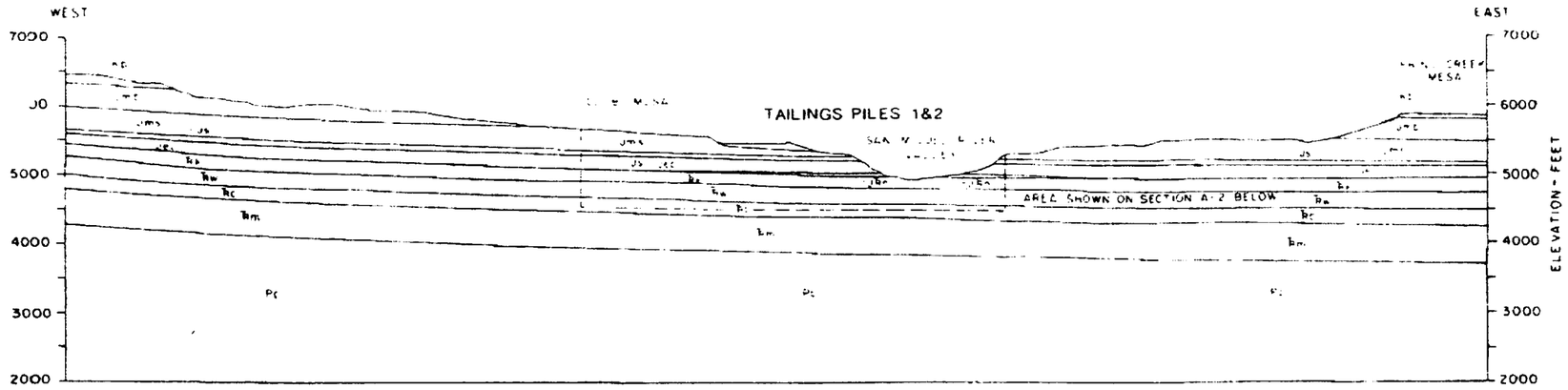
CONSULTING ENGINEERS
DS S. ZUNI · DENVER, CO. 80223

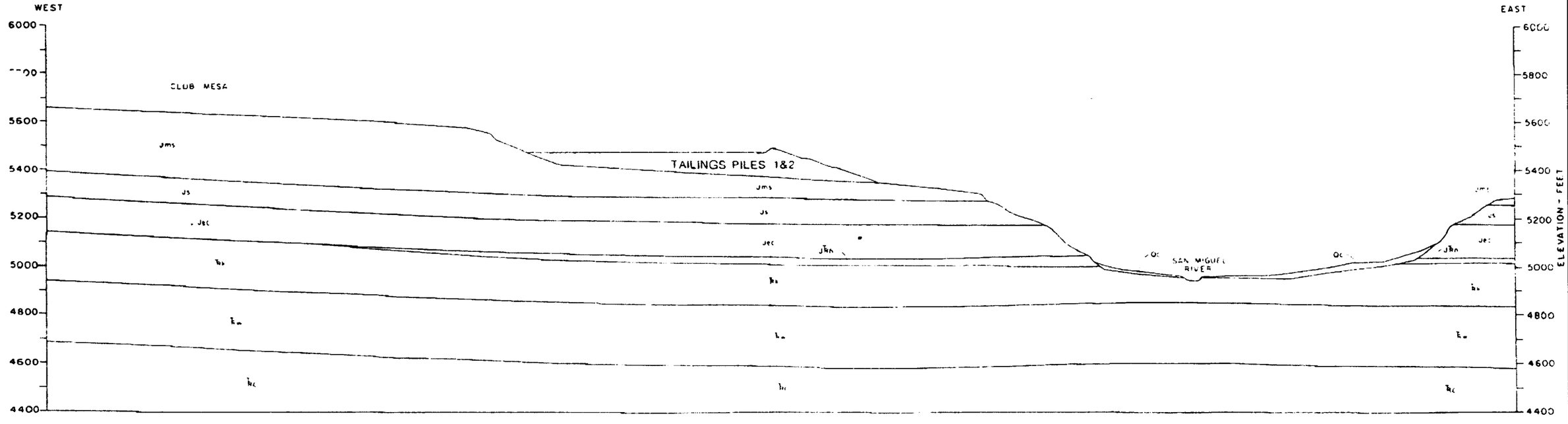
Date: JULY, 1982

Fig. 3.2.1-1



SECTION A-1

SCALE 1"=2000' HORIZ & VERT



SECTION A-2

SCALE 1"=400' HORIZ & VERT

EXPLANATION

Qal Alluvium	Kbc Burro Canyon Formation
Jmb Brushy Basin Member	Jms Salt Wash Member
Js Summerville Formation	Jec Entrada Sandstone & Carmel Formation
Kd Dakota Sandstone	Kb Burro Canyon Formation
Kmv Mancos Shale	Pc Cutler Formation

MORRISON FORMATION

NOTE Subsurface geology is approximate and is based on test hole and inferences from outcrop geology

GEOLOGIC CROSS-SECTIONS TAILINGS PILES AND CLUB MESA AREA

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[illegible] SOUTH FUNK STREET . DENVER, COLORADO [illegible]

JULY 1983

25,998

Fig. 3.2.1-2

less than 10 feet thick, and are composed of residuum, colluvium, and alluvium. These surficial materials are thickest in the small, intermittent drainages and on small benches formed along the canyon walls. These materials are not shown on the geologic map (Figure 3.2.1-1) because of their limited thickness and lateral extent.

The resistant sandstone cliffs in the Salt Wash member of the Morrison Formation which make up the upper and lower Club Mesa rims are actively retreating. Based on long-term downcutting rates observed for the Colorado River system, it is estimated that incision of the San Miguel River through the lower Club Mesa caprock (the onset of mesa rim retreat) probably took place about 1.9 to over 3.0 million years ago. Geomorphic studies at Uravan (Smith, 1980) indicate maximum retreat rates between 1.0 and 4.0 feet per thousand years which are similar to rates reported elsewhere in the Colorado Plateau. These average rates are exceeded locally by gully erosion along drainages on the mesa rims.

Both tailings disposal and raffinate evaporation operations have occurred on Club Mesa. The location of these areas is shown on Figures 1.1-1 and 2.1-1. Geologic conditions particular to each of these areas are briefly described below.

Club Mesa Tailings Piles: The existing Tailings Piles are likely underlain by a thin veneer of surficial materials that is less than 10 feet thick, and sandstone bedrock. This bedrock is the Salt Wash Member which is about 100 feet thick and composed of thick sandstone with interstratified lenses of claystone and siltstone. Joints in the Salt Wash are similar to the three orthogonal joint sets described above. Beneath the Salt Wash is the shaley Summerville Formation and sandstones of the Entrada/Carmel, Navajo, and Kayenta Formations. The sandstone units beneath the Tailings Piles have both primary and secondary permeability.

Club Mesa Spray Area: The raffinate evaporation area on the highest bench of Club Mesa is up-slope from the Tailings Piles and is underlain by the same bedrock sequence as the Club Mesa Tailings Piles. The area is near the contact between the Salt Wash and Brushy Basin Members of the Morrison Formation. This stratigraphic horizon has provided much of the uranium ore in the Uravan mining district. The general outline of the abandoned mine workings which are presently inaccessible is shown in Figure 3.2.1-1. The extent of the mined-out area shown is based on old mine maps on file with UCC/Umetco. Elevations on the mine maps indicate that the depth of mining is relatively shallow and ranges from 20 to 30 feet below the ground surface and that pillars exist throughout the mines. The Salt Wash is probably a

relatively stable roof rock but there is some evidence of subsidence and soil piping into the abandoned mines. Judging from the relatively shallow depth of the mines and past subsidence, these abandoned workings represent relatively high potential for future mine subsidence. It is reasonable to expect the development of additional subsidence pits at the ground surface over the long term. These pits could be several tens of feet in plan dimension and could be several feet to a few tens of feet deep.

3.2.2 Hydrogeology

Uranium and vanadium have been mined and milled in the Uravan area for several decades. In the past, industry was not required to determine background or pre-mining conditions of resources, including that of ground water. Because of this situation, it is not possible to determine pre-operational background conditions at areas that are presently impacted or contaminated. Therefore, the regional description of the hydrogeology presented in Section 2.2 will be considered as the general background condition and data collected from specified on- and off-site wells will be used to represent background conditions of currently contaminated areas. The approximate location of observation wells at the Uravan Facility is depicted in Figure 3.1.2-1.

The same hydrostratigraphic sequence described in Section 2.3.3 occurs beneath Club Mesa. The uppermost unit is the Salt Wash Member of the Morrison Formation and the deepest is the Kayenta-Wingate. Units younger than the Salt Wash have either been removed by erosion or exist only as isolated erosional remnants.

Envirologic Systems, Inc. (1983b) describes the Club Mesa monitoring system which includes wells drilled by IECO, and Dames and Moore for Union Carbide. The "V" series wells, which were established by IECO in 1980, range in depth from 50 feet to 438 feet (International Engineering, 1981) and monitor the Kayenta-Wingate and Salt Wash water-bearing zones, and the Summerville aquitard. Water quality data collected by UCC/Umetco since January 1981 from the "V" series wells, excluding 1983 data, are presented by Envirologic Systems, Inc., 1983b. Bishop, Brogden, and Rumph, Inc. (BBRI) drilled five additional "V" series wells for UCC/Umetco on Club Mesa in January and February 1986 (V-768, V-769, V-770, V-771, and V-772.

Kayenta-Wingate Water-Bearing Zone: The Kayenta-Wingate sequence beneath Club Mesa includes a 400-foot sequence of sandstones with interbeds of shales. Both formations are approximately 200 feet thick. The lower part of the Kayenta-Wingate sequence is saturated and water level elevations observed

in monitoring wells V-768 and V-769 indicate that the groundwater system in the Kayenta-Wingate is hydrologically connected to the San Miguel River. The data also suggest that the gradient beneath Club Mesa is low. The direction of ground water flow is projected to be to the north and northeast. Aquifer testing in wells V-768 and V-769 by BBRI revealed that transmissivities for this sequence are low and are approximately 0.11 and 1.6 gallons per day per square foot, respectively, as calculated by BBRI (BBRI, 1986).

Summerville and Entrada Formations: Little is known about these zones beneath Club Mesa. Monitoring well V-764S is completed in the Summerville and consistently shows a water elevation of about 5223 feet, which indicates about 4 or 5 feet of water in the well. The water levels in V-764S also show possible seasonal variations, but these variations are not distinct. Only one analysis has been performed due to the low water level, and that analysis showed very high concentrations of sulfate, chloride, and nitrate with total dissolved solids (TDS) of 11,148 milligrams per liter (mg/1).

Salt Wash Member of the Morrison Formation: There is no direct evidence for the presence of a saturated zone in the Salt Wash prior to mining and Union Carbide's disposal activities on Club Mesa. Waste disposal activities have contaminated the Salt

Wash sandstone and formed a perched zone within this unit. If a saturated zone did exist prior to milling, it must have been very thin and perched above the Summerville aquitard. Monitoring wells (V-763S, V-765 and V-767) have shown cyclical variations in water levels indicating the possibility of seasonal recharge. Seasonal cycles in the milling operation and disposal could also account for these cyclical water level fluctuations. BBRI drilled three wells into the Salt Wash in January and February 1986 (V-770, V-771, and V-772).

Water quality data indicate that most of the Salt Wash member is contaminated beneath the Tailings Piles and Spray Area. For the most part, this contamination is in the form of high concentrations of sulfate, chloride, ammonia, and nitrate, but at several shallow monitoring sites, thorium-230 and uranium are found at elevated levels. The present water surface is relatively shallow and parallels the surface topography, discharging from the canyon wall.

3.3 CONCEPTUAL AQUIFER MODELS AND AQUIFER CONTAMINATION

3.3.1 Conceptual Aquifer Models

The following discussion describes a conceptualization of the hydrogeologic model for Uravan based upon data generated in the January 1986 BBRI field investigation. While the following discussion focuses on the hydrologic characteristics of the Kayenta and Wingate stratigraphic units, it is important to recognize that the Kayenta and the Wingate are in direct hydraulic connection and they form a single aquifer unit. Key features of the hydrogeologic model are: 1) a low-permeability Kayenta-Wingate sequence beneath Club Mesa, and 2) a Kayenta-Wingate sequence in the River Valley which has a high-permeability in its upper portion (fractured Kayenta) and generally has low-permeability at depth (less-fractured Wingate). The sandstones beneath Club Mesa and at depth beneath the river valley are not extensively fractured and water is transmitted through the sandstones by primary porosity and permeability. These sandstones contain groundwater in storage but generally release only small amounts of groundwater to properly constructed wells. In contrast, the highly fractured Kayenta Formation in the River Valley yields relatively large amounts of ground water. Aquifer tests of wells V-768, V-769 and CRP-15, -16, -17 and -18 were drilled to test the aquifer properties of the Kayenta and

the Wingate and to collect water samples from the aquifer in these locations. The data from these tests showed that the permeabilities of Kayenta Formation in the river valley are higher than the permeabilities found in the Wingate Sandstone and in the river valley Kayenta-Wingate sequence beneath Club Mesa. Testing of CRP-15, -16, -17, and -18 using packers to isolate specific intervals reveal that the Kayenta in the river valley can yield between 50 and 200 gallons per minute to pumping. This investigation showed that production from the Wingate in the river valley and the Kayenta-Wingate sequence beneath Club Mesa was generally in a range of 5 to 10 gallons per minute. These differences are primarily due to the presence of fractures. Where the Wingate is fractured, it has a higher permeability that is similar to the permeability of the Kayenta. In the absence of fractures, the Wingate is a low-permeability aquifer.

The highly fractured Kayenta Formation in the River Valley is a narrow and restricted but active groundwater system in hydrologic contact with the San Miguel River. This active system is approximately 1000 fee wide, 200 feet deep, and runs the length of the valley.

Contaminants from hillside seepage, the River Ponds and the Club Ranch Ponds are present in the Kayenta Formation. Contaminants have also been measured in the underlying low-

permeability Wingate Sandstone. The fact that the near-surface Kayenta Formation is highly fractured and exhibits high permeabilities suggests that a groundwater restoration program may be feasible.

Contaminants in the river valley occur in the fracture voids in the Kayenta-Wingate sequence and to some extent in the sandstone rock matrix. Studies by Chandra (1981) for Union Carbide, revealed that within the zone of contamination from the Club Ranch Ponds, calcium carbonate-sulfate crystals have formed along the fractures. The significance of these crystal growths on the fractures is that the bleed rate of contaminants into the fractures from the matrix may be relatively slow. However, no extensive study has been made to confirm the extent or significance of crystal growth in the fractures. Monitoring of the groundwater remedial action will provide the best information on this issue.

In this type of regime, a groundwater restoration plan can concentrate on removing contaminants from the fractures of the sandstone and rely on a low bleed rate from the matrix to remove additional contaminants. The sandstone matrix itself produces very little water relative to the production from the fractures. Thus, constructing pumping wells in the area of contamination in the vicinity of the Club Ranch Ponds, will remove most if not all

of the contamination that can flow freely to the well within a relatively short period of time.

3.3.2 Aquifer Contamination and Geochemistry

The acidic raffinate liquid undergoes a series of geochemical reactions as it enters and moves through the subsurface. These geochemical reactions include precipitation, adsorption, and neutralization. These reactions occur to varying degrees, but their effect is to reduce the apparent level of contamination in the groundwater by reducing concentrations of metals, radionuclides, and inorganic contaminants. It is important to recognize that many of these reactions are reversible and that the contaminants may be released back into the groundwater. It is because of these geochemical reactions, and because of dispersion and dilution of contaminants in the aquifer that the contaminant levels in the groundwater are less than the concentrations found in the raffinate liquid.

Contaminant plumes are present beneath and downgradient from the Club Mesa Tailings Piles and Spray Area (Envirologic Systems, Inc., 1983b) and the Club Ranch Ponds (Envirologic Systems, Inc., 1983a), the A-Plant area, and the southern bank area of the San Miguel River between Club Mesa and the river. Groundwater contamination is suspected to be present beneath and downgradient

from the River Ponds (on both sides of the river), although no monitoring wells have been drilled in this area for confirmation. Geochemical reactions in these areas follow the general framework set forth above. Subsurface liquid migration from the Spray Area is enhanced by mine voids that underlie the Spray Area. Infiltration travels into the underlying sedimentary rocks and exits along the mesa rim in seeps and vertically down toward the underlying aquifers. In the area of the Club Ranch Ponds, raffinate infiltrated the surficial materials and the Kayenta Formation directly from the bottoms of the ponds. In time this contamination ultimately discharges to the San Miguel River.

Chemical analyses from perched liquid on Club Mesa indicate that some of the raffinate seepage has been neutralized by reactions with the sedimentary rocks (Envirologic Systems, Inc., 1983a). These analyses also show that the perched liquid contains elevated levels of sulfate, chloride, potassium, sodium, magnesium, ammonia, nitrate, zinc, vanadium, selenium, uranium, arsenic, and mercury. Water quality information from the past monitoring program has shown that the total dissolved solids concentrations of fluids in the Salt Wash on Club Mesa range from 1,388 to 48,914 milligrams per liter (mg/1), sulfate concentrations ranged from 308 to 17,305 mg/1, ammonia concentrations ranged from less than 0.5 to 890 mg/1, and the pH ranged from 3.4 to 8.2. Elevated levels of sulfates, magnesium,

chlorides, metals, radionuclides, and other inorganic constituents are present. Wells in the Salt Wash on Club Mesa from which UCC/Umetco has collected these data include wells V-763S, V-764S, V-765 and H-7.

Water quality sampling completed on V-768 and V-769 show little to no contamination of the groundwater system in the Kayenta-Wingate sequence from the overlying mill operations. A water sample collected from V-768 revealed low levels of ammonia and nitrates. Slightly elevated levels above background of magnesium and sulfate were also found in this sample. The total dissolved solids concentration was 4560 mg/1. The water from V-768 was a sodium chloride type. Water quality samples from V-769 showed similar results but the overall concentrations of parameters analyzed were lower. There was no ammonia or nitrate measured in the water sample and the water was of a sodium chloride type. Magnesium and sulfate concentrations were low. The concentration of total dissolved solids was 1340 mg/1.

A similar geochemical situation is indicated in the area downgradient of the Club Ranch Ponds. These geochemical reactions do not fully neutralize the raffinate solution before it enters the San Miguel River. High levels of total dissolved solids, some dissolved metals, radionuclides, and other inorganic contaminants are transported into the river. The concentrations

of dissolved metals and radionuclides in the groundwater are lower than the concentrations of these constituents in the parent raffinate liquid.

Previously, 14 observation wells were drilled into the upper part of the Kayenta Formation in the River Valley. These 14 wells, CRP-1 through CRP-14 have been monitored for several years by UCC/Umetco and records of water level fluctuations and groundwater quality are available. The data indicate that leakage from the Club Ranch Ponds has migrated into the Kayenta Formation and is moving generally in a down-valley direction. Water levels in observation wells also indicate that the direction of ground water flow is generally down-valley and towards the river. Total dissolved solids (TDS) concentrations in the observation wells range from less than 15,000 milligrams per liter (mg/1) to as much as 170,000 mg/1 in wells downgradient from the Club Ranch Ponds. Radionuclides, dissolved metals, and inorganic contaminants are also present at elevated levels in the aquifer as shown by monitoring well analyses downgradient of the Club Ranch Ponds (see Table 3.3-1). Background (uncontaminated) groundwater in the Kayenta Formation has TDS concentrations in a range from 200 to 500 mg/1 as shown in wells CRP-1, CRP-4, G-block, and F-block.

TABLE 3.3-1 GROUNDWATER QUALITY AT URAVAN COMPARING GROUNDWATER SAMPLE RESULTS FOR CRP-4 (BACKGROUND WELL) AND CRP-2 (CONTAMINATED WELL)

PARAMETER	UNITS	CRP-2	CRP-4	LLD'S
Date		11/15/84	10/18/94	
Sample Type		Pumped	Pumped	
Top Casing Elev.	ft.	4941.980	4995.650	0.001
B. Casing Elev.	ft.	4891.980	4935.650	0.001
Phreatic Elev.	ft.	4927.880	4959.950	0.001
Temp.	C.	14	14	-2.000
Cond. @25 C	umhos	17,136	365	10.000
pH	Units	6.64	7.58	0.100
TDS	mg/1	27,090	272	10.000
Sol. Sulfates	mg/1	18,560	28	10.000
Sol. Chlorides	mg/1	1,420	4	10.000
Sol. Sodium	mg/1	783	19.6	0.100
Sol. Calcium	mg/1	494	45.4	10.000
Sol. Potassium	mg/1	378	10.1	0.100
Sol. Nitrite/N	mg/1	0.02	<0.02	0.100
Sol. Nitrate/N	mg/1	2	<0.04	0.100
Sol. Ammonia	mg/1	1,610	0.2	1.000
Sol. Zinc	mg/1	0.208	<0.02	0.020
Sol. Selenium	mg/1	<0.250	<0.01	0.010
Sol. Magnesium	mg/1	1,202	22.1	0.100
Sol. Manganese	mg/1	6.63	0.028	0.050
Sol. Iron	mg/1	26.8	0.059	0.025
Sol. Carbonate	mg/1	<1	<1	1.000
Sol. Bicarbonate	mg/1	1,960	258	1.000
Sol. U-Nat.	pC/1	470	<3	0.200
Sol. Th-230	pC/1	0.20±0.50	0.00±0.40	3.100
Sol. RA-226	pC/1	2.40±0.50	1.10±0.40	0.310
Sol. Pb-210	pC/1	0.40±0.90	13.00±2.00	4.800
Sol. Po-210	pC/1	0.10±0.60	-0.50±0.90	1.000
Zinc*	mg/1	0.63	<0.01	0.01
Copper*	mg/1	0.07	<0.01	0.01
Arsenic*	mg/1	<0.01	<0.01	0.01
Mercury*	mg/1	<0.0003	<0.0003	0.0003
Cadmium*	mg/1	<0.01	<0.01	0.01
Chromium*	mg/1	<0.01	<0.01	0.01
Lead*	mg/1	<0.01	<0.01	0.01
Silver*	mg/1	<0.01	<0.01	0.01

* CRP-2 sample 10/6/83, CRP-4 sample 10/5/83)

LLD = Lower Limits of Detection
pC/1 = picoCuries per liter

3.4 SOILS AND VEGETATION

3.4.1 Soils

A description of soils in the vicinity of Uravan is presented in Section 2.5.1. Widespread, heavy grazing of the area has resulted in disturbance of the surface layers of much of the soil. Road construction, excavation, stockpiling of ore and waste materials, and other activities associated with mining and milling operations have contributed to soil disturbance near Uravan, along the San Miguel River canyon walls, and on Club Mesa. Cover by cryptogamic crust ranges from nonexistent in areas of intense disturbance, to light over most of the soil surface in the Uravan vicinity, to moderately heavy on isolated areas protected from grazing and free from other disturbance. Erosion varies with level of disturbance.

The Uravan mill has been shown to be the source of soil contamination through dispersion of airborne contaminants (ERI Logan, 1986). Soils in the vicinity of the mill show elevated levels of arsenic, barium, cadmium, lead, nickel, vanadium, zinc, gross alpha and gross beta. Soil contaminant concentrations decrease with increasing distance from the mill. Nickel concentrations are affected by geologic parent material and proximity to mine workings and ore storage piles. The distributions of levels of the other contaminants are not affected by these factors. The most widespread contaminant is vanadium.

Locations at which the soils show elevated levels of contamination include tops of mesas in all directions from the mill site, benches above the San Miguel River upstream and downstream of Uravan, and the riparian zone upstream and downstream of Uravan. The areal extent of contamination varies with contaminant, wind direction, physiographic position of the soil, and other factors.

3.4.2 Vegetation

Vegetation in the vicinity of Uravan generally resembles the description of regional vegetation presented in Section 2.5.2. Grazing by livestock and big game is the major land use in this area.

In pinon-juniper woodland areas, shrubs are sparse and in low vigor. The understory vegetation consists of approximately one-third of its potential cover. Annual species are common. Range trend appears to be downward (Gibbs & Hill, 1984). Several stands of pinon and juniper trees were observed in the vicinity of the Uravan mill.

Sagebrush/grass vegetation is very heavily grazed. A difference in grazing intensities between mesas on the north and south sides of the San Miguel River was observed. Different livestock operators lease the grazing allotments of the two sides of the river and use different management practices. Mesa and bench vegetation on the north side of the river was more heavily used than that on the south

side of the river. Vegetation in the large open areas within the pinon-juniper woodland on the north side of the river consisted of dense stands of sagebrush (Artmeisia tridentata) with an understory of broom snakeweed (Xanthocephalum sarothrae), cheatgrass (Bromus tectorum), prickly-pear cactus (Opuntia spp.), and occasional perennial grasses. The abundance of broom snakeweed and annual grasses, as well as the increasing cover of sagebrush, are indications of overgrazing and downward range trend.

Vegetation in the large open areas within the pinon-juniper woodland on mesas and benches on the south side of the San Miguel River consisted primarily of assorted perennial grasses. Shrubs were generally scattered sparsely in these areas. Common grass species identified included blue grama (Bouteloua gracilis), three-awn (Aristida longiseta), alkali sacaton (Sporobolus airoides), and others which could not be identified at the time of observation in January. Shrubs included sagebrush, rubber rabbitbrush (Chrysothamnus nauseosus), four-wing saltbrush (Atriplex canescens), and winterfat (Ceratoides lanata). Broom snakeweed was present along with buckwheat (Eriogonum spp.) and a few other forbs. Some of the vegetation differences on the south side of the river relative to the north side may be attributable to soil and aspect differences.

The riparian zone along the San Miguel River near Uravan consists of several zones of vegetation. Directly along the banks of

the river and in areas that flood seasonally, the vegetation consists of willows (Salix spp.), alders (Alnus tenuifolia), cottonwoods (Populus angustifolia), tamarisk (Tamarix pentandra) and other species adapted to periodic floodings. Farther from the river bank are zones dominated by rubber rabbitbrush and sage brush with various associated grasses, forbs and shrubs. The number of vegetation zones present and the sizes of the zones depend on the width of the canyon bottom in a given area.

Within the town of Uravan, vegetation consists of lawn grass, shade trees, various ornamental plants, and weedy species common in urban and industrial areas.

Agricultural vegetation in the Uravan area consists of irrigated fields and pastures at some distance from Uravan in the riparian zone and on the lower benches upstream on the San Miguel River. Some miles downstream on the Dolores River, the first downstream crops occur. Crops consist of mostly hay and some corn used for livestock feed. Water from the San Miguel River is used for irrigation of crops and pasture grass upstream of Uravan. Tributaries to the rivers are used as the source of irrigation water downstream of Uravan.

No vegetation samples were obtained for analysis during the ERI 1986 January Winter Baseline Investigation. Results of previous

studies of vegetation contamination are summarized in the following paragraphs.

In determining off-site impacts to vegetation in the vicinity of the Uravan uranium mill, there are two general areas to be considered. First are the tops of neighboring mesas located north and east of the Uravan Mill site. Radionuclide concentrations have been determined for five forage plant species at four sample sites on Spring Creek Mesa (Figure 3.4.2-1).

For all radionuclides in all plant species sampled at these sites, concentrations at site D are somewhat higher than concentrations at any of the other sites. Site D has been noted to be affected by airborne contaminants from a mine vent nearby. U-nat and Th-230 are the only radionuclides that are affected by mining activities (Jones, 1983). Ra-226 concentrations in blue grama (Bouteloua gracilis), Indian rice grass (Oryzopsis hymenoides), galleta grass (Hilaria jamesii), and four-wing saltbush (Altiplex canescens) are plotted against distance in Figure 3.4.2-2. These graphs illustrate the general tendency for concentrations at site D to exceed concentrations at the other sites. No other data exist for vegetation concentrations on the mesa tops.

The second area of potential contamination to be considered is the San Miguel River Canyon in which the town of Uravan is located. There is evidence that off-site vegetation in the canyon in and around Uravan has been contaminated by radionuclides. In the "Radiation Dose Commitment Assessment for the Town of Uravan, Colorado" (Jones, 1983), radionuclide concentrations in forage vegetation were found to exceed background concentrations in similar vegetation by 1.3 to almost 10 times. Levels of Ra-226 exceeded background levels in the housing areas of A-, B-, D-, and F-Blocks, the sewage plant area, the swimming pool area, and west of Tailings Pile 2. A site in C-Block Area showed excess levels for 3 of 4 radionuclides measured. All other sites showed excess levels for 2 of 4 radionuclides measured. Geographic location relative to the mill did not seem to affect concentrations (See Figure 3.4.2-3).

In the same study (Jones, 1983), radionuclide concentrations for local garden vegetables were reported. Most of the reported concentrations exceeded concentrations measured in commercial vegetables from Uravan and Grand Junction, Colorado. Lowest relative concentrations for all radionuclides were reported for sites in B-Block and a combined sample for H- and J-Blocks.

These data for concentrations of radionuclides in garden vegetables were used to calculate ingestion dose rates which were

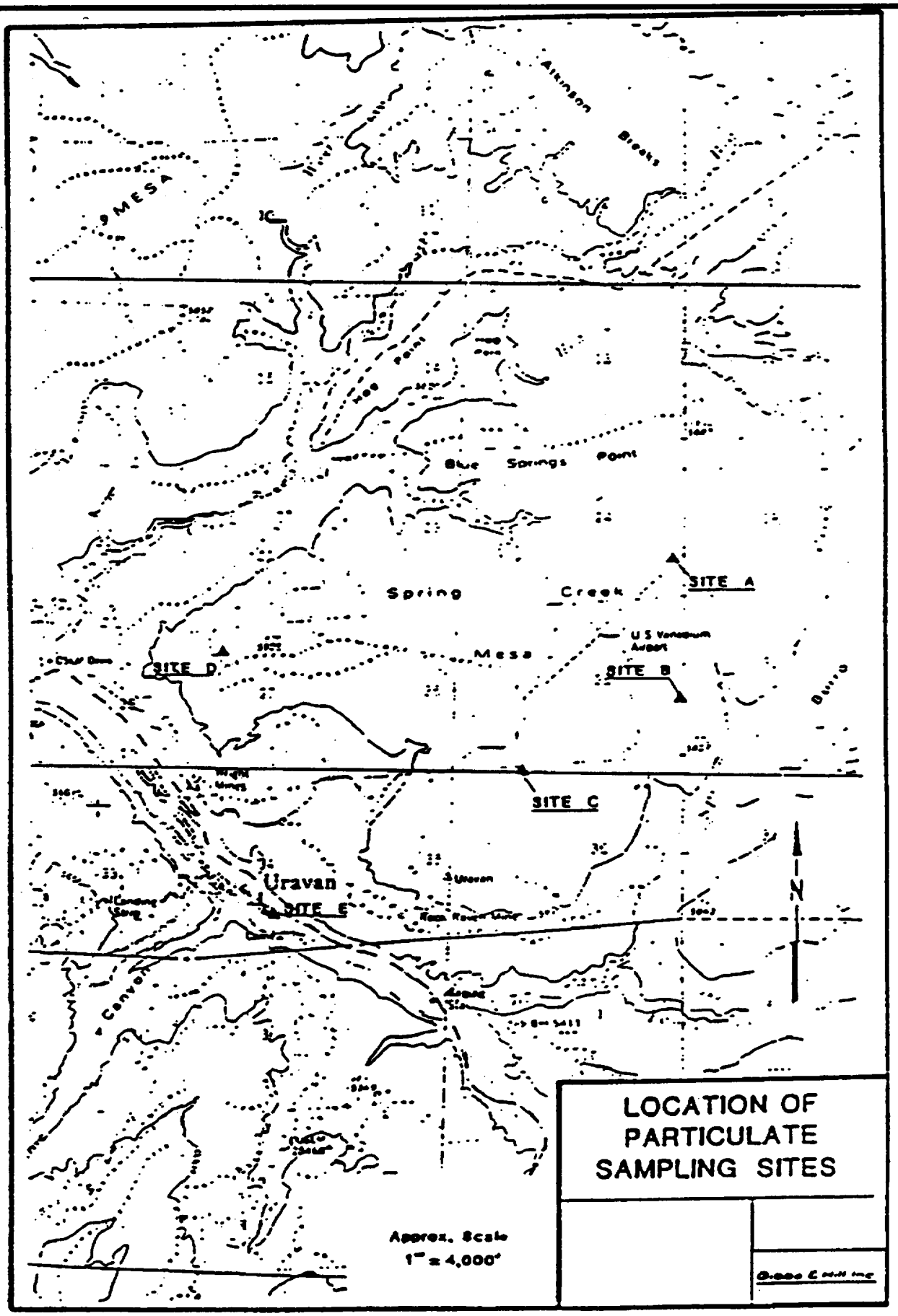
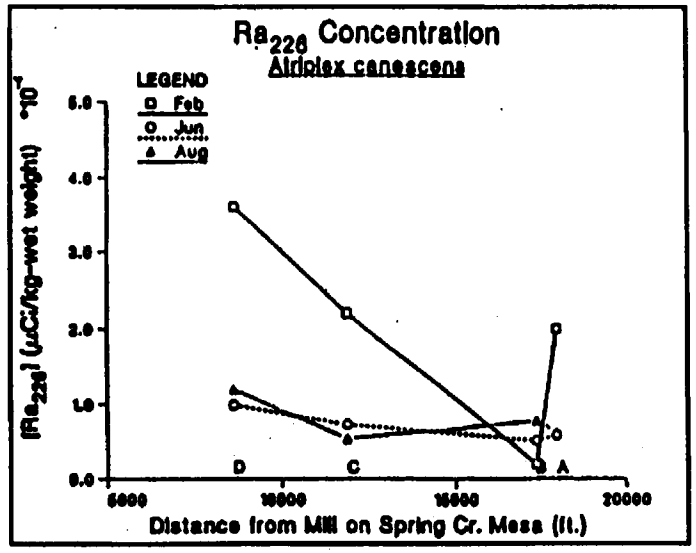
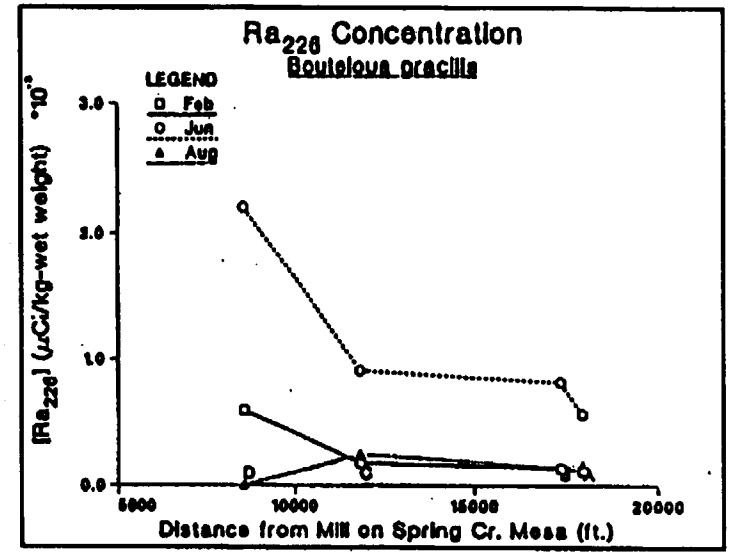
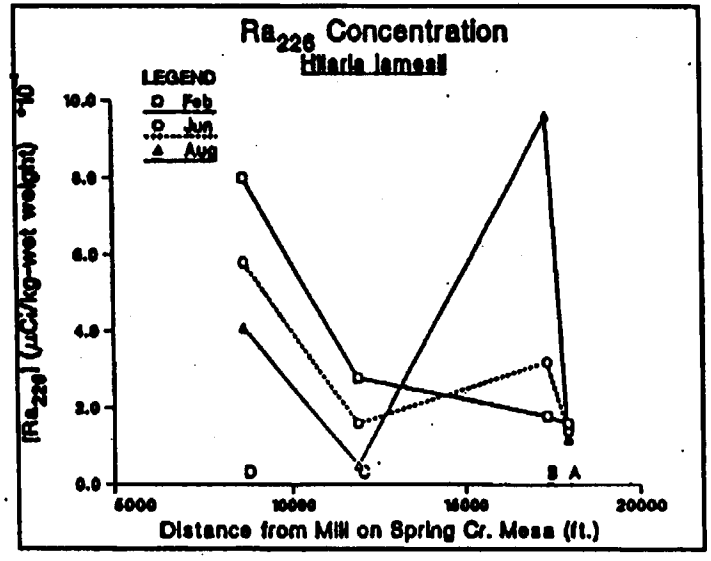


FIGURE 3.4.2-1 LOCATION OF SITES AT WHICH VEGETATION WAS SAMPLED FOR RADIONUCLIDES (Gibbs and Hill 1984)







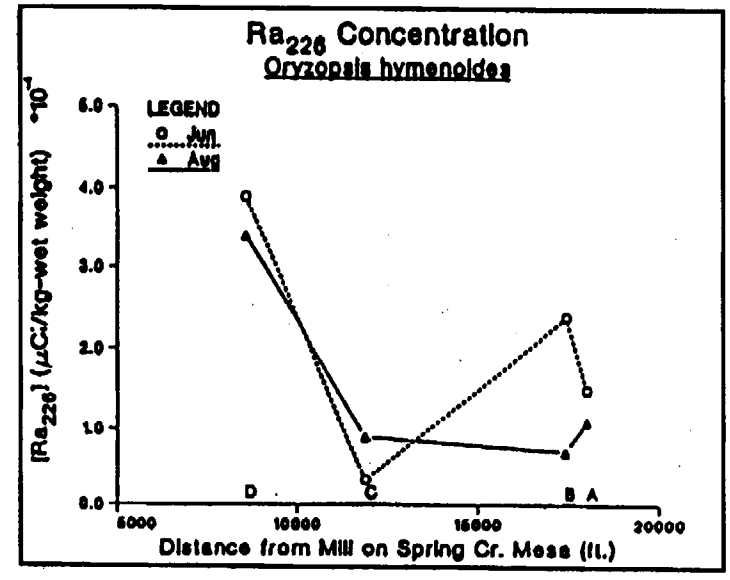


FIGURE 3.4.2-2 Ra-226 CONCENTRATIONS IN VEGETATION VS. DISTANCE FROM THE URAVAN MILL.

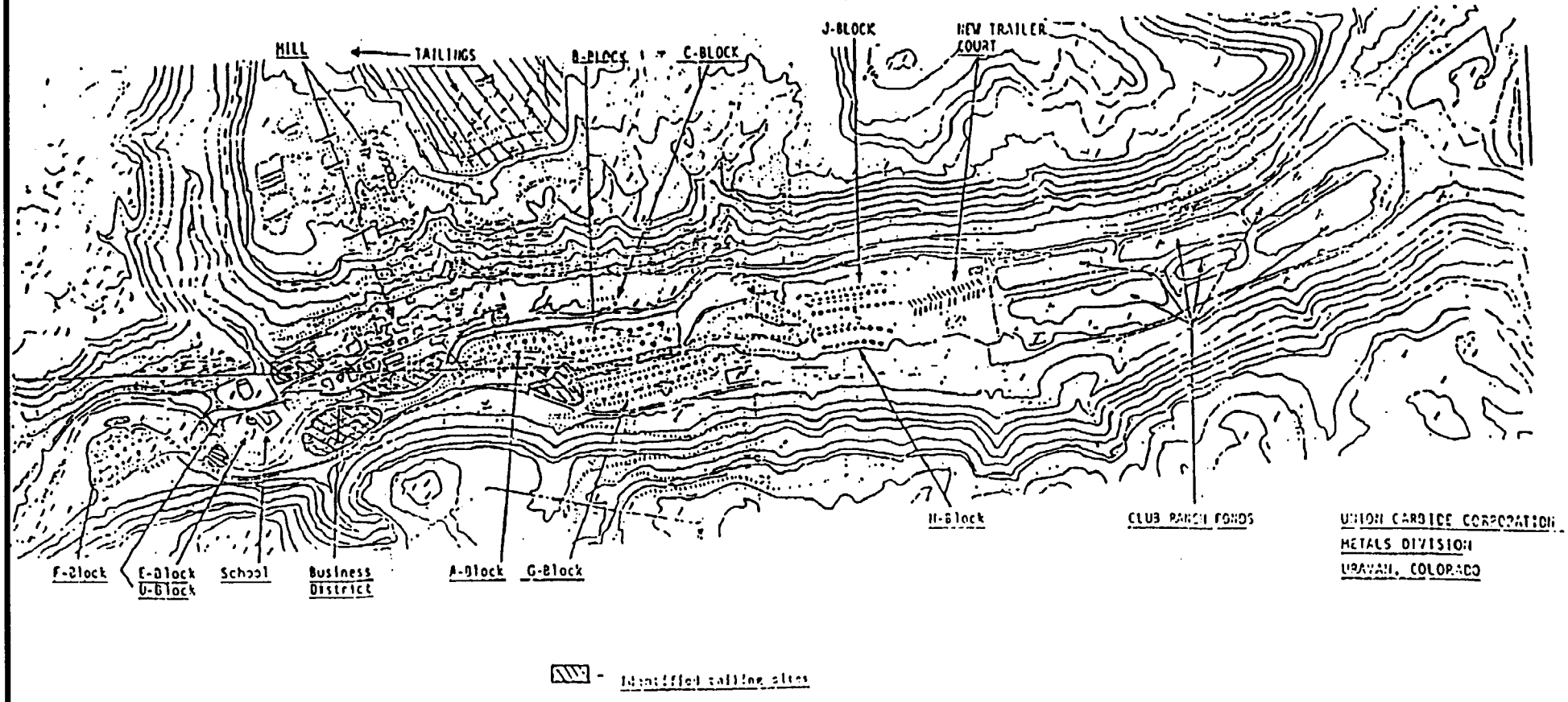


FIGURE 3.4.2-3 SAMPLE SITE LOCATIONS, TOWN OF URAVAN, COLORADO (Jones 1983).

reported in "Calculated Uravan Garden Vegetative Uptake Ingestion Dose Rates - 1982" (Union Carbide, 1983a). Dosages from vegetable ingestion exceeded 40 CFR 190 standards at sites F, H, J, and the old trailer court. While lower concentrations were observed in vegetables grown in J-Block, dose standards were exceeded due to the larger quantities of vegetables consumed. Only vegetables grown in B-Block showed concentrations and ingestion rates below the 40 CFR 190 standard for safety.

Measured concentration of radionuclides in vegetation and dose rates calculated from those concentrations indicate off-site impacts in the town of Uravan and within the San Miguel River Canyon.

3.5 AQUATIC RESOURCES - SURFACE WATER CHEMISTRY

3.5.1 Surface Water Chemistry

Historical data for water quality reveals evidence of heavy metal contamination of the San Miguel River by mining and milling activities upstream of Uravan. While there is attenuation of water column metals with downstream distance in the San Miguel, these concentrations are not reduced to zero upstream of Uravan (ERI, 1986). There are current loadings from upstream sources such as Naturita, Telluride Area, South Fork, and others which indicate a continuing metal contamination problem in the San Miguel River upstream of Uravan. Current ambient data is not sufficient to fully document the upstream contributions and the Uravan additions on a seasonal basis.

A substantial data base exists for the San Miguel River for dissolved Ra-226, TDS, sulfates and chlorides. This information has been collected by Federal agencies, the State (CDH) and by Union Carbide as part of its Radioactive Materials License. The data show the effect of the Uravan operations on water quality in the San Miguel River.

Ra-226 concentrations in the San Miguel River were examined by reviewing data from the series of weekly analyses of the river at and

downstream of Uravan from 1961 to 1972 collected by the U.S. EPA Radium Monitoring Networks. The highest observed dissolved concentration downstream was 26 picoCuries per liter (pCi/1) while the upstream control was generally below 0.5 pCi/1. More current monitoring data supplied by UCC/Umetco (total Ra-226) show peaks and seasonality which are very similar to those observed in the EPA Radium Monitoring Network (1961-1972) data.

A detailed analysis of the surface water quality was conducted in January 1986 (ERI, 1986). Upstream of Uravan, the San Miguel River receives loadings of Al Cd, cobalt (Co), Cu, Fe, Pb, manganese (Mn), silver (Ag), and Zinc. The trends in the chemistry of the study section of the San Miguel River are in part a recovery from these upstream loadings and in part a response to increased loadings. Table 3.5.1-1 shows the concentrations of Ag, Al Cd, Cu, Fe, nickel (Ni), Pb, molybdenum (Mo), vanadium (V), and Zn between stations ASM08 (below Naturita) and ASM01 (below Uravan at the confluence of the San Miguel and Dolores Rivers). Sediments show decreases in Ni and Pb and macroinvertebrates show decreases in Cu, Pb, and Zn. In general, it was observed that the level of all six contaminants rises between stations ASM05B and ASM03.

Maintaining acceptable water quality in the Uravan river reach is a function of the non-point and point loadings from the

TABLE 3.5.1-1 MAXIMUM CONCENTRATIONS OF TEN METALS IN WATER QUALITY SAMPLES IN THE SAN MIGUEL AND DOLORES RIVERS, JANUARY 1986.

	Concentrations (mg/1)									
Location	Al	Cd	Cu	Fe	Pb	Mo	Ni	Ag	V	Zn
ASMO1	1.18	0.0005	0.014	1.75	<0.005	<0.005	<0.01	<0.0005	0.006	0.056
ASMO3	1.1	<0.001	n.a.	1.84	<0.01	n.a.	n.a.	<0.0005	0.007	0.053
ASMO4	0.65	0.0006	n.a.	1.26	0.014	n.a.	n.a.	<0.0005	0.005	0.055
ASMO5	1.28	0.0003	n.a.	1.72	<0.01	n.a.	n.a.	<0.0005	0.006	0.041
ASMO5A	0.45	0.0002	n.a.	0.46	0.005	n.a.	n.a.	<0.0005	0.003	0.027
ASMO5B	0.64	0.0002	n.a.	0.63	0.005	n.a.	n.a.	<0.0005	0.003	0.027
ASMO5C	0.19	0.0001	n.a.	0.84	0.005	n.a.	n.a.	<0.0005	<0.002	0.022
ASMO6	0.22	0.0001	0.005	0.26	<0.005	<0.005	<0.01	<0.0005	<0.002	0.024
ASMO7	0.09	0.0001	n.a.	0.12	<0.005	n.a.	n.a.	<0.0005	<0.002	0.021
ASMO8	0.20	0.0002	n.a.	0.22	<0.005	n.a.	n.a.	<0.0005	<0.002	0.032
ADRO3	0.55	<0.0002	n.a.	0.62	<0.005	n.a.	n.a.	<0.0005	0.004	0.01
ADRO4	0.29	<0.0005	n.a.	0.73	<0.005	n.a.	n.a.	<0.0005	<0.01	<0.02

*n.a. = no analysis done

UCC/Umetco facility, upstream water quality, the release of previously adsorbed and/or precipitated metal back to the water column and sediment transport of contaminated sediments downstream.

3.5.2 Aquatic Biology

During the January 1986 study (ERI, 1986), sample collection included periphyton and macroinvertebrate in conjunction with water quality and sediments. The periphyton data appeared sensitive to metal loadings, and showed rapid uptake of metals downstream of potential sources. Several of metals showed elevated levels upstream from SMO6, the upstream control. Metals showing increased concentration in this location were A1, Cu, Mo, Pb, and V. These levels support other data indicating the existence of additional sources of contamination upstream of Uravan.

Metals (Ag, A1, Cd, Cu, Mo, Ni, Pb, V and Zn) increased markedly in the periphyton immediately downstream of the Club Ranch Ponds in samples on the Club Ranch Pond side of the river. This indicates that the Club Ranch Ponds are a major source of all nine contaminants in the San Miguel River. Additional increases in concentrations were seen immediately upstream of the confluence of the San Miguel with the Dolores River. Metals increasing in this reach included Ag, A1, Cu, and V and could be

indicative of groundwater contamination from the Club Ranch Ponds entering the river.

Overall, concentrations of five metals (Ag, Al, Cu, Mo, and Zn) increased from levels measured upstream of Uravan in the San Miguel River to those measured downstream of Uravan at the confluence with the Dolores River.

Results of analyses for stream invertebrate metals concentrations are similar to the periphyton. Metals (Ag, Al, Cd, Cu, Mo, Ni, Pb, V, and Zn) increased downstream of the Club Ranch Ponds. Contamination upstream of Uravan was noted, similar to that observed in the periphyton. The periphyton and invertebrates were good indicators of water quality and are particularly effective indicators of point source loading by heavy metals.

4.0 REMEDIAL ACTION PLAN - SOLIDS

Remedial activities at the Uravan Facility consist of the cleanup and reclamation of contaminated areas of the site and/or closure and reclamation of ancillary areas impacted by remedial activities. Contaminated areas (Figure 1.1-1) include:

- Atkinson Creek Crystal Disposal Area
- Club Ranch Ponds Area
- River Ponds Area
- Tailings Piles
- Club Mesa Area
- Mill Areas
- Town and Adjacent Areas

Ancillary areas include the Burbank Quarry and Borrow Area on Club Mesa. If these areas are unavailable, alternative disposal or borrow areas must meet the technical and schedule requirements prescribed in this Remedial Action Plan (RAP).

For each affected area, this chapter presents (1) a description of operations and observed impacts, (2) remedial actions, including cleanup criteria, (3) requisite assessments and engineering activities, (4) schedule, (5) quality control, quality assurance, monitoring, performance evaluation and

inspection. Conceptual designs and material specifications are presented for purposes of clarifying detail design requirements.

For Final Plans and Specifications, and all other items, documents or actions for which State approval is required by this Remedial Action Plan: (1) the term "approval" shall mean "prior approval in writing," (2) the State shall respond within one hundred twenty (120) days unless otherwise specified by the Consent Decree with a determination of approval or denial, unless an alternate response time is specified, and (3) the State shall provide a statement of the reasons, with supporting information, for any determination other than unconditional approval.

Once approval is given by the State, UCC/Umetco shall implement any required work in accordance with the Approved Final Plans and Specifications and supporting documents.

4.1 ATKINSON CREEK CRYSTAL DISPOSAL AREA

4.1.1 Description of Operations and Observed Impacts

The Atkinson Creek Crystal Disposal Area is located downstream from the Club Ranch Ponds and adjacent to Atkinson Creek, as shown on Figure 1.1-1. This disposal area was constructed in the early 1970's on the site of a mobile home park. The mobile homes were removed and the underlying soils were excavated and stockpiled adjacent to the area. After preparation of the site, raffinate crystals from Club Ranch Ponds 1 and 6 were removed and stored in the area. No liner was placed beneath the crystals. The natural soils stockpiled at the site were then placed on the raffinate crystals to form a soil cover approximately twelve inches thick. Side slopes on the disposal area are generally about 3(H):1(V); however, some sections steepen to approximately 1(H):1(V). UCC/Umetco estimates that approximately 200,000 cubic yards of raffinate crystals are stored within the Atkinson Creek Crystal Disposal Area. Radon flux measurements on the Atkinson Creek Crystal Disposal pile exhibited a mean radon flux of 4.42 $\pm$ 0.21 picoCuries per square meter per second (Uravan Radon Flux Survey, May 17, 1985, Report to CDH)

The Atkinson Creek Crystal Disposal Area was studied for

UCC/Umetco in detail by Envirologic Systems, Inc. (1983a). Data from this study indicate that contaminants are present in both saturated and unsaturated flow conditions beneath the crystal pile. These contaminants may migrate into the ground water which ultimately discharges into the San Miguel River. Continued migration may occur in the long term because of the high solubility of the crystals, the lack of adequate cover to prevent infiltration of water, and the lack of adequate bottom liner material. Also, the siting of a permanent disposal area in the river valley is impractical due to river-stream flood risk and geomorphic processes (PELRS, 1984). The potential for future contamination of the ground and surface water by raffinate crystal dissolution or erosion requires that the crystals be removed and placed in the Burbank Quarry, an approved crystal storage area, (Figure 1.1-1). This action will remove this material as a source of contaminant release.

4.1.2 Remedial Activities

For the Atkinson Creek Crystal Disposal Area, UCC/Umetco shall perform remedial activities in the following manner:

(1) UCC/Umetco has estimated that 200,000 cubic yards of raffinate crystals (primarily hydrated ammonium sulfate) are stored within the existing disposal area.

All raffinate crystals from the disposal area, as well as the cover soils, shall be excavated and removed from the Atkinson Creek location. These materials shall be placed, compacted, and disposed in the secure crystal repository, the Burbank Quarry (Figure 1.1-1) in accordance with the Approved Final Plans and Specifications.

(2) After crystal removal, peripheral contaminated soils and the contaminated soils beneath the crystals shall be excavated, placed, compacted and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications. Excavation of contaminated soils beneath the crystals shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the crystals, at least one (1) foot of the soil or bedrock shall be excavated, placed, and disposed on the Tailings Piles.

b. In addition to removal described in Item a. above, all surficial materials with greater than 20 percent by volume of raffinate crystals as determined by visual inspection of the exposed surface and surficial materials with scintillometer measurements greater than a corrected (true) measurement of thirty (30) microRoentgen per hour (uR/h) shall be excavated, placed and disposed on the Tailings Piles.

c. Where sandstone or siltstone bedrock or the water table is encountered, no additional material shall be removed.

(3) Completion of contaminated soil removal shall be based upon both criteria specified in Table 4.1.2-1. However, if sandstone or siltstone bedrock or the water table is encountered, soil sampling shall not be necessary.

(4) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(5) The Atkinson Creek Area shall be graded to contours that provide a stable ground surface configuration consistent with the goal of long-term stability and erosion resistance of the area.

(6) The graded area shall be covered with at least one (1) foot of random fill and shall be vegetated. UCC/Umetco estimates that approximately 9,000 cubic yards of random fill will be needed for cover material.

(7) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and

Table 4.1.2-1
Criteria for Contaminated Soil Removal

Criterion 1: Scintillometer Investigations

A scintillometer investigation shall be conducted by qualified personnel approved by the State over the Uravan Facility in sufficient density approved by the State prior to execution. The ~~grid point~~ **survey** intervals shall ~~not exceed fifty (50) meters~~ **be set forth in the State-approved characterization or confirmation survey plans** for windblown contamination areas and ~~five (5) meters~~ for the town, source and source fringe areas, and shall be tied to an identifiable reference point. [12/15/99] For areas with scintillometer measurements averaged as set forth in the approved Quality Plan, inclusive of background, the following shall apply:

1.1 For exposure rates above 30 microRoentgens/hour (uR/h) (corrected/true), UCC/Umetco shall remove additional materials until Criterion 1.2 or 1.3 is met.

1.2 For exposure rates below 30 uR/h (corrected/true) and above 20 uR/h (corrected/true), UCC Umetco shall remove additional materials until Criterion 1.3 is met or prepare and submit for State approval a recommendation for further remedial activities based upon a comparative assessment of alternatives. UCC/Umetco's assessment shall be based upon analysis of all pertinent radiometric and past land use information and shall consider the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and potential land use. UCC/Umetco shall conduct the approved remedial alternative.

1.3 For exposure rates below 20 uR/h (corrected/true), no further action based on scintillometer investigations shall be required.

UCC/Umetco may conduct designed, site-specific investigations and sampling to determine the degree of correlation between scintillometer readings and radium-226, thorium-230, arsenic, cadmium, lead and/or vanadium. If an appropriate statistically-significant correlation is found between scintillometer readings and radium-226 or indicator metal levels, UCC/Umetco may propose and the State shall consider approval of an alternative value either higher or lower than a corrected measurement of 30 uR/h (true) for use in Criterion 1.1 and 1.2. This alternative value shall not exceed a corrected reading of 40 uR/h (true) and shall be used only in revising this Criterion 1.

Criterion 2: Soil Assay for Radium and Other Metals

When UCC/Umetco believes Criterion 1 is met, UCC/Umetco shall conduct a representative confirmatory soil sampling program based on a design approved by the State prior to execution. The soil samples shall be taken in sufficient density from multiple depths composited in a statistically acceptable manner on a sub-area basis and assayed for radium-226, thorium-230, arsenic, cadmium, lead, vanadium, and up to six (6) additionally potentially toxic metals (e.g., nickel, zinc, molybdenum, and selenium). The soil cleanup shall be to these levels:

2.1 The concentration of radium-226 averaged over any area of 100 square meters shall not exceed the background level by more than 5 picoCuries (pCi) radium-226 per gram (g), averaged over the first 15 centimeters (cm) of soil below the surface and 15 pCi/g averaged over 15 cm thick layers more than 15 cm below the surface; and,

2.2 The necessity for further remedial actions shall be based upon an evaluation prepared by UCC/Umetco and approved by the State, of the potential health significance of the residual levels of all other metals. UCC/Umetco's assessment shall be based upon analysis of all pertinent radiometric and past land use information and shall consider the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and potential land use. UCC/Umetco shall conduct the approved remedial alternative.

Note: Criteria 1 and 2 are designed to achieve soil cleanup to ranges of naturally-occurring radioactive and toxic constituent concentrations which approximate the levels existing prior to operations at the Uravan site. It is recognized that the As-Low-As-Reasonably-Achievable principle (ALARA below standards) applies.

The document titled "Soil Cleanup Methodology for Uravan, Colorado" as agreed to by the State and Umetco defines the specific methods used to implement the soil cleanup criteria presented in this table. This document should be referred to for additional details. [12/15/99]

implement additional remedial actions to achieve required performance.

(8) Restoration of the underlying aquifer is presented in Chapter 5.0 - Remedial Action Plan - Liquids.

4.1.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the following:

(1) Final Plans and Specifications certified by a Registered Professional Engineer or equivalent qualified specialist approved by the State. The Final Plans and Specifications shall include design drawings (plans, profiles and details) and specifications (all construction materials, procedures, surveys and schedules) for all remedial activities required in Section 4.1.2, according to the schedule in Section 4.1.4, and the controls in Section 4.1.5. All surveys shall be conducted by qualified personnel approved by the State. Appropriate base maps shall show existing topography. Boundary surveys shall be prepared by a Registered Land Surveyor. Base maps of the ground surface configuration prior to initiation of remedial

activities shall be prepared at a scale and contour interval to give sufficient detail for the State to review designs and to allow inspection and verification of remedial activities.

Requisite plans shall include but shall not be limited to the following:

- A proposed surface runoff and drainage control plan.
- A proposed cleanup and survey plan for all material.
- A proposed grading and vegetation plan.

(2) A proposed Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation Plan in accordance with the requirements of Section 4.1.5 and Addendum A, which Addendum is adopted and incorporated by reference herein.

(3) A Final Construction Report including:

a. As-built drawings showing construction details, limit-of-excavation and the final ground surface configuration.

b. A description of any unexpected conditions and problems encountered in construction, and the method employed to resolve such conditions and

problems.

c. A final summary of construction and quality control activities, quality assurance audits and materials and radiologic test data taken during construction.

d. A proposed-long term monitoring and surveillance program.

(4) The Certification Report shall include the Final Construction Report for the Atkinson Creek Crystal Disposal Area and an assessment and evaluation of the effectiveness of reclamation in demonstrating compliance with The RAP and with statutes, rules and regulations, licenses and permits rendered applicable under the RAP or Consent Decree. The performance of soil cleanup, vegetation of the area, and erosion control activities satisfying specified performance criteria shall be presented.

4.1.4 Schedule

UCC/Umetco shall design and conduct the Atkinson Creek Disposal Area remedial activities according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) Removal of raffinate crystals and contaminated soils shall be initiated not later than the date specified in the Approved Final Plans and Specifications and completed not later than December 31, ~~1992~~ **1993**. [3/29/93]

(3) The area shall be graded, covered and vegetated no later than December 31, 1993.

(4) A Final Construction Report shall be submitted to the State not later than ninety (90) days after the completion of initial vegetation.

(5) The Certification Report shall be submitted not later than 120 days after completion of all remedial activities at the Uravan Facility.

4.1.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation, and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Excavation of all materials
- All surveys and field and laboratory tests
- Final limits of excavations to assure that soil cleanup levels specified in Section 4.1.2 are achieved
- Placement of fill materials to final grade
- Vegetation
- Submission of Documents and Reports as described in Section 4.1.3.

Monitoring of the Atkinson Creek Area shall include:

- Surface configuration
- Vegetation activities

Performance of the remedial activities shall be evaluated on the basis of the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B, which is

adopted and incorporated by reference herein.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.2 CLUB RANCH PONDS AREA

4.2.1 Description of Operations and Observed Impacts

The Club Ranch Ponds Area consists of six unlined liquid waste disposal ponds located down valley from the Uravan mill site, and ancillary disposal areas, as shown on Figure 1.1-1. The Club Ranch Ponds were constructed in the early 1960's to serve as both evaporative and seepage discharge ponds. The ponds were excavated into terrace deposits of the San Miguel River. The lower ponds (Ponds 2, 3 and 5) have crest elevations varying from about 4,960 to 4,964 feet. The upper ponds (Ponds 1, 4 and 6) have crest elevations of between 4,979 and 4,985 feet. The downstream slopes on the ponds are generally between 1(H):1(V) and 1.5(H):1(V) with upstream slopes of approximately 2(H):1(V). The depth of the ponds ranges from approximately eight feet to almost thirty feet. UCC/Umetco estimates that the ponds contain about 560,000 cubic yards of raffinate crystals and 30 million gallons of liquid. The crystals have been measured to exhibit a radon flux in a range of 2.82 $\pm$ 0.08 to 13.33 $\pm$ 0.44 picoCuries per square meter per second (Uravan Radon Flux Summary, May 17, 1985, Report to CDH). Contaminants are present in the alluvial gravels and underlying Kayenta Formation. Geochemical reactions between the acidic raffinate seepage and calcium carbonate in the bedrock raises the pH of the liquid and causes gypsum

precipitation. It is thought that a majority of the radionuclides are likely to be trapped in the material directly below the ponds.

The crystals and heavily contaminated materials shall be removed from the ponds. These materials shall be removed from the San Miguel River valley because of their potential as long-term health and environmental hazards. Removal of the crystals, ponded liquids and contaminated soils will eliminate these materials as a source of contaminated seepage into the Kayenta-Wingate aquifer and the San Miguel River.

4.2.2 Remedial Activities

For the Club Ranch Ponds Area, UCC/Umetco shall perform remedial activities in the following manner:

(1) UCC/Umetco has estimated that 560,000 cubic yards of raffinate crystals and 30 million gallons of ponded liquids are presently stored in the six ponds. All liquids shall be evaporated in place as provided in Section 5.2.1. Crystals removed in order to construct evaporation ponds for hillside seepage, toe berm seepage and tailings liquids may be temporarily stored on Club Mesa, existing unlined Club Ranch Ponds, or in

another disposal area approved by the State. All raffinate crystals shall then be removed from the remaining existing ponds and finally disposed in the secure crystal repository, the Burbank Quarry.

(2) UCC/Umetco has estimated that 60,000 cubic yards of contaminated soils are located beneath the raffinate crystals and in the pond dikes. After removal of the raffinate crystals, the contaminated soils beneath the crystals and surrounding the Club Ranch Ponds shall be excavated, placed, compacted, and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications. Excavation of contaminated soils beneath the crystals shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the crystals, at least one (1) foot of the soil or bedrock shall be excavated, placed, and disposed on the Tailings Piles.

b. In addition to removal described in Item a. above, all surficial materials with greater than 20 percent by volume of raffinate crystals as determined by visual inspection of the exposed surface and surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

c. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(3) After excavation of contaminated soils as prescribed in item (2) above, UCC/Umetco shall conduct scintillometer surveys and soil assays for radionuclides and heavy metals to ascertain residual contamination levels.

(4) Any uncontaminated materials remaining in the pond dikes may be used to grade the site after removal of raffinate crystals and contaminated soils.

(5) UCC/Umetco shall reclaim any area not used as a site for the evaporation of liquids, in the following manner:

a. After reshaping, UCC/Umetco shall perform scintillometer surveys and soil assays in a manner consistent with the methods in Table 4.1.2-1.

b. If Criterion 2, from Table 4.1.2-1 is met, UCC/Umetco shall cover the area with sufficient material capable of sustaining vegetation and shall conduct an effective vegetation program as approved by the State.

c. If Criterion 2 from Table 4.1.2-1 is not met, UCC/Umetco may elect to irrigate or treat the area to determine whether the area will achieve the criteria in Table 4.1.2-1. If irrigation or treatment proves to be effective, irrigation or treatment may be continued until soils meet Criterion 2 or until closure of the Uravan Facility, whichever occurs first. If irrigation or treatment is not used or is not effective, UCC/Umetco shall design and construct a drainage diversion system and a cover which meets the radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E. The cover shall consist of at least one (1) foot of random fill.

(6) UCC/Umetco shall reclaim evaporation pond areas within the schedule specified in Section 4.2.4(4) in the following manner:

a. Contaminated synthetic liner and solid residues shall be removed, placed and compacted in a secure repository on Club Mesa. Location and design of this repository shall be approved by the State, and;

b. The area shall be regraded, and reclaimed in accordance with the provisions of 4.2.2 (5) a, b & c.

(7) Reclamation of any part of the Club Ranch Pond Area shall be governed by the procedures stated in Section 4.2.2(5) or Section 4.2.2(6), according to its use.

(8) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose for review and approval by the State, and implement additional remedial actions to achieve required performance.

(9) As specified below, the evaporation ponds shall be designed, constructed, and installed in accordance with 40 CFR 192.32(a)(1) [as it incorporates 40 CFR

264.221(a), (f) and (g)] to prevent the migration of any hazardous constituents into the adjacent subsurface soil or groundwater or surface water during their operational life. Pond construction within the Club Ranch Pond Area (see Figure 1.1-1) shall be designed so as to optimize the use of the area for evaporation. A maximum of forty-five (45) acres of evaporative capacity shall be provided. Each pond shall have a thirty (30) mil high density polyethylene synthetic liner or other synthetic liner as approved by the State in the Approved Final Plans and Specifications of appropriate strength, thickness, and chemical properties to prevent failure of the liner and shall be placed on a suitable compacted clayey foundation or base having a minimum thickness of twelve (12) inches and containing at least thirty (30) percent fines passing No. 200 sieve. **[Note: 4/12/91 Field Change Order authorizing replacement of the compacted clayey base with a 30 mil very-low-density-polyethylene liner.]** Pond design shall have engineered, compacted dikes with sufficient capacity and freeboard to contain the liquid waste and precipitation/runoff for the design precipitation event and design evaporation rate. The annual rainfall used for freeboard design shall be the greatest amount expected for one year out of

twenty-five (25) and the annual evaporation rate used shall be the annual rate expected nine years in ten. The design for each pond shall include a separate leak detection system as shown on Figure 4.2.2-1, with design details as depicted on Figure 4.2.2-2 and liner failure contingency plans. If the contaminated effluent rate collected in any respective pond drainage sump exceeds five (5) gallons per minute (gpm), the liner failure contingency plan shall be implemented for that respective pond. Excess free liquids shall not be allowed to stand in the detection sumps. A groundwater monitoring program designed in accordance with 40 CFR Part 264 Subpart F and other applicable rules and regulations shall be proposed by UCC/Umetco to the State for approval. The monitoring program shall include action levels for response. UCC/Umetco shall construct and install the approved pond design and shall install and conduct the approved monitoring program.

(10) Restoration of the underlying aquifer is presented in Chapter 5.0 Remedial Action Plan - Liquids.

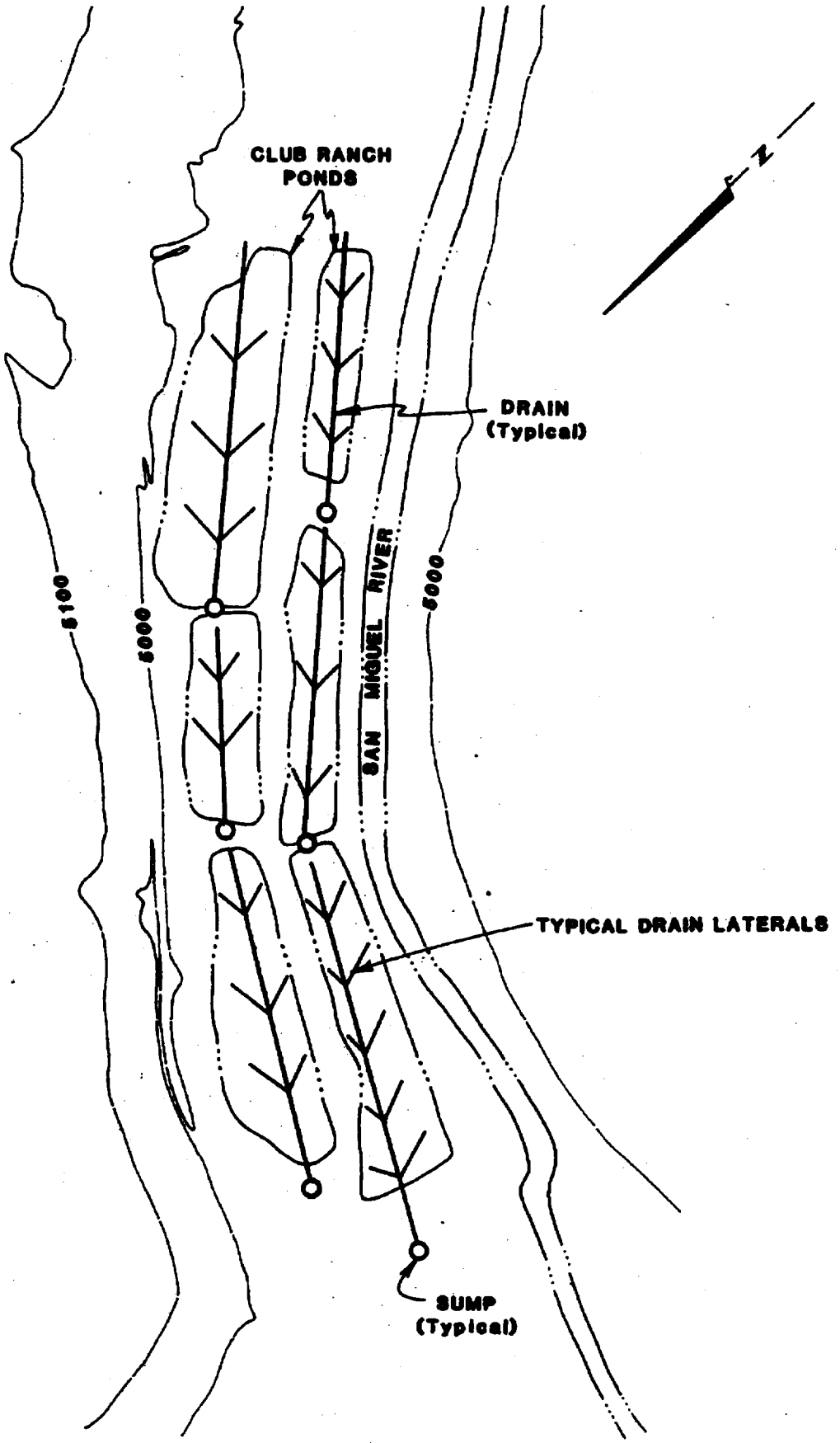
4.2.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.2.2, 4.2.4 and 4.2.5.

Detailed plans and specifications for the new lined ponds shall be provided to the State for approval. Plans and specifications shall include a single synthetic liner, and a leakage detection system underlined with appropriate material, a liner failure contingency plan, and a final reclamation plan. The basic design requirements of these ponds are contained in Section 4.2.2 (9) and on Figures 4.2.2-1 and 4.2.2-2.

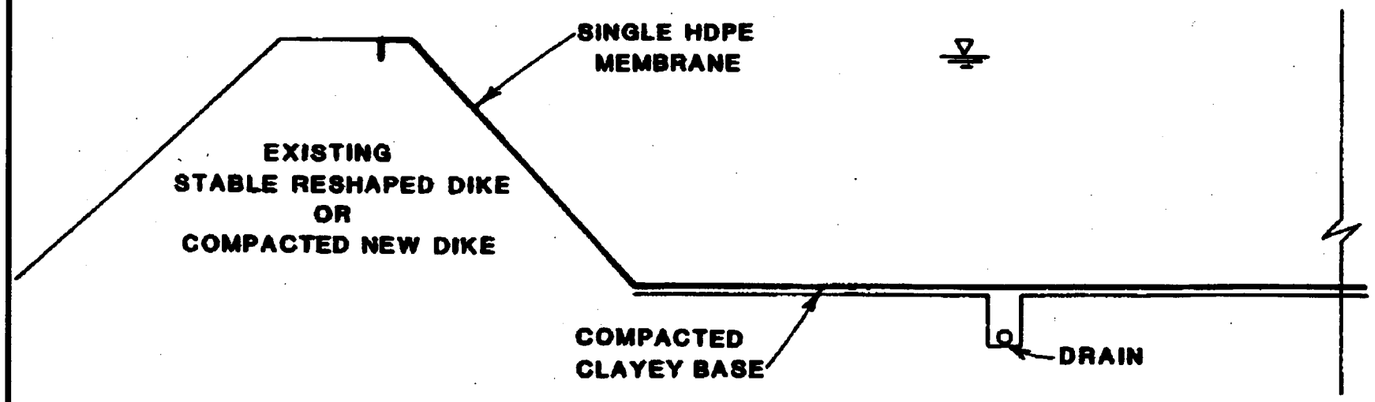
4.2.4 Schedule

UCC/Umetco shall design and conduct the Club Ranch Ponds Area remedial activities according to the following schedule: Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than sixty (60) days as to the ponds to be used for evaporation of hillside seepage, toe berm seepage and tailings liquids, and not later than 120 days as to the remaining Work after the Consent Decree is entered by



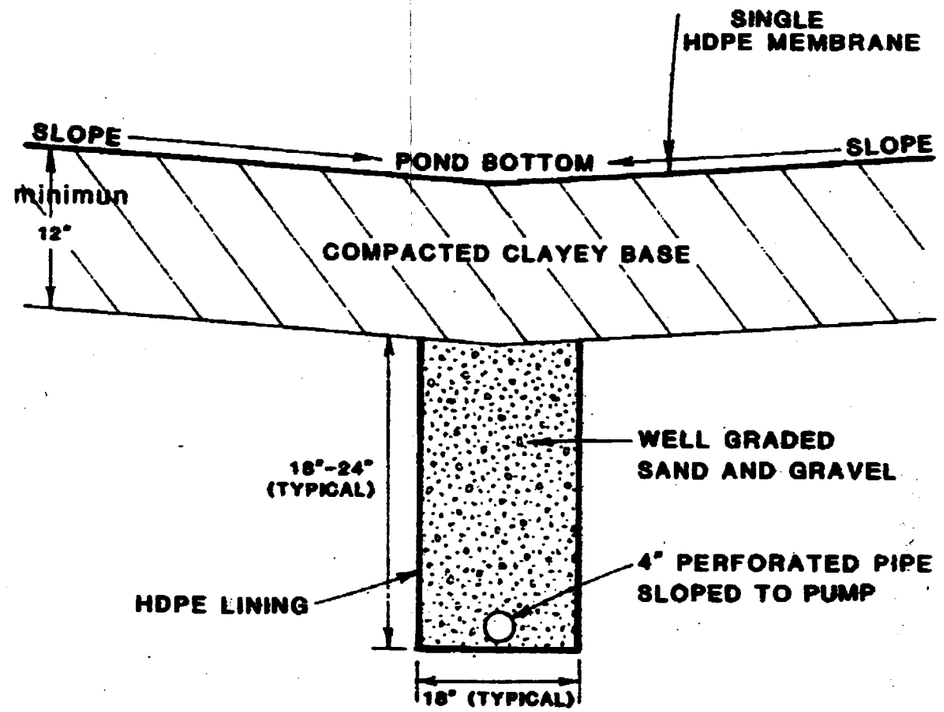
0 100 86	Chen & Associates	CONCEPTUAL LEAK DETECTION PLAN EVAPORATION PONDS	Fig. 4.2.2-1

TYPICAL CROSS SECTION
LINED EVAPORATION PONDS



1. Existing dikes to be reshaped as necessary.
2. HDPE membrane to be single layer.
3. Clayey base to contain at least 30% passing No. 200 sieve. Fines shall classify as CL or CH soils in the Unified Soil Classification System.
4. Clayey base to be compacted to provide a stable firm layer beneath the synthetic liner.

TYPICAL DETAIL
LEAK DETECTION SYSTEM
EVAPORATION PONDS



TYPICAL
DESIGN DETAILS
EVAPORATION PONDS

the Court.

(2) All discharge of liquid waste to the unlined Club Ranch Ponds shall cease not later than ~~November 1, 1987~~ ~~January 31, 1988 [11/9/87]~~ **May 31, 1988.** [3/1/88]

(3) All liquids shall be evaporated or otherwise removed from the unlined Club Ranch Ponds not later than December 31, 1988.

(4) Removal of existing raffinate crystals and contaminated soil as provided in Section 4.2.2(2) shall be initiated not later than the date specified in the Final Plans and Specifications and shall be completed not later than December 31, 1991. **As ponds are taken out of service, r**emoval of new **Club Ranch P**ond **liners** and associated crystals shall be completed not later than one year after evaporation has been completed **in that pond.** [12/15/99]

(5) The Club Ranch Pond Area shall be **reclaimed according to Section 4.2.2(5).**[4/2/96] ~~and [4/13/93] regraded, covered and vegetated not later than December 31, 1992. September 30, 1995 [4/13/93], if the groundwater evaluation (2-year pumping analysis) indicates that~~

~~these areas are not needed for additional evaporation ponds. [4/13/93] However, for areas..If, however, this area is used as used for an evaporation ponds, regrading, covering and vegetation shall begin after removal of the new pond liner and associated crystals at a suitable time after groundwater remediation. [4/13/93]~~ **A reclamation plan, including site regrading, covering, and revegetation, and evaporation or treatment of any residual hillside or tailings pile seepage, shall be developed within one year of termination of groundwater extraction and shall be submitted to the State of Colorado for review and approval. The plan shall include a schedule for reclamation activities.** [4/2/96]

(6) A Final Construction Report shall be submitted not later than ninety (90) days after completion of final vegetation.

(7) A Certification Report shall be submitted not later than 120 days after completion of all remedial activities at the Uravan Facility.

4.2.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Excavation of all materials
- All surveys and field and laboratory tests
- Final limits of excavations to assure that soils cleanup levels as specified in Section 4.2.2 are achieved
- Placement of fill materials to final grade
- Vegetation
- Submission of Documents and Reports as described in Section 4.2.3.

Monitoring of the Club Ranch Ponds Area after vegetation shall include:

- Surface configuration

- Vegetation activities

Performance of the remedial activities shall be evaluated on the basis of the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.3 RIVER PONDS AREA

4.3.1 Description of Operations and Observed Impacts

The River Ponds Area, as shown in Figure 1.1-1, consists of seven small ponds constructed along the San Miguel River adjacent to the mill. Five of the ponds are located on the mill side (south side) of the river and two ponds are located on the north side of the river. These ponds were constructed within old tailings piles by excavating into and, in some cases, through the tailings. The exposed surfaces of the excavations were then mantled with natural soils. The five ponds on the mill side of the river were used as settling basins for liquids collected within the mill area and stored there prior to discharge into the river. The two ponds on the north side of the river were used to clarify treated process liquors prior to discharge. These ponds contain neutralized sludge from the clarification operation. UCC/Umetco estimates that about 200,000 cubic yards of mill wastes and contaminated soils are contained in the River Ponds Area.

The Environmental Report prepared by Dames and Moore (1978) for Union Carbide estimates seepage from the River Ponds to be 10 to 40 gallons per minute when they are in use. This seepage enters the groundwater system which, in time, discharges into the

San Miguel River. Removal of all sludge and tailings material during remedial activities will eliminate these materials as sources of contamination.

4.3.2 Remedial Activities

For the River Ponds Area, UCC/Umetco shall perform remedial activities in the following manner:

(1) UCC/Umetco shall remove all River Pond liquids as provided in Section 5.2.2. UCC/Umetco has estimated that the River Ponds Area consists of approximately 200,000 cubic yards of tailings, neutralized sludge and contaminated soils. These materials shall all be removed, placed, compacted, and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications.

(2) Excavation of contaminated materials shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the tailings and sludges, at least one (1) foot of the soil or bedrock shall be excavated, placed, and disposed on the Tailings Piles.

b. In addition to removal described in Item a. above, surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed and disposed on the Tailings Piles.

c. Where sandstone or siltstone bedrock or the water table is encountered, no additional material shall be removed.

(3) Completion of contaminated soil removal shall be based upon both criteria specified in Table 4.1.2-1 except that: If sandstone or siltstone bedrock or the water table is encountered, soil sampling shall not be necessary.

(4) During remedial activities, runoff controls shall be in place to prevent releases of hazardous materials.

(5) The River Ponds Area shall be regraded to contours that provide a stable ground surface configuration consistent with the goal of long-term stability and erosion resistance of the area.

(6) The River Ponds Area shall be covered with at least one (1) foot of random fill and shall be vegetated.

(7) Regrading, filling, and vegetation shall not be required if excavation has removed materials below the average flow level of the San Miguel River.

(8) If monitoring of the cover and vegetation performance,

after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.3.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.3.2, 4.3.4, and 4.3.5.

4.3.4 Schedule

UCC/Umetco shall design and conduct the River Ponds remedial activities according to the following schedule:

(1) The Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) All discharge to the River Ponds shall cease immediately upon completion of improvements in the surface runoff control system as described in Section 5.3.2, but in no event later than sixty (60) days after entry of the Consent Decree.

(3) All liquids shall be removed from the ponds not later than December 31, 1987.

(4) Removal of the River Ponds solids shall be initiated by the date specified in the Approved Final Plans and Specifications but in no event later than September 30, 1988. Disposal of River Ponds solids on the Tailings Piles shall be completed not later than December 31, 1990.

(5) The area shall be regraded, covered and vegetated not later than December 31, 1991.

(6) A Final Construction Report shall be submitted not later than ninety (90) days after completion of remedial activities at the River Ponds Area.

(7) A Certification Report shall be submitted not later than 120 days after completion of all remedial

activities at the Uravan Facility.

4.3.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Excavation of all materials
- All surveys and field and laboratory tests
- Final limits of excavations to assure that soil cleanup levels as specified in Section 4.3.2 are achieved
- Placement of fill materials to final grade
- Vegetation
- Submission of Documents and Reports as described in Section 4.3.3.

Monitoring of the River Ponds Area shall include:

- Surface configuration
- Vegetation activities

Performance of the remedial activities shall be evaluated on the basis of the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.4 TAILINGS PILES

4.4.1 Description of Operations and Observed Impacts

The Tailings Piles at Uravan were started in the mid 1950's to store tailings generated by the Uravan Mill. The Tailings Piles are located on Club Mesa above the mill site, as shown on Figure 4.4.1-1. The Tailings Piles were constructed using the upstream construction method whereby the tailings slurry was pumped from the mill to the Tailings Piles and deposited through spigots placed along the tailings delivery line. The embankment raises are constructed from tailings sands that were regraded, placed and compacted.

Prior to 1980, the downstream slopes on the tailings embankments varied from approximately 1.5(H):1(V) to 3(H):1(V). As the height of the embankments increased, there was concern for the stability of the embankments. Consequently, in 1980, rockfill berms including a drainage blanket for seepage control were constructed to buttress the lower portions of the Tailings Piles. Horizontal drains to promote drainage of the tailings were also installed but were ineffective.

Observed impacts from the existing tailings disposal system include: 1) seepage of contaminated liquids into the bedrock on

LEGEND:

AREA OF NEUTRALIZED SLUDGE

RAFFINATE SPRAY AREA

CLUB MESA STOCKPILE AREA

SCALE 1" = 800'

HIGHWAY 141

PLAN OF CLUB MESA AREA
AND TAILINGS PILES

chen and associates, inc.
CONSULTING ENGINEERS
86 S. ZUNI · DENVER, CO. 80223

Job Number	Date	Fig 4.4.1-1
25,908	JULY, 1983	

Club Mesa, 2) erosion and transport of tailings material away from the disposal area by wind and water action, and 3) radon emanation from the Tailings Piles. These conditions will be controlled by the cessation of discharge to the Tailings Piles, removal of liquids, and the covering of the slope of the Tailings Piles material prior to final reclamation. After the final reclamation cover is placed on the tops of the Tailings Piles, infiltration and seepage, wind and water erosion and radon emanation will be reduced to acceptable levels.

4.4.2 Remedial Activities

For the Tailings Piles, UCC/Umetco shall perform remedial activities which can be subdivided into six different components: (1) Dewatering, (2) Slopes and Contours, (3) Rock Fill Buttress and Toe Drain System, (4) Side Slopes Protective Cover, (5) Top Cover, and (6) Drainage Diversion. UCC/Umetco shall conduct remedial activities as required for pile stability and long-term tailings control in accordance with 6 CCR 1007-1-3, Schedule E. All remedial activities shall be detailed in the Final Plans and Specifications to be prepared and submitted by UCC/Umetco for approval by the State. UCC/Umetco shall use the Probable Maximum Precipitation (PMP) and the Probable Maximum Flood (PMF) as the design basis for determining erosion protection for the Tailings Piles and the Crystal Repository covers. UCC/Umetco shall use

the Maximum Credible Earthquake (MCE) as the design basis for slope stability. Final cover design shall be calculated using state-of-the-art formulas and procedures. UCC/Umetco may submit modified proposed cover designs based on state-of-the-art regulatory guidance for review and approval in the Final Plans and Specifications. Specific reports and methods to be considered in these calculations shall include the Hydrometerological Report (HMR) No. 49 (Hansen and others, 1977), Safety Factors Method (1975), Stephenson Method (1979), NUREG/CR-4620, "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments" (June 1986), or other state-of-the-art methods determined appropriate by the State. If the State determines prior to closure of the Uravan Facility that the stability of the final cover and drainage diversion system are inadequate, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve performance that complies with the provisions of 6 CCR 1007-1-3, Schedule E.

4.4.2.1 Dewatering

The dewatering program for the Tailing Piles shall be designed and constructed as follows:

(1) The dewatering program shall include shallow trenches

in selected areas as reasonably necessary to promote drainage of the near-surface materials and serve as channels to the sumps.

(2) Sumps shall be installed as reasonably necessary to collect liquids which shall be pumped to the disposal system as presented in Section 5.1.2. The number and location of trenches and sumps will be determined by the ability of the surface of the tailings pile to accommodate construction equipment.

(3) Fill (wastes) will be placed in designated areas on the Tailings Piles to surcharge these areas to accelerate dewatering and consolidation.

4.4.2.2 Slopes and Contours

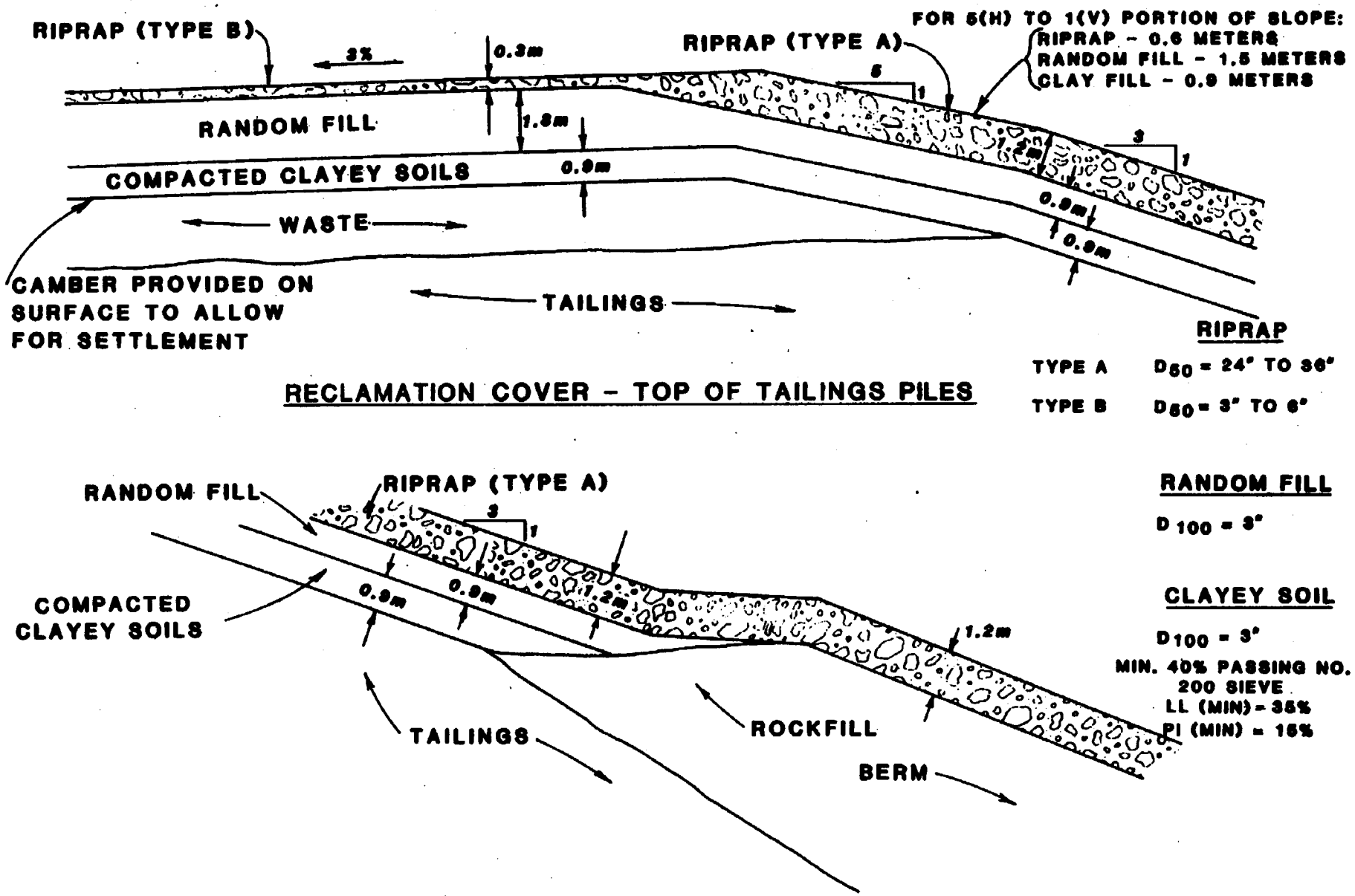
The configuration of the Tailings Piles shall be designed and constructed as follows:

(1) The sides of the piles have been regraded to 3(H):1(V) above the rock buttress and have been covered with an interim soil cover twelve (12) inches thick at a minimum.

(2) Neutralized sludges and contaminated soils removed from the River Ponds Area, Club Ranch Ponds Area, Club Mesa Area and other areas identified during the implementation of the Remedial Action Plan shall be placed on top of the Tailings Piles in an appropriate lift of approved thickness and compacted in accordance with the Approved Final Plans and Specifications. Placement and compaction shall be conducted in a manner that will expedite future reclamation activities by promoting consolidation of slimes and dewatering of the tailings.

(3) Neutralized sludges and contaminated soil shall be placed in select locations on top of the piles at an outer slope of 5(H):1(V) or less as shown in Figure 4.4.2.2-1 in accordance with the Approved Final Plans and Specifications.

(4) The tops of the Tailings Piles shall be contoured to slope at three (3) percent grade away from the embankment face. The surface shall be cambered in defined areas to compensate for settlement of the underlying slimes.



TAILINGS PILES COVER CONCEPTUAL DESIGN

Fig 4.4.2.2-1

4.4.2.3 Rock Fill Buttress and Toe Drain System

The design and construction of the rock fill buttress and toe drain system shall be as follows:

(1) The existing rock fill buttress shall be covered with 1.2 meter of Type A riprap as shown on Figure 4.4.2.2-1 or as determined during final design and presented in the Approved Final Plans and Specifications.

(2) The toe drain system, presently in place at the base of the Tailings Piles, shall be maintained until seepage ceases. Seepage shall be collected and disposed of as described in Section 5.1.2.

(3) Cover for the rock fill buttress shall be obtained from the Burbank Quarry or State-approved alternative source. Placement and inspection of these materials shall be conducted in accordance with the approved Quality Control/Quality Assurance Program described in Addendum A.

4.4.2.4 Side Slope Reclamation Cover

The design and construction of the side slope reclamation cover shall be as follows:

(1) The conceptual design of the side slope reclamation cover is depicted in Figure 4.4.2.2-1.

(2) The cover on the 3(H):1(V) portion of the slope shall consist of 0.9 meters of compacted clay, 0.9 meters of random fill and 1.2 meters of riprap for a total cover thickness of 3.0 meters measured perpendicular to the slope. The cover on the 5(H):1(V) portion of the slope will consist of 0.9 meters of compacted clay, and 1.5 meters of random fill and 0.6 meters of riprap, or as determined during final design and presented in the Approved Final Plans and Specifications, for a total cover thickness of 3.0 meters measured perpendicular to the slope. Riprap shall be obtained from the Burbank Quarry or State-approved alternative source. Random fill and clays shall be obtained from the Burbank Quarry and from the Borrow Area on Club Mesa (Figure 1.1-1) or State-approved alternative source.

4.4.2.5 Top Cover

The design and construction of the top reclamation cover shall be as follows:

(1) The conceptual design of the top reclamation cover is depicted in Figure 4.4.2.2-1.

(2) The cover shall consist of 0.9 meters of compacted clay, 1.8 meters of random fill and 0.3 meters of Type B riprap, or as determined during final design and presented in the Approved Final Plans and Specifications, for a total of 3.0 meters measured perpendicular to the slope. Riprap, random fill and clays shall be obtained from the Burbank Quarry, the Borrow Area on Club Mesa (Figure 1.1-1), or State-approved alternative source.

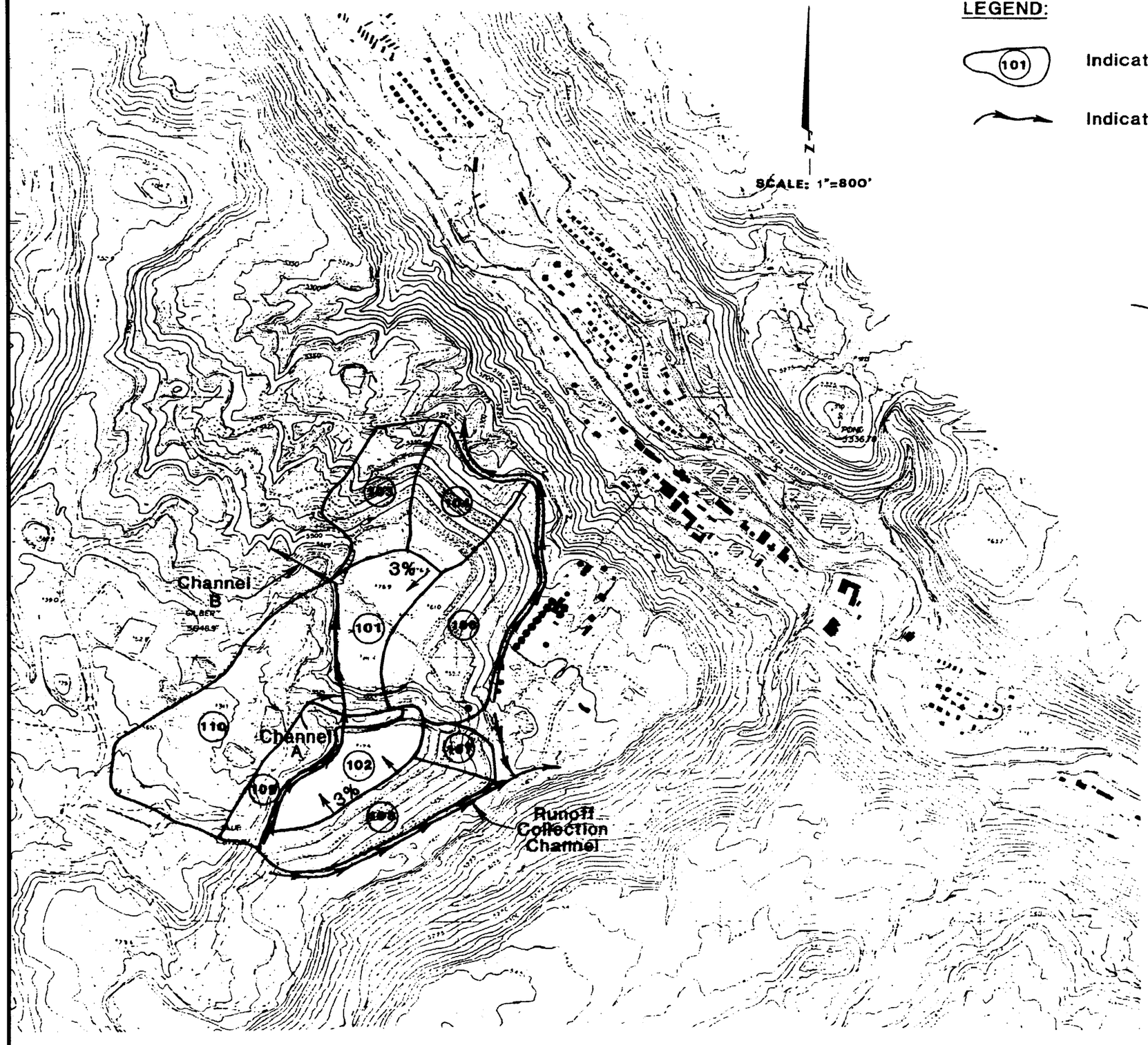
4.4.2.6 Drainage Diversion

Drainage from the areas adjacent to the piles and precipitation runoff from the piles shall be controlled. The drainage diversion system shall be designed and constructed as follows:

(1) The Club Mesa Spray Area runoff shall be directed away from the Tailings Piles.

(2) Drainage from areas adjacent to the Tailings Piles shall be intercepted by a drainage ditch at the back of the piles and conveyed through Channels A and B to a gully as shown in Figure 4.4.2.6-1. The drainage ditch and Channels A & B shall be designed to pass the Probable Maximum Flood (PMF) and constructed to minimize erosion. Riprap shall be sized to withstand PMF velocities across the piles and shall be obtained from the Burbank Quarry or State-approved alternative riprap source.

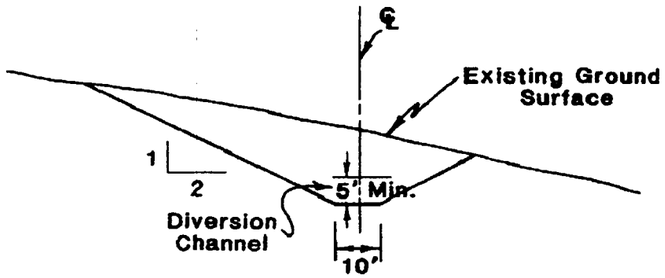
(3) Surface runoff from the top of the Tailings Piles shall be directed away from the embankment face and shall be collected and conveyed by the drainage ditch and conveyed through Channels A and B to an existing gully as shown in Figure 4.4.2.6-1.



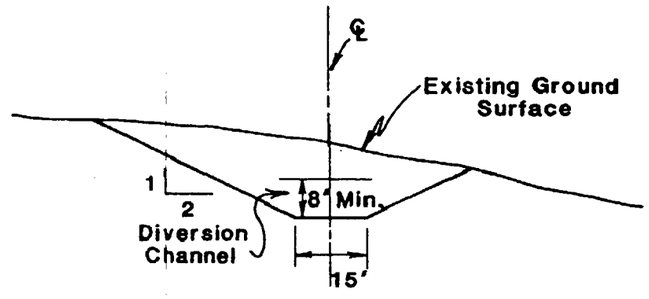
LEGEND:

101 — Indicates Drainage Area 101

Indicates Channel And Direction Flow



TYPICAL SECTION FOR DRAINAGE CHANNEL
BACK OF TAILINGS PILES
CHANNEL A
No Scale



TYPICAL SECTION CHANNEL B
No Scale

PLAN OF MESA AREA AND TYPICAL SECTIONS OF RUNOFF COLLECTION CHANNELS		
	Date: JULY, 1982	Fig.4.4.2.8-1

(4) Surface runoff from faces of the embankments shall be collected at the base of the reclaimed embankments and shall be conveyed to the cliff face where long-term cliff retreat shall not impact the disposal site. These collection channels shall be located as shown in Figure 4.4.2.6-1 and shall consist of a minimum of 4.0 ft of riprap Type A (Figure 4.4.2.2-1) overlying 1.0 ft of riprap bedding, or as determined during final design and presented in the Approved Final Plans and Specifications.

4.4.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.4.2, 4.4.4, and 4.4.5.

In addition, the Final Plans and Specifications shall include:

- A prediction of the load/settlement relationship over key areas of piles for the duration of the remedial action program. All pertinent information including surface movement monuments, piezometer levels, seepage

rates and materials placement shall be reviewed, assessed and summarized. This information shall subsequently be used for comparison with predicted and observed system performance during the remedial action program.

- A proposed materials placement plan, including, but not limited to, material type, disposal location, schedule of placement, and compaction specifications for each material type.

- A proposed dewatering plan, including but not limited to surcharge location(s) and construction details with predictions of tailings dewatering and consolidation rates based on planned materials placement.

4.4.4 Schedule

UCC/Umetco shall design and conduct remedial activities for the Tailings Piles according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) All discharge of slurried tailings ceased as of November 15, 1984 and shall not be resumed.

(3) The side slopes have been regraded and an interim soil surface cover has been placed on the tailings side slopes.

(4) Remedial activities pertaining to the dewatering program outlined in Section 4.4.2.1 shall commence as specified in the Approved Final Plans and Specifications but not later than September 30, 1988.

(5) A monitoring program consistent with the performance evaluation plan for the Tailings Piles as prescribed in Addendum A shall be prepared by UCC/Umetco and submitted not later than 120 days after the Consent Decree is entered by the Court.

(6) Placement of sludges and materials from the River Ponds Area shall be completed not later than December 31, 1990.

(7) Placement of neutralized sludges and contaminated soils from Club Mesa shall be completed not later than

December 31, 1994.

(8) Placement of the final reclamation cover on the 3(H):1(V) side slopes shall be initiated not later than the date specified in the Approved Final Plans and Specifications and shall be completed not later than December 31, 1989. Monitoring devices shall be installed and operated in accordance with the Approved Final Plans and Specifications.

(9) The clay and random fill reclamation cover shall be placed on top of ~~the piles~~ **Tailing Piles 1-2 and 3** not later than December 31, ~~1996~~ **2002.** [4/2/96]

(10) Permanent drainage diversion channels will be operational by December 31, ~~1996~~ **2002.** [4/2/96]

(11) Final grading shall occur and riprap shall be placed on tops of the Tailings Piles as soon as further settlement (consolidation) will not adversely affect cap integrity, as determined by an analysis of performance evaluation data, but not sooner than the currently scheduled placement.

(12) A Final Construction Report shall be submitted to the State not later than ninety (90) days after the final placement of riprap

on the top of the Tailings Piles.

(13) A Certification Report shall be submitted to the State not later than 120 days after completion of all remedial activities at the Uravan Facility.

(14) The area between Tailings Piles 1-2 and Tailings Pile 3 shall be available for the receipt of waste materials by June 1, 1998 in conformance with the construction requirements in RAP sections 4.4, 4.2.2.(6) and 4.5.2.1(1) and may remain available for disposal of waste materials from the Club Ranch Ponds or other areas identified during cleanup activities. [4/2/96]

4.4.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring, and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Approved Final Plans and Specifications.

QC/QA shall be conducted in accordance with the basic requirements in Addendum A and shall specifically include the following:

- Sump placement, operation and performance
- Contaminated material types, sizes, quantities, location on the pile, schedule, placement procedures, compaction, and other characteristics
- Installation and maintenance of all monitoring systems
- Cover material selection, placement and compaction
- Construction of drainage channels and diversion ditches
- Construction of runoff control structures on the Club Mesa Spray Area
- Visual surveillance
- Submission of Documents and Reports described in Section 4.4.3

Monitoring of the Tailings Piles shall be conducted in accordance with the requirements of Addendum A and shall specifically include the following:

- Dewatering rates, quantities and quality
- Slope stability, including surface monuments and any required slope indicators
- Piezometer levels
- Toe drain effluent rates, quantities and quality
- Siltation in runoff collection channels
- Monitoring of the rock fill buttress, side slope cover, top cover, and drainage diversion channels

Performance of the remedial activities shall be evaluated to assure long-term stability, cover integrity, and the decline of seepage over time by the analysis of:

- Settlement rates
- Toe drain seepage rates
- Movement monument, erosion monument, and slope indicator data, if required
- Aerial photography (after all remedial activities are complete)

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.5 CLUB MESA AREA

4.5.1 Description of Operations and Observed Impacts

The Club Mesa Spray Disposal Area is located upslope from Tailings Piles 2 and 3, as shown on Figure 4.4.1-1. This area was used primarily for evaporation of raffinate. Mounds of raffinate crystals formed around the spray nozzles within the spray areas. As part of the raffinate spray process, two clay-lined storage ponds were constructed upslope of the raffinate spray area. The purpose of these ponds was to provide hydrostatic head for the spray system. Also present in the Club Mesa area is neutralized sludge which was excavated from the River Ponds. These sludge disposal sites and storage ponds are also shown on Figure 4.4.1-1.

UCC/Umetco has estimated that 484,000 cubic yards of contaminated materials are in the Club Mesa Spray Area. These materials include 250,000 cubic yards of raffinate crystals; 150,000 cubic yards of neutralized sludge; 40,000 cubic yards of contaminated pond material; and 44,000 cubic yards of contaminated soils in the fringe area.

Surficial and subsurface contamination have occurred as a result of the raffinate spray process. Surficial contamination

is due to the presence of the raffinate crystals, in addition to the windblown spray which contaminated soils in the adjacent fringe area. Subsurface contamination is caused by seepage of excess spray liquids into the underlying soils and bedrock through the unlined surface of the spray area.

4.5.2 Remedial Activities

4.5.2.1 Club Mesa Spray Area and Contaminated Fringe Areas

UCC/Umetco shall perform remedial activities in the Club Mesa Spray Area in the following manner:

(1) UCC/Umetco has estimated that 250,000 cubic yards of raffinate crystals and 84,000 cubic yards of contaminated soils are in the spray area and contaminated fringe areas, respectively. All raffinate crystals shall be excavated and removed from the spray area. The crystals shall then be disposed in the secure crystal repository, the Burbank Quarry (Figure 1.1-1), or State-approved alternate if the Burbank Quarry is unavailable, and compacted in accordance with the Approved Final Plans and Specifications.

(2) After crystal removal, all contaminated soils beneath

the crystals and in the spray contaminated fringe areas shall be excavated, placed, compacted and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications. Excavation of contaminated soils shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the crystals, at least one (1) foot of the soil or bedrock shall be excavated and placed on the Tailings Piles.

b. In addition to removal described in Item a. above, all surficial materials with greater than 20 percent by volume of raffinate crystals as determined by visual inspection of the exposed surface and surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated and placed on the Tailings Piles.

c. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(3) After excavation of contaminated soils as prescribed in Item (2) above, UCC/Umetco shall conduct scintillometer surveys and soil assays for radionuclides and heavy metals to ascertain residual contamination levels. If bedrock is encountered, soil sampling shall not be necessary.

(4) Based on the assessment of residual contamination levels in the Club Mesa Spray Area and Contaminated

Fringe Area, UCC/Umetco shall design a drainage control system and a cover which meets radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E, or shall conduct additional soil removal sufficient to achieve Criterion 2 of Table 4.1.2-1.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) Runoff control structures on the Club Mesa Spray Area and Contaminated Fringe Area shall be designed to direct runoff away from the Tailings Piles.

(7) The graded area shall be covered with at least one (1) foot of random fill and shall be vegetated in accordance with a program prepared and submitted by UCC/Umetco and approved by the State. If bedrock is exposed and all applicable radon and other public health standards and criteria are met, the random fill shall not be required.

(8) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved

Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.5.2.2 Neutralized Sludge Disposal Area

UCC/Umetco shall conduct remedial activities in the Neutralized Sludge Disposal Area as follows:

(1) UCC/Umetco has estimated that 150,000 cubic yards of neutralized sludge are stored on Club Mesa. All neutralized sludge shall be removed from the Club Mesa area and placed, compacted, and disposed on the tops of the Tailings Piles in accordance with the Approved Final Plans and Specifications.

(2) After removal of the neutralized sludge, all contaminated soils beneath the neutralized sludge shall be excavated, placed, compacted, and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications. Excavation of contaminated soils shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the neutralized sludge, at least one (1) foot of the soil or

bedrock shall be excavated and placed on the Tailings Piles.

b. In addition to removal described in Item a. above, surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

c. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(3) After excavation of contaminated soils as prescribed in Item (2) above, UCC/Umetco shall conduct scintillometer surveys and soil assays for radionuclides and heavy metals to ascertain residual contamination levels. Where bedrock is encountered, soil sampling shall not be necessary.

(4) Based on the assessment of residual contamination levels in the Neutralized Sludge Disposal Area UCC/Umetco shall design a drainage control system and a cover which meets radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E, or shall conduct additional soil removal sufficient to achieve Criterion 2 of Table 4.1.2-1.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) Runoff control structures on the Neutralized Sludge Disposal Area shall be designed to direct runoff away from the Tailings Piles.

(7) The graded area shall be covered with at least one (1) foot of random fill and shall be vegetated in accordance with a program prepared and submitted by UCC/Umetco and approved by the State. If bedrock is exposed and radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E, are met, the random fill shall not be required.

(8) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.5.2.3 Storage Ponds Area

UCC/Umetco shall conduct remedial activities in the Storage Ponds Area as follows:

(1) UCC/Umetco has estimated that 40,000 cubic yards of raffinate crystals and contaminated pond material are within the Storage Ponds Area on Club Mesa. All raffinate crystals and contaminated pond materials shall be excavated and removed from the Storage Ponds Area. The materials shall be placed, compacted and disposed in accordance with the Approved Final Plans and Specifications.

(2) After removal of crystals in the Storage Ponds, all contaminated soils beneath the Storage Ponds shall be excavated, placed, compacted, and disposed on the tops of the Tailings Piles on Club Mesa in accordance with the Approved Final Plans and Specifications. Excavation of contaminated soils shall be governed by the following:

a. If gravels, clayey soils, or shale (claystone) bedrock are encountered beneath the crystals, at least one (1) foot of the soil or bedrock shall be excavated, placed, and disposed on the Tailings Piles.

b. In addition to removal described in Item a. above, surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

c. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(3) After excavation of contaminated soils as prescribed in Item (2) above, UCC/Umetco shall conduct scintillometer surveys and soil assays for radionuclides and heavy metals to ascertain residual contamination levels. If bedrock is encountered, soil sampling shall not be necessary.

(4) Based on the assessment of residual contamination levels in the Storage Ponds Area, UCC/Umetco shall design a drainage control system and a cover which meets radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E, or shall conduct additional soil removal sufficient to achieve Criterion 2 of Table 4.1.2-1.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) Runoff control structures on the Storage Ponds Area shall be designed so as to direct runoff away from the Tailings Piles.

(7) The graded area shall be covered with at least one (1) foot of random fill and shall be vegetated in accordance with a program prepared and submitted by

UCC/Umetco and approved by the State. If bedrock is exposed and radon and other applicable criteria in 6 CCR 1007-1-3, Schedule E, are met, the random fill shall not be required.

(8) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.5.2.4 Underground Mines and Portals

UCC/Umetco shall conduct remedial activities for subsided areas and accessible mine portals as follows:

(1) All subsided areas shall be filled with appropriate earth materials and compacted or graded in accordance with the Approved Final Plans and Specifications.

(2) All exposed mine portals shall be sealed in accordance with the Approved Final Plans and Specifications.

4.5.3 Requisite Assessment and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval, the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.5.2, 4.5.4, and 4.5.5.

In addition, Approved Final Plans and Specifications shall include:

- A proposed sealing plan for exposed mine portals.

4.5.4 Schedule

UCC/Umetco shall perform remedial activities for the Club Mesa Area according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) All discharge to the Club Mesa Area has ceased and shall not resume.

(3) Removal of raffinate crystals, neutralized sludges, and

contaminated soils shall be initiated not later than the date specified in the Approved Final Plans and Specifications but in no event later than September 30, 1993 and shall be completed not later than December 31, 1994.

(4) Runoff Control Structures shall be as set forth in the approved schedule for the Club Mesa remedial activities.

(5) The area shall be regraded, covered ~~and vegetated~~ not later than December 31, ~~1995~~ **1997 and revegetated by June 1, 1998.** [4/2/96]

(6) A Final Construction Report shall be submitted to the State not later than ninety (90) days after completion of vegetation.

(7) A Certification Report shall be submitted to the State not later than 120 days after completion of all remedial activities at the Uravan Facility.

4.5.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Excavation of all materials
- Final limits of excavations to assure that soils cleanup levels as specified in Section 4.5.2 are achieved
- Sealing of portals and filling subsidence areas
- Placement of random fill to final grade
- Vegetation
- Submission of Documents and Reports described in Section 4.5.3

Monitoring of the Club Mesa Area after vegetation shall include:

- Surface configuration

- Vegetation activities

Performance of the remedial activities shall be evaluated on the basis of the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.6 MILL AREAS

4.6.1 Description of Operations and Observed Impacts

The mill areas shown on Figure 1.1-1 include the A-Plant in the valley northwest of the Tailings Piles; the B-Plant, Ore Stock Pile Area, Barrel Storage Area, and a Heap Leach Site on a bench below and east of Tailings Pile 2; a Bone Yard for miscellaneous scrap plant equipment located west of Tailings Pile 2. These areas have all been impacted by the presence of radioactive materials. The extent of contamination is anticipated to be primarily surficial. All materials shall be assumed to be contaminated unless determined to be uncontaminated by application of methods specified in the Colorado Radioactive Materials License 660-02S.

4.6.2 Remedial Activities

4.6.2.1 A- and B-Plants

UCC/Umetco shall, in decommissioning the A- and B-Plants, perform remedial activities in the following manner according to the schedule described herein:

(1) Uncontaminated equipment, structures and waste

materials from mill decommissioning may be disposed of by sale, transferred to other UCC/Umetco facilities, transferred to an appropriate off-site solid waste site, or disposed in one of the sites listed in Section 4.6.4 in accordance with applicable standards in duly-promulgated rules and regulations, licenses and permits.

(2) Contaminated equipment, structures and waste materials from mill decommissioning, contaminated soils underlying the mill areas, and ancillary contaminated materials shall be disposed in one of the sites listed in Section 4.6.4 in accordance with applicable State and federal statutes, rules, regulations, licenses and permits.

a. The wooden thickener tanks in the B-Plant area, as shown on Figure 1.1-1, may be removed prior to mill decommissioning. [1/5/90]

(3) Excavation of contaminated soils in the area of the A- and B-Plants shall be governed by the following:

a. Surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

b. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(4) Completion of contaminated soil removal shall be based upon all the criteria specified in Table 4.1.2-1, except that if bedrock is encountered, soil sampling shall not be necessary.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) The A- and B- Plant areas shall be graded and vegetated to minimize soil erosion, except where bedrock is exposed at the surface.

(7) If monitoring of the vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the area performance requirements as stated in the approved QC/QA document have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

(8) The A- or B-Plant area may be used for the containment and evaporation of residual seepage liquids after termination and reclamation of the lined Club Ranch Ponds. UCC/Umetco shall propose, for review and

approval by the state, Final Plans and Specifications for an evaporation cell in the A- or B-Plant area, if necessary. Evaporation cell design shall include the design features set forth in Section 4.2.2 for the lined Club Ranch Ponds. [12/15/99]

4.6.2.2 Ore Stockpile Area

For the Ore Stockpile Area, UCC/Umetco shall perform remedial activities in the following manner:

(1) All ore has been previously removed from the ore stockpile area.

(2) Contaminated surface materials in the stockpile area will be shipped to the White Mesa mill at Blanding, Utah, or disposed of by sale, transferred to other UCC/Umetco facilities, transferred to an appropriate off-site solid waste site, or disposed in one of the sites listed in Section 4.6.4 in accordance with applicable duly-promulgated standards in rules and regulations, licenses and permits.

(3) Excavation of contaminated soils in the Ore Stockpile Area shall be governed by the following:

a. Surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

b. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(4) Completion of contaminated soil removal shall be based upon all the criteria specified in Table 4.1.2-1, except that if bedrock is encountered, soil sampling shall not be necessary.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) The Ore Stockpile Area shall be graded and vegetated to minimize soil erosion, except where bedrock is exposed at the surface.

(7) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve

required performance.

4.6.2.3 Barrel Storage Area

Barrels containing the general types of materials described in this section are stored at designated areas in A-Plant and B-Plant. The origin and nature of the contents of nearly all of the barrels are known and documented by UCC/Umetco. UCC/Umetco shall analyze the contents of all barrels with unknown contents to determine their contents and the existence of any hazardous constituents.

A description of the materials and plans for remedial activities (i.e. disposal of the barrels and their contents) are as follows:

(1) Feed Materials: These barrels contain materials that have not been processed at Uravan and that were acquired for the purpose of extracting vanadium or uranium. UCC/Umetco shall ship these materials to the White Mesa mill or to another UCC/Umetco facility for processing.

(2) Intermediate Process Materials: Materials that have been partially processed at Uravan and were removed

from the process stream during maintenance or housekeeping activities. UCC/Umetco shall transfer these materials to the White Mesa mill or other licensed facility for processing, or shall move them to disposal on the Tailings Piles. After any limited processing of materials authorized by the Colorado Radioactive Materials License, the solid wastes shall be disposed on the Tailings Piles and the liquid wastes shall be temporarily stored in the existing tanks and finally disposed by evaporation in lined ponds.

(3) Hazardous Mill Wastes: UCC/Umetco shall dispose of any waste materials found to be hazardous by the terms of the Resource Conservation and Recovery Act of 1976 (RCRA) or the terms of State and federal rules or regulations promulgated pursuant to RCRA at an off-site RCRA disposal site.

(4) Analytical Pulps: These are remnants of samples of materials that were assayed at the Grand Junction laboratory and returned to Uravan for storage or disposal. UCC/Umetco shall move these materials to disposal on the Tailings Piles.

(5) Exploration Samples: These barrels contain materials,

primarily drill cores, that were obtained in uranium exploration activities and assayed or examined at the Grand Junction laboratory and subsequently shipped to Uravan for storage or disposal. UCC/Umetco shall ship these materials to the White Mesa mill for processing or shall move them to disposal on the Uravan Tailings Piles.

(6) Non-Hazardous Mill Wastes: UCC/Umetco shall move non-hazardous waste materials to disposal on the Tailings Piles.

(7) Contaminated Soils: Contaminated soils in the Barrel Storage Area shall be excavated. Excavation shall be governed by procedures set forth in Sections 4.6.2.1(3) and (4).

(8) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

4.6.2.4 Heap Leach Site

UCC/Umetco has estimated that the Heap Leach Site consists of approximately 15,000 tons of partially processed ore resting on a 12-inch thick compacted clay pad that UCC/Umetco estimates

contains 1,800 cubic yards of clay. UCC/Umetco shall perform remedial activities at the Heap Leach Site in the following manner:

(1) UCC/Umetco shall ship the ore to the White Mesa mill for processing or shall move it to disposal on the Uravan Tailings Piles.

(2) The clay pad and associated drainage piping shall be moved to disposal on top of the Tailings Piles or other approved location in accordance with the Final Plans and Specifications.

(3) Structures are considered to be a part of the B-Plant area and shall be disposed as described in Section 4.6.2.1.

(4) Contaminated soils in the Heap Leach Site shall be excavated. Excavation shall be governed by the following:

a. Surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

b. If sandstone bedrock is encountered, no additional material shall be removed.

(5) Completion of the reclamation of the Heap Leach Site will be done as part of the Ore Stockpile Area reclamation in accordance with the provisions in Section 4.6.2.2 (4), (5), (6) and (7).

4.6.2.5 Bone Yard

The Bone Yard, where scrap and other solid materials have been stored, is located northwest of and adjacent to Tailings Pile 2. A pile of soils placed there during the installation of the stabilization berm in 1980 is included. UCC/Umetco shall perform remedial activities at the Bone Yard in the following manner:

(1) UCC/Umetco shall move all contaminated materials contained on this site to disposal on the Tailings Piles. Materials found to be uncontaminated may be disposed on the Tailings Piles or elsewhere in accordance with applicable standards in duly-promulgated rules and regulations, licenses and permits.

(2) Ancillary contaminated materials shall be removed and disposed of by sale, transferred to other UCC/Umetco facilities, transferred to an appropriate off-site solid waste site, or disposed in one of the sites

listed in Section 4.6.4, in accordance with applicable State and federal statutes, rules and regulations, licenses and permits.

(3) Excavation of the contaminated soils shall be governed by the following:

a. Surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

b. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(4) Completion of contaminated soil removal shall be based upon all the criteria specified in Table 4.1.2-1, except that if bedrock is encountered, soil sampling shall not be necessary.

(5) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(6) The Bone Yard shall be graded and vegetated to minimize soil erosion, except where bedrock is exposed at the surface.

(7) If monitoring of the cover and vegetation performance,

after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.6.2.6 Other Mill Areas

UCC/Umetco shall perform remedial activities in other mill areas in the following manner:

(1) UCC/Umetco shall remove all ancillary contaminated materials including pipelines, deposits in ditches, surface contamination of roads, etc., and shall dispose of them by sale, transfer to other UCC/Umetco facilities, transfer to an appropriate off-site solid waste site, or disposal in one of the sites listed in Section 4.6.4 in accordance with applicable standards in duly-promulgated rules and regulations, licenses and permits.

(2) Excavation of contaminated soils in the ditches and roads shall be governed by the following:

a. Surficial materials with scintillometer measurements greater than a corrected (true) measurement of 30 uR/h shall be excavated, placed, and disposed on the Tailings Piles.

b. Where sandstone or siltstone bedrock is encountered, no additional material shall be removed.

(3) Completion of contaminated soil removal shall be based upon all the criteria specified in Table 4.1.2-1, except that if bedrock is encountered, soil sampling shall not be necessary.

(4) During remedial activities runoff controls shall be in place to prevent releases of hazardous materials.

(5) The areas shall be graded and vegetated to minimize soil erosion, except where bedrock is exposed at the surface.

(6) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan are not met, UCC/Umetco shall propose, and implement for review and approval by the State, additional remedial actions to achieve required

performance.

4.6.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval, the documents stated and described in Section 4.1.3 but which shall meet requirements of Sections 4.6.2, 4.6.4, and 4.6.5. In addition, an inventory of all structures, equipment and waste materials shall be included in the cleanup plan.

4.6.4 Schedule

UCC/Umetco shall inform the State of its plans to decommission the mill at least one year prior to the start of decommissioning. These plans shall be consistent with the RAP schedule and shall not cause a delay in the implementation of the RAP. Disposal sites for the mill shall be chosen from the following, dependent on its availability at the time of mill decommissioning: the Tailings Piles, the crystal disposal site (the Burbank Quarry) or a disposal site in the Elk Claim area (Figure 1.1-1).

The mill areas shall be reclaimed according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) Decommissioning of the mill (A- and B-Plants), **excluding county road EE-22**, [4/2/96] shall be completed ~~within 3 years after UCC/Umetco notifies the State of its intent to decommission. UCC/Umetco shall submit its plans to the State for approval prior to~~

~~implementation, including detailed Plans and Specifications~~ by ~~July 1, 1997~~ ~~[2/7/95]~~ **December 31, ~~1999~~** ~~[4/2/96]~~ **2002** [12/15/99] **according to detailed plans and specifications submitted ~~on September 29, 1993 [2/7/95]~~to and approved by the State** [2/7/95] **on October 13, 1993** [4/2/96] ~~**Final grading and vegetation of the A-Plant area will be completed by December 31, 2001.**~~ ~~[4/2/96]~~ **County Road EE-22 and remnant waste materials in the A- and B-Plant areas associated with site remedial activities, e.g., wheel wash and roads, will be removed and/or remediated prior to regrading and vegetation.** [12/15/99]

a. Removal of the wooden tanks in the B-Plant area shall be completed as soon as practicable, but not later than the completion of mill decommissioning. Removal and final placement of the thickener tanks shall be in accordance with the requirements of Section 4.6.2 of the RAP. [1/5/90]

(3) The Ore Stockpile Area may be maintained in its present condition, with dust control as specified in Chapter 6.0 of this RAP and the Colorado Radioactive Materials License. Removal of contaminated materials and reclamation of the ore stockpile area shall be completed not later than the completion of mill decommissioning.

(4) Removal at the Barrel Storage Area shall be completed not later than December 31, 1987.

(5) Removal and excavation at the Heap Leach Site shall be completed in accordance with Section 4.6.2.4, Items (1) through (4), not later than December 31, 1988.

(6) Removal and excavation at the Bone Yard shall be completed not later than December 31, 1988.

(7) Remedial activities for all mill areas shall be completed not later than the completion of mill decommissioning.

(8) The Certification Report shall be submitted to the State not later than ninety (90) days after completion of removal and/or excavation activities.

(9) A Certification Report shall be submitted to the State not later than 120 days after completion of all prescribed remedial activities at the Uravan Facility.

4.6.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and shall include the following:

- Excavation of all materials
- Final limits of excavations to assure that contamination cleanup levels as specified in Section 4.6.2 are achieved
- Placement of fill materials to conform to final grade requirements
- Placement of all other materials including structural members, barrels, waste from decommissioning
- Grading of all areas
- Vegetation
- Submission of Documents and Reports described in Section 4.6.3

Monitoring of the reclaimed areas after revegetation shall

include:

- Surface configuration
- Vegetation activities

Performance of remedial activities shall be evaluated on the basis of the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.7 TOWN AND ADJACENT AREAS

Union Carbide Corporation/Umetco shall conduct remedial activities in the Town and Adjacent Areas as defined in Section 4.7. Remedial activities requiring contaminated soil or waste removal shall be in accordance with the Final Plans and Specifications. Where sandstone or siltstone bedrock or the groundwater table is encountered, no additional material shall be removed. [4/2/96]

4.7.1 Description of Operations and Observed Impacts

The town of Uravan (Figure 1.1-1) occupies the valley area just northwest of Tailings Piles 1 and 2. Adjacent areas are the town dump, which is northwest of the town obliquely opposite to Atkinson Creek on the south side of the San Miguel River, and areas adjacent to the town which were affected primarily by the windblown material including Hieroglyphic Canyon, San Miguel River and Atkinson Creek drainageways. Tailings were used in localized construction activities in and around the town. Wind- and surface water-transported tailings are found in the town and adjacent drainages.

4.7.2 Remedial Activities

4.7.2.1 Town and Dispersed Deposits

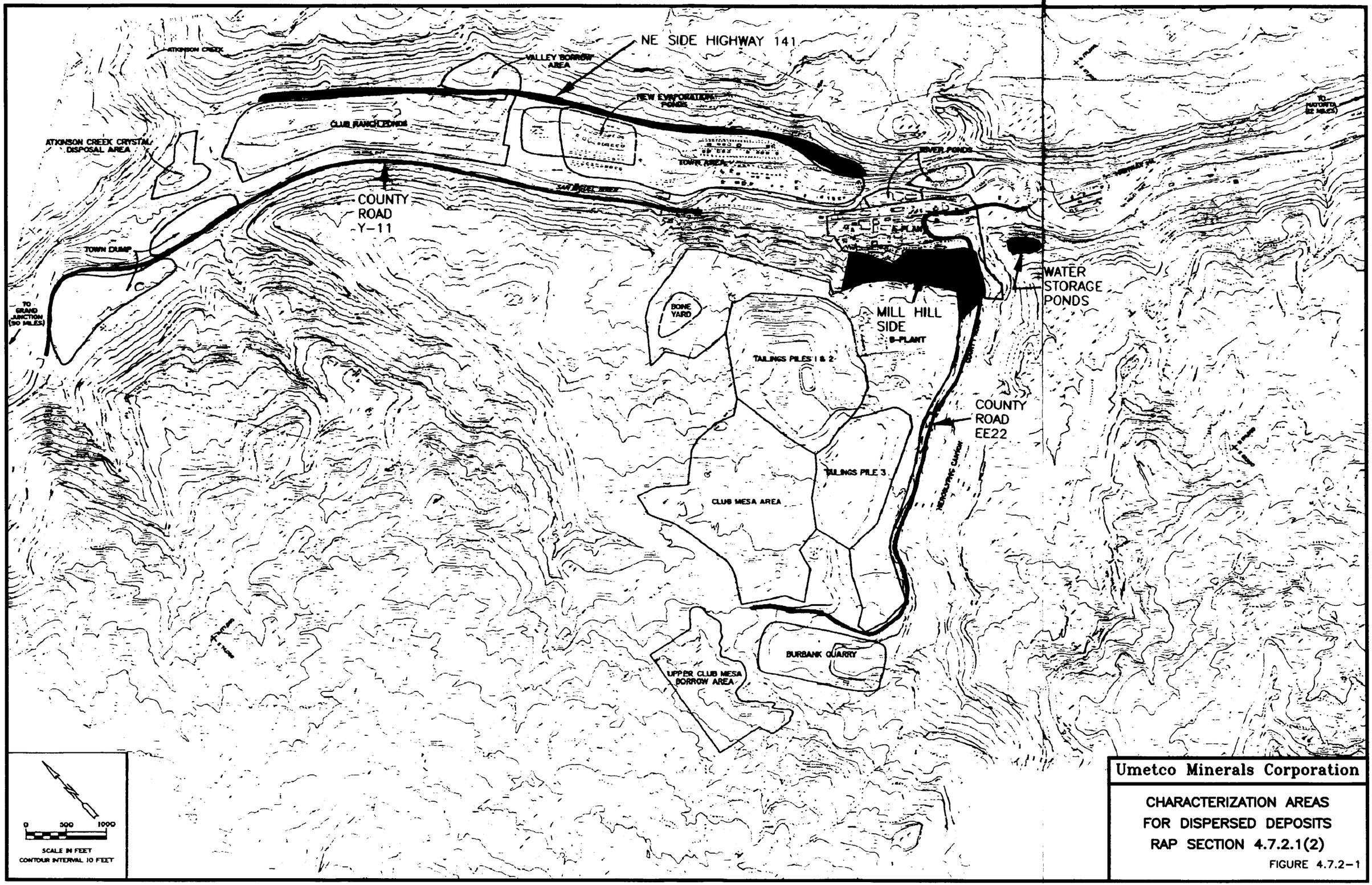
UCC/Umetco shall perform remedial activities in the following manner:

(1) UCC/Umetco shall remove or decontaminate all contaminated structures as provided in Section 4.6.2.1.

(2) For dispersed contaminated materials in the town, in adjacent areas along the San Miguel River Valley, and in such other adjacent locations outside the waste repository areas as are specified by the State, UCC/Umetco shall determine the extent of contamination and shall clean up areas found to be contaminated to meet both the criteria stated in Table 4.1.2-1.

4.7.2.2 Town Dump

UCC/Umetco shall investigate the town dump, an area of approximately 5 acres, located south and west of the Atkinson Creek confluence across the San Miguel River to determine what remedial action is appropriate, if any. This investigation shall include:



Umetco Minerals Corporation

CHARACTERIZATION AREAS FOR DISPERSED DEPOSITS RAP SECTION 4.7.2.1(2)

FIGURE 4.7.2-1

(1) A records search for all available information relating to disposal practices at the town dump.

(2) Investigations to ascertain whether hazardous substances are present. Investigations shall include, at a minimum, test pits and/or borings and laboratory tests. The investigation program shall be prepared by UCC/Umetco and submitted to the State for approval prior to execution.

(3) If hazardous materials are present, UCC/Umetco shall develop an action plan for removal and disposal of the materials and submit the plan to the State for review and approval prior to implementation.

Remedial activities by UCC/Umetco for removal and disposal of town dump contaminated material shall conform to applicable standards in duly-promulgated rules and regulations, licenses and permits.

4.7.2.3 Remnant Tailings

Remedial activities described in this section address remnant tailings deposits located in and around the Town of Uravan. These deposits include tailings material (1) located

under Colorado Highway 141, (2) located beneath the entrance road to B-Block, and (3) used for construction or backfill within the Town of Uravan. UCC/Umetco shall perform remedial activities regarding remnant tailings in the following manner:

(1) Tailings deposits and associated contaminated soils shall be removed from under Colorado Highway 141 at such time as the subsurface may be exposed for any reason. The materials shall be placed and disposed on Tailings Piles 1, 2, or 3. Removal shall be accomplished by UCC/Umetco, but UCC/Umetco shall have no responsibility to expose the subsurface or repair or replace Colorado Highway 141. UCC/Umetco shall have no responsibility for removing these materials after closure of the Tailings Piles.

(2) Tailings and associated contaminated soils shall be removed from beneath the entrance road to B-Block and shall be placed and disposed on the Tailings Piles.

(3) Discrete deposits of radioactive materials identified in the town by previous surveys and during cleanup activities shall be removed, placed, and disposed on the Tailings Piles.

(4) Cleanup of tailings deposits and contaminated soils shall be governed by criteria stated in Table 4.1.2-1.

4.7.2.4 Windblown Material

Windblown material is defined as mill-derived contaminants dispersed by wind to surrounding areas. The area likely containing windblown contamination is depicted on Figure 4.7.2.4-1. UCC/Umetco shall perform remedial activities for these materials as follows:

(1) General windblown material in the Club Mesa area as outlined on Figure 4.7.2.4-1 shall not be removed or plowed due to the presence of a thin soils cover and the environmentally sensitive nature of the Club Mesa area. To the maximum extent reasonably achievable, concentrated, contaminated deposits shall be removed if scintillometer measurements greater than a corrected measurement of 30 microRoentgens per hour (true) are encountered. Final cleanup for the concentrated, contaminated deposits shall be consistent with the criteria stated in Table 4.1.2-1.

(2) Sediment traps shall be constructed in the immediate area of the Tailings Piles and spray areas and shall be designed to collect sediment carried into the

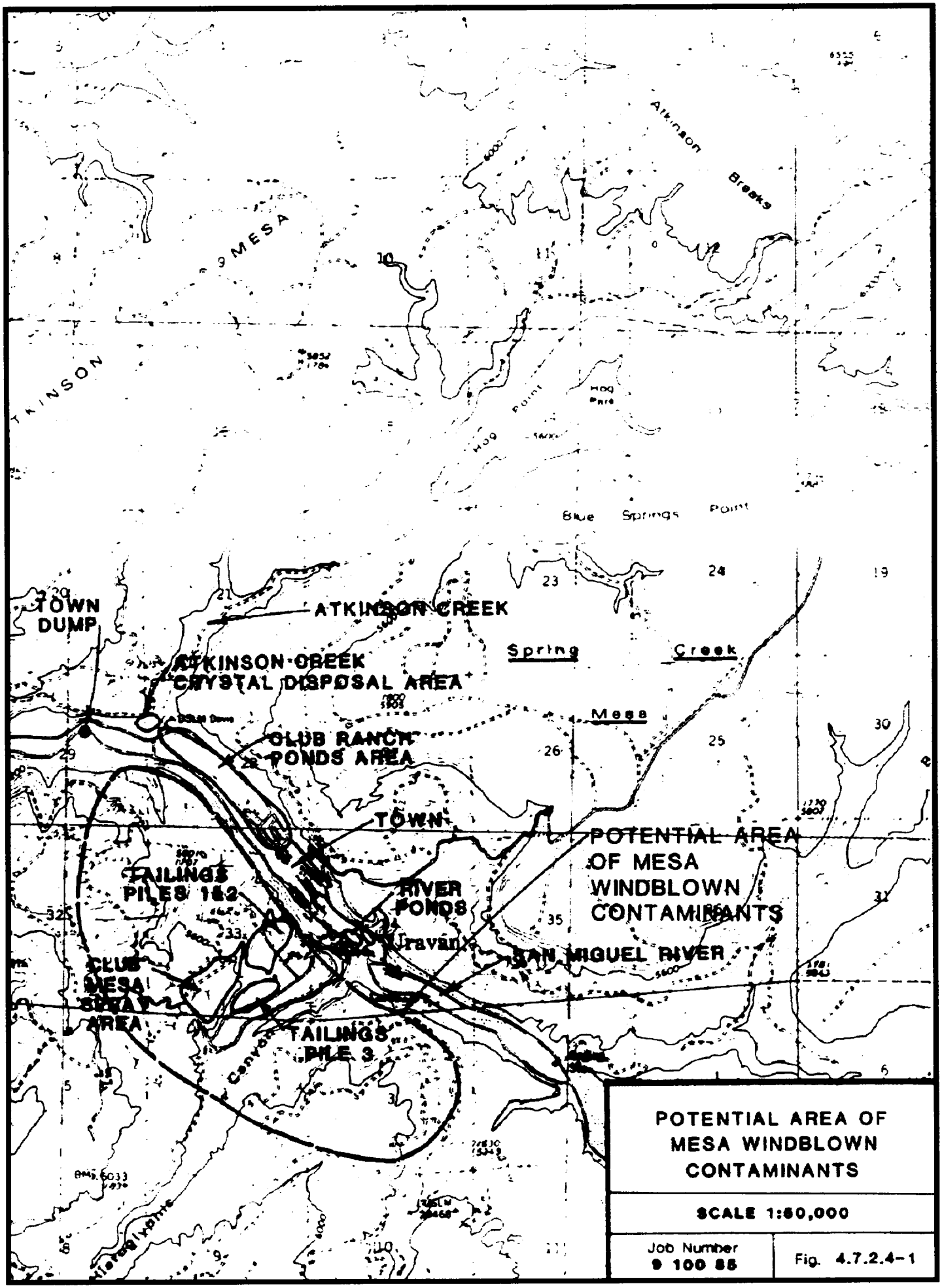
intermittently flowing drainages. Sediment trap locations, details, cleanout frequency, removal criteria and reclamation plans shall be submitted to the State with the Final Plans and Specifications.

4.7.2.5 Streamway and Drainageway Deposits

Stream and drainageways in the area of Uravan contain contaminants from the milling activities. Three principal drainages are included for possible remedial activities: (1) San Miguel River, (2) Atkinson Creek, and (3) Hieroglyphic Canyon. UCC/Umetco shall perform remedial activities for these drainageways in the following manner:

(1) Sediments in the San Miguel River, other than those removed when the River Ponds are excavated, shall not be removed.

(2) If found in the Atkinson Creek stream bed within 1,000 feet of the San Miguel River, concentrated contaminated sediments with scintillometer measurements greater than 30 uR/hr (true) shall be removed, placed, and disposed on the Tailings Piles. Final cleanup of concentrated



POTENTIAL AREA OF MESA WINDBLOWN CONTAMINANTS

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Fig. 4.7.2.4-1

contaminated materials shall be consistent with the Criteria stated in Table 4.1.2-1.

(3) Concentrated contaminated material in Hieroglyphic Canyon stream bed with scintillometer readings greater than corrected 30 uR/hr. (true) may be removed. The need for cleanup will be determined considering technical feasibility, cost effectiveness, environmental impact, and threat to the public health. Final cleanup of concentrated, contaminated materials in Hieroglyphic Canyon shall be consistent with the Criteria stated in Table 4.1.2-1.

4.7.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State, for review and approval prior to execution, the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.7.2, 4.7.4, and 4.7.5.

4.7.4 Schedule

UCC/Umetco shall conduct remedial activities in accordance with the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(2) Atkinson Creek remedial activities shall be completed no later than December 31, 1992.

(3) Hieroglyphic Canyon remedial activities shall be completed not later than December 31, 1994.

(4) Cleanup in the town as provided in Section 4.7.2.1 shall be completed not later than December 31, 1994. **The area shall be revegetated after soil verification studies have been completed and approved by the State.** [4/2/96]

(5) For the town dump, **characterization** investigations shall be ~~initiated not later than June 30, 1987, with remedial action based thereon and completed in accordance with a schedule approved by the State~~ **completed by July 1, 1996. Cleanup activities at the town dump shall be completed** ~~and disturbed areas shall be regraded and revegetated~~ [12/15/99] **by December 31, 1999.**[4/2/96] **Final grading of the Town Dump shall be**

completed by June 30, 2000 and revegetated by December 31, 2000. [12/15/99]

(6) Remnant tailings removal shall be completed not later than December 31, 1989.

(7) Sediment traps shall be constructed not later than December 31, 1987.

(8) The sediment traps shall be inspected at least once a year and cleaned in accordance with the schedule given in the Approved Final Plans and Specifications.

(9) A Final Construction Report shall be submitted to the State not later than ninety (90) days after completion of remedial activities for each area.

(10) A Certification Report shall be submitted to the State not later than 120 days after completion of all remedial activities at the Uravan Facility.

(11) Dispersed 11.e.(2) materials described in Section 4.7.2.1(2) and shown on Figure 4.7.2.1 shall be characterized by December 31, 1998. If necessary appropriate remedial activities shall be developed

and submitted to the State for review and approval. Cleanup verification surveys in identified contaminated areas shall be completed by December 31, ~~1999~~. [4/2/96] **2002** [12/15/99]

4.7.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform QC/QA, Monitoring and Performance Evaluation as prescribed in Addendum A and in Section 4.6.5 and in accordance with a plan to be submitted with the Final Plans and Specifications.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.8 BURBANK QUARRY

4.8.1 Description of Operations

The Burbank Quarry (Figure 4.8.1-1) is intended to be the source of riprap for remedial activities. Random fill and clays may be mined from the pit for use in remedial construction. The quarry shall also be the raffinate crystal repository and may serve as the repository for other wastes as approved by the State. If, however, the Burbank Quarry is unavailable for these purposes by reason of objection of the U.S. Bureau of Land Management, or other federal agency an appropriate alternative shall be proposed by UCC/Umetco that shall meet the technical and schedule requirements of this section, and that alternative site shall be submitted to the State for review and approval.

4.8.2 Program of Activities

UCC/Umetco shall perform activities for the Burbank Quarry in the following manner:

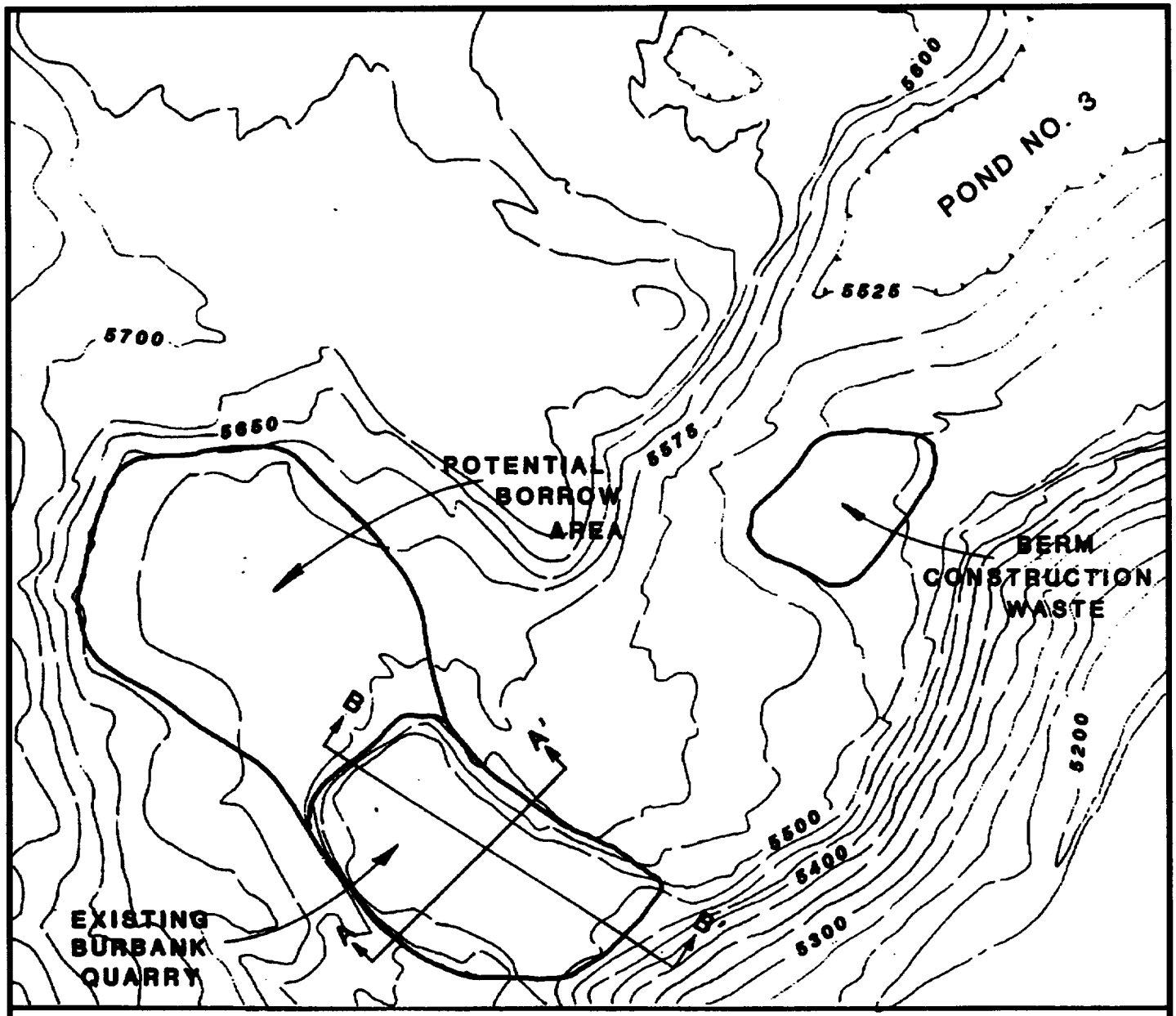
(1) UCC/Umetco shall mine the existing quarry to obtain borrow material and riprap for use in the remedial action program. The Burbank Quarry, and/or any approved alternative, shall have sufficient capacity to

accommodate disposal activities as required by the Remedial Action Plan. Portions of the borrow material may be stockpiled for later use.

(2) The bottom of the quarry underlying the crystal repository area shall be covered by at least one (1) foot of compacted in-situ or imported clay.

(3) The raffinate crystals removed from the Atkinson Creek Disposal Area, the Club Ranch Ponds and the Club Mesa Area and any other crystal disposal areas shall be placed, compacted, and disposed in accordance with Approved Final Plans and Specifications in the quarry in "cells". Each cell shall have a maximum length of 44 meters, a maximum width of 44 meters and a maximum height of 6.6 meters. Each cell shall be covered and separated from adjacent cells by at least one (1) foot of compacted clayey soil. Typical cross-sections which illustrate the "cell" concept are shown on Figures 4.8.1-2 and 4.8.1-3. Specifications for crystal and clayey soil compaction shall be estimated in the Approved Final Plans and Specifications for verification during initial cell placement.

(4) The deposited crystals shall be contained in the quarry



NOTES:

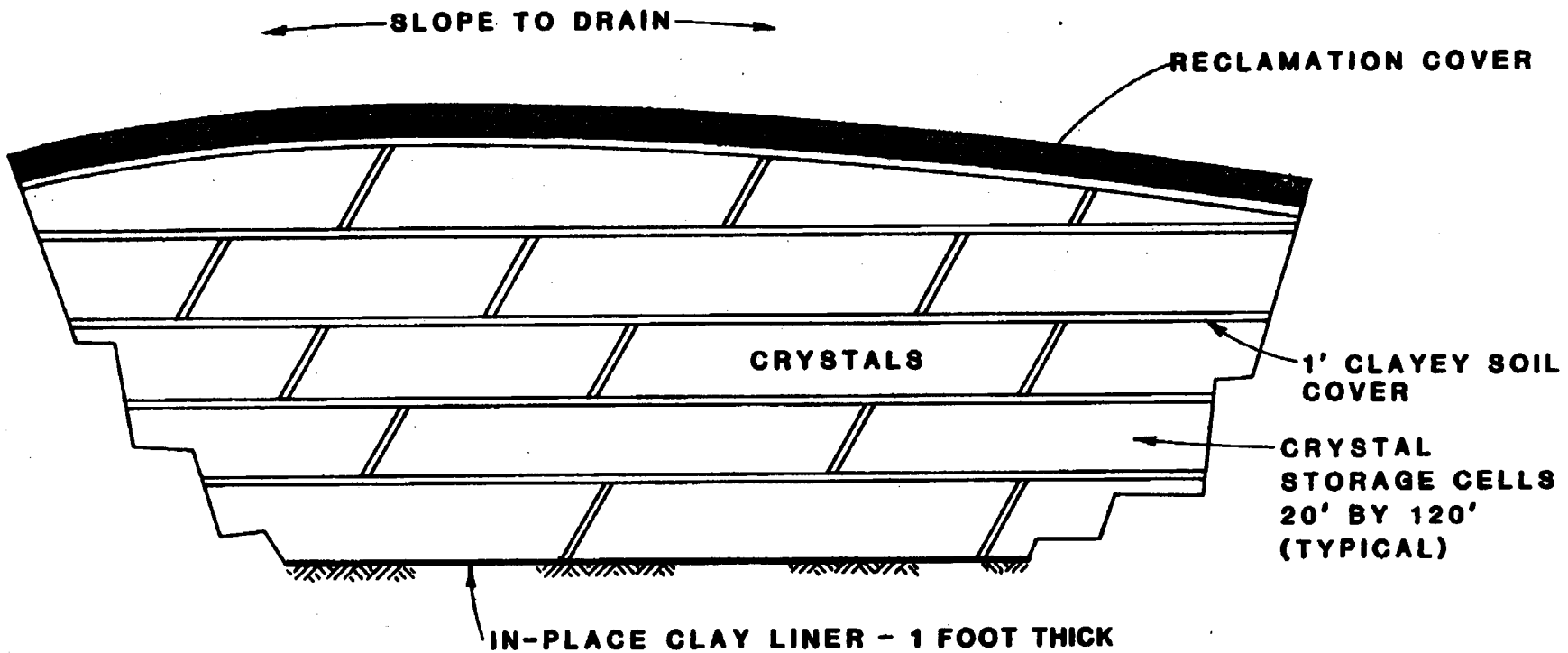
1. Burbank Quarry to be mined for riprap and random fill for tailings pile reclamation.

2. Expanded quarry to be designed as a below-grade repository for crystal storage.

3. Burbank pit will be reclaimed with a protective cover to minimize infiltration and provide for long-term stability.

		PLAN VIEW OF BURBANK QUARRY	Fig. 4.8.1-1

CONCEPTUAL DIAGRAM
CRYSTAL STORAGE
BURBANK PIT



SECTION A - A'

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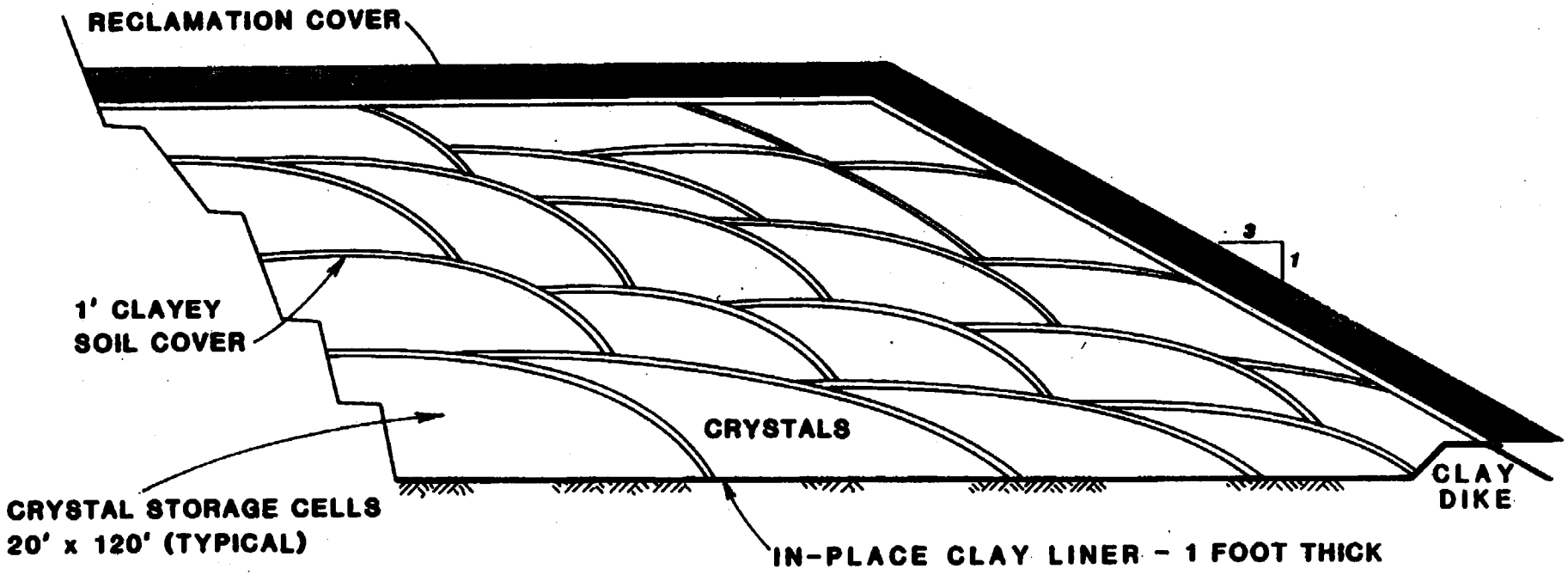
Fig. 4.8.1-2

CONCEPTUAL CROSS-SECTION
CRYSTAL STORAGE
BURBANK PIT



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SECTION B - B'

Fig. 4.8.1-8

without modification of the side slopes. The final exterior slope of the quarry shall be no steeper than 3(H):1(V).

(5) The exposed surfaces shall be reclaimed with a cover 1.83 meters thick, consisting of 0.33 meters of compacted clay, 0.84 meters of random fill and 0.66 meters of riprap, or as determined during final design and presented in the Final Plans and Specifications in order to provide for long-term stability in accordance with 6 CCR 1007-1-3, Schedule E. Pursuant to 6 CCR 1007-1-3, Section 1.5.1, the State has determined that UCC/Umetco is exempt from the 3.0 meter cover requirement of Criterion 6 of Schedule E on the following basis: The cell design of the Burbank repository provides several layers of cover; radon exhalation rates will comply with the radon exhalation criterion of Schedule E; and, the Burbank repository will meet the requirements for long-term integrity of Schedule E. A typical cross-section drawing of the reclamation cover including slope, minimum thicknesses and materials is depicted in Figure 4.8.1-4.

(6) Areas on the quarry walls which may emit water shall be evaluated and appropriate measures to prevent dissolving of crystals or disruption of the repository

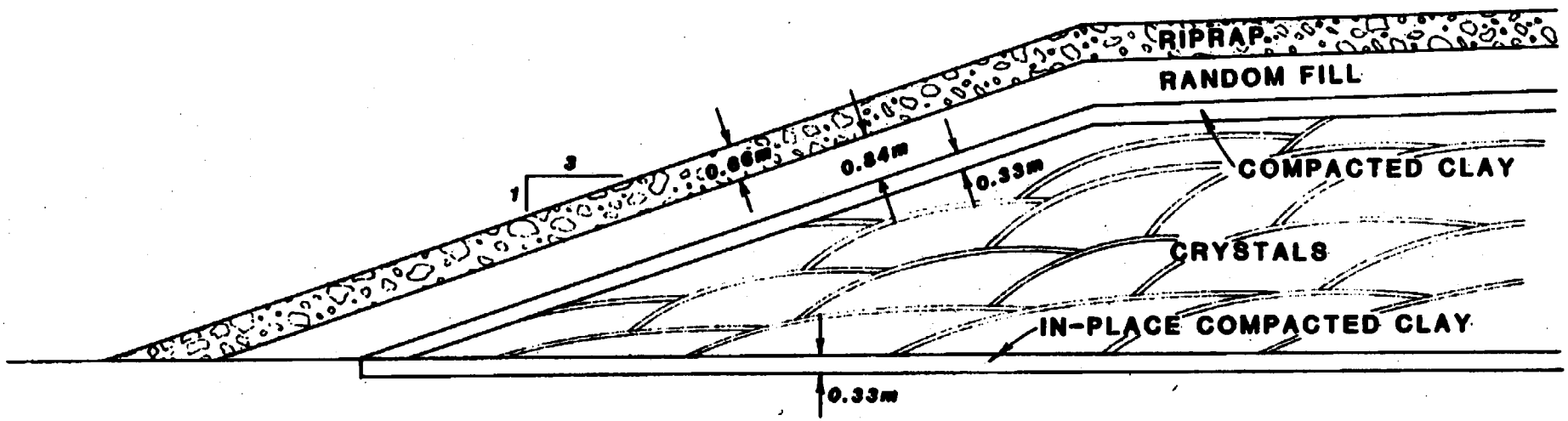
shall be implemented by UCC/Umetco upon approval by the State.

(7) Runoff control structures shall be constructed to divert surface water away from the quarry.

(8) A drainage control system shall be constructed prior to the initiation of storage activities to prevent releases of hazardous constituents.

(9) Areas disturbed by quarry activities outside of the crystal repository area shall be graded and vegetated in accordance with a plan prepared and submitted by UCC/Umetco and approved by the State through its Mined Land Reclamation Division.

(10) If monitoring of the cover and vegetation performance, after completion of remedial activities but prior to closure of the Uravan Facility, demonstrates that the performance requirements as stated in the approved Quality Plan have not been met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.



RECLAMATION COVER - CRYSTAL DISPOSAL REPOSITORY

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Fig. 4.8.1-4

(11) If monitoring of the integrity of the cells prior to closure demonstrates that the performance requirements of Section 4.8.5 are not met, UCC/Umetco shall propose, for review and approval by the State, and implement additional remedial actions to achieve required performance.

4.8.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval, the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.8.2, 4.8.4, and 4.8.5.

Evaluations of areas of the quarry walls where seepage may occur and proposed plans for seepage control measures, as appropriate, shall be prepared by UCC/Umetco and submitted to the State for review and approval. These evaluations and plans shall be submitted by UCC/Umetco so as to permit the State sixty (60) days for review and approval without delaying the schedule for crystal disposal described in Section 4.8.4.

In addition, the Final Plans and Specifications shall include:

- A proposed pit development plan showing the sequence of operations up to final closure.

- Specifications for all materials including a methodology to develop placement and compaction specifications for raffinate crystals and clay materials.

4.8.4 Schedule

UCC/Umetco shall mine the Burbank Quarry, and shall place and compact crystals and clay lining in it according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than 120 days after the Consent Decree is entered by the Court.

(1) Excavation of the quarry shall be consistent with the need for tailings cover material and shall not conflict with the schedule for placement of crystals.

(3) The raffinate crystals removed from the Atkinson Creek Disposal Area, the Club Ranch Ponds and the Club Mesa

Area shall begin to be placed in the Burbank Quarry no later than September 30, 1989 and shall be completed not later than December 31, 1994. Final reclamation cover shall be placed over these materials not later than December 31, ~~2000~~ **1998** [4/2/96] ~~except that an area to contain the crystal residue from the lined evaporation ponds may remain open until one year following disposal of the liner and residue from the evaporation ponds.~~ [4/2/96]

(4) ~~Any remaining residual crystals from evaporation ponds shall be in the Burbank Quarry, covered and reclaimed not later than one (1) year after completion of evaporation.~~ [4/2/96]

(5) Construction of the diversion ditches and drainage system shall be initiated not later than September 30, 1988 and shall be completed not later than December 31, 1989.

(6) A Final Construction Report shall be submitted to the State not later than ninety (90) days after completion of vegetation.

(7) A Certification Report shall be submitted to the

State not later than 120 days after completion of all remedial activities.

(8) The Burbank Quarry toe drain collection system shall be plugged if no liquids are removed from the collection sump for three consecutive years. If liquids are removed, collection system plugging will be based on a technical evaluation of repository stability as it relates to toe drain seepage. [12/15/99]

4.8.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring, Performance Evaluation and Inspection as prescribed in Addendum A.

QC/QA shall meet the requirements stated in Addendum A and shall include the following:

- Excavation of all materials
- Preparation of the base compacted clay liner
- Drainage and surface runoff control elements
- Placement and compaction of all materials during

construction

- Development of compaction specifications for clay and raffinate crystals
- Vegetation
- Submission of Documents and Reports as described in Section 4.8.3

Monitoring of the Burbank Quarry after revegetation shall include:

- Surface configuration
- Vegetation activities

Performance of the remedial activities shall be evaluated on the basis of maintaining the long-term integrity of the cells and crystal repository, preventing contact of the crystals with moisture in sufficient quantities to cause dissolving of the crystals, the adequacy of the stability of the final cover with respect to maintaining its configuration, and, the effectiveness of vegetative activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

4.9 BORROW AREAS ON CLUB MESA

4.9.1 Description of Operations

Borrow Areas on Club Mesa shall be used as sources of clayey soils and random backfill to be used during remedial activities. These areas are shown on Figure 1.1-1.

4.9.2 Program of Activities

UCC/Umetco shall perform the program of activities for the Borrow Areas on Club Mesa in the following manner:

(1) UCC/Umetco shall excavate borrow materials as needed for use during the implementation of the Remedial Action Plan.

(2) Construction and reclamation shall be conducted in accordance with a plan prepared and submitted by UCC/Umetco and approved by the State through its Mined Land Reclamation Division.

4.9.3 Requisite Assessment and Engineering Activities

UCC/Umetco shall prepare and submit to the State for

review and approval the documents stated and described in Section 4.1.3 but which shall meet the requirements of Sections 4.9.2, 4.9.4, and 4.9.5.

In addition, Final Plans and Specifications shall include:

- A proposed pit development plan showing the sequence of operations up to final anticipated configuration prior to regrading and showing material characteristics, including their vertical and areal extent.

- An inventory of materials and a plan showing final placement destination of all major categories of borrow materials.

- All reclamation details specified by the Mined Land Reclamation Division.

4.9.4 Schedule

UCC/Umetco shall develop the Borrow Area on Club Mesa according to the following schedule:

(1) Final Plans and Specifications shall be prepared by UCC/Umetco and submitted to the State not later than

120 days after the Consent Decree is entered by the Court.

(2) Excavation of the Borrow Area shall be consistent with the need for fill material and shall not conflict with the schedule in this Remedial Action Plan.

(3) Construction and reclamation of the Borrow Area shall be in accordance with a schedule submitted to and approved by the State through its Mined Land Reclamation Division.

4.9.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring, Performance Evaluation and Inspection as prescribed in Addendum A.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Excavation of all materials
- Drainage and surface runoff control elements
- Grading

- Vegetation
- Submission of Documents and Reports as described in Section 4.9.3

Monitoring of the Borrow Areas after regrading and revegetation shall include:

- Surface configuration
- Vegetation activities

5.0 REMEDIAL ACTION PLAN - LIQUIDS

Contaminated liquids are migrating from the Uravan mill complex and waste disposal areas. The Remedial Action Plan for liquids addresses the following issues in subsections:

1. Tailings liquids issuing as hillside seepage, toe berm seepage, and the tailings dewatering liquids.
2. Ponded liquids in Club Ranch Ponds, River Ponds, and storage ponds on Club Mesa, and other liquids in the mill circuit and ponds.
3. Surface runoff from the mill complex and affected watershed.
4. Groundwater under both Club Mesa and San Miguel River Valley.

Remedial activities for liquids shall be conducted as specified in the Sections and Tables herein. For each affected area this section presents (1) a description of operations and observed impacts, (2) remedial actions, including cleanup criteria, (3) requisite assessments and engineering activities, (4) schedule, and (5) quality control, quality assurance, monitoring, performance evaluation and inspection. Conceptual designs and material specifications are presented for purposes of clarifying detailed design requirements.

For Final Plans and Specifications and all other items, documents, or actions for which State approval is required by this Remedial Action Plan: (1) the term "approval" shall mean "prior approval in writing," (2) the State shall respond within one hundred twenty (120) days unless otherwise specified by the Consent Decree with a determination of approval or denial unless an alternate response time is specified, and (3) the State shall provide a statement of the reasons, with supporting information, for any determination other than unconditional approval.

Once approval is given by the State, UCC/Umetco shall implement any required work in accordance with the approved Final Plans and Specifications, and supporting documents.

5.0.1 Surface Water Discharge Prohibition

Notwithstanding any other provision of the RAP, there shall be no discharge from any point source at the Uravan Facility to any surface waters of the State of Colorado except as follows: discharge from the runoff collection and sedimentation ponds will be allowed only in the event that the design and operation standards required in Paragraph 5.3.2 have been complied with; when the removal of contaminant sources is complete and after performance of the other remedial activities specified in Sections 4.4.2 and 4.5.2 all in accordance with the

schedules in Sections 4.4.4 and 4.5.4 discharge of precipitation runoff from the permanent drainage channels will be allowed, subject to UCC/Umetco's obligation to obtain and comply with all necessary regulatory permits. For the purposes of this paragraph, "discharge from point sources" shall include but not be limited to discharges from the Club Ranch Ponds, the River Ponds, Storage Ponds on Club Mesa, Tailings Piles, Burbank Pit, and any and all evaporation ponds, but shall not include seepage from said ponds or piles where such seepage has not been collected at some point in a confined, discrete, or discernible conveyance constructed by UCC/Umetco.

5.0.2 Groundwater Discharge Prohibition

UCC/Umetco shall implement the liner failure contingency plan as required by Section 5.1.1.2(4) and 4.2.2(9) of this RAP.

5.0.3 Notification

(1) UCC/Umetco shall immediately upon discovery orally notify the State of any actual or imminently anticipated release of collected liquids from any surface impoundment or pipeline which is reaching, has reached, or may reach surface waters of the State of Colorado. In addition, within 24 hours of such

discovery UCC/Umetco shall report to the State in writing all information then in their possession regarding such actual or imminently anticipated discharge.

(2) Any evidence of failure of the liner or leak detection system beyond design criteria from any lined evaporation ponds and/or any evidence of any release beyond design criteria from any lined evaporation ponds to any groundwater of the State shall be orally reported to the State immediately upon discovery. In addition, within 24 hours of such discovery UCC/Umetco shall report to the State in writing all information then in their possession regarding such actually or imminently anticipated release.

5.1 HILLSIDE SEEPAGE AND TAILINGS LIQUIDS

5.1.1 Hillside Seepage

Discharge Prohibition: There shall be no discharge of any liquids collected or detained by the hillside collection system after they have reached the pipeline or other conveyance designed or installed to remove the liquids except to the evaporation ponds as described in paragraph 5.1.1.2(4) of the RAP.

5.1.1.1 Description of Hillside Seepage and Observed Impacts

Seepage is occurring intermittently along approximately 4600 linear feet of the Club Mesa rim. Seepage occurs near the contact between the Summerville and Salt Wash Formations and exits along the valley walls of Hieroglyphic Canyon and the San Miguel River above the A-Plant area. Some of the seepage is presently collected in ditches and along roadways and conveyed to the Club Ranch Ponds.

The hillside seepage is composed of geochemically-modified tailings solutions from the Tailings Piles and raffinate seepage from the Club Mesa Spray Area. The level of total dissolved solids (TDS) and ionic concentrations are much lower than that of the parent solutions. Average concentrations of contaminants are

shown in Table 5.1.1-1. UCC/Umetco estimates the present seepage rate to be approximately 30 gpm. Collection system improvements may increase this rate. The volume of hillside seepage is expected to diminish with time.

5.1.1.2 Remedial Activities

UCC/Umetco shall perform remedial activities for the hillside seepage in the following manner:

(1) Improvements shall be made to the existing collection system and new collection ditches shall be constructed so as to optimize the containment of liquids. All existing and new collection ditches and ponds shall be lined with high density polyethylene lining (HDPE) to enhance seepage collection.

(2) A collection system shall be installed near the base of the Entrada Formation and shall be designed and shall operate to collect to the extent practicable both surface flow over the cliff face and interflow through the hillside colluvium. This collection system shall consist of at least a four-inch perforated poly-vinyl chloride (PVC) pipe embedded in a gravel-filled trench. The bottom of the trench shall be lined with relatively

Table 5.1.1-1

AVERAGE WATER QUALITY OF THE TOE BERM DRAIN, HILLSIDE SEEPAGE
UCC/UMETCO WATER QUALITY DISCHARGE STUDY, 1984

	TOE BERM DRAINS		HILLSIDE	
	Mean X, mg/l	Std. Dev. s, mg/l	Mean X, mg/l	Std. Dev. s, mg/l
Al	1154.	200.	4.76	9.04
As	1.80	0.73	0.049	0.066
Be	-	-	-	-
Cd	1.91	0.41	0.0295	0.264
CRIII	-	-	-	-
CrVI	-	-	-	-
Cu	-	-	-	-
Fe	-	-	-	-
Pb	0.082	0.205	< 0.023	< 0.04
Mn	-	-	-	-
Hg ppb	0.64	0.513	0.61	0.82
Ni	-	-	-	-
Se	0.855	0.416	0.331	0.153
Ag	0.131	0.219	0.0152	0.017
Cl	0.48	0.23	< 0.418	< 0.191
U uCi/ml	6.88E-6	2.39E-6	1.95E-6	0.57E-6
Zn	43.4	13.4	0.618	0.353
Ra-226 uCi/ml	13.7E-8	9.29E-8	89.0E-9	182.0E-9
Ammonia	1567.	782.	174.	113.
Nitrate	79.7	10.9	29.4	10.8
Nitrite	0.13	0.116	27.94	9.60
Cyanide	.017	.0067	0.058	0.016
Sulfate	25750.	5389.	9592.	1844.
TDS	35500.	9390.	15990.	3076.

impervious (permeability of less than 10-7/ cm/sec) material to promote drainage into the collection system. Design features and system operation shall be detailed by UCC/Umetco in the Approved Final Plans and Specifications.

(3) So long as contaminated hillside or toe berm seepage with concentrations in excess of the groundwater agricultural-use criteria (Table 5.4.3.2-1) and concentrations which would cause a violation of the surface water San Miguel River quality criteria (Table 5.4.3.2-3) continues, UCC/Umetco shall collect and dispose of the liquid as described below. **If concentrations are in excess of the groundwater agricultural-use criteria but do not cause a violation of the surface water San Miguel River quality criteria, UCC/Umetco may evaluate removal and/or sealing of the hillside or toe berm collection systems considering future health risks, environmental impacts, and alternative treatment technologies. Results of the evaluation will be submitted to the State for review and approval. If flows are zero for three consecutive years in any collection system segment, that segment may be removed or plugged.** [12/15/99]

(4) Collected liquids shall be disposed in the Club Ranch Ponds until **a** lined evaporation pond~~s~~ in the Club Ranch Pond Area **now known as CRP-7** ~~are~~ **is** available according to the schedule in Section 5.1.1.4. **A second lined evaporation pond in the Club Ranch Pond Area now known as CRP-8 shall also be made available according to the schedule in Section 5.1.1.4. Additional lined ponds shall be constructed as necessary to satisfy the capacity requirement recited in Section 4.2.2(9) according to the schedule in 5.1.1.4.** [11/9/87] These lined evaporation ponds shall be designed, constructed, and installed with a synthetic liner to prevent the migration of any hazardous constituents into the subsurface soil or ground water or surface water during the operational life of the pond(s) in accordance with Section 4.2.2(9) and Figures 4.2.2-1 and 4.2.2-2.

(5) Until December 31, 1989, liquids may be stored in the lined surge pond on Tailings Pile 2 as approved by the State. The existing lined upper return water pond, located in the B-Plant Area, may be utilized for liquids storage as long as it is required.

5.1.1.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the following:

(1) Final Plans and Specifications certified by a Registered Professional Engineer or equivalent qualified technical specialist approved by the State. These Final Plans and Specifications shall include design drawings (plans, profiles and details) and specifications (all construction materials, procedures, surveys and schedules) for all remedial activities required in Section 5.1.1.2, according to the schedule in Section 5.1.1.4, and the controls in Section 5.1.1.5. Appropriate base maps shall show the existing topography. Boundary surveys, where applicable, shall be prepared by a Registered Land Surveyor.

Requisite plans and programs pursuant to Section 5.1.1.2 shall include the following:

a. A proposed plan for the seepage collection ditch system, including final reclamation activities.

b. A proposed plan for the drainage system to be located near the base of the Entrada Formation, including final reclamation activities.

c. The proposed design of the evaporation pond(s) in

accordance with Section 5.1.1.2(4) along with monitoring of the ponds and groundwater in the area, contingency plans for liner failure and repair, and for final reclamation.

d. A performance evaluation report for the seepage collection system as provided in Section 5.1.1.5.

(2) A proposed Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation Plan ("Quality Plan") in accordance with Section 5.1.1.5 and Addendum A requirements. This plan should include periodic monitoring reports of the performance of the evaporation ponds.

(3) An Annual Report of data collected in the San Miguel River monitoring program and brief analysis thereof.

(4) A Final Construction Report including:

a. As-built drawings for all construction activities and showing limit-of-excavation and the final ground surface configuration. All construction activities and any differences between the as-built drawings and designs and specifications shall be described and explained.

b. A final summary of construction and quality control activities, quality assurance audits and materials and other test data taken during construction.

(5) A Certification Report including an assessment and evaluation of the effectiveness of the cleanup effort

in comparison with the RAP and Consent Decree and with statutes, rules and regulations, licenses and permits rendered applicable under the RAP or Consent Decree. Items discussed in this report shall include San Miguel River concentrations for State-regulated chemical constituents and key indicator biotic and chemical species as required in Addendum A, Section A5.0.1, and final reclamation of the ditch, evaporation ponds and drainage systems.

5.1.1.4 Schedule

UCC/Umetco shall perform remedial activities for the hillside seepage according to the following schedule.

(1) Final Plans and Specifications and the Quality Plan, including monitoring, shall be prepared by UCC/Umetco and submitted not later than 120 days after the Consent Decree is entered by the Court.

(2) Final Plans and Specifications for the evaporation pond(s) required by paragraph 5.1.1.2(4), shall be prepared by UCC/Umetco and submitted not later than 60 days after the Consent Decree is entered by the Court.

(3) Improvements of the existing collection facilities shall be completed not later than December 31, 1988.

(4) The drainage system shall be installed near the base of the Entrada Formation not later than December 31, 1988.

(5) The evaporation pond **in the Club Ranch Pond Area now known as CRP-7** as specified and required in Section 5.1.1.2(4) shall be completed and shall be placed in use by ~~November 1, 1987 January 31, 1988 [11/9/87]~~ **May 31, 1988. [3/1/88] A second lined evaporation pond in the Club Ranch Pond Area now known as CRP-8, and other lined ponds which are necessary to satisfy the requirements of Section 4.2.2(9), shall be completed and placed in use by June 30, 1988.** [11/9/87]

(6) An approved river ambient (upstream), and downstream San Miguel River monitoring program approved by the State shall be initiated no later than one hundred twenty (120) days after entry of the Consent Decree. Monitoring shall continue as required in Addendum A.

(7) The Annual Report required by Section 5.1.1.3(3) shall be submitted not later than March 31st of each year for each prior calendar year.

(8) A Final Construction Report shall be submitted to the State not later than 90 days after the completion of construction.

(9) The proposed long-term monitoring plan required by Section 5.1.1.5 shall be submitted not later than ninety (90) days prior to completion of all remedial activities.

(10) The Certification Report shall be submitted to the State not later than 120 days after completion of all remedial activities.

(11) The seepage collection system performance evaluation report described in Section 5.1.1.5 shall be submitted on March 31 of the sixth year of seepage collection and every fifth year thereafter.

5.1.1.5 Quality Control/Quality Assurance, Monitoring Performance Evaluation, and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation, as prescribed in Addendum A. The Quality Plan shall accompany the Final Plans and Specifications.

QC/QA shall meet the requirements of Addendum A and specifically shall include the following:

- All construction procedures, materials and surveys
- Detailed procedures for collection of samples, handling, and processing
- Appropriate use of field blanks, duplicates, and laboratory spikes (in no case at a frequency less than 10% of the samples collected)
- Parameter detection limits to be used for each sample type and the appropriate analytical method

Monitoring shall be planned and implemented so as to include the hillside collection and evaporation system and the San Miguel River, and shall specifically include the following:

- Quantity and quality of flow from the hillside collection and drainage systems
- Upstream monitoring of the San Miguel River to establish seasonal ambient levels of parameters
- Seasonal downstream monitoring in the San Miguel River
- Monitoring of evaporation pond and leak detection system performance and groundwater in the area of the ponds.
- An annual report of all monitoring data shall be submitted by March 31st of each year for the prior calendar year.

Monitor wells V-766 and CRP-15 will be used to determine the effectiveness of the collection system. Performance of the hillside collection and drainage systems shall be evaluated on the basis of their effectiveness to intercept flows to the San Miguel River. A performance evaluation report for the seepage collection system shall be prepared and submitted to the State

for every five (5) years of operation.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

5.1.2 Toe Berm Seepage and Tailings Dewatering Liquids

Discharge Prohibition: There shall be no discharge of any liquids collected or detained by the toe berm seepage collection system after they have reached the pipeline or other conveyance designed or installed to remove the liquids, except to the evaporation ponds as described in Paragraph 5.1.1.2(4) of the RAP.

5.1.2.1 Description of Liquids and Observed Impacts

Liquids will be forced from the Tailings Piles during dewatering and consolidation and for some time prior to and after final reclamation. Presently, seepage from the tailings is collected by a toe drain system at the base of the slopes of the Tailings Piles, and conveyed to the Club Ranch Ponds. UCC/Umetco

estimates this seepage to be at the rate of approximately 30 gpm. Typical composition of the tailings liquid is shown in Table 5.1.1-1.

5.1.2.2 Remedial Activities

UCC/Umetco shall perform remedial activities in the following manner:

(1) Trenches and sumps shall be constructed in selected areas of the Tailings Piles to enhance dewatering and consolidation of the tailings. The liquids collected shall be pumped to the lined evaporation ponds in the same manner as the contaminated hillside seepage. The determination of location and number of trenches shall include consideration of accessibility of equipment and, thus, shall be determined in the field.

(2) The toe berm seepage shall continue to be collected in the existing collection system until such seepage ceases and shall be evaporated as described in Section 5.1.1.2(4) in the same manner as the contaminated hillside seepage as described in Section 5.1.1.2(3).

5.1.2.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the following:

(1) Final Plans and Specifications certified by a Registered Professional Engineer, or equivalent qualified technical specialist approved by the State. These shall include design drawings (plans, profiles and details) and specifications (all construction materials, procedures, surveys and schedules) for all remedial activities required in Section 5.1.2.2, according to the schedule in Section 5.1.2.4, and the controls in Section 5.1.2.5. Appropriate base maps shall show the existing topography. Boundary surveys shall be prepared by a Registered Land Surveyor, or equivalent qualified technical specialist approved by the State. Requisite plans and programs as provided by Item c. in Section 5.1.1.3(1) shall also include the following:

- A proposed dewatering plan to include trenches, sumps and loads induced by placement of solid waste to enhance dewatering and consolidation of the tailings. Predictions of both dewatering and settlement rates shall be incorporated in this

plan. Based on performance, if enhancements or modifications are reasonable to achieve the proposed dewatering and consolidation, UCC/Umetco shall at that time prepare additional plans and specifications and submit them to the State for approval prior to implementation.

(2) A proposed Quality Control/Quality Assurance (QC/QA), Monitoring, and Performance Evaluation Plan ("Quality Plan") in accordance with Section 5.1.2.5 and Addendum A requirements.

(3) A Final Construction Report including:

a. As-built drawings for all construction activities and showing limit-of-excavation and the final ground surface configuration. All construction activities and differences between the as-built drawings and designs and specifications shall be described and explained.

b. A final summary of construction and quality control activities, quality assurance audits and materials and other test data taken during construction.

(4) The Certification Report including an assessment and evaluation of the effectiveness of the dewatering effort shall be included with the Tailings Pile Certification Report. Major items shall include discharge rate and quality, and settlement rates.

5.1.2.4 Schedule

UCC/Umetco shall perform remedial activities for tailings liquids and seepage according to the following schedule:

(1) Final Plans and Specifications and the Quality Plan, including monitoring shall be prepared and submitted by UCC/Umetco not later than sixty (60) days after the Consent Decree is entered by the Court.

(2) The evaporation ponds as specified and required in Section 5.1.1.2(4) shall commence operations not later than November 1, 1987.

(3) The schedule in items (6) through (10) in Section 5.1.1.4 shall be applicable to toe berm seepage and tailings dewatering liquids.

5.1.2.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation, and Inspection

QC/QA, Monitoring and Performance Evaluation shall be as prescribed in Addendum A and shall include all requirements of Section 5.1.1.5. The Quality Plan shall accompany the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following inspection activities:

- Installation of trenches and sumps
- All surveys, field and laboratory testing

The monitoring program shall include:

- Seepage rates
- Response of the Tailings Piles to dewatering and loading

Performance of the remedial activities shall be evaluated on the basis of the settlement and seepage rates as prescribed in Section 4.4.3.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

5.2 PONDED LIQUIDS

5.2.1 Club Ranch Ponds Liquid

5.2.1.1 Description of Liquids and Observed Impacts

Contaminated liquid contained in the Club Ranch Ponds consists primarily of toe drain and hillside seepage collected since mid-1985 and raffinate solution present in the ponds since the last discharge of raffinate to the ponds in 1984. These liquids are currently seeping into the subsurface at an undetermined rate. Ponded water evaporates at a rate of approximately two (2) gpm per acre. Typical raffinate liquid composition is shown on Table 1.1-2.

5.2.1.2 Remedial Activities

UCC/Umetco shall perform remedial activities for ponded liquids in the following manner:

(1) All liquid waste in the existing unlined Club Ranch Ponds shall be evaporated in place. Movement of liquids from a Club Ranch Pond to another Club Ranch Pond is allowed.

5.2.1.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall determine the water surface elevations of the Club Ranch Ponds so that evaporation rates may be quantified.

5.2.1.4 Schedule

UCC/Umetco shall perform remedial activities for liquids in the Club Ranch Ponds according to the following schedule:

> The liquids in the unlined Club Ranch Ponds shall be evaporated in place or removed not later than December 31, 1988.

5.2.1.5 Quality Control/Quality Assurance, Monitoring and Performance Evaluation

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A. The monitoring program shall include periodic water surface elevations in the ponds. The Quality Plan shall accompany the Final Plans and Specifications.

5.2.2 Other Liquids

5.2.2.1 Description of Liquids and Potential Impacts

Liquids of an undetermined chemistry may accumulate in the River Ponds and the Storage Ponds on Club Mesa. Liquids, if not removed, will likely seep into underlying subsurface zones from unlined ponds. Additional liquids are currently stored within the mill circuit which has a maximum storage capacity of 4,100,000 gallons.

5.2.2.2 Remedial Activities

All liquids accumulating in the River Ponds and Storage Ponds on Club Mesa shall be pumped to the Club Ranch Ponds. Liquids within the mill circuit shall be disposed of in lined ponds as necessary and in a manner so as not to delay other scheduled RAP activities.

5.2.2.3 Requisite Assessments and Engineering Activities

These activities shall be performed as specified in Section 5.1.1.3 but shall meet the requirements of Sections 5.2.2.2, 5.2.2.4 and 5.2.2.5.

5.2.2.4 Schedule

UCC/Umetco shall perform remedial activities for other liquids according to the following schedule:

(1) The River Ponds shall be emptied on an annual basis until the River Ponds are removed. **[Note: On 5/2/89, CDH confirms that River Ponds have been removed and no longer need to be emptied.]**

(2) Storage Ponds on Club Mesa uphill from the spray area shall be emptied on an annual basis until the Storage Ponds are removed.

5.2.2.5 Quality Control/Quality Assurance, Monitoring and Performance Evaluation

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A. The Quality Plan shall accompany the Final Plans and Specifications.

5.3 SURFACE RUNOFF

5.3.1 Description of Runoff

Surface water runoff occurs and will continue to occur after reclamation of the facilities. Hydrology studies for the existing and reclaimed facilities have been conducted for UCC/Umetco by Dravo Engineers. Water quality of the storm runoff is undefined at present but will be determined by the requirements of Section 5.3.3(1).

5.3.2 Remedial Activities

The runoff collection and sedimentation pond system is being constructed based on the hydrology studies conducted on the site. Runoff is collected and clarified in these ponds, which were designed to contain a 10-year, 24-hour storm event. The collection ponds presently in operation shall be maintained until all site remedial activities described in this Remedial Action Plan are completed.

It is recognized that seepage from these ponds will be beneficial to the overall groundwater program. UCC/Umetco shall design, maintain and operate the runoff collection and sedimentation ponds to contain a 10-year, 24-hour storm event.

In the event of a storm in excess of a 10-year, 24-hour storm event, the overflow from the sedimentation ponds shall be discharged to the San Miguel River. Operations shall include procedures for restoring the pond capacity within thirty (30) days following a major precipitation event. The liquids detained from surface precipitation runoff shall only be used as follows:

(1) Evaporated in the Club Ranch Ponds

or

(2) Used as construction water for dust control on top of the Tailings Piles or for compaction of contaminated materials.

UCC/Umetco shall have two (2) days in which to create three (3) feet of freeboard and thirty (30) days in which to remove all liquids from a major precipitation event.

5.3.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall develop and submit to the State for approval the following:

(1) Final Plans and Specifications including:

- a proposed detailed analytical program to define

the major contaminant concentrations in storm runoff and clarified liquid, if disposal methods other than evaporation are used.

- a proposed maintenance program for the runoff collection and sedimentation ponds.
- a proposed reclamation program, including grading, vegetation, and scheduling of remedial activities.

(2) The Certification Report including an assessment and evaluation of the effectiveness of the reclamation effort in comparison with applicable State and federal statutes, rules, regulations, licenses and permits. Major items shall include vegetation and erosion.

5.3.4 Schedule

UCC/Umetco shall perform the remedial activities prescribed in Section 5.3.2 and 5.3.3 in accordance with the schedule in the Approved Final Plans and Specifications, and Quality Plan. The analytical program required by Section 5.3.3 shall be submitted not later than 120 days after entry of the Consent Decree.

5.3.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A. The Quality Plan shall accompany the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- All construction procedures, materials and surveys
- Detailed procedures for the collection of samples, handling, and processing
- Appropriate use of field blanks, duplicates, and laboratory spikes (in no case at a frequency less than 10% of the samples collected)
- Parameter detection limits to be used for each sample type and the appropriate analytical method

Monitoring of the clarified liquid and runoff shall include at least one (1) set of analyses for all parameters on Table 5.3.5-1 every two (2) years. If overflows occur, UCC/Umetco shall monitor for flow, pH, total ammonia, temperature, total radium-226, total suspended solids and zinc.

The Performance Evaluation program for the sedimentation ponds shall be based on Addendum A in order to verify the ponds are functioning as designed. If the State determines prior to closure of the Uravan Facility that performance levels have not

been achieved, UCC/Umetco shall propose and implement additional remedial action as approved by the State.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance if any, after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

Table 5.3.5-1

CONSTITUENTS FOR CLARIFIED LIQUID AND PRECIPITATION RUNOFF MONITORING

Constituent	Constituent
Alkalinity	Mercury
Aluminum	Nitrate
Ammonia	Nitrite
Arsenic	pH
Cadmium	Potassium
Calcium	Radium-226
Chloride	Selenium
COD	Silver
Conductivity	Sodium
Copper	Sulfate
Iron	Total Dissolved Solids
Lead	Total Suspended Solids
Magnesium	Uranium
Manganese	Zinc

5.4 GROUNDWATER

5.4.1 Club Mesa Salt Wash Member of the Morrison Formation

5.4.1.1 Description of Operations and Observed Impacts

Seepage from Uravan Mill operations and waste disposal has infiltrated into the Salt Wash and has created a body of perched fluids on Club Mesa. This infiltration primarily consists of raffinate from the Club Mesa Spray Area and seepage from the Tailings Piles. Hydrologic data from monitoring wells constructed into the Salt Wash indicate that the areal extent of the fluids is in the area beneath and down-gradient from the three Tailings Piles and the spray evaporation area. The direction of flow is to the northeast towards the valley walls of the San Miguel River and Hieroglyphic Canyon. Discharge of this contamination from the Salt Wash occurs as a series of hillside seeps on the face of the valley walls.

5.4.1.2 Remedial Activities

UCC/Umetco shall collect and dispose of contaminated hillside and toe berm seepage as described in Sections 5.1.1 and 5.1.2.

UCC/Umetco shall monitor the Salt Wash wells on Club Mesa as prescribed in Addendum A.

UCC/Umetco shall attempt to pump the underground mine workings in Club Mesa Spray area. Such pumping will be conducted on a one-time basis and the results of the pumping included in the Annual Report. [12/15/99]

5.4.1.3 Requisite Assessments and Engineering Activities

The requirements for the seepage collection system in Section 5.1.1.3 comprise the required engineering activities.

UCC/Umetco shall compile annually the data collected from the Salt Wash wells on Club Mesa and from the Plant side of the river valley. This compilation and a brief analysis shall be submitted in the Annual Report.

5.4.1.4 Schedule

UCC/Umetco shall perform approved remedial activities for the hillside seepage collection according to the schedule set forth in Section 5.1.1.4.

The first compilation and analysis of Salt Wash monitoring

well data shall be submitted to the State in the Annual Report due March 31, 1987. Subsequent compilations shall be submitted in the Annual Report not later than March 31 of each year for each prior calendar year.

UCC/Umetco shall submit the Quality Plan, including monitoring, not later than 120 days after entry of the Uravan Consent Decree by the Court.

UCC/Umetco shall initiate the approved monitoring program within sixty (60) days of approval by the State.

The proposed long term monitoring program shall be submitted not later than ninety (90) days prior to completion of Uravan Facility remedial activities.

5.4.1.5 Quality Control/Quality Assurance, Monitoring and Performance Evaluation

The Quality Plan accompanying Final Plans and Specifications for Section 5.1.1.3 shall incorporate the following Club Mesa Salt Wash elements.

QC/QA shall meet the requirements stated in Addendum A and shall include the following specific activities:

- Installation of required replacement monitoring wells, if any
- Sample collection, preservation, storage and transport to the laboratory
- Laboratory analytical procedures
- Maintenance and operation of the seepage collection and treatment systems in accordance with Section 5.1.1.

UCC/Umetco shall monitor the wells specified in Addendum A in order to establish baseline conditions and track changes in the Salt Wash member of the Morrison Formation throughout the period of remedial activity at the Facility. The monitoring program shall comply with all applicable State and federal statutes, rules, regulations, licenses and permits. The provisions of 40 CFR Part 192 shall be applied on a site-specific basis.

Performance evaluation for the Salt Wash Formation shall be a description of monitor well data for comparison to past information and for use in the performance evaluation described in Section 5.1.1.5.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance, if any, after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

5.4.2 Club Mesa - Kayenta-Wingate Sequence

5.4.2.1 Description of Operations and Observed Impacts

UCC/Umetco's past operations on Club Mesa and past waste disposal activities pose potential impact to the groundwater quality in the Kayenta-Wingate aquifer beneath Club Mesa. Past activities which could potentially impact the aquifer were the use of the Club Mesa Spray Area and Tailings Piles. These activities have ceased and the areas shall be reclaimed. Seepage of infiltrated raffinate and seepage of liquid from the Tailings Piles shall be collected and will abate over time.

The low permeability of the Summerville shale formation above the Kayenta-Wingate aquifer prevents or retards significant contaminant movement down to the Kayenta-Wingate. In 1986, UCC/Umetco drilled wells V-768 and V-769 into the Kayenta-Wingate Formation beneath Club Mesa. These wells show no significant contamination.

5.4.2.2 Remedial Activities

The Kayenta-Wingate aquifer beneath Club Mesa currently shows no significant contamination. Therefore, no remedial activity beyond monitoring will be instituted. Sampling of Club Mesa wells which monitor the Kayenta-Wingate shall be conducted as described in Section 5.4.2.5 and Addendum A. This monitoring will provide data for continuing confirmation that groundwater quality in the Kayenta-Wingate is acceptable.

5.4.2.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall compile the data collected from the Club Mesa Kayenta-Wingate monitoring program. This compilation and a brief analysis shall be submitted in the Annual Report.

5.4.2.4 Schedule

UCC/Umetco shall submit the Quality Plan, including monitoring, not later than 120 days after entry of the Consent Decree by the Court.

UCC/Umetco shall initiate the approved monitoring program within sixty (60) days of approval by the State.

UCC/Umetco shall submit the compiled Club Mesa Kayenta-Wingate data and a brief analysis as part of the Annual Report due March 31st of each year for each prior calendar year.

The proposed long-term monitoring program, if any, shall be submitted not later than ninety (90) days prior to completion of Uravan Facility remedial activities.

5.4.2.5 Quality Control/Quality Assurance, Monitoring and Performance Evaluation

The Quality Plan accompanying Final Plans and Specifications for Section 5.1.1.3 shall incorporate the following Club Mesa Kayenta-Wingate elements.

QC/QA shall meet the requirements stated in Addendum A and specifically shall include the following:

- Installation of required replacement monitoring wells, if any
- Sample collection, preservation, storage, and transport to the laboratory
- Laboratory analytical procedures

Monitoring of the Club Mesa Kayenta-Wingate wells shall be

conducted by UCC/Umetco as described in Addendum A and results shall be reported to the State in the Annual Report required in Section 5.4.1.3 according to the schedule in Section 5.4.1.4. The monitoring program shall comply with all applicable State and federal statutes, rules, regulations, licenses and permits. The provisions of 40 CFR Part 192 shall be applied on a site-specific basis.

Performance evaluation of the Club Mesa Kayenta-Wingate shall be by reference to monitoring well data for comparison to past information.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring, if any, after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

5.4.3 River Valley - Kayenta-Wingate Sequence

5.4.3.1 Description of Operations and Observed Impacts

UCC/Umetco's liquid waste handling and disposal operations in the river valley have released contaminants into the Kayenta-

Wingate aquifer. The most significant contribution to groundwater contamination was the disposal of liquid raffinate in the Club Ranch Ponds. Seepage from the Club Ranch Ponds has been found in monitoring wells beneath and downgradient from the ponds.

The groundwater system in the river valley is a complex, fractured aquifer which maintains a recharge-discharge relationship with the San Miguel River. The monitoring well system in the river valley has measured contamination in the fracture system. This contaminated groundwater acts as a source of non-point contamination to the San Miguel River. The sandstone matrix likely produces very little liquid relative to the fractures and may contribute contaminants to the fracture system at a relatively slow rate. The proposed remedial actions are expected to remove the majority of fracture contamination but recognize that contaminant bleed to the fractures from the matrix may occur slowly for a long time period after pumping. The presence of the fracture system in the aquifer makes cleanup of the groundwater contamination feasible, because contaminated groundwater can be readily withdrawn from the fractures.

5.4.3.2 Remedial Activities

5.4.3.2.1 Performance of Remedial Activities

The goal of the remedial activities for aquifer restoration is to remove fracture contamination and improve groundwater quality to a beneficial use. Achieving this goal, coupled with the removal of crystals and ponded liquids from the river valley, will substantially reduce the contaminated non-point load to the river. This will significantly reduce the impact of the non-point load on river quality. The remedial program shall be designed to achieve this goal within seven (7) years, with up to four (4) years additional pumping. Such additional pumping shall be evaluated on a year-by-year basis.

UCC/Umetco shall design, maintain and operate a groundwater restoration system optimized as described below. Data collected during implementation phases may, after analysis, indicate the need for modifications to the initial design and operation. UCC/Umetco shall analyze annually the aquifer response and performance of the remedial actions. If the State's review of this analysis indicates that an operational or design modification is necessary and proper to maintain optimal system performance as determined by the State, UCC/Umetco shall submit to the State for approval a plan which incorporates the indicated

modifications. A prediction of the performance of the modified system shall accompany the proposed plan.

UCC/Umetco shall perform the following remedial activities for the San Miguel River Valley aquifer:

(1) A model of the ground water system shall be provided by UCC/Umetco to the State for review. UCC/Umetco shall evaluate alternative designs (i.e., well locations, well depths, pumping rates, pumping schedules, and number of wells) and shall select the final remedial design. The model shall be based on the data collected as provided in item (2) below which shall be used as input to a reliable and technically-justified predictive model.

(2) Wells in the San Miguel River valley shall be monitored in accordance with Addendum A. Data shall be collected during the Initial Sampling Program beginning not later than January 1, 1987, in order that the information be available for remedial design and as a baseline for comparison with the performance of the restoration program over time.

(3) The restoration program shall consist of at least two

(2), withdrawal wells constructed in the areas of highest concentration of total dissolved solids in the vicinity of the Club Ranch Ponds. Each well shall be completed in the zone of maximum contaminant concentrations in the fractured part of the aquifer and shall be designed to produce at least 30 gallons per minute.

(4) Discharge from each well shall be pumped to lined evaporation pond or ponds. Such lined evaporation pond(s) shall be constructed in the Club Ranch Ponds Area in accordance with Section 5.1.1.2(4) after the area has been cleaned as prescribed in Section 4.2.

(5) The wells shall be pumped continuously or intermittently to optimize contaminant withdrawal from the aquifer at an annual average pumping rate of approximately 60 gallons per minute, or such other rate determined to be necessary and proper pursuant to Item (6) below as limited only by the optimized evaporative capacity available in accordance with Section 4.2.2(9), storage, inflow from other sources, and evaporation. Spray evaporation must be considered to maintain sufficient pond capacity so that the ground water cleanup goal can reasonably be met.

(6) The performance of the ground water withdrawal system shall be monitored in compliance with Addendum A and a performance evaluation report which complies with Section 5.4.3.5 of this RAP shall be prepared. This report, which shall be submitted when and as required by Section 5.4.3.4(6) of the RAP, shall describe any operational adjustments which may be necessary and proper to maintain optimal system performance.

(7) Pumping shall be initiated four (4) years after the effective date of the Consent Decree if construction schedules permit, but not later than December 31, 1991 at an average annual pumping rate of 60 gpm and maintained pursuant to Items (5) and (6) above and any subsequent operational adjustments necessary and proper to maintain optimal system performance pursuant to Items (5) and (6) above, as approved by the State, shall be implemented by UCC/Umetco.

5.4.3.2.2 Compliance with 40 CFR Part 192

(1) Notwithstanding any other provision of this RAP, UCC/Umetco shall comply with the provisions of 40 CFR, Part 192, Subpart D, as detailed in this paragraph. If

the groundwater standards established in this paragraph under 40 CFR 192.32(a)(2) are exceeded, a corrective action program as required by 40 CFR 192.33 shall be implemented. For purposes of this requirement, the concentration limits of hazardous constituents required by 40 CFR 192.32(a)(2) [as that section incorporates the requirements of 40 CFR 264.92, 264.93 and 264.94] for groundwater protection are those set forth in Table 5.4.3.2-2. Comparison of concentrations relative to background as required in Table 5.4.3.2-2 shall be determined by the methodology described in Addendum A. For purposes of this requirement, the point of compliance beyond which the concentration limits shall not be exceeded, as specified by 40 CFR 192.32(a)(2) [as that section incorporates the requirements of 40 CFR 264.92 and 264.95] is Monitor Well ~~CRP-18~~ **TD 98-3** [12/15/99], which is downgradient of the waste management area. The waste management area is shown in Figure 5.4.3.2.2-1. **TD 98-3 is a replacement well for CRP-18. CRP-18 shall be plugged and abandoned.** [12/15/99]

(2) UCC/Umetco shall be entitled to removal of any constituent listed on Table 5.4.3.2-2 upon

Table 5.4.3.2-2 GROUNDWATER QUALITY PROTECTION STANDARDS

Constituent	**Concentration**
~~Antimony~~	~~Background~~
~~Arsenic~~	~~0.05 mg/l~~
~~Barium~~	~~1.0 mg/l~~
~~Beryllium~~	~~Background~~
Cadmium	~~0.01~~ **0.05** mg/l
~~Chromium~~	~~0.05 mg/l~~
~~Cyanide~~	~~Background~~
Fluoride	~~Background~~ **4.0 mg/l**
~~Lead~~	~~0.05 mg/l~~
~~Mercury~~	~~0.002 mg/l~~
~~Molybdenum~~	~~0.5 mg/l (during period of RAP activities) 0.6 mg/l, Safe Drinking Water Act MCL, 0.7~~ **0.5** ~~or Background, whichever is higher (after conclusion of RAP activities~~
Nickel	Background
Selenium	~~0.01~~ **0.05** mg/l
~~Silver~~	~~0.05 mg/l~~
~~Thallium~~	~~Background~~
Uranium (U-nat)	~~0.03 mg/l (during period of RAP activities 0.015 mg/l, Safe Drinking Water Act MCL, or Background, whichever is higher (after conclusion of RAP activities)~~ **0.044 mg/l**
Vanadium	Background
Zinc	~~Background~~ **5.0 mg/l**
Radium **226**	~~Background~~ **5.0 pCi/l**
Gross Alpha	~~Background~~ **15 pCi/l**

Note: Background to be determined **for dissolved constituents** [12/15/99] by methodology adopted pursuant to Addendum A

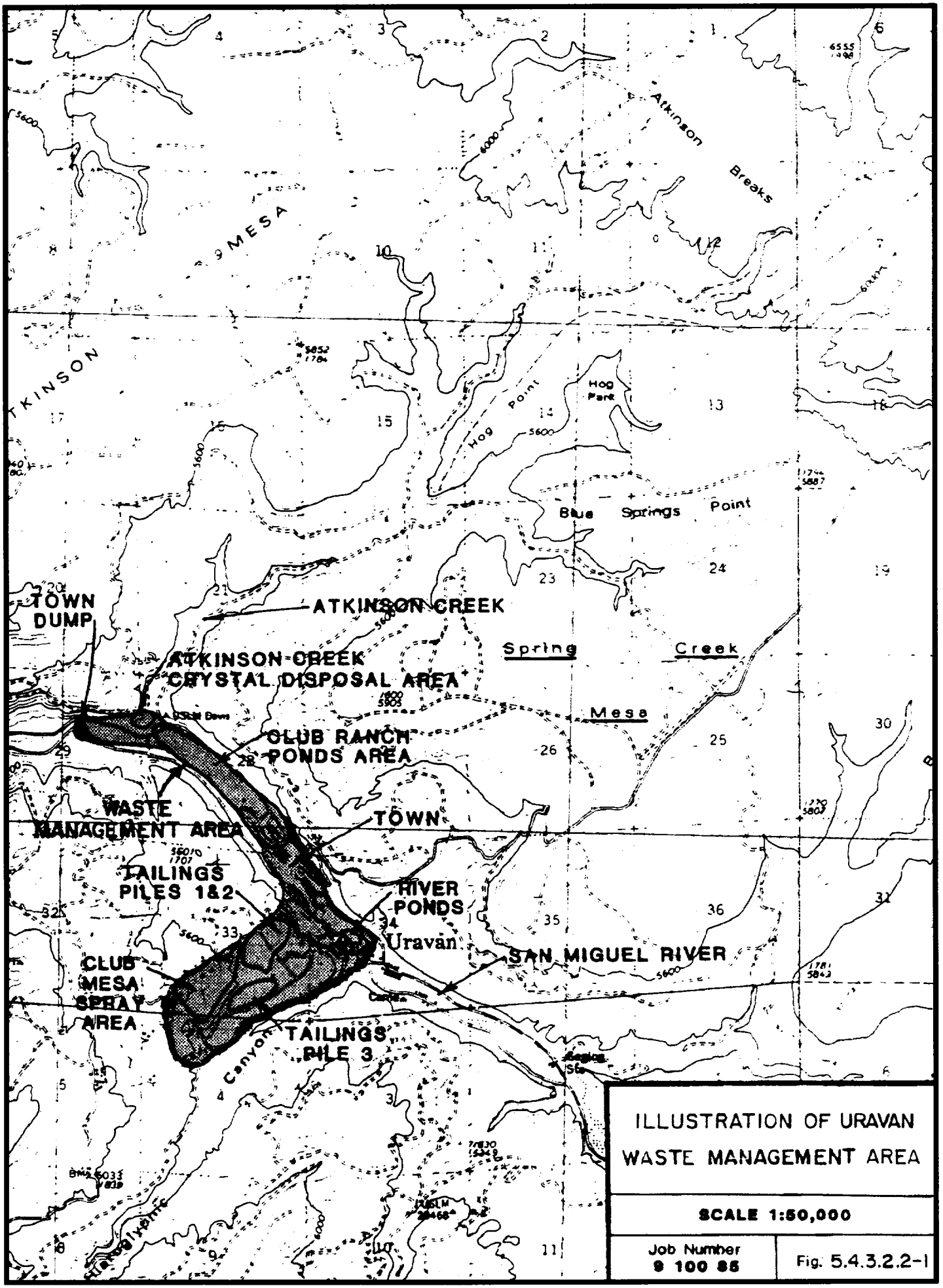

ILLUSTRATION OF URAVAN WASTE MANAGEMENT AREA

SCALE 1:50,000

Job Number
9 100 85

Fig. 5.4.3.2.2-1

demonstrating to the State's satisfaction in accordance with 6 CCR 1007-3, Sec. 264.93, that the constituent has not been detected in groundwater in the uppermost aquifer underlying a regulated unit or that said constituent is not reasonably expected to be in or derived from waste contained in a regulated unit and upon a determination that the constituent is not subject to regulation under any legally applicable standard, criteria, or limitation under any Federal or State environmental law

(3) Subject to the applicable limitations of Sections 121 (d)(2)(B)(ii) and 121 (d)(4) of CERCLA as amended, UCC/Umetco shall be entitled to seek an alternate concentration limit for any constituent listed on Table 5.4.3.2-2 upon an investigation and analysis of each of the factors listed in 40 CFR 264.94 and making a sufficient showing as to each such factor to the State's satisfaction.

5.4.3.2.3 Termination

The groundwater remedial action shall be terminated upon acceptance by the State of UCC/Umetco's determination that one of the following has occurred in each of the selected monitoring

wells (Addendum A) and the withdrawal wells:

I. The groundwater quality as measured in designated monitoring and withdrawal wells meets one of the following use criteria:

   a. the "agricultural-use quality" criteria prescribed in Table 5.4.3.2-1 or as subsequently promulgated; and a determination that cessation of the optimized withdrawal system will not cause a violation of the surface water San Miguel River quality criteria (Table 5.4.3.2-3) from non-point loads.

   b. the background aquifer quality as measured in well CRP-1.

II. The performance of the aquifer system, as determined by a statistical analysis of the aquifer cleanup rate, no longer shows significant improvement. Or,

III. The pumping system has been operating for eleven (11) years with allowance for normal maintenance.

The achievement of Criteria I or II shall be determined by

TABLE 5.4.3.2-1 AGRICULTURAL USE-BASED GROUND WATER QUALITY CRITERIA TO BE APPLIED AT URAVAN (1)

Constituent	Concentration	Units
Aluminum (Al)	5.0	mg/l (2)
Arsenic (As)	0.1	mg/l
Beryllium (Be)	0.1	mg/l
Boron (B)	0.75	mg/l
Cadmium (Cd)	0.01	mg/l
Chromium (Cr)	0.1	mg/l
Cobalt (Co)	0.1	mg/l
Copper (Cu)	0.2	mg/l
Fluoride (F)	2.0	mg/l
Iron (Fe)	5.0	mg/l
Lead (Pb)	0.1	mg/l
Lithium (Li)	2.5	mg/l
Manganese (Mn)	0.2	mg/l
Mercury (Hg)	0.01	mg/l
Molybdenum (Mo)	0.01	mg/l
Nickel (Ni)	0.20	mg/l
Nitrite (NO2-N)	10	mg/l as N
Nitrite & Nitrate (NO2+NO3-N)	100	mg/l as N
Selenium (Se)	0.02	mg/l
Vanadium (V)	0.1	mg/l
Zinc (Zn)	2.0	mg/l
pH	6.5-8.5	s.u.
SAR	10	meg/l
RSC	1.5	meg/l
TDS	1.25	times background

Notes:

(1) Derived from Tables 3 and 4 of proposed Colorado ground water rules. This table shall be revised to conform to applicable Colorado rules and regulations, licenses and permits for the "Agricultural Use-Quality" ground water classification as promulgated by the State.

(2) Means dissolved concentration for all parameters except pH. The same water shall be filtered through a 0.45 micron membrane filter prior to preservation. The total concentration (not filtered) may be required on a case-by-case basis if deemed necessary to characterize the pollution caused by the activity.

Table 5.4.3.2-3

SURFACE WATER QUALITY CRITERIA TO BE APPLIED AT URAVAN

Parameter	Concentration (mg/l)
Al (soluble)	~~0.1~~ **0.087**
As	~~0.05~~ **0.1**
Be	~~0.3~~ **0.1**
B	0.75
Cd	~~0.001~~ **0.002**
CrIII	~~0.1~~ **0.36**
CRVI	~~0.025~~ **0.011**
Cu	~~0.01~~ **0.02**
Dissolved Oxygen	5.0
Fe	1.0
Pb	~~0.025~~ **0.01**
Mn	1.0
Hg	0.000005~~1~~ **1** (or 0.0~~5~~ **1** ppb)
Ni	~~0.10~~ **0.16**
Se	~~0.05~~ **0.005**
Ag	~~0.0001~~ **0.001**
Tl	0.015
Unat	~~0.2~~ **3.2**
Zn	~~0.05~~ **0.19**
Ra-226, pCi/l	5.0
TH-230, pCi/l	60.
Ammonia (unionized)	0.06
Nitrate	100.
Nitrite	0.50
Cyanide	~~0.006~~ **0.005**
Sulfate	576.
pH (s.u.)	6.5-9.0

Notes:

(1) Total concentration in mg/l, unless otherwise specified, for warm water aquatic life and 200 mg/l hardness.

(2) Criteria for regulated, priority, site-specific or potentially hazardous constituents from the existing Colorado "Basic Standards and Methodology", unless the Water Quality Standard for the San Miguel segment is more stringent. Nitrate, nitrite and sulfate are agricultural based.

(3) ~~Proposed standards for CrVI, Pb, Hg and NH3 are more stringent than the criteria listed in this table.~~ If in the future duly-promulgated Basic Standard and/or San Miguel River Water Quality Standard ~~for these or other~~ [12/15/99] parameters become more stringent, this table shall be modified based upon the new standards

statistical evaluation of results of the analysis of groundwater samples for each of the selected monitoring wells sampled as described in Addendum A.

5.4.3.3 Requisite Assessments and Engineering Activities

UCC/Umetco shall prepare and submit to the State for review and approval the following:

(1) The model described in Section 5.4.3.2 for designing and demonstrating validity of the groundwater restoration program.

(2) Final Plans and Specifications for lined Club Ranch evaporation pond(s). These plans and specifications shall be for ponds with a leakage detection system and an appropriate synthetic liner constructed on an appropriate base. Design detail requirements are set forth in Sections 4.2.2(9) and 5.1.1.2(4).

(3) A Final Construction Report shall be submitted to the State describing any construction activity associated with the River Valley Kayenta-Wingate remedy; specifically, construction of lined Club Ranch Evaporation Ponds and installation of withdrawal and

monitoring wells.

(4) A Quality Control/Quality Assurance, Monitoring, and Performance Evaluation Plan ("Quality Plan").

(5) A compilation of the data collected from the San Miguel River Valley Kayenta-Wingate wells and a brief analysis in the Annual Report.

(6) The performance evaluation reports on the ground water restoration program required by Section 5.4.3.2.1(6) shall be submitted to the State for review.

5.4.3.4 Schedule

UCC/Umetco shall design and conduct the ground water remedial activities according to the following schedule:

(1) Final Plans and Specifications and the Quality Plan, including monitoring and a preliminary groundwater model but not including the location of the withdrawal wells, shall be submitted not later than 120 days after execution of the Uravan Consent Decree by the Court.

(2) An initial operational groundwater model, the location

of the withdrawal wells, proposed restoration program, and revised Quality Plan shall be developed by UCC/Umetco and submitted to the State at least six (6) months prior to the installation of the withdrawal wells prescribed in Section 5.4.3.2.1(3).

(3) Monitoring of the San Miguel River Valley wells shall be initiated not later than sixty (60) days after approval by the State.

(4) Installation of the withdrawal wells shall be completed and pumping of the wells shall commence not later than December 31, 1991.

(5) Monitoring of these withdrawal wells shall begin immediately after the wells are constructed and are operational in accordance with Addendum A.

(6) The performance evaluation report required by Section 5.4.3.2.1(6) shall be submitted to the State for review not later than ninety (90) days after the end of two years of groundwater withdrawal. An updated performance evaluation shall be submitted as part of the Annual Report not later than March 31 of each year for each prior calendar year.

(7) Pumping of the wells shall continue until the performance criteria stated in Section 5.4.3.2.3 are met.

(8) The proposed long-term monitoring program for ground water shall be submitted not later than ninety (90) days prior to completion of Uravan Facility remedial activities.

(9) The Final Construction Report shall be submitted to the State not later than (90) ninety days after installation of construction of the lined Club Ranch Ponds and installation of any monitoring or withdrawal wells.

(10) The Certification Report shall be submitted not later than 120 days after completion of remedial activities at the Uravan Facility.

5.4.3.5 Quality Control/Quality Assurance, Monitoring, Performance Evaluation and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance, Monitoring and Performance Evaluation as prescribed in

Addendum A.

QC/QA shall meet the basic requirements stated in Addendum A and shall include the following specific activities:

- installation of withdrawal wells
- installation of required monitoring wells, if any
- construction of lined Club Ranch evaporation pond(s)
- field sampling and measurements for water quality samples
- laboratory analysis of water quality samples
- well production rates and volumes

A groundwater monitoring and data collection program shall be established according to Addendum A. Samples shall be collected from each designated monitoring well and withdrawal well and analyzed for constituents as prescribed in Addendum A.

Performance evaluation as described in Section 5.4.3.2.1(6) of the remedial activities shall be conducted by UCC/Umetco and submitted to the State. The performance evaluation shall include:

a. The model provided pursuant to Section 5.4.3.2.1(1) and monitoring data shall be used as analytical tools to

modify remedial system operation as operational experience is gained.

b. Evaluation of the performance of the withdrawal system with respect to its design criteria so that (1) operational adjustments can be made as indicated by the performance evaluation to maintain optimal system performance, and (2) termination of the system operation may be permitted prior to the eleventh year of pumping.

c. Prediction of the groundwater quality during the post-operation monitoring period as a final measure of the effectiveness of remedial activities.

The State shall conduct an appropriate Inspection and Certification Program in accordance with Addendum B.

Long-term monitoring and maintenance after closure of the Uravan Facility shall be conducted pursuant to the Colorado Radioactive Materials License.

6.0 MISCELLANEOUS REMEDIAL ACTION PLAN REQUIREMENTS

In performing the remedial activities as described in Chapters 4.0 Remedial Action Plan - Solids, and 5.0 Remedial Action Plan - Liquids, of this Remedial Action Plan, UCC/Umetco shall additionally comply with the ~~following miscellaneous provisions.~~ **requirements contained in Radioactive Materials License 660-02S. The following is a summary of remedial actions completed in accordance with the RAP.** [12/15/99]

URAVAN REMEDIAL ACTION PLAN STATUS
AUGUST 1999

RAP Section 4.1 Atkinson Creek Disposal Area

The Atkinson Creek Disposal Area is located down valley from the Club Ranch Ponds and was the storage area for crystals removed from Club Ranch Ponds in the 1970's. Approximately 200,000 cubic yards of raffinate crystals existed in this area and were contained by a soil cover. The RAP called for removal of these crystals with disposal in the Burbank Repository.

Initial removal of the crystals started in the spring of 1991 and continued until mid-summer of 1991. During this time, approximately 116.000 cubic yards of crystals and contaminated soils were removed and transported to the Burbank Repository. Micro-R and soil sampling surveys were conducted in late 1991. Arsenic, molybdenum, thorium-230 and vanadium were found to exceed the "No Further Action" Criterion for soils in a small percentage of the area. Umetco evaluated the health risk of the residual concentrations in excess of the "No Further Action" levels using three different exposure scenarios. The Colorado Department of Health evaluated the risk assessment and found that there was no significant health risk posed by the residual levels so long as the area was covered with one foot of clean soil. The RAP called for initial removal of crystals to be completed by December 31, 1992. Umetco requested a RAP modification to this date since the results of the risk evaluation were still outstanding in 1992. Final reclamation was completed as required by December 31, 1993. This project is 100% complete.

RAP Section 4.2 Club Ranch Ponds Area

The Club Ranch Ponds Area consists of six unlined liquid disposal ponds located downvalley from the Uravan Mill. The ponds were excavated into terrace deposits of the San Miguel River in order to evaporate waste liquid (raffinate) from the Uravan Mill. Approximately 560,000 cubic yards of raffinate crystals existed in the ponds. The RAP called for removal of the crystals and placement of these crystals in the Burbank Repository and contaminated soils on top of Tailings Pile # 1-2. The ponds area was reconstructed and is used to evaporate contaminated ground water that exists under the San Miguel River valley.

New evaporation ponds, called the Club Ranch Ponds No. 7 and 8 were constructed in fall of 1987 and spring of 1988 in order to contain hillside seepage liquids and to contain liquids transferred from the old, unlined Club Ranch Ponds. These ponds were constructed in conformance with state and federal requirements in order to preclude discharge of mill related liquids.

Initial removal of the crystals in the old club ranch ponds commenced during the fall of 1989 and all discrete deposits, a total of approximately 475,000 cubic yards, were removed by mid-1991. Initial removal of crystals is 100% complete. The RAP called for removal of all crystals by December 31, 1991 and reconstruction of the ponds by December 31, 1991. Umetco requested and was granted a modification to this date in order to perform phased reconstruction of the ponds. Phased reconstruction would allow ponds to be built as needed rather than be constructed and sit empty. Three ponds CRP-1,4&6 were reconstructed during late 1991 and 1992. No other ponds were reconstructed since there was adequate evaporative capacity. Pond reconstruction is 100% complete.

During initial crystal removal and pond reconstruction , contaminated ground water was encountered in the alluvial materials on top of the bedrock. This ground water was intercepted and placed in evaporation ponds CRP-7 and CRP-8. Final reclamation of this area will be undertaken after completion of the valley ground water cleanup.

Removal of additional contaminated materials, totaling approximately 55,000 cubic yards, from the lower Club Ranch Ponds was performed in 1998. This action removed the final significant source of contamination from the Club Ranch Ponds Area. Sumps and trenches have also been used in the lower Club Ranch Ponds to intercept precipitation before it enters ground water. Final removal of all contaminated soils will commence after the phased removal of the lined Club Ranch Ponds

RAP Section 4.3 River Ponds Area

The River Ponds Area consisted of seven small ponds located on the San Miguel River adjacent to the mill. Approximately 290,000 cubic yards of tailings and mill sludges existed in the ponds. Initial removal of these ponds commenced in late 1988 and was completed in mid-1989. These materials were placed in Tailings Piles #1-2 and 3. Excavation of the ponds was down to the water table. Umetco subsequently constructed rock berms to trap sediment carried by the river during high flows. These areas have re-established vegetation on the areas behind the berms that have been filled with sediment by the river. The RAP called for final reclamation by December 31, 1991. A final construction report from Umetco was submitted and approved in mid-93. This component is 100% complete.

RAP Section 4.4 Tailings Piles

The three tailing piles at Uravan were started in the mid-1950's and are located on Club Mesa above the mill. The RAP calls for six remedial action components: (1) Dewatering; (2) slopes and contours; (3) rock fill buttress and toe drains; (4) sideslopes protective cover; (5) top covers; and (6) drainage diversion. Components 1-4 have been completed (100%). The top cover except for riprap has been placed on Tailings Pile #3. A portion of the diversion channel system has been constructed. Component 5 is 85% complete and component 6 is 20% complete.

The top of Tailings Piles #1-2 is the final repository for tailings and contaminated soils from valley areas and Club Mesa. The placement of contaminated soils and other materials on Tailings Piles #1-2 is 100% complete. The capacity of Tailings Pile #1-2 has been met. A new disposal cell, known as the B-Plant Repository, has been constructed to handle the additional waste being cleaned up at the site. All remaining tailings, soils and liner materials from the final cleanup of the Club Ranch Ponds will be placed in the B-Plant Repository.

Completion of the top slope cover for Tailings Pile #1-2 is scheduled for completion by December 31, 2002. Diversion Channels are also scheduled for completion by December 31, 2002. The tailings pile project is 98% complete. The initial construction of the B-Plant Repository is 100% complete.

RAP Section 4.5 Club Mesa Area

The Club Mesa Spray Area is located upslope from Tailings Piles #1-2 and 3. This area was used primarily for evaporation of mill derived raffinate. It was estimated that 250,000 cubic yards of raffinate crystals, 150,000 cubic yards of neutralized sludge, 40,000 cubic yards of contaminated pond material and 44,000 cubic yards of contaminated soils existed in this area. The raffinate crystals were to be removed to the Burbank Repository and the other materials were placed in the tailing piles.

Removal of neutralized sludge and other contaminated material began in June, 1989. Initial removal of crystals from the Club Mesa Area began in the summer of 1990 and was completed in mid-1992 prior to the RAP deadline of December 31, 1994. Approximately 375,000 cubic yards of contaminated material was removed from Club Mesa. Mines and portals encountered during construction were sealed with earthen material per the remedial action plan. Final reclamation of the Club Mesa Spray Area was modified in the RAP and completed on December 31, 1997. Drainage control structures and an erosion resistant rock/soil cover was added to the area to control runoff. This component is 100% complete.

RAP Section 4.6 Mill Area

The Mill Area includes the A-Plant Area in the valley, the B-Plant Area, Ore Stockpile Area, Barrel Storage Area and Heap Leach Area located on a bedrock bench on, Club Mesa, below and east of Tailings Pile #1-2, and the Boneyard Area located to the west of Tailings Pile #1-2. The RAP called for the demolition and removal of all structures, scrap, barrels and contaminated materials (including soil) from these areas.

Removal of contaminated materials from the Ore Stockpile Area, the Barrel Storage Area, Heap Leach Area and Boneyard Area occurred during the period from early 1987 to late 1988. The Ore Stockpile area was remedied in 1989. In these areas, contaminated soils, totaling some 160,000 cubic yards, were removed down to bedrock. In 1990 and 1991 seven thickener tanks were removed from the B-Plant Area. Uranium/vanadium ores and mill reagents were sent to the White Mesa uranium mill in Utah. Umetco initiated mill decommissioning in 1995. This involved the demolition of mill circuits, ancillary facilities and removal of contaminated soils. Contaminated soil removal was performed in the mill area and at a storage area known as Treasure Island. A total of 250 mill buildings were removed and approximately 160,000 cubic yards of contaminated soils were excavated and placed in Tailings Pile 1-2 and the B-Plant Repository. Mill demolition is 100% complete and contaminated soil removal in the A-Plant and B Plant Areas is 100% complete.

RAP Section 4.7 Town and Adjacent Areas

The Town of Uravan occupied the valley area across the river from the mill. The areas described in the RAP include Town and Dispersed Deposits, Town Dump, Remnant Tailings, Windblown Material and Stream and Drainageway Deposits. All housing structures have been removed from the Town of Uravan. Approximately 260 structures were removed and 186,000 cubic yards of contaminated soils were excavated from 1987 through 1994. In 1997 and 1998, contaminated soils characterization was performed, for Dispersed Deposits adjacent to Uravan including material located along the Mill Hillside, the water storage pond adjacent to Hieroglyphic Canyon, Highway 141, and County Roads Y-11 and EE-22. All areas have been characterized and cleanup activities have commenced. The foundations of the Joe Junior Mill have been removed and most of the tailings under county road EE-22 have been removed. These activities are 85% completed.

Cleanup of the Town Dump was performed in 1998. Approximately 250,000 cubic yards of material was taken to Tailings Pile 1-2 and the B-Plant Repository. This activity is 99% complete.

Remnant tailing materials, composed of discrete sources used in construction activities and spilled from delivery pipelines exists within the town area. Wind and surface water transported tailings are found throughout the area. Remnant tailings also exist under Highway 141. Removal of remnant tailings occurred from 1987 to 1989. Initial removal was completed in December, 1989. The RAP schedule called for initial removal to be accomplished by December 31, 1989. Removal of tailings up to the right-of-way for Highway 141 was also completed. This activity is 100% complete.

Preliminary characterization of windblown material was conducted in 1998. Remedial activities for this material are being developed in accordance with the RAP.

Streamway and drainageway deposits include sediments in Atkinson Creek and Hieroglyphic Canyon streambeds. In 1991, Umetco performed surveys to determine the extent of contamination in the Atkinson Creek and Hieroglyphic canyon. The results of the Atkinson Creek survey indicated that the materials in the streambed were not contaminated and did not warrant removal. The results of the Hieroglyphic canyon survey indicated that no further remedial actions are needed in the streambed. Contaminated materials discovered at the mouth of Hieroglyphic Canyon were removed in 1994. Assessment of the upper reach of Hieroglyphic Canyon indicated no significant contamination present in the streambed. Excavation of any low activity material would result in significant environmental impacts. This activity is approximately 90% complete.

RAP Section 4.8 Burbank Quarry and Repository

The Burbank Quarry is located southwest of Tailings Pile #3 and is the source of rock cover and riprap materials for remedial activity. Random fill and clay materials were also mined for use in reclamation construction. The quarry has been transformed into a repository for long-term containment of raffinate crystals, through the placement of clay sidewall and bottom liners.

The RAP schedule called for initiation of crystal placement by September 30, 1989 and placement of the final reclamation cover not later than December 31, 1998. Placement of crystals was initiated in late September, 1989. Diversion ditches for the repository were in place mid-1989 and were required to be in place by December 31, 1989. Revised plans and specifications were accepted by the State to allow for construction of a seepage interception tunnel to be placed into the bedrock adjacent to the repository. The revised plans also contained provisions for placing a clay liner up the interior sideslopes of the repository.

Just over 700,000 cubic yards of material has been placed in the repository from the Club Ranch Ponds and Club Mesa Areas. The placement of the final portion of the rock cover was completed just after the December 31, 1898 deadline due to the weather. Construction of this project is 100% complete. A toe drain collection system for the repository is currently being monitored.

RAP Section 4.9 Borrow Areas

Two borrow areas (locations where earthen material is excavated for use in construction) exist for the Uravan site, one on Club Mesa above the Burbank Repository and the other in the valley across Highway 141 from the Club Ranch Ponds. The borrow area on Club Mesa was expanded in 1992 and 1997. Both borrow areas are operated in compliance with Mined Land Reclamation Permits. Bonding for borrow area reclamation is also held by the Mined Land Reclamation Division.

RAP Section 5.1 Hillside Seepage

Seepage has occurred intermittently along 4600 linear feet of the Club Mesa rim, near the contact between the Summerville Formation and the Salt Wash member of the Morrison Formation above the A-Plant Area. The hillside seepage is geochemically modified tailings solution from the tailing piles and raffinate that has seeped into the bedrock beneath Club Mesa.

The RAP calls for improvements to be made to the existing collection system and construction of new collection ditches and pipes along the bedrock rim. This project was completed in late 1988. Approximately 1500 linear feet of drainpipe and 3200 feet of drainage ditch were constructed to intercept seepage. Maintenance and repair work was performed on some of the ditches in 1992. During mill decommissioning, some 600 feet of the collection pipes was removed in order to take out foundations and excavate contaminated soils. The only portion of the project remaining is to remove the pipes and ditches when they are no longer needed and to reclaim the disturbed areas. This project is 95% complete. This system has intercepted over 38 million gallons of seepage since completion in 1988.

Two evaporation ponds, CRP-7 and CRP-8 were constructed to handle the contaminated liquids intercepted by this project. These ponds were completed in May, 1988. One pond developed liner problems and was patched. A vent system was also placed under the liner to reduce the formation of gas bubbles under the liner. The liner and vent work was completed in mid-December, 1990. The only future work required is final cleanup and revegetation. The RAP calls for final reclamation sometime after 2003, once ground water is cleaned up. This project is 75% complete.

RAP Section 5.2 Ponded Liquids

Contaminated liquid was contained in the Club Ranch Ponds, River Ponds, Club Mesa Storage Area and the Tailings Piles. Liquids from all of these areas have been evaporated or removed to lined ponds. This project is 100% complete.

RAP Section 5.3 Surface Runoff

Surface water runoff occurs and will continue to occur after reclamation of the facilities. The runoff collection and sedimentation pond system is designed to contain the 10-year, 24-hour storm event. This system was completed in 1986 and the project is 100% complete.
The existing surface runoff control ponds in the valley were replaced in 1997 and 1998 during decommissioning of the A-Plant Mill.

RAP Section 5.4 Ground Water

The ground water remedial activities for Club Mesa involve monitoring of ground water quality in the Salt Wash member of the Morrison Formation and the construction of the Hillside Seepage Collection System described in RAP Section 5.1.

Three new ground water monitoring wells were drilled in the Club Mesa Area during 1993. Two of the wells monitor ground water below the Burbank Repository in the Kayenta-Wingate sequence. The third well will help to determine any impacts to the Kayenta-Wingate from the Tailings Repositories. Well installation was completed in September, 1993.

In the River Valley, monitoring of ground water within the Kayenta-Wingate aquifer is required. Water from the Kayenta-Wingate aquifer flows into the San Miguel River in the Uravan Area. The RAP also calls for the removal of contaminated liquids from the Kayenta-Wingate aquifer. The first step is the characterization and development of a model for the aquifer. This was done during 1991 using a United States Geological Survey model called MOC (Method of Characteristics flow). A minimum of two withdrawal wells were required to be constructed and a minimum of 60 gallons per minute (gpm) withdrawn from the aquifer starting December 31, 1991. Umetco designed and subsequently constructed a system of two withdrawal wells. Umetco also replaced a total of 14 existing monitoring wells with 19 new wells, all designed to be used as either monitoring or withdrawal wells. This construction allows the withdrawal system to be operated in several different configurations to optimize performance. The withdrawal wells were drilled in late 1991 and were placed in operation on December 30,1991. The replacement wells were drilled in late 1991 and early 1992. Five of the replacement wells, CRP-19A, CRP-19B, CRP-19C, CRP-20 and CRP-21, have been used as withdrawal wells. During 1992 and 1993, the withdrawal wells pumped at an average rate in excess of 68 gpm, which exceeds the RAP requirement of 60 gpm. In 1996 wells WD-3 and WD-4 were drilled, completed and put into production, in order to optimize system performance. After evaluating the system in 1998, it was decided to concentrate on pumping wells in low permeability zones and to waive the 60 gpm requirement. In July, 1999, a total of 14.7 gpm were being pumped from wells WD-4, 5, 6, CRP 19A and 20. These are predominantly low permeability zones in the aquifer. This project is 70% complete. It is anticipated that this project will be from 7 to 11 years in duration. During the period from 1992-1998, a total of 200,000,000 gallons of liquids were removed from the aquifer containing about 7000 tons of total dissolved solids. A comparison of the MOC predictions for TDS in 1998, with observed 1998 concentrations, shows a good correlation.

Other Activities

During 1993, the EPA conducted a 5-Year Remedy Review of the Uravan Site. The report noted that construction of the remedy has been well documented and that the remedial design appears to be suited to the site conditions. The only area of noncompliance noted in the report was the late submittal of the 1992 Environmental Monitoring Data Report. A total of 4 recommendations were made in the report including, 1) the need to improve the format of the ground water monitoring data, 2) the need for a careful review of the seepage collection system performance evaluation report to be submitted in March, 1994, 3) a suggestion to sample ice that forms along the hillside in the winter, and 4) the need to explain differences in the external gamma data between the 1991 and 1992 Annual Reports.

The EPA is in the process of performing another five-year review during 1999. It is anticipated that the results will be available by the end of 1999.

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Summary

During 1998 and 1999, the major accomplishments were the continued cleanup of the Town and Adjacent Areas, and Mill Areas. Activities included the removal of contaminated materials from the Town Dump, removal of the U.S. Vanadium Mill, hillside, foundations, cleanup of the water storage pond area, county road EE-22, A-Plant and ancillary areas. These materials were placed in the new B-Plant Repository.

Major projects for late 1999 and 2000 include the construction an enhanced evaporation system for the Club Ranch Ponds, placement of the last two ground water withdrawal wells (WD-7&8) into operational status, and continued cleanup adjacent to State Highway 141. The removal of contaminated ground water will continue and an evaluation of that system will be submitted to the State in early 2000.

6.1 OFF SITE DOSE LIMITS

UCC/Umetco shall conduct remedial activities in such a manner as to provide reasonable assurance that the annual radiation dose equivalent of 25 millirens to the whole body, 75 millirens to the thyroid, and 25 millirens to any other organ of any member of the public is not exceeded as the result of exposures of radioactive materials, radon and its progeny excepted, to the general environment.

6.1.1 Compliance Reporting

Determination of Compliance in relation to Section 6.1 above shall be based upon an annual report which evaluates, using site-specific input parameters and methods approved by the State, doses to off-site individuals and populations, and, as necessary, indicates if the standards of Section 6.1 above are exceeded. UCC/Umetco's evaluation shall refer to details of regional natural radiation background and of past and present uranium fuel cycle of other operations which have contributed or could contribute to radiation doses above those from natural radiation background. UCC/Umetco's evaluation shall also include an up-to-date inventory of sources other than authorized by RML 660-02S which could reasonably be expected to affect compliance with Section 6.1, such as mine waste dumps and sub-ore storage piles,

and shall include a detailed topographic map locating all sources (with their area, height above ground surface, and average grade) within five (5) miles (8 km) of the controlled area boundary, to the extent the information is available.

UCC/Umetco's evaluation shall also include an environmental monitoring and analysis program and a personnel and facility monitoring program in accordance with Sections 6.4, 6.5, and 6.6 of this RAP.

6.1.2. Garden Produce

UCC/Umetco shall insure that no garden produce is grown for human consumption on the Uravan Facility.

6.1.3 Residences

UCC/Umetco shall cause all present residents of the Town of Uravan to vacate their residences by December 31, 1986. UCC/Umetco shall not permit any building or improvement at the Uravan Facility to be constructed for or occupied as a residence.

6.1.4 Quality Control/Quality Assurance, Monitoring, Performance Evaluation, and Inspection

UCC/Umetco shall perform Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation as prescribed in Addendum A in accordance with a plan to be submitted with the Final Plans and Specifications.

QC/QA shall meet the basic requirements stated in Addendum A and specifically shall include the following:

- Input parameters and methodology for evaluation of compliance with Section 6.1.

- Inspection and report for evaluation of compliance with Sections 6.1.2 and 6.1.3.

6.2 HEALTH, SAFETY, AND ENVIRONMENTAL PROCEDURES

UCC/Umetco shall maintain and conduct remedial activities in accordance with comprehensive written health, safety and environmental procedures manuals, approved by the State. The procedures manuals shall contain safety, monitoring, decontamination, and emergency procedures, including:

- Administrative and operating procedures relating to radiological health and safety;

- Instructions and precautions to keep exposures As Low As Reasonably Achievable (ALARA);

- Specific information on analytical equipment, laboratories, and procedures for each aspect of the monitoring program.

6.3 AREA SOURCE AIR EMISSIONS CONTROLS

6.3.1 Residue Storage Areas

UCC/Umetco shall implement dust control procedures as approved by the State, in accordance with the Quality Plan.

6.3.2 Roads

UCC/Umetco shall control dusting from controlled area roads by sprinkling or chemical crusting agents and shall limit vehicle speeds to twenty (20) miles per hour.

6.3.3 Tailings Dusting

UCC/Umetco shall minimize, to the maximum extent reasonably achievable, dispersion of airborne particulates from the tailings disposal area according to a plan approved by the State.

6.4 PERSONNEL AND FACILITY MONITORING

UCC/Umetco shall monitor personnel and facility in such a manner as to enable the State to estimate maximum potential occupational radiation dose commitment and to determine compliance with 6 CCR 1007-1-4, in accordance with a written plan approved by the State. The monitoring results shall be reported to the State and presented in such tabular and graphical form that trends may be readily identified. Personnel monitoring control badges shall be kept in a background location.

6.4.1 Bioassay

UCC/Umetco shall comply with the program as in the procedures manual approved by the Colorado Department of Health and (NRC) Regulatory Guide 8.22 "Bioassay at Uranium Mills" U.S. Nuclear Regulatory Commission (Revision 0 or as subsequently revised), unless other conditions of RML 660-02S or this RAP are more restrictive, and the following:

Urinalysis for uranium shall be performed for employees assigned to Radiation Work Permit activities exceeding one work day. Specimens shall be collected as close as is reasonably possible to the period beginning 48 hours and ending 96 hours after the last exposure. The measurement sensitivity shall be 5

ug/1 or less. A special urinalysis shall also be performed if there is any reason to suspect an inhalation exposure to yellowcake exceeding 40 x 10^{-10} uCi/hr/ml in a period of one work week or to ore dust exceeding 520 x 10^{-10} uCi-hr/ml in a period of one calendar quarter. UCC/Umetco shall make a formal documented evaluation if bioassay measurements exceed any of the following criteria:

6.4.1.1.1 The urinary uranium concentration exceeds 30 ug/1 for any two consecutive sampling periods.

6.4.1.1.2 The urinary uranium concentration for any measurement exceeds 80 ug/.

6.4.1.1.3 Action levels based on bioassay measurements shall be in accordance with Tables 1 and 2 of NRC Regulatory Guide 8.22. In addition, all bioassay results shall be evaluated and acted upon by the Radiation Safety Officer (RSO) and appropriate officials of UCC/Umetco.

6.4.1.2 Urinalysis results exceeding 15 ug/1 shall be reported to the OSC within 20 days of specimen collection.

6.4.1.3 Urinalysis results exceeding 30 ug/1 shall be reported immediately to the On-Site Coordinator (OSC) by

telephone

Prevention of specimen contamination shall be in accordance with Section C.6 of NRC Regulatory Guide 8.22.

6.4.1.4 UCC/Umetco shall implement a documented quality control program for urine specimens that includes background samples, blanks, and spikes and also criteria for requiring repeat collection and analysis.

6.4.1.5 A baseline urine sample shall be obtained from any new worker who will be subject to urinalysis, prior to start of work.

6.4.2 Mill Air Sampling

UCC/Umetco shall conduct an air sampling program to assess airborne radioactivity concentrations to which employees may be exposed, as follows:

6.4.2.1 A representative air sample for no less than thirty (30) minutes duration shall be collected at least quarterly at specified work stations approved by the State to determine airborne uranium concentrations.

Based upon at least two initial samples at each work area and a sample at the start of each major work activity, the initial monitoring frequency for each work area shall be determined according to the following:

Work Area Status	Initial Monitoring Frequency**
Conc. <10% MPC*	Quarterly
Conc. <25% MPC*	Monthly
Conc. >25% MPC*	Weekly

* U-natural, or the average of uranium decay series radionuclides, in accordance with pertinent footnotes to 6 CCR 1007-1-4, Appendix A

** unless a different minimum duration is approved by the Department and included in LC 11.2, or LC 11.4-1 or 11.4-2

6.4.2.2 Breathing zone sampling shall be completed at least quarterly to determine how representative the station air samples are.

6.4.2.3 Monthly air samples for no less than thirty (30) minutes duration (unless a different minimum duration

is approved by the State), representative of potential employee exposure, shall be collected at activity and storage locations, as appropriate, to determine airborne uranium concentrations.

6.4.2.4 Sampling at selected work areas shall be performed at least monthly to determine radon daughter concentrations. If these values exceed 25 percent of the applicable standards, the frequency of sampling at these locations shall be increased to weekly.

6.4.2.5 If the air sampling program reveals work activity locations where concentrations exceed 25 percent of the applicable standards, the licensee shall establish a program to determine time-weighted exposures of employees working at these locations and establish additional procedures required to maintain employee exposures as low as reasonably achievable. Time-weighted studies shall be done at least quarterly.

6.4.2.6 Uranium particulate air sampling, supplementing the routine air sampling program, shall be conducted for cleanup and maintenance activities as appropriate.

6.4.2.7 In-plant air monitoring committed to in LC 11.2 or 11.3

shall be performed under conditions typical of employee exposures.

6.4.2.8 Along with results of airborne activity, UCC/Umetco shall keep a record of the activity underway during sampling.

6.4.2.9 UCC/Umetco shall maintain records of any respirator maintenance, fit and training program.

6.5 FACILITY ALPHA CONTAMINATION SAMPLING

UCC/Umetco shall perform documented spot surveys for alpha contamination at least quarterly on ten (10) percent of the workers leaving the Facility. Alpha contamination on skin or clothes exceeding 1000 dpm/100 cm^2 shall require decontamination and an investigation by the RSO as to the cause.

UCC/Umetco shall conduct alpha contamination surveys of the lunch rooms, control rooms, change rooms and offices at least monthly. If the surveys reveal contamination levels that exceed Colorado Department of Health (CDH) guidelines, (1) the area shall be decontaminated immediately, (2) an investigation shall be made by the SM to determine the cause and corrective measures required to prevent recurrence, and (3) the location shall be surveyed weekly until four consecutive weekly surveys are below guidelines, at which time the survey frequency shall revert to monthly.

6.6 ENVIRONMENTAL MONITORING AND ANALYSIS PROGRAM

UCC/Umetco shall conduct an environmental monitoring and analysis program in such a manner as to enable the State to estimate maximum potential radiation dose commitment to individuals and populations off-site and to determine compliance with RAP Section 6.1, in accordance with a written plan approved by the State.

6.6.1 Air Particulates

Air Particulates shall be:

- Monitored at the locations specified in the Procedures Manual for Plant Operations at Uravan, at least one nearest feasible residence, and at a control location;

- Collected with weekly filter changes, or more frequently as required by dust loading;

- Composited monthly by location;

- Analyzed for natural uranium, thorium-230, radium-226, and lead-210.

6.6.2 Ambient Radon

Ambient radon shall be monitored at the locations specified in the Procedures Manual for Plant Operations at Uravan continuously, or at least once per month, representing approximately the same period each month.

6.6.3 Other

Groundwater, surface water, river sediments, surface soils, and beta/gamma contamination surveys shall be monitored in accordance with the other provisions of Chapters 4.0 and 5.0 of this RAP.

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ADDENDUM A

OUTLINE FOR QUALITY CONTROL/QUALITY ASSURANCE, MONITORING AND PERFORMANCE EVALUATION PLAN (QUALITY PLAN)

QUALITY PLAN

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A1.0 INTRODUCTION

Quality Control/Quality Assurance (QC/QA), Monitoring and Performance Evaluation are interwoven. Quality control ensures that the construction proceeds in accordance with specifications. Quality Assurance provisions are the internal cross-checks on quality control. Monitoring assures that required information is available to allow comparison of actual performance with design expectations. The performance evaluation is the vehicle by which monitoring feedback is linked to the performance prediction to ensure that the result of both the design and construction effort are effective.

UCC/Umetco shall develop a Quality Control/Quality Assurance, Monitoring and Performance Evaluation Plan (the "Quality Plan") for remedial activities and near-term surveillance upon facility closure. The Quality Plan shall be designed to assure that the remedial activities are conducted in a safe manner and the designed systems and structures perform in accordance with the approved Remedial Action Plan. The Quality Plan shall be submitted to the State for review, comment and approval in accordance with the approved schedule.

The State shall institute an Inspection and Certification Program as stated in Addendum B. This program shall be designed to monitor and verify the quality control/quality assurance,

monitoring and performance of designed and constructed components and documentation in order that certification of the site can be achieved.

A2.0 SCOPE OF THE QUALITY PLAN

The Quality Plan, developed by UCC/Umetco, shall include worker health and safety and shall further include all activities related to a plan for cleanup and reclamation of the existing facilities. The Quality Plan shall be submitted to the State of Colorado for its review and approval. This program shall include the monitoring of remedial activities outlined in the Remedial Action Plan (RAP) and shall describe the duties of the quality control contractor. The quality control contractor shall implement, conduct and document The Quality Plan. The contractor shall be nominated by UCC/Umetco and approved by the State, based upon assessment of the contractor's ability to perform the work. The contractor shall report directly to appropriate UCC/Umetco personnel and shall maintain close liaison with designated State representatives.

The Quality Plan for solids is described for each of the following contaminated areas:

- Atkinson Creek Crystal Disposal Area
- Club Ranch Ponds Area
- River Ponds Area
- Tailings Piles
- Club Mesa Area

- Mill Areas
- Town and Adjacent Areas

Ancillary areas for solids include the Burbank Quarry and Borrow Area on Club Mesa.

The Quality Plan for liquids addresses the following:

- Tailings liquids as hillside seepage, toe berm seepage, and the tailings dewatering liquids.
- Ponded liquids in Club Ranch Ponds, River Ponds, and storage ponds on Club Mesa.
- Surface runoff from the mill complex and affected watershed.
- Groundwater under both Club Mesa and San Miguel River Valley.
- Liquids currently stored in the mill circuit.

A3.0 GENERAL REQUIREMENTS

A3.1 CONTENTS OF QUALITY PLAN

The Quality Plan shall have a definite organizational structure, shall contain specific plans for inspection, sampling, testing and audit procedures, authority for changes and corrective actions, and oversight of document control. Where appropriate, the Quality Plan shall incorporate the procedures and approach contained in Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities, NUREG/CR-3356 and Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80. Sampling and analysis shall be according to standard methods. Analytical methods shall follow State and/or USEPA authorized Quality Control/Quality Assurance guidance unless otherwise authorized by the State.

A3.1.1 Organizational Structure

That portion of the Quality Plan describing organizational structure shall include the following:

(1) A description of the quality control management organization.

(2) The number, classification, qualifications, duties, responsibilities and authority of personnel.

(3) The individual who shall be responsible for overall management at the site for quality control.

(4) The specific authority and responsibility of all other personnel regarding the Quality Plan.

(5) A program for information flow among workers, construction management and inspectors about various QC/QA, and health and safety requirements of the RAP.

(6) A health and safety plan which describes those activities necessary to assure public and worker health and safety. The Quality Plan shall include radiation control and monitoring, industrial hazards control and emergency procedures.

A3.1.2 Surveys, Inspection, Sampling and Testing

The portion of the Quality Plan describing the surveys, inspection, sampling and testing shall include the following:

(1) Methods and procedures for surveys, inspections, sampling and testing during various construction tasks.

(2) The necessary qualifications of individuals performing surveys, inspections, sampling and testing.

(3) The number and type of surveys, inspections and/or tests to be conducted.

A3.1.3 Changes and Corrective Actions

The methodology for dealing with changes and corrective actions shall be detailed in the Quality Plan and shall include:

(1) Identification of the person who has authority to reject work or material, to require removal or placement, to specify and require appropriate actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, tests, records are not conforming to contract plans and specifications.

A3.1.4 Documentation Requirements

Documentation requirements shall include the following:

(1) The identification of the person who has authority to provide for the submittal and/or storage of all survey, test and inspection reports.

(2) Specification of reporting requirements forms, formats, and distribution of reports.

(3) A description of record keeping to document construction methods and results, surveys, sampling, testing and inspection of construction. Samples of forms and records shall be included.

(4) Provisions for permanent document and data storage.

A4.0 PLAN FOR CONTAMINATED SOLIDS

A4.0.1 Soils Investigation and Removal Method

The soils investigation and removal method shall be as follows:

To efficiently implement the soils cleanup criteria in Table 4.1.2-1 and removal requirements in the RAP, UCC/Umetco shall develop a step by step procedure so that adequate cleanup is reasonable assured. Major steps in this cleanup procedure shall include: 1) Initial Removal, 2) Characterization Investigation, 3) Remedial Action, 4) Confirmation Investigation. Background soil mean concentrations and variability shall be determined from selected 100 square meter plots of equal populations from four mesa top and two valley sites as set forth in the approved Quality Plan.

Activities involved in each of these steps shall include the following:

(1) Initial Removal: UCC/Umetco shall remove known wastes and discrete deposits from each source area identified in the RAP. Initial removal levels required in specific sections of the RAP are 30 uR/hr and 20 percent visual.

(2) Characterization Investigation: UCC/Umetco shall conduct a detailed scintillometer and soil investigation of each source area described in the RAP so that criteria 1.2 and 2.2 can be analyzed. The scintillometer investigation shall be appropriate for the anticipated level and source of contamination, and shall be tied to an identifiable reference point. ~~Grid point~~ **Survey** intervals ~~shall not exceed fifty (50) meters~~ **be set forth in State-approved characterization plans** for windblown contamination areas and ~~five (5) meters~~ [12/15/99] for the town, source and source fringe areas as delineated in Figure 4.7.2.4-1. This investigation will form the cornerstone of future remedial actions. Next, a soil investigation for radionuclides and heavy metals will be conducted in each source area. This soil investigation will be designed to determine the correlation, if any, between the soil assays and scintillometer readings, establish a scintillometer cleanup level, and determine the best method to achieve soil cleanup. Soil sampling density, including multiple depth samples, will be determined on an area by area basis using the scintillometer investigation.

In determining the best soil cleanup method, consideration shall be given to both the potential health effect of any residual contamination and on the feasibility, cost-effectiveness, cost, and environmental impact of the proposed remedial action and potential land use. The 40 CFR 192 soil

cleanup standard shall be met by the proposed remedial action within the licensed facility. 40 CFR 492 is relevant and appropriate and may be applied in un-licensed source areas, after consideration of all pertinent available radiometric and past land use information, the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and potential land use. If data are insufficient or if no correlation exists between the soil assays and gamma-ray measurements, a cleanup level of 20 uR/hr will be used to meet this standard. The Characterization Investigation shall be submitted to the State for review and approval.

(3) Remedial Action: UCC/Umetco shall use the cleanup levels and scintillometer readings determined by the Characterization Investigation to conduct remedial actions for each area. All activities will be monitored by UCC/Umetco and the State during their implementation.

(4) Confirmation Investigation: UCC/Umetco shall perform and document a scintillometer investigation, and soil investigation of the remediated area prior to backfilling or placement of cover material to confirm that cleanup levels established in the Characterization Investigation and implemented in the Remedial Action were successful. The scintillometer investigation will be conducted on a detailed grid.

Representative soil sampling shall be conducted and should include multiple depth samples. The Confirmation Investigation should give reasonable assurance that cleanup Criteria 1 and 2 of Table 4.1.2-1 have been met.

A4.1 ATKINSON CREEK CRYSTAL DISPOSAL AREA

A4.1.1 QC/QA

For remedial activities at the Atkinson Creek Crystal Disposal, QC/QA shall meet the requirements of Section A3.0 and, specifically, shall include the following inspection and reporting activities:

- Excavation of all materials (type, quantity, location)
- All surveys (construction) and field tests (scintillometer) and laboratory tests (soils assays for radionuclides and metals required by Table 4.1.2-1)
- Final limits of excavations to assure that soil cleanup levels specified in Section 4.1.2 of the RAP are achieved
- Placement of fill materials to final grade (type, quantity, origin and placement location)
- Vegetation procedures
- Inclusion of documents and reports as set forth in Section 4.1.5 of the RAP.

A4.1.2 Monitoring

Monitoring of the Atkinson Creek Crystal Disposal Area shall include:

- o Surface configuration, to check for surface erosion and formation of pot holes.
- o Vegetation activities to ensure that the vegetation program is effective.

A4.1.3 Performance Evaluation

Performance of the remedial activities shall be evaluated on the basis of the satisfactory completion of the tasks set forth in Section 4.1.2 of the RAP; the adequacy of the stability of the final cover with respect to maintaining its configuration, and; the effectiveness of vegetation activities in sustaining growth in comparison to local areas of naturally-occurring vegetation.

A4.2 CLUB RANCH PONDS AREA

A4.2.1 QC/QA and Monitoring

In relation to remedial activities in the Club Ranch Ponds Area, the QC/QA and monitoring shall meet the requirements set

forth in Section A3.0 and, specifically, shall include the inspection, reporting, and monitoring activities set forth in Sections A4.1.1 and A4.1.2 but for the Club Ranch Ponds Area. The QC/QA requirements in Section A3.0 shall apply to all construction activities. Specifically, QC/QA and monitoring activities shall be developed for pond construction and operation activities.

A4.2.2 Performance Evaluation

Performance of remedial activities shall be evaluated on the basis of satisfactory completion of the tasks set forth in Section 4.2.2 of the RAP; the adequacy of stability of the final cover with respect to maintaining its configuration; the effectiveness of the vegetation activities in sustaining growth in comparison to reference areas of naturally-occurring vegetation. Performance, operation, and maintenance of the lined ponds shall be evaluated by the flows from the leak detection system.

A4.3 RIVER PONDS AREA

A4.3.1 QC/QA and Monitoring

For the remedial activities at the River Ponds Area, QC/QA

shall meet the requirements set forth in Section A3.0 and, specifically, shall include the inspection and monitoring activities stated in Section A4.1.1 and A4.1.2 as appropriate for the River Ponds Area.

A4.3.2 Performance and Evaluation

Performance of remedial activities shall be evaluated on the basis of satisfactory completion of the tasks set forth Section 4.3.2 of the RAP; the adequacy of the stability of any required final cover with respect to maintaining its configuration; and the effectiveness of vegetation activities in sustaining growth in comparison to local areas of naturally-occurring vegetation.

A4.4 TAILINGS PILES

A4.4.1 QC/QA

For remedial activities for the Tailings Piles, QC/QA shall be conducted in accordance with the requirements set forth in Section A3.0 and shall, specifically, include the following inspection and reporting activities:

- Sump placement, operation and performance
- Contaminated material types, sizes, quantities, location

on the pile, schedule, placement procedures, compaction, and other characteristics

- o Installation and maintenance of all monitoring systems
- o Cover material selection, placement and compaction
- o Construction of drainage channels and diversion ditches
- o Construction of runoff control structures on the Club Mesa Spray Area
- o Visual surveillance
- o Submission of documents and reports required by Section 4.4.3 of the RAP

A4.4.2 Monitoring

Monitoring of the Tailings Piles shall be conducted in accordance with the requirements of Section A3.0 and Table A4.4-1 and shall, specifically, include the following:

- o Slope stability, including surface monuments and any required slope indicators
- o Piezometer levels
- o Toe drain effluent rates, quantities and quality
- o Siltation in runoff collection channels
- o Monitoring of activities on the rock fill buttress, side slope cover, top cover, and drainage diversion channels

A4.4.3 Performance Evaluation

Performance of remedial activities shall be evaluated to assure long-term stability, cover integrity, and the decline of seepage over time by the analysis of the following:

- Settlement rates
- Toe drain seepage rates
- Movement monument, erosion monument, and slope indicator data, if required
- Aerial photography
- Installation of all instrumentation
- Monitoring of all instrumentation
- Reporting of all monitoring data
- Evaluation of all monitoring data in the context of design expectations and performance predictions. The periodic evaluation shall be comprehensive and shall include discussion of the interrelationship between the monitoring data and the predicted performance of the tailings piles with respect to short and long term pile stability, cover integrity, dewatering and seepage. Based on a comprehensive assessment, "action" and "concern" levels shall be specified and discussed in each evaluation.

TABLE A4.4-1 MONITORING REQUIREMENTS FOR CLUB MESA REPOSITORIES

The monitoring program for Club Mesa involves the surveillance of Tailings Piles 1, 2, and 3, the crystal disposal area, and conditions beneath the mesa. Reports on the Club Mesa monitoring program will address the key factors and components described in the following sections.

Tailings Ponds 1, 2, and 3

The monitoring program for the Club Mesa Tailings Piles is designed to provide information on the phreatic levels in the pile, to ascertain settlement rates and amounts, provide data on stability and erosion of the protective cover, and to determine the rate and impact of cliff retreat. To determine these factors the tailings pile monitoring system is divided into four parts: 1) piezometers, 2) surface movement monuments, 3) erosion monuments, and 4) visual inspection/aerial photography. Ground water monitoring for Club Mesa is described in Chapter 5.0 of the RAP and Section A5.0 of this Addendum A and includes seepage monitoring for Tailings Piles 1, 2, and 3.

Piezometers: Piezometers are or are to be installed within the tailings piles at the locations shown in Drawing C-102 (00-831216-03) or alternative locations authorized in the "Procedures Manual for Plant Operations at Uravan", dated March 31, 1982 and revised through December 1984. These piezometers are to be designed in accordance with information provided in drawing C-107 (00-831216-03). Generally, the piezometers will monitor the change in fluid levels in the piles at the crest of the rock fill buttress, on the embankment face, and on the retirement crest.

Subject to approval and Final Plans and Specifications, eleven (11) piezometers will be used on Tailings Piles 1 and 2 and nine (9) piezometers will monitor Tailings Pile 3. Readings from the piezometers will be at least every year until the tailings piles no longer contain free liquids as determined by two successive readings.

Data collected from the piezometers should be used to aid in estimating tailings pile settlement (consolidation) and determining when the toe drain system can be abandoned. Additionally, the monitoring of the piezometers should be used to determine if the remedial plan is operating as proposed. When all necessary information has been obtained, the piezometers should be properly plugged with a bentonite slurry.

Surface Movement Monuments: Subject to approval of Final Plans and Specifications, surface movements monuments are to be installed on the top and sides of the tailings ponds according to Drawing C-102 and designed according to Drawing C-107 (00-831216-03). An additional monument will be used to more fully establish the post-remediation settlement, erosion, and to determine the amount of movement of the embankments.

Thirteen (13) monuments are set for Tailings Piles 1 and 2 and ten (10) monuments for Tailings Pile 3. These locations are at each piezometer installation as well as at additional location on the reclaimed surface. Monuments currently in place will continue to be read at least every six months until the final reclamation cover is placed.

After final remediation, the monuments will be surveyed for horizontal and vertical movements on an annual basis until the accumulated settlement is within 10 percent of total settlement estimated by the monitoring program. Data collected from the surface monuments should be used to determine the integrity and effectiveness of the reclamation cover by ascertaining the amount of settlement, erosion, and embankment movement.

Erosion Monuments: Erosion monitoring monuments will be installed along the mesa rim and in gully areas according to Drawings C-102 and C-107 (00-831216-03). These erosion monuments will be used to determine the amount and rate of gully erosion and cliff retreat in the subject area.

Fourteen (14) erosion monuments will be constructed, most of which will be near the mesa rim. These monuments will be surveyed and their location described. Additionally, the proximity to the cliff edge and other pertinent observations will be described and recorded. The monuments will be observed visually and surveyed, if necessary, during the long-term monitoring program. From these observations, the rate of cliff retreat should be determined and potential impact on the integrity of the disposal area assessed.

Visual Inspection and Aerial Photography: The surface monuments and reclamation cover will be visually inspected on an annual basis after remediation has been completed. Detailed (large scale) stereoscopic aerial photographs of the tailings piles will also be taken after completion of the reclamation cover and drainage channels. Additional aerial photographs will be required only if the visual inspection indicates such a necessity.

In conjunction with observation of the surface monuments and reclamation cover, the runoff collection and diversion channels will be observed for evidence of erosion or debris and sediment accumulation. These observations will be made at the same time as the monitoring of the erosion monuments.

Burbank Crystal Disposal Area

Final plans and specifications for the new disposal area for crystals located on Club Mesa shall include a method to determine settlement, dissolution, and erosion of the reclaimed area, including the number and location of surface monuments, erosion monuments, aerial photographs and visual inspection schedule.

"Concern" level shall mean that monitoring data is reflecting tailings pile performance which is grossly inconsistent with expectations and may lead to environmental damage. "Action" level means action must be taken immediately to mitigate the problem reflected by the monitoring data. Contingencies shall be included in this evaluation where appropriate.

A4.5 CLUB MESA AREA

A4.5.1 QC/QA

In relation to remedial activities in the Club Mesa Area, QC/QA shall be conducted in accordance with the requirements of Section A3.0 and Section A4.1.1, as appropriate for the Club Mesa Area, and shall, specifically, include the following inspection and reporting activities:

- Excavation of all materials
- Final limits of excavations to assure that soils cleanup levels as specified in Section 4.5.2 of the RAP are achieved
- Sealing of portals and filling subsidence areas
- Placement of random fill to final grade
- Vegetation

- o Submission of documents and reports as required in Section 4.5.5 of the RAP.

A4.5.2 Monitoring

Monitoring of the Club Mesa Area after revegetation shall include:

- o Surface configuration, to check for surface erosion and formation of pot holes and sink holes.
- o Vegetation activities to ensure that the vegetation program is effective.

A4.5.3 Performance Evaluation

Performance of the remedial activities shall be evaluated on the basis of the satisfactory completion of the tasks named in Section 4.5.2 of the RAP; the adequacy of the stability of final cover with respect to maintaining its configuration, and the effectiveness of vegetative activities in sustaining growth in comparison to local areas of naturally-occurring vegetation.

A4.6 MILL AREAS

A4.6.1 QC/QA

For remedial activities at the Mill Areas, QC/QA shall meet

the requirements set forth in Section A3.0 and Section A4.1.1, but for the mill areas, and shall include the following specific inspection and reporting activities:

- o Excavation of all materials
- o Final limits of excavations to assure that contamination cleanup levels as specified in Section 4.6.2 of the RAP are achieved
- o Placement of 14 fill materials to conform to final grade requirements
- o Placement of all other materials including structural members, barrels, waste from decommissioning
- o Grading of all areas
- o Vegetation
- o Submission of documents and reports required by Section 4.6.5 of the RAP

A4.6.2 Monitoring

Monitoring of the reclaimed areas after vegetation shall include:

- o Surface configuration, to check for surface erosion and formation of pot holes, or sink holes
- o Vegetation activities to ensure that the vegetation program is effective

A4.6.3 Performance Evaluation

Performance of the remedial activities shall be evaluated on the basis of the satisfactory completion of the tasks named in Section 4.6.2 of the RAP; the adequacy of the stability of the final cover with respect to maintaining its configuration; and the effectiveness of vegetative activities in sustaining growth in comparison to local areas of naturally-occurring vegetation.

A4.7 TOWN AND ADJACENT AREAS

A4.7.1 QC/QA

For remedial activities at the Town and Adjacent Areas, QC/QA shall meet the requirements of Section A3.0 and Section A4.1.1, but for the Town and Adjacent Areas and shall include the following inspection and reporting activities:

- Decontamination activities
- Excavation and removal of all materials including materials in sediment traps
- All surveys and field and laboratory tests
- All investigations for hazardous materials
- Submission of required documents and reports

A4.7.2 Monitoring

Monitoring of the town and adjacent areas shall include:

- o Surface configuration to check for erosion
- o Vegetation activities where applicable to ensure that the vegetation program is effective

A4.7.3 Performance Evaluation

Performance of the remedial activities shall be evaluated on the basis of the satisfactory completion of the tasks named in Section 4.7.2 of the RAP; the adequacy of the stability of the final cover with respect to maintaining its configuration; and the effectiveness of vegetative activities in sustaining growth in comparison to local areas of naturally-occurring vegetation.

A4.8 BURBANK QUARRY

A4.8.1 QC/QA

Regarding remedial activities related to the Burbank Quarry, QC/QA shall meet the requirements set forth in Section A3.0 and Section A4.1.1, but for the Burbank Quarry, where applicable, and shall include the following specific inspection and reporting activities:

- o Excavation of all materials
- o Preparation of the base compacted clay liner
- o Drainage and surface runoff control elements
- o Placement and compaction of all materials during construction
- o Development of compaction specifications for clay and raffinate crystals
- o Submission of required documents and reports by Section 4.8.5 of the RAP

A4.8.2 Monitoring

Monitoring of the Burbank Quarry after reclamation shall be conducted in accordance with Table A4.4-1 and shall include:

- o Surface configuration, to check for surface erosion and formation of pot holes

A4.8.3 Performance Evaluation

Performance of the remedial activities shall be evaluated on the basis of the satisfactory completion of the tasks set forth in Section 4.8.2 of the RAP maintaining the long-term integrity of the cells and the crystal repository; preventing contact of the crystals with moisture in sufficient quantities to cause dissolving of the crystals; and the adequacy of the stability of

the final cover with respect to maintaining its configuration.

A4.9 BORROW AREA ON CLUB MESA

A4.9.1 QC/QA

For activities at the Borrow Area on Club Mesa, QC/QA shall meet the requirements set forth in Section A3.0 and Section A4.1.1, but for the Borrow Area on Club Mesa, where applicable, and, specifically, shall include the following inspection and reporting activities:

- Excavation of all materials
- Drainage and surface runoff control elements
- Regrading to final grade
- Revegetation
- Submission of documents and reports required by Section 4.9.5 of the RAP

A4.9.2 Monitoring

Monitoring of the Borrow Areas after regrading and revegetation shall include:

- Surface configuration to check for surface erosion
- Vegetation activities to ensure that the vegetation program is effective

A5.0 PLAN FOR CONTAMINATED LIQUIDS

A5.0.1 River Monitoring

A5.0.1.1 Rationale

The San Miguel River monitoring program shall be designed to track improvement in stream quality as contaminants are contained and removed during remedial activities. A two-year baseline sampling program will be refined to reduce the number of constituents, locations and time periods sampled as remedial action progresses.

UCC/Umetco shall propose for approval by the State programs for Base Sampling and Improvement Sampling which include at a minimum the locations in Section A5.0.1.2, periods and components in Section A5.0.1.3, and constituents in Section A5.0.1.4. Sampling and analysis shall be consistent with the QC/QA requirements of Section A3.0.

A5.0.1.2 Sample Locations

a. Site 1: San Miguel River downstream of Tabeguache Creek near gaging station
b. Site 2: San Miguel River near Hieroglyphic Canyon
c. Site 3: San Miguel River downstream of A-Plant

d. Site 4: San Miguel River between A-Plant and Club Ranch Ponds

e. Site 5: San Miguel River near Atkinson Creek

f. Site 6: San Miguel River downstream of corrals

A5.0.1.3 Sample Periods

a. Base Sampling (years 1 and 2)

Water Quality: Monthly at locations 1-6

Biology: Semi-annual (pre-runoff and summer baseflow) for algae and one additional biotic component

b. Improvement Sampling (until sampling required in Section A5.4.3.3.1 is terminated)

Water Quality: Quarterly at locations 1-6

Biology: Semi-annual (pre-runoff and summer baseflow) for algae and one additional biotic component for metals

A5.0.1.4 Constituents During Base Sampling

Radionuclides, Dissolved and Total: U-natural and Ra-226

Metals, Dissolved and Total: Al, As, Cd, Cu, Fe, Hg, Pb, Mn, Ag, Se, Zn

Major Ions: Total NH_3, SO_4, Cl, Na, K, Ca, Mg, NO_3, NO_2

Other: Alkalinity, Conductivity, flow, pH, Chemical Oxygen Demand, Total Dissolved Solids, Total Suspended Solids

The foregoing list of monitoring parameters shall be refined and reduced, as appropriate, following the two-year Base Sampling Program.

A5.1 HILLSIDE SEEPAGE AND TAILINGS LIQUIDS

A5.1.1 Hillside Seepage

A5.1.1.1 QC/QA

QC/QA shall meet the basic requirements stated in this section and Section A3.0 and specifically shall include the following for the Hillside Seepage:

- o All construction procedures, materials and surveys
- o Detailed procedures for the collection of samples, handling, and processing
- o Appropriate use of field blanks, duplicates, and laboratory spikes (in no case at a frequency less than 10% of the samples collected)

- o Parameter detection limits to be used for each sample type and the appropriate analytical method

A5.1.1.2 Monitoring

Monitoring shall include the hillside collection and evaporation system and the San Miguel River, and shall specifically include the following:

- o Quantity and quality of flow from the hillside collection and drainage systems
- o Upstream monitoring of the San Miguel River to establish seasonal ambient levels of parameters listed on Table 5.4.3.2-3.
- o Seasonal downstream monitoring in the San Miguel River
- o Monitoring of evaporation pond and leak detection system performance and groundwater in the area of the ponds
- o An annual report of all monitoring data shall he submitted by March 31st of each year for the prior calendar year.

A5.1.1.3 Performance Evaluation

Performance of the collection and drainage systems shall be evaluated on the basis of their effectiveness to intercept flows to the San Miguel River. A performance evaluation report for the

hillside seepage collection system shall be prepared and submitted to the State for every five (5) years of operation, in order to determine the necessity of modifying the hillside collection system design or operation.

A5.1.2 Toe Berm Seepage and Tailings Liquids

A5.1.2.1 QC/QA

For the toe berm seepage and tailing dewatering liquids, QC/QA shall meet the requirements stated in Section A3.0 and specifically shall include the following inspection activities:

- Installation of trenches and sumps
- All surveys, field and laboratory testing

The monitoring program shall include:

- Seepage rates
- Response of the tailings piles to dewatering and loading

Performance of the remedial activities shall be evaluated an the basis of the settlement and seepage rates as prescribed in Section 4.4.3 and Section A4.4.

A5. 2 PONDED LIQUIDS

A5.2.1 QC/QA

QC/QA shall meet the requirements stated in Section A3.0 and shall include the applicable inspection activities stated in Section A4.3 and A4.5

A5.2.2 Monitoring

The monitoring program shall consist of obtaining the water surface elevations in the ponds each month and measuring the quantity and quality of all liquids pumped from the existing ponds to lined evaporation ponds.

A5.3 SURFACE RUNOFF

A5.3.1 QC/QA

QC/QA shall meet the requirements stated in Sections A3.0, and specifically shall include the following:

- All construction procedures, materials and surveys
- Detailed procedures for the collection of samples, handling, and processing
- Appropriate use of Field blanks, duplicates, and

laboratory spikes (in no case at a frequency less than 10% of the samples collected)

- o Parameter detection limits to be used for each sample type and the appropriate analytical method

A5.3.2 Monitoring

Monitoring of the runoff and clarified liquids shall include at least one (1) set of analyses for all parameters on Table A5.3.2-1 every two (2) years from each sedimentation pond. If overflows occur, UCC/Umetco shall monitor for flow, pH, total ammonia, temperature, total radium-225, total suspended solids and zinc.

A5.3.3 Performance Evaluation

The performance evaluation program for the sedimentation ponds shall be developed in order to verify the ponds are functioning as designed.

Table A5.3.2-1

CONSTITUENTS FOR CLARIFIED LIQUID AND PRECIPITATION RUNOFF MONITORING

Constituent	Constitutent
Alkalinity	Mercury
Aluminum	Nitrate
Ammonia	Nitrite
Arsenic	pH
Cadmium	Potassium
Calcium	Radium-226
Chloride	Selenium
COD	Silver
Conductivity	Sodium
Copper	Sulfate
Iron	Total Dissolved Solids
Lead	Total Suspended Solids
Magnesium	Uranium
Manganese	Zinc

A5.4 GROUNDWATER

A5.4.1 Club Mesa - Salt Wash Member Of The Morrison Formation

A5.4.1.1 QC/QA

QC/QA shall meet the requirements stated in Sections A3.0 and A5.1.1 where applicable, and shall include the following specific activities:

- Installation of any required replacement monitoring wells
- Well monitoring and sample collection, preservation, storage and transport to the laboratory
- Reporting of field and laboratory analysis results
- Sample chain-of-custody procedure and documentation
- Laboratory analytical procedures
- Construction and operation of evaporation pond areas with required leak detection systems and contingency plans
- Maintenance and operation of the hillside seepage collection and disposal systems in accordance with Section 5.1.1 of the RAP
- Submission of documents and reports as required

A5.4.1.2 Monitoring

UCC/Umetcc shall conduct a ground water monitoring system on Club Mesa to determine the geohydrologic changes in the perched liquid zone in the Salt Wash Member of the Morrison Formation. Objectives of this monitoring program are to establish base line conditions and to determine decline rates within the perched zone. Changes within the perched zone, will be compared to seepage decline rates for the tailings ponds and hillside collection system to aid in determining when the seepage collection systems may be abandoned. UCC/Umetco shall monitor the wells specified in Table A5.4-1 and collect monitoring data from these wells as prescribed in Table A5.4-2. An analysis shall be conducted upon groundwater samples from selected monitoring wells for volatile organic constituents and shall be reported to the State in the first annual monitoring report. It is recognized that the monitoring wells at the site were not installed for the purpose of collecting organic samples and organic materials may be present due to well installation or construction.

Sample splits during the annual sampling program are necessary only to satisfy requirements of the Quality Plan. Any well destroyed during the period of remedial activities shall he plugged with an acid resistant cement/bentonite mixture from bottom to top. Wells destroyed or that are unable to produce representative samples as determined by the State shall be

TABLE A5.4-1 SALT WASH WELLS TO BE MONITORED ON CLUB MESA

Well No.	Depth	Perforation Interval	Casing Elevation	Monitoring Well
V-762	308	20 - 308	5608	Salt Wash
V-763S	50	20 - 50	5450	U. Salt Wash
V-764S	123	88 - 123	5338	L. Salt Wash
V-770	98	38 - 98	5375	Salt Wash
V-771	111	30 - 109	5370	Salt Wash
V-772	250	3 - 250	5575	Salt Wash

Note: Additions or deletions to this list can be made only with State review and approval. UCC/Umetco shall prepare a program to be submitted to the State for approval prior to installation of any wells.

Table A5.4-2 SAMPLING FREQUENCY AND CHEMICAL ANALYSES FOR THE SALT WASH MONITORING WELLS ON CLUB MESA

Activity	Time/Interval (Months) 0-12	13-24	25-end
Field Parameters	Monthly	Quarterly	Annually
Chemical Analyses	Quarterly	Annually	Annually

Field parameters to include: pH, temperature, conductivity, water level

Chemical analyses to include:

Major Ions: TDS, Ca, Mg, Na, K, Cl, SO_4, CO_3, HCO_3, NO_3, Al, and NH_3

Heavy Metals and Radiochemical: Fe, Mn, Zn, Se, Uranium, Ra-226, Ra-228 and Th-230

Notes:

1) Chemical analyses will be performed quarterly for the first year to establish baseline conditions. Chemical analysis will be performed only until equilibrium is shown by three (3) successive annual samples to be within ten (10) percent of each other and until analysis from the monitoring program indicates that contamination is abating.

2) Field parameters will be collected until hillside and toe berm seepage collection systems are abandoned.

replaced in a location as near as feasible to the previous location with the same well design and with at least the same quality of construction. Dry wells need not be replaced. The monitoring program shall comply with all applicable State and federal statutes, and duly-promulgated rules and regulations, licenses and permits.

A5.4.1.3 Performance Evaluation

Performance evaluation for the Salt Wash shall include a description of monitor well data for comparison to past information and data, and for use in the performance evaluation described in Section 5.1.1.5 in the RAP.

A5.4.2 Club Mesa Kayenta-Wingate

A5.4.2.1 QC/QA

QC/QA shall meet the requirements stated in Sections A3.0 and A5.1.1 where applicable, and shall include the following specific activities:

- Installation of required replacement monitoring wells
- Well monitoring and sample collection, preservation, storage and transport to the laboratory of samples
- Reporting of field and laboratory analysis results
- Sample chain-of-custody procedure and proposed forms

- o Laboratory analytical procedures
- o Maintenance and operation of the toe berm and hillside seepage collection and disposal systems in accordance with Sections 5.1.1 and 5.1.2
- o Submission of documents and reports as required

A5.4.2.2 Monitoring

UCC/Umetco shall conduct a ground water monitoring system on Club Mesa and in the A-Plant Area. Objectives of this monitoring program are to establish baseline conditions within the Kayenta-Wingate formation below Club Mesa and to monitor the improvement of water quality in the A-Plant area as reclamation proceeds. UCC/Umetco shall monitor the wells listed in Table A5.4-3 and collect monitoring data from these wells as specified in Table A5.4-4. An analysis shall be conducted upon groundwater samples from selected monitoring wells for volatile organic constituents and shall be reported to the State in the first annual monitoring report.

Sample splits during the annual sampling program are necessary to satisfy requirements of the Quality Plan. Any well destroyed during the period of remedial activities shall be plugged with an acid resistant cement/bentonite mixture from bottom to top. Wells destroyed or otherwise unable to produce representative samples, as determined by the State, shall be

TABLE A5.4-3 KAYENTA-WINGATE WELLS TO BE MONITORED NEAR CLUB MESA

Well No.	Depth	Perforation Interval	Casing Elevation	Monitoring Zone
V-768	818	608-808	5599	Kayenta-Wingate
V-769	516	306-506	5334	Kayenta-Wingate
~~CRP-16~~	~~512~~	~~443-512~~	~~4994~~	~~Kayenta-Wingate~~
CRP-15	351	291-351	4976	Kayenta-Wingate
V-766	75	20-75	4975	Kayenta-Wingate
CM 93-1	**850**	**650-830**	**5607**	**Wingate**
CM 93-2	**880**	**740-860**	**5704**	**Wingate**
CM 93-3	**690**	**560-680**	**5458**	**Kayenta-Wingate**

Note: Additions or deletions to this list can be made only with State approval.

Table A5.4-4 SAMPLING FREQUENCY AND CHEMICAL ANALYSES FOR THE KAYENTA-WINGATE MONITORING WELLS NEAR CLUB MESA

	Time/Interval (Months)		
Activity	0-12	13-24	25-end
Short-list Parameters	Monthly	Quarterly	Annually
Chemical Analyses	Quarterly	Annually	Annually

Short-list parameters to include: pH, temperature, conductivity, water level, NH_3, and NO_3

Chemical analyses to include:

Major Ions: TDS, Ca, Mg, Na, K, Cl, SO_4, CO_3, HCO_3, NO_3, Al, and NH_3

Heavy Metals and Radiochemical: Fe, Mn, Zn, Se, Uranium, Ra-226, Ra-228 and Th-230

NOTES:

1) Chemical analyses will be performed for the first year. Any subsequent years where significant contamination is detected, additional chemical analyses will be conducted.

2) Short-list parameters will be collected until reclamation activities are completed at Uravan. If significant increases in the short-list parameters occur, additional chemical analyses will be conducted on an annual basis.

replaced in a location as near as feasible to the previous location, with the same well design and with at least the same quality of construction. Dry wells need not be replaced. The monitoring program shall comply with all applicable State and Federal statutes, duly-promulgated rules and regulations, licenses and permits.

A5.4.3 River Valley Kayenta-Wingate

A5.4.3.1 QC/QA

QC/QA shall meet the requirements stated in Sections A3.0 and A5.1.1 where applicable, and shall include the following specific activities:

- Installation of required withdrawal wells
- Installation of required replacement monitoring wells
- Well monitoring and sample collection, preservation, storage and transport to the laboratory of samples
- Reporting of field and laboratory analysis results
- Sample chain-of-custody procedure and proposed forms
- Laboratory analytical procedures
- Construction and operation of evaporation pond areas with required leak detection systems and contingency plans
- Submission of documents and reports as required

A5.4.3.2 Monitoring

A groundwater monitoring and data collection program shall be developed by UCC/Umetco for the Kayenta-Wingate in the San Miguel River Valley and shall follow the guidelines presented in this section. General objectives of this monitoring program are to establish baseline conditions, to evaluate ground water cleanup rates in the Club Ranch Ponds Area, and to determine the effectiveness of the withdrawal system. Samples shall be collected from monitoring and withdrawal wells, as presented in Table A5.4-5. The frequency and parameters for monitoring of these wells are presented in Table A5.4-6 and discussed below. An analysis shall be conducted upon groundwater samples from selected monitoring wells for volatile organic constituents and shall be reported to the State in the first annual monitoring report. It is recognized that the monitoring wells at the site were not installed for the purpose of collecting organic samples and organic materials may be present due to well installation or construction.

Any well destroyed during the period of remedial activities shall be plugged with an acid resistant cement/bentonite mixture from bottom to top. Wells destroyed or that are otherwise unable to produce representative samples, as determined by the State,

~~TABLE A5.4-5 KAYENTA-WINGATE SEQUENCE WELLS TO BE MONITORED IN THE RIVER VALLEY AQUIFER MONITORING PROGRAM~~

~~Primary Wells~~

~~Well Number~~	~~Total Depth (ft)~~	~~Perforation Interval (ft)~~	~~Casing Elevation (ft above MSL)~~	~~Monitor Formation~~	~~Well Type~~
~~CRP-1~~	~~152~~	~~72-152~~	~~4995~~	~~Kayenta-Wingate~~	~~Background~~
~~CRP-2~~	~~100~~	~~60-100~~	~~4942~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-2A~~	~~56~~	~~41-56~~	~~4941~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-3~~	~~133~~	~~50-133~~	~~4962~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-5~~	~~25~~	~~10-25~~	~~4941~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-7~~	~~81~~	~~10-81~~	~~4962~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-8~~	~~26~~	~~10-26~~	~~4966~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-9~~	~~100~~	~~10-100~~	~~4968~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-11~~	~~100~~	~~10-100~~	~~4967~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-13~~	~~61~~	~~10-61~~	~~4941~~	~~Kayenta-Wingate~~	~~Contaminated~~
~~CRP-17~~	~~287~~	~~227-287~~	~~4954~~	~~Kayenta-Wingate~~	~~Contaminated~~

~~PLUS ANY GROUNDWATER WITHDRAWAL WELLS~~

~~Compliance Point Well~~

~~CRP-18~~	~~236~~	~~177-236~~	~~4972~~	~~Kayenta-Wingate~~	~~Uncontaminated~~

~~Secondary Wells~~

~~CRP-4~~	~~60~~	~~20-60~~	~~4996~~	~~Kayenta-Wingate~~	~~Uncontaminated~~

CRP-6	60	10-60	4936	Kayenta-Wingate	Contaminated
CRP-10	100	10-99	4977	Kayenta-Wingate	Contaminated
CRP-12	33	10-83	4969	Kayenta-Wingate	Contaminated
CRP-14	76	10-76	4953	Kayenta-Wingate	Contaminated
CRP-16	512	443-512	4994	Kayenta-Wingate	Contaminated
G-Block	550	tbd	tbd	Kayenta-Wingate	Contaminated

NOTES: Additions or deletions from this list can be made only with State approval

tbd - to be determined

Table A5.4-5 KAYENTA-WINGATE SEQUENCE WELLS TO BE MONITORED IN THE RIVER VALLEY AQUIFER MONITORING PROGRAM

Well I.D.	Northing (Feet)	Easting (Feet)	Surface Elevation (Feet MSL)	Top of Casing Elevation (Feet MSL)	Depth of Well (Feet)	Screen Interval (Feet)	Top Screen Elevation (Feet MSL)	Zone of Completion	Hydraulic Conductivity (Feet/day)
Primary Wells									
CRP-1	181265.32	79820.55	4995.48	4995.98	152.0	80.0	4925.48	Kayenta	---
CRP-6B	179044.50	80882.70	4963.20	4964.70	92.0	10.0	4891.20	Kayenta	2.40
CRP-6C	179036.80	80890.30	4963.50	4965.00	160.0	10.0	4823.50	Kayenta	---
CRP-7A	179809.90	80268.20	4956.50	4958.00	63.0	10.0	4908.50	Kayenta	0.00
CRP-7B	179820.80	80264.40	4956.40	4957.90	105.0	10.0	4866.40	Kayenta	0.03
CRP-7C	179829.50	80260.50	4955.80	4957.30	150.0	10.0	4825.80	Kayenta	0.05
CRP-8A	179882.00	80527.30	4966.90	4968.40	50.0	10.0	4926.90	Kayenta	7.06
CRP-8B	179891.50	80520.50	4967.93	4969.43	93.5	10.0	4887.93	Kayenta	3.51
CRP-8C	179900.60	80511.90	4968.10	4969.60	154.0	10.0	4829.10	Kayenta	0.71
CRP-9A	181512.60	78604.10	4965.81	4967.31	70.0	10.0	4910.81	Kayenta	0.21
CRP-9B	181513.30	78603.20	4965.12	4966.62	140.0	10.0	4840.12	Kayenta	88.20
CRP-9C	181513.10	78603.70	4966.90	4968.40	170.0	10.0	4811.90	Kayenta	6.62
CRP-19A	181028.90	78383.20	4942.11	4943.61	56.5	10.0	4914.11	Kayenta	0.63
CRP-19B	181048.80	78390.60	4942.72	4944.22	100.0	10.0	4862.72	Kayenta	3.53
CRP-19C	181055.80	78392.80	4942.61	4944.11	135.0	10.0	4827.61	Kayenta	6.67
WD-1	181481.40	78623.50	4964.22	4965.72	174.0	110.0	4910.22	Kayenta	8.75
WD-2	180029.60	80409.70	4974.57	4976.07	158.0	98.0	4924.57	Kayenta	7.33
WD-3	180845.77	79057.81	4950.56	4952.06	150.0	100.0	4900.56	Kayenta	8.10
WD-4	179980.07	80102.04	4954.33	4955.83	150.0	100.0	4904.33	Kayenta	0.08
WD-5	181014.41	79244.08	4965.70	4967.20	150.0	70.0	4890.70	Kayenta	0.45
WD-6	179858.58	80280.37	4957.03	4958.53	90.0	40.0	4912.03	Kayenta	0.11
WD-7	179863.04	80391.28	4961.23	4961.94	150.0	100.0	4916.23	Kayenta	0.41
WD-8	179519.63	80544.82	4960.88	4962.01	115.0	70.0	4920.88	Kayenta	0.04
Compliance Point Well									
TD98-3	181059.23	75282.92	4962.09	4963.59	115.0	10.0	4860.09	Kayenta	0.06
Secondary Wells									
CRP-20	181192.70	78912.00	4974.68	4976.18	180.0	19.0	4824.68	Kayenta	0.03
CRP-21	180569.00	79558.10	4958.30	4959.80	140.0	20.0	4843.30	Kayenta	---
CRP-22	181798.00	78189.00	4971.10	4972.60	100.0	10.0	4886.10	Kayenta	---
CRP-23	181512.10	77307.80	4951.60	4953.10	96.0	10.0	4870.60	Kayenta	---
CRP-24	180748.96	79656.21	4961.45	4962.95	88.0	10.0	4888.45	Kayenta	0.35
CRP-25	180312.97	79855.31	4985.49	4986.99	140.0	60.0	4910.49	Kayenta	2.20
CRP-26	179272.61	81226.39	4979.06	4980.56	150.0	10.0	4844.06	Kayenta	0.04
TD98-1	181002.31	76665.00	4979.06	4980.56	113.0	20.0	4889.06	Kayenta	0.48
TD98-2	181623.24	76629.75	4940.48	4941.98	53.0	10.0	4900.48	Kayenta	---
TD98-4	181316.34	74753.32	4965.95	4967.45	125.0	30.0	4875.95	Kayenta	8.24

Note: Additions or deletions from this list can be made only with State approval

Table A5.4-6 SAMPLING FREQUENCY AND PARAMETERS TO BE ANALYZED FOR RIVER VALLEY KAYENTA-WINGATE GROUNDWATER MONITORING PROGRAM

(1) Initial Sampling Program

Activity	Time/Interval (Years) Year 1	Year 2
1. Primary Wells (Table A5.4-5)		
Field Parameters	Monthly	Quarterly
Chemical Analyses	Quarterly	Quarterly
2. Secondary Wells (Table A5.4.5)		
Field Parameters	Monthly	Quarterly
Chemical Analyses	None	None

Field Parameters to include: pH, temperature, conductivity, and water level

Chemical Analyses to include: Table A5.4-8 parameters

(2) Performance Monitoring Program

Activity	Time/Interval (Years) 3 to end of pumping
1. Primary Wells	
Field Parameters	Quarterly
Chemical Analyses	Annually during the quarter designated by the State
2. Secondary Wells	As needed to determine system performance

Field Parameters to include: pH, temperature, conductivity and water level

Chemical Analyses to include:

Major Ions: TDS, Ca, Mg, Na, K, Cl, SO_4, HCO_3, NO_3, Al, and NH_3

Heavy Metals and Radionuclides: Fe, Mn, Zn, Se, Uranium, Ra-226, Ra-228, and Th-230

Agricultural-Use Criteria Parameters: Those determined to be exceeded during the Initial Sampling Program

Note: Election by UCC/Umetco to attempt to satisfy Criterion II requires that four (4) replicates be analyzed for each well annually, or single analyses quarterly for each well.

Table A5.4-6 (Cont.)

(3) Confirmatory Sampling Program
(to be conducted if UCC/Umetco elects to attempt to satisfy Criterion Ia or Ib)

	Activity	Time/Interval
1.	Primary Wells	
	Field Parameters	Initially/Repeated Within 60 Days
	Chemical Analyses	Initially/Repeated Within 60 Days
2.	Secondary Wells	None

Field Parameters to include: pH, temperature, conductivity, and water level

Chemical Parameters to include: Table A5.4-8 parameters measured in four (4) replicates collected from each well.

(4) Post-Operational Monitoring Program

	Activity	Time/Interval
1.	Primary Wells	
	Field Parameter	Annually
	Chemical Analyses	Annually
2.	Secondary Wells	None

Field Parameters to include: pH, temperature, conductivity, and water level

Chemical Parameters to include: Table A5.4-8 parameters measured in four (4) replicates collected from each well, unless a total of eleven (11) years of pumping has already been completed, in which case the replicate analyses are not required.

shall be replaced in a location as near as feasible to the previous location, with the same well design and with at least the same quality of construction.

A5.4.3.3 Performance Evaluation

Performance evaluation as described in Section 5.4.3.2.1(6) shall be conducted by UCC/Umetco and submitted to the State for review and shall include the following:

a. Development of a ground-water model pursuant to Section 5.4.3.2.1 (1) of the RAP.
b. Use of the model provided pursuant to Section 5.4.3.2.1(1) and monitoring data as analytical tools to modify remedial system operation as operational experience is gained.
c. Evaluation of the performance of the withdrawal system with respect to design criteria and system limitations (i.e., disposal capacity) so that any operational adjustments can be made as indicated by the performance evaluation to maintain optimal system performance.
d. Prediction of the groundwater quality during the post-operation monitoring period as a measure of the effectiveness of remedial activities.

A5.4.3.3.1 Monitoring Well Program

The Kayenta-Wingate River Valley monitoring well program is comprised of four programs. They are as follows:

(1) Initial Sampling Program

An initial sampling program shall be conducted to determine the short-list of parameters to be analyzed in the annual performance monitoring program and the time of the year for the subsequent Annual Performance monitoring program.

The primary monitoring wells listed in Table A5.4-5 will be monitored for the parameters listed in Table A5.4-6 for two years. After the conclusion of that two-year period, UCC/Umetcc shall develop a ground water model using data from the primary and secondary wells. Additionally, UCC/Umetco will propose the quarter of the year during which all subsequent Performance Sampling will be performed and will propose the short-list of parameters for analysis. This short-list will include those parameters listed on Table A5.4-6 and will include all parameters which exceed the agricultural-use criteria listed in Table A5.4-7. UCC/Umetco shall submit the model, proposed short-list, and proposed monitoring period to the State for review and approval.

TABLE A5.4-7 AGRICULTURAL USE-BASED GROUND WATER QUALITY CRITERIA TO BE APPLIED AT URAVAN*

Constituent	Concentration	Units
Aluminum (Al)	5.0	mg/1
Arsenic (As)	0.1	mg/1
Beryllium (Be)	0.1	mg/1
Boron (B)	0.75	mg/1
Cadmium (Cd)	0.01	mg/1
Chromium (Cr)	0.1	mg/1
Cobalt (Co)	0.1	mg/1
Copper (Cu)	0.2	mg/1
Fluoride (F)	2.0	mg/1
Iron (Fe)	5.0	mg/1
Lead (Pb)	0.1	mg/1
Lithium (Li)	2.5	mg/1
Manganese (Mn)	0.2	mg/1
Mercury (Hg)	0.01	mg/1
Molybdenum (Mo)	0.01	mg/1
Nickel (Ni)	0.20	mg/1
Nitrite (NO2-N)	10	mg/1 as N
Nitrite & Nitrate (NO2+NO3-N)	100	mg/1 as N
Selenium (Se)	0.02	mg/1
Vanadium (V)	0.1	mg/1
Zinc (Zn)	2.0	mg/1
pH	6.5-8.5	s.u.
SAR	10	meg/1
RSC	1.5	meg/1
TDS	1.25 times background	

*Derived from Tables 3 and 4 of proposed Colorado ground water rules. This table shall be revised to conform to applicable Colorado rules and regulations, licenses and permits for the "Agricultural Use-Quality" ground water classification as promulgated by the State.

(2) Performance Monitoring Program

Samples shall then be collected annually at the time of year agreed upon by the State and analyzed for the selected parameters agreed upon by the State at the end of the Initial Sampling Program. This is the Performance Monitoring Program. The lab analyses conducted on the samples must have limits of detection below the criteria on Table A5.4-7. These results shall be compared to the background arithmetic mean (see following discussion of Criterion Ib). The comparison shall consider, individually, each well monitored and shall use the statistical tests described to satisfy the criteria described below.

If UCC/Umetco elects to try to meet Criterion II (Equilibrium Conditions) four replicates will be analyzed for each sample beginning at the sampling period after concentrations have decreased to that value calculated using the equation in Criterion II, where n=0.3. The State will be notified when this election is made, and shall be provided the results of the replicate analyses. Alternatively, UCC/Umetco may begin sampling quarterly instead of conducting four replicate analyses of each well annually.

(3) Confirmatory Sampling Program

If an annual sampling episode suggests that either Criterion Ia

or Ib might be met, UCC/Umetco may elect to begin the Confirmatory Sampling Program. Notice shall be provided to the State. Confirmatory Sampling Episode shall include analyses for all parameters listed in Table A5.4-8. Four replicates shall be analyzed. The Confirmatory Sampling Program shall consist of two sampling episodes. The first will be conducted within sixty (60) days of the annual episode. If the results of the first episode indicate that either Criterion Ia or Ib has been satisfied, a second sampling episode will take place within sixty (60) days of the first. If the results of the second sampling episode are consistent with the results of the first (the same Criterion is satisfied), then the period of Interim Termination of the Withdrawal System and the three-year Post-Operational Monitoring Program shall begin.

When each of the designated monitoring and withdrawal wells meets either Criterion Ia or Ib (as demonstrated by the Confirmatory Sampling Program) or Criterion II, an Interim Termination of the withdrawal system shall begin and the Post-Operational Monitoring Program shall begin. During the Interim Termination Period, the wells, pumps, plumbing, electrical systems, and water disposal system shall be maintained.

If eleven (11) years of groundwater withdrawal has occurred, the operation of the withdrawal system can be completely

TABLE A5.4-8 CONSTITUENTS TO BE ANALYZED IN RIVER VALLEY KAYENTA-WINGATE GROUNDWATER MONITORING PROGRAM

Constituent

- Ammonia (NH_3)
- Aluminum (Al)
- Arsenic (As)
- Beryllium (Be)
- Bicarbonate
- Boron (B)
- Cadmium (Cd)
- Calcium (Ca)
- Carbonate
- Chloride (Cl)
- Chromium (Cr)
- Cobalt (Co)
- Copper (Cu)
- Fluoride (F)
- Iron (Fe)
- Lead (Pb)
- Lithium (Li)
- Magnesium (Mg)
- Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Nitrite (NO_2-N)
- Nitrite & Nitrate (NO_2+NO_3-N)
- pH
- Potassium (K)
- Radium (RA-226)
- Selenium (Se)
- Sodium (Na)
- Sulfate (SO_4)
- Thorium (Th-230)
- Total Dissolved Solids (TDS)
- Uranium (U-nat)
- Vanadium (V)
- Zinc (Zn)

terminated. The Post-Operational Monitoring Program shall be implemented.

(4) Post-Operational Monitoring Program

All designated monitoring and withdrawal wells shall be sampled annually as described above for a period of three years after termination of the system operation. The Post-Operational Monitoring shall consist of annual sampling of all designated monitoring and withdrawal wells for the parameters listed in Table A5.4-6. Four replicates of each sample will be analyzed. The system termination criteria specified below require that each well satisfy one of the criteria before the withdrawal system can be completely terminated. Additionally, these criteria must be satisfied for a period of three years after interim termination before final termination of the withdrawal system can be accomplished. If the criteria are violated at any designated well (monitoring or withdrawal) pumping must resume, unless a total of eleven years of pumping has already been conducted. If a total of eleven (11) years of pumping has already been completed, the Post-Operational Monitoring Program shall be as described above, except that replicate analyses shall not be required.

A5.4.3.3.2 Statistical Testing Methods

Statistical tests to determine when the groundwater remedial action shall be terminated upon approval by the State are described below. These statistical tests described in Section 5.4.3.2 are set forth below:

Criterion Ia. Agricultural-Use

The test to compare the quality of water in monitoring and withdrawal wells against agricultural use-quality criteria is designed to comply with the State regulations, and allow for variability in water-quality parameters because of random noise. For the parameters analyzed in the Confirmatory Sampling Program or Post-Operational Monitoring Program, the data collected shall be used to calculate the arithmetic mean concentration of each parameter in each well. If the mean of any parameter in any well exceeds the respective standard for that parameter, the criterion shall not have been met. For pH only, if the mean is outside the range 6.5 to 8.5, the criteria shall not have been met. The test for comparison to Total Dissolved Solids (TDS) requires, first, that the background TDS be determined. This determination shall be based on water quality data from the well designated as background. Data collected within the same sampling episode from the background monitoring well which the State has determined to

represent background for the hydrological environment being remediated shall be used to calculate a mean value of TDS. To terminate groundwater withdrawal under this Criterion UCC/Umetco must also demonstrate and the State must agree that termination of withdrawals will not cause a violation of the San Miguel River surface water quality criteria (Table 5.4.3.2-3) from non-point loads.

Criterion Ib. Background Conditions

Comparison of water quality parameters against parameters measured in background monitoring wells shall be done using Cochran's approximation to the Behrens-Fisher Student's t-test (described in Appendix IV of 40 CFR Part 264). The test shall in general be a one-tailed test, as the case where the parameter exceeds the respective background parameter is generally of concern. For pH only, a two-tailed test shall be used. Monitoring populations shall be data for the parameters listed in Table A5.4-8, measured in water collected during the individual episodes in the Confirmatory and Post-Operational Monitoring Programs for the monitoring and withdrawal wells. Background populations shall be the respective parameters from the background wells measured during the same time period. If the concentration of any parameter in any of the monitoring or withdrawal wells are significantly (at a 95 percent confidence

limit) greater than the respective background parameter using the prescribed test, the criterion shall not have been met.

Criterion II. Equilibrium Conditions

The purpose of the termination criterion based on aquifer cleanup rate is to allow Umetco/UCC to terminate pumping if, after significant remediation has occurred, the rate of decrease in contaminant concentration is so slow that no noticeable improvement in water quality will occur within the remainder of the remediation period. Hydrologic theory and experience indicate that following a period of moderately rapid decrease in concentration (the length of which is governed by various aquifer parameters and the rate of water recharge and removal), the rate at which concentration changes may become very low, even though background concentrations have not been attained. This typically occurs when concentrations have decreased to a concentration between 10 to 30 percent of the distance from the background concentration to the starting concentration:

$$c = n\ (c_i - c_b) + c_b$$

where the c_i and c_b indicate initial and background concentrations, and n is approximately 0.1 to 0.3.

This test shall be applicable when concentrations are less than the concentration calculated by this equation, with n = 0.3.

The initial concentration shall be determined by the Initial Sampling Program (Table A5.4-6).

When concentrations have decreased to the point calculated above, the data set to be used in the test may be collected. Four replicate analyses of each sample shall be required. The parameters shall be those agreed upon in the short list for the annual performance sampling. Alternatively, UCC/Umetco may conduct quarterly sampling of the monitoring wells for the short-list parameters for four consecutive years. This option of quarterly sampling for four years does not require replicate analyses in excess of the requirements of the Quality Plan. This test shall be performed by calculating a linear, least-squares, regression of time (independent variable) against concentration (dependent variable). Each replicate analysis shall be treated as a separate data point. A minimum of four consecutive years of data shall be required. If a one-tailed t-test of slope of the regression line for each parameter shows that the slope is not significantly different from zero at the 95-percent confidence level, then the system has reached a point where no significant improvement is occurring. Under these conditions, Umetco/UCC may stop operating the withdrawal wells and the restoration program may be considered complete. The Post-Operational Monitoring Program shall then begin.

ADDENDUM B

OUTLINE OF INSPECTION AND CERTIFICATION PROGRAM

INSPECTION AND CERTIFICATION PROGRAM

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ADDENDUM B

OUTLINE OF INSPECTION AND CERTIFICATION PROGRAM

1.0 INTRODUCTION

Inspection and certification is the process by which the State of Colorado, with the concurrence of the U.S. Nuclear Regulatory Commission (NRC), determines that the remedial actions for the Uravan site have been constructed according to the approved Final Plans and Specifications submitted pursuant to the Remedial Action Plan (RAP), and determines that the remedial action has been completed in accordance with the requirements of the Consent Decree, Remedial Action Plan, Rules and Regulations Pertaining to Radiation Control, especially Part III, Schedule E, the standards promulgated by the U.S. EPA, and all applicable Federal and Colorado statutes, rules, regulations, licenses and permits. This Addendum B provides for establishment by the State of Colorado of an Inspection and Certification (IC) Program for Uravan remedial actions. This Program will be designed as an external inspection and auditing system to ensure that remedial activities are being conducted properly.

Regulatory and enforcement activities for remedial actions at Uravan are the specific responsibility of the Colorado

Department of Health (CDH). CDH shall be responsible for designing and implementing the IC Program, including review and approval of documents, identification of the specific remedial activities to be inspected, and a specification of the frequency of inspections. CDH may appoint appropriate staff or independent third parties to conduct all or part of the Inspection and Certification Program.

2.0 PROGRAM REQUIREMENTS

Certification is the final step in the remedial action process. Prior to certification of the site, the State will conduct an Inspection and Certification (IC) Program. This Program will include the review and approval of documents prepared by UCC/Umetco, as provided in the RAP and Addendum A, field inspection, and verification of the completion of remedial activities. At the time of successful completion of remedial activities, the State will certify that remedial activities have been conducted properly, according to the Consent Decree, the Remedial Action Plan and all applicable State and Federal statutes, rules, regulations, licenses and permits.

2.1 DOCUMENT REVIEW AND APPROVAL

The State's IC Program will focus on review and approval of certain key documents, including, but not limited to the following:

- Final Plans and Specifications
- Quality Control/Quality Assurance, Monitoring and Performance Evaluation Plan
- Final Construction Report(s)
- Certification Report

The basic objectives of review of these documents by the State are:

- To determine that the Final Plans and Specifications comply with the requirements and activities set forth in the Remedial Action Plan;
- To determine that the Quality Control/Quality Assurance, Monitoring and Performance Evaluation Plan is consistent with the Remedial Action Plan requirements and is capable of assuring proper evaluation and documentation of the remedial actions;
- To confirm that the Final Construction Report adequately and accurately documents the remedial activities performed; and
- To determine if the Certification Report accurately assesses the remedial activities and to certify that remedial actions are complete.

2.2 INSPECTION ACTIVITIES

In order to assure that the Final Construction Report(s) and Certification Report are correct, the State will inspect remedial activities in the field. Inspection activities will be tied directly to UCC/Umetco's Quality Control/Quality Assurance, Monitoring and Performance Evaluation Plan. The objectives of

inspection activities are:

- To determine by direct observation whether performance of the work and quality control activities conform with plans, specifications, and procedures;
- To determine whether the system for preparing and maintaining records is functioning properly;
- To determine whether records reflect performance of the work in a manner which complies with the plans, specifications and procedures; and
- To determine whether the records and/or work activities indicate problems, inadequacies or weaknesses that could impact acceptability of remedial actions.

APPENDIX II

RADIOACTIVE MATERIALS LICENSE 660-02S

Please refer to the current Radioactive Materials License on file at the Colorado Department of Public Health and Environment [12/15/99]

APPENDIX III

Ownership Map

UMETCO MINERALS CORPORATION
Land Status
2-5-86

UMETCO MINERAL CORP. PROPERTY BOUNDARY
Patented placer, millsites & lode claims
Approved mineral surveys (millsites)
UMETCO millsites & lode claims
DEPARTMENT OF ENERGY (AEC withdrawn lands)
PUBLIC LANDS (Administered by the Bureau of Land Management, BLM)

APPENDIX IV

The Terms used in XVII(B) are defined as follows:

"Assets" means all existing and all probable future economic benefits obtained or controlled by a particular entity.

"Current assets" means cash or other assets or resources commonly identified as those which are reasonably expected to be realized in cash or sold or consumed during the normal operating cycle of the business.

"Current liabilities" means obligations whose liquidation is reasonably expected to require the use of existing resources properly classifiable as current assets or the creation of other current liabilities including, if applicable, by generally accepted accounting principles, consistently applied, surety obligations for source material milling or related operations other than the one for which compliance with a financial test is being determined.

"Eligible Investments" shall mean (i) direct obligations of the United States or any agency thereof, or obligations guaranteed by the United States or any agency thereof, (ii) commercial paper rated in the highest grade by a nationally recognized credit rating agency, (iii) time deposits with, including certificates of deposit issued by and banker acceptances issued by, either any office located in the United States or any bank or trust company which is organized under the laws of the United States or any state thereof and the securities of which (or of the holding company of such bank or trust company) are rated in one of the two highest rating categories by a recognized rating service or any of the fifty largest international commercial banks which is organized outside the United States, or (iv) general tax-exempt obligations issued or guaranteed by any State of the United States of America or any political subdivision thereof which are rated, at the time of the acquisition of such obligation, single A or above by Standard & Poor's Corporation or Moody's Investors Service, Inc. or its equivalent or higher by a nationally recognized rating agency, provided in each case that such investment matures within twelve (12) months from the date of acquisition thereof.

"Liabilities" means probable future sacrifices of economic benefits arising from present obligations to transfer assets or provide services to other entities in the future as

a result of past transactions or events, including, if applicable, by generally accepted accounting principles, consistently applied, surety obligations for source material milling or related operations other than the one for which compliance with a financial test is being determined.

"Net working capital" means current assets minus current liabilities.

"Net worth" means total assets minus total liabilities and is equivalent to owner's equity.

"Parent corporation" means a corporation which directly owns at least 50 percent of the voting stock of a second corporation which is the facility owner or operator; the latter corporation is deemed a "subsidiary" of the parent corporation.

"Tangible net worth" means the tangible assets that remain after deducting liabilities, such assets would not include intangibles such as goodwill and rights to patents or royalties.

Appendix V

Allocation of Monetary Payments

The payments described in Section XXV shall be allocated as follows:

	Past Response Costs (as provided in Section XXII(A) of this Consent Decree)	Future Response Costs (as provided in Section XXII(B) of this Consent Decree)	Natural Resources Damages (as provided in Section XXIII of this Consent Decree)	Contributions (as provided in Section XXIV(A) of this Consent Decree)
December 1, 1986*	$ 0.00	$100,000.00	$675,000.00	$300,000.00
December 1, 1987	50,000.00**	100,000.00	0.00	0.00**
December 1, 1988	150,000.00	75,000.00	125,000.00	0.00
December 1, 1989	260,000.00	65,000.00	200,000.00	0.00
December 1, 1990	40,000.00	50,000.00	0.00	0.00
December 1, 1991	0.00	50,000.00	0.00	0.00
December 1, 1992	0.00	50,000.00	0.00	0.00
December 1, 1993	0.00	10,000.00	0.00	0.00

* Or thirty (30) days following entry of this Consent Decree, whichever is later.

** Sum due as a result of the credits provided by sections XXII(A) and XXIV(A).

APPENDIX VI

URAVAN WATER TRUST

THIS TRUST AGREEMENT, DATED December 19, 1986, is between UNION CARBIDE CORPORATION ("Union Carbide"), a New York corporation, and UMETCO MINERALS CORPORATION ("Umetco"), a Delaware corporation, hereinafter collectively referred to as "Grantors"; and the Trustees of the Uravan Water Trust, as identified in paragraph 1.1 below, hereinafter collectively referred to as "Trustees."

1.0. TRUSTEES

1.1. Present Trustees

There shall be two (2) Trustees of the Uravan Water Trust at all times. Union Carbide Corporation and Umetco Minerals Corporation, and the State of Colorado, hereinafter referred to as the "Trustee Entities," have each, prior to the date of execution of this Trust Agreement, appointed a trustee of the Uravan Water Trust. The Trustees of the Uravan Water Trust on the date of execution of this Trust Agreement are Earl Shortridge, appointed by Umetco Minerals Corporation with approval of UCC, and Dan Noble, appointed by the State of Colorado.

1.2. Successor Trustees

In the event of resignation, incapacity, or death of a Trustee prior to the termination of the Trust, the Trustee Entity which appointed that Trustee shall immediately appoint a successor Trustee. Any successor Trustee shall have all rights, powers, duties and obligations granted to the original Trustee. The Trustees shall be appointed as follows:

1.2.1. A duly authorized officer of Umetco Minerals Corporation shall appoint one Trustee, with approval by a duly authorized officer of Union Carbide Corporation.

1.2.2. One Trustee shall be appointed by the Governor of the State of Colorado in consultation with the Attorney General of the State of Colorado.

1.2.3. Trustees are employees, agents or designees of the Trustee Entity. At any time during the term of this Trust, an appointing Trustee Entity shall have the right to remove its employee, agent or designee serving as a Trustee hereunder and/or appoint a successor Trustee, who shall be a person and not a corporation or other legal entity. Should a Trustee leave the employment of the appointing Trustee entity, the appointing Trustee Entity shall appoint another employee, agent or designee to serve as Trustee. A Trustee may be removed with or without cause.

1.3. Term of Service Trustees

Each Trustee shall serve as Trustee until such time as the Trustee ceases to serve by reason of resignation, incapacity, death, or removal by the Trustee Entity which appointed that Trustee, or until termination of the Trust, whichever comes first.

1.4. Notice of Appointment, Resignation, Incapacity or Death

Each Trustee Entity shall promptly notify the other Trustees and Trustee Entities in writing of the appointment, resignation, incapacity, death, or removal of any Trustee.

1.5. Powers of Successor Trustees

Every successor or substitute Trustee shall have all the title, rights, powers, privileges, and duties herein conferred or imposed upon the original Trustee without any act of conveyance or transfer.

1.6. Bonds Waived

The Grantors direct that each Trustee, including successors, shall be permitted to qualify without the necessity of giving a bond or other undertaking in this or any other jurisdiction for the faithful performance of such Trustee's duties, or if any bond shall be required by law, statute or rule of court, without the necessity of sureties thereon.

1.7. Compensation

Each Trustee shall not be compensated by the Trust.

2.0. CREATION OF THE TRUST

2.1. Trust Property

By execution of this agreement and the Quitclaim Deed attached hereto as Schedule B, Grantors hereby transfer to the Trustees, in trust, the respective water rights descried in the attached Schedule A (hereinafter collectively referred to as the "Water Rights"). By the execution of this Agreement the Trustees accept these Water Rights in trust, and the Trustees also accept the terms of the Trust hereby created.

2.2. Title of Trust

The Trust hereby created shall be known as The Uravan Water Trust (herein sometimes the "Trust"). All of the Water Rights held in the Uravan Water Trust shall be held by the Trustees in trust and shall be administered upon the terms set forth in this Trust Agreement.

3.0. TRUST PURPOSE

3.1. Purpose

The purpose of the Uravan Water Trust is to make available the Water Rights, subject to the subordination provisions of Section 8.2.2. and the duration provisions of Section 4.0. of this Agreement, for the beneficial use of any lawful user of valid water rights on the San Miguel River

System (including tributary groundwater) who, in the joint determination of the Trustees, has demonstrated that the Grantors' milling operations, disposal practices, or remedial activities at the Uravan facility have created water quality conditions which materially impair the ability of that user to put those rights to their decreed use(s). In the event that the Trustees disagree about their respective determinations, the Trustees shall present the disputed matter(s) for resolution in accordance with Sections XIII and XIV of the Consent Decree. Each party shall bear its own costs and attorneys' fees incurred in the dispute resolution process. The costs of the Special Master shall be shared equally by the parties.

3.2. No Intent to Abandon

By establishing this Trust, the Grantors do not intend to abandon the Water Rights contained in the Trust. To the contrary, the Grantors intend that for the period of time set forth in Section 4.0., the Water Rights be used in accordance with the subordination provisions of Section 8.2.2. and the Trust purposes defined in Section 3.1. of this Agreement.

4.0. DURATION AND TERMINATION

4.1. This Trust Agreement is attached to the Consent Decree as Appendix VI. The parties' Remedial Action Plan

('RAP") for implementation of remedial work at the Uravan Facility is attached to the Consent Decree as Appendix I. The Water Rights conveyed to the Trustees shall be available for the Trust purpose beginning on the date the Consent Decree is entered as a final order by the United States District Court for the District of Colorado in State of Colorado v. Union Carbide Corporation and Umetco Minerals Corporation, Civil Action No. 83-C-2384. The Water Rights shall be available for the Trust purpose until completion of the RAP or final termination of milling operations and decommissioning of the Uravan Mill, whichever is the last to occur, and the Trust shall then terminate.

4.2. Upon termination of the Uravan Water Trust, the Trustees shall convey by quitclaim deed the Water Rights held in the Trust to the Water Conservation Board, Department of Natural Resources, State of Colorado.

5.0. BENEFICIARIES

5.1. The beneficiaries of the Uravan Water Trust shall be those lawful users of valid water rights on the San Miguel River System (including tributary groundwater) who, in the determination of the Trustees, have demonstrated that the Grantors' milling operations, disposal practices, or remedial activities at the Uravan Facility have created water quality

conditions which materially impair the ability of those users to put those rights to their decreed use(s).

6.0. DECISIONS OF THE TRUSTEES

6.1. All of the decisions of the Trustees shall be made by a unanimous vote of the Trustees.

7.0. IRREVOCABILITY

7.1. The Uravan Water Trust is an irrevocable trust.

7.2. The Grantors reserve no power whatsoever to alter or amend any of the provisions hereof.

8.0. ADMINISTRATIVE POWERS AND DUTIES

8.1. Administration of Trust

It is the Grantors' intention that the Trust provided for by this instrument be administered free from the active supervision of any court having jurisdiction over such Trust. This provision shall not limit the power of the Trustees to invoke the dispute resolution provisions of Sections XIII and XIV of the Consent Decree, nor to take action in judicial settlement of accounts or otherwise to invoke the jurisdiction of the court or the power of any beneficiary to bring suit for an accounting.

8.2. Administrative Powers with Respect to the Exercise of Water Rights

8.2.1. The Trustee shall direct the application of the Water Rights in accordance with the subordination

provisions described below. The authority described herein shall include, without limitation, the following powers:

(a) To seek the approval of the appropriate water judge for changes of water rights, augmentation plans, exchange plans or substitution plans, which may include the use of wells as points of diversion; and

(b) Subject to the approval of the State Engineer or the Division Engineer, as appropriate, to develop plans of temporary substitution or temporary exchange.

8.2.2. The Water Rights held in the Uravan Trust shall be applied in the first instance to the Grantors' milling operations, and Grantors hereby reserve the right to make such application. In the second instance, the Water Rights shall be applied to the implementation of the RAP, and Grantors hereby reserve the right to make such application. To the extent not required for the beneficial uses described above, the Water Rights shall be applied to protect the beneficiaries of the Trust, as stated in Sections 3.1. and 5.1. of this Agreement. In no event may the Trustees direct that any beneficiary receive more water than the amount that user would otherwise be entitled to but which has been significantly affected as provided in Section 3.1. of this Agreement.

8.3. Additional Administrative Powers of the Trustees

In addition to the powers enumerated in the Colorado Fiduciary's Powers Act, the Trustees shall have the power, without prior appraisal, authorization, or approval of any court, to do everything they consider advisable in the management of the Trust created by this Agreement, even though such would not otherwise be authorized under any statute or rule of law.

8.4. Settlement of Claims

The Trustees shall have the power to settle, compromise, or abandon claims due to or made against the Trust, if in the Trustees' judgment it is in the best interest of the Trust to do so.

8.5. Employment of agents

The Trustees shall have the power, at the expense of Union Carbide Corporation and Umetco Minerals Corporation, to employ such agents, consultants and advisors as the Trustees may deem appropriate, including attorneys, hydrologists, geohydrologists, and others.

8.6. Meetings of Trustees

The Trustees shall meet at such places as the Trustees may decide and at their own expense or the appointing Trustee Entities' expense, and as often as necessary to

accomplish the Trust purpose, but in no event less than biennially.

9.0. GOVERNING LAW

The laws of the State of Colorado shall govern all questions as to the validity and construction of this Trust Agreement.

10.0. RECEIPT OF PROPERTY

The Trustees acknowledge receipt from Grantors of all of the Water Rights described in Schedule A and accept the Trust hereby created.

11.0. BINDING EFFECT

This instrument shall bind the respective representatives, successors, and assigns of the Grantors and Trustees.

IN WITNESS WHEREOF, the parties have executed this instrument the day and year first above written.

For the Grantor Union Carbide Corporation	For the Grantor Umetco Minerals Corporation
	Earl W. Shortridge, Trustee
	Dan D. Noble, Trustee

SCHEDULE A

Description of Water Rights

(a) 3.80 c.f.s. from the Johnson Ditch, with a priority date of April 10, 1891, original decree date of June 10, 1891; priority no. 46 in Water District 60 for irrigation, domestic, industrial and power use.

(b) 3.75 c.f.s. from the Johnson Ditch, with a priority date of February 16, 1903, original decree date of June 3, 1911; priority no. 405B in Water District 60 for irrigation, domestic, industrial and power use.

(c) 26.20 c.f.s. from the Johnson Ditch, with a priority date of February 16, 1903, original decree date of October 31, 1911; priority no. 22 in Water District 60 for irrigation, domestic, industrial, and power use.

(d) 16.80 c.f.s. from the Johnson Ditch, with a priority date of July 21, 1913, decree date of February 16, 1920; priority no. 139 in Water District 60 for irrigation, domestic, industrial and power use.

By decree entered in Case No. 7107 in Montrose County District Court on January 25, 1956, the above described decreed priorities may be diverted from any of the alternative points of diversion described below:

(a) A point on the North Bank of the San Miguel River from which the Northeast Corner of Section 34 T.48N., R.17W., N.M.P.M., bears North 33` 22' West a distance of 4830 feet;

(b) A point on the North Bank of the San Miguel River from whence the Northeast Corner of Section 34, T.48N., R.17W., N.M.P.M., bears North 40` 06' West a distance of 5414 feet;

(c) A point on the South Bank of the San Miguel River from whence the Northeast Corner of Section 34, T.48N., R17W., N.M.P.M. bears North 34` 32' West a distance of 3776 feet.

Mineral Camp Well: located in the SW1/4NW1/4NW1/4, Section 28, Township 48 North, Range 17 West of the New Mexico Principal Meridian, having the San Miguel River as its source, for 0.0550 c.f.s. with an appropriation date of May 1, 1958, and an adjudication date of December 31, 1971.

Uravan No. 1 Well: located in the NW1/4NW1/4, Section 34, Township 48 North, Range 17 West of the New Mexico Principal Meridian, having the San Miguel River as its source, for 0.290 c.f.s. with an appropriation date of May 13, 1959, and an adjudication date of December 31, 1971.

Uravan No. 2 Well: located in the NW1/4SE1/4, Section 34, Township 48 North, Range 17 West of the New Mexico Principal Meridian, having the San Miguel River as its source, for 1.100 c.f.s. with an appropriation date of December 2, 1959, and an adjudication date of December 31, 1971.

Tabeguache Well No. 1: located in the NW1/4NE1/4, Section 1, Township 47 North, Range 17 West of the New Mexico Principal Meridian, having the West Tabeguache Creek as its source, for 0.440 c.f.s. with an appropriation date of July 23, 1973, and an adjudication date of December 31, 1973.

Tabeguache Well No. 2: located in the SE1/4NE1/4, Section 1, Township 47 North, Range 17 West of the New Mexico Principal Meridian, having the West Tabeguache Creek as its source, for 0.280 c.f.s. with an appropriation date of July 23, 1973, and an adjudication date of December 31, 1973.

Eula Belle Mine Well: located in the SE1/4NE1/4, Section 31, Township 49 North, Range 17 West of the New Mexico Principal Meridian, having the West Dolores River as its source, for 0.0310 c.f.s. with an appropriation date of January 15, 1961, and an adjudication date of December 31, 1971.

Recorded at 11:08 o'clock A. M., April 21, 1988
Reception No. 548458 Ruth E. Heath Recorder.

QUIT CLAIM DEED

BOOK 784 PAGE 957

UNION CARBIDE CORPORATION, successor in interest to the UNITED STATES VANADIUM CORPORATION,

whose address is 39 Old Ridgebury Road, Danbury,

County of Fairfield, and State of

Connecticut, for the consideration of

Ten and 00/100 ---------- Dollars, in hand paid,

STATE DOCUMENTARY FEE
DATE APR 21 1988
$ -0-

hereby sell(s) and quit claim(s) to Water Conservation Board, Department of Natural Resources, State of Colorado,
whose address is 1313 Sherman Street

City and County of Denver, and State of Colorado, the following ~~real property~~ water right in the County of Montrose, and State of Colorado, to wit:

San Miguel Power Company Canal, located in the SW¼SW¼SE¼ of Section 34, Township 48 North, Range 17 West of the New Mexico Principal Meridian, having the San Miguel River as its source, in the amount of 240.00 cubic feet of water per second of time, for power generation purposes, with an appropriation date of April 28, 1914, and an adjudication date of October 22, 1926.

~~also known by street and number~~

with all its appurtenances

Signed this 13th day of April, 19 88.

ATTEST:

Assistant Secretary

UNION CARBIDE CORPORATION

By: John B. Powers
Vice President

STATE OF CONNECTICUT }
County of Fairfield } ss.

The foregoing instrument was acknowledged before me this 13th day of April 19 88, by John B. Powers

My commission expires March 31, 1992

WITNESS my hand and official seal.

Colleen A. O'Rourke
Notary Public

COLLEEN A. O'ROURKE
NOTARY PUBLIC
MY COMMISSION EXPIRES MARCH 31, 1992

No. 158v

QUIT CLAIM DEED

UNION CARBIDE CORP.

UNITED STATES VANADIUM CORP.

TO

†WATER CONSERVATION BOARD
†DEPARTMENT OF NATURAL RESOURCES
†STATE OF COLORADO

STATE OF COLORADO }
County of MONTROSE } ss.

I hereby certify that this instrument was filed for record in my office at 11 o'clock A. M. APR 21 1988 P. M., and is duly recorded in book 784 page 257. 4-13-88

Ruth E. Heath
Clerk and Recorder

By Norma Jahn
Deputy

Fees. $ 3.00

BRADFORD PUBLISHING CO

ENV.
Return to:

Theodore Allegra, Esq.
Nelson, Hoskin, Groves &
Prinster, P.C.
Post Office Box 40
Grand Junction, CO 81502

RECEIVED
JUL 1 1991
E. W. SHORTRIDGE

San Miguel Basin
STATE BANK NORWOOD, COLORADO

DAN D. NOBLE
PRESIDENT

June 28, 1991

Earl W. Shortridge
P. O. Box 1029
Grand Junction, CO 81502

Dear Earl:

Enclosed you will find a copy of a letter I received from Laura E. Perrault and a copy of the letter she received from Keith Kepler relative to my request for info on the records of the State Engineers office on the water rights of the Uravan Water Trust.

Please go over the letters and then let me know your thoughts on their contents.

Sincerely,

Dan D. Noble
President

DDN:kk
Enc.

Gale A. Norton
Attorney General

Timothy M. Tymkovich
Solicitor General

The State of Colorado

DEPARTMENT OF LAW

OFFICE OF THE ATTORNEY GENERAL

CERCLA LITIGATION SECTION
ONE CIVIC CENTER PLAZA
1560 Broadway, Suite 250
Denver, Colorado 80202
Phone: (303) 894-2289 & 894-2299
FAX: [303] 894-2290

June 20, 1991

Mr. Dan D. Noble
P.O. Box 508
Norwood, Colorado 81423

Re: *State of Colorado v. Union Carbide Corp. and Umetco Mineral Corporation*, Case No. 83-C-2384

Dear Mr. Noble:

In an effort to clear up any confusion surrounding the status of the water rights in the Uravan case, I requested that Mr. Keith Kepler, a Division Engineer for the Division of Water Resources, research this matter. His response is included herewith.

I hope the information concerning the Uravan Water Trust water rights from the Johnson Ditch (50.55 c.f.s.) is useful for you.

Please call if you need any other information.

FOR THE ATTORNEY GENERAL

Laura E. Perrault
Assistant Attorney General
CERCLA Litigation Section

LEP:jmb

Enclosure

d:\wp-data\uravan\noble.ltr

DMER
ior

JERIS A. DANIE
State Engineer

DIVISION OF WATER RESOURCES
WATER DIVISION IV

Keith C. Kepler
Division Engineer
1540 East Niagara
P.O. Box 456
Montrose, Colorado 81402
(303) 249-6622

April 17, 1991

Laura E. Perrault
Assistant Attorney General
1560 Broadway, Suite 250
Denver, CO 80202

Dear Ms. Perrault:

This is in response to your March 6, 1991 letter regarding the Uravan Water Trust water rights. Two right are of concern: 50.55 cfs in the Johnson Ditch and 240 cfs in the San Miguel Power Company Ditch.

Prior memorandums which you transmitted on this subject appear to be accurate and I won't repeat a lot of that information. (Reference 4-17-86 and 4-29-76 memos from Sherry Caloia to Larry Tannenbaum and Jackie Beradini).

With regard to the 240 cfs in the San Miguel Ditch, 200 cfs was previously abandoned in the abandonment procedures ten years ago. According to Water Commissioner Lyman Campbell, the remaining 40 cfs was not included on the earlier list because of the owner's stated desire to retain that amount for an intended use. It was not used at that time ten years ago and hasn't been used since. This 40 cfs should have been listed on the current abandonment list, but it was not. The non-use period speaks for itself, however, and would be considered by the Water Court in a change case. For this reason, the state may wish to consider abandoning this water right voluntarily.

The Johnson Ditch has been used to some extent. Sherry Caloia's 4-17-86 memo describes uses prior to that time. Since that time, our records show the following use:

	Total Amt Diverted for Season-AF	Days Used	Average cfs
1985	730	365	1.00
1986	No Record		
1987	2009	365	2.75
1988	1603	365	2.20

These amounts represent total diversions. I believe uses for the past few years have been limited to domestic use and dust control. It is likely that a fair portion of the amount diverted returned to the stream, especially when demand for dust control is low and I expect it would be low in the winter. The amount of the Johnson Ditch which has not been used probably should have been put on the 1990 abandonment list, but it was not. However, in a change case, historic use would be considered. I would estimate only a few cfs of the Johnson Ditch could be transfered to a new use based on this data and the data in Sherry Caloia's memo.

The Highline Ditch (aka C.C. Ditch, which serves the Nucla area) is most effected by what happens with the Uravan Water Trust rights. The several priorities of the Highline Ditch are intermingled with the four priorities of the Johnson Ditch. Historically, there have been some times when the the more senior Johnson Ditch priorities have called out some of the priorities in the Highline Ditch. If the Highline Ditch is to have an assurance of a continuation of the stream conditions they have enjoyed for the past ten years, then the unused portions of the San Miguel Power Company right and the Johnson Ditch should be abandoned to the stream.

This matter has been pending for some time. My suggestion might be that the state apply to change the few cfs of the Johnson Ditch decree which has historically been used in recent years, to allow for in-stream flow at such times as the need for dust control and domestic water at the Uravan site is reduced. I would further suggest that any water rights above this small amount be voluntarily abandoned to the stream.

Sincerely,

Keith Kepler
Division Engineer

KK: bt
cc: Lyman Campbell

III-Uravan

SEQ NO	NAME OF STRUCTURE	TYPE	WR STR NO	STREAM NAME	CTY	Q10	Q20	Q30	SEC	TS		RNG		PM	USE CODE	DCRD AMNT	UNT	ADJ TYPE	ADJ DATE	PREV ADJ DATE	APPROP DATE	ADMIN NO	CIVIL ACTION NO	COMMENTS		
343	Johnson Ditch	1	1	San Miguel River	43	NE	SW	SE	34	48	N	17	W	N	1	3.30	C	2	05/03/1911	06/11/1897	04/10/1891	17329.15075	1627	DPN 46	San Miguel River	P
426	Highline Canal	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	31.28	C	2	05/03/1911	06/11/1897	06/01/1895	17329.16688	1627	DPN 74	Loc corrected by 79CW256	P 90
344	Johnson Ditch	1	1	San Miguel River	43	NE	SW	SE	34	48	N	17	W	N	1	3.75	C	2	05/03/1911	06/11/1897	02/16/1903	19404.00000	1627	DPN 104B	San Miguel River	P 8
269	Johnson Ditch	1	1	San Miguel River	43	NE	SW	SE	34	48	N	17	W	N	1	26.20	C	2	10/31/1911	06/03/1911	02/16/1903	22433.19404	1885	DPN 22	San Miguel River	P 5
428	Highline Canal E	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	39.62	C	2	09/30/1915	11/02/1914	12/08/1908	23681.21526	2207	DPN 123	Loc corrected by 79CW256	P 32
20	Johnson Ditch	1	1	San Miguel River	43	NE	SW	SE	34	48	N	17	W	N	1	16.80	C	2	09/15/1920	09/30/1616	07/21/1913	24379.23212	2533	DPN 139	San Miguel River	P 33
427	Highline Canal E	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	10.00	C	23	02/26/1929	09/19/1920	10/20/1925	28051.00000	3785	DPN 211	Loc corrected by 79CW256	P 214
355	Highline Canal E	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	10.00	C	28	02/2681929	09/16/1920	10/20/1926	28051.00000	W 95	DPN 211	Made ABS 11/303/1970 Loc corrected by 79CW256	
429	Highline Canal	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	14.10	C	2	11/01/1939	10/16/1933	05/01/1932	30604.30071	2207	DPN 323	Loc corrected by 79CW256	P 49
649	Highline Canal	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	15.00	C	28	11/01/1939	10/16/1933	05/01/1932	30604.30071	4641	DPN 323	Cond To Absolute 01/27/1942	P 580
1911	Highline Canal	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	15.00	C	23	11/01/1939	10/16/1933	05/01/1932	30604.300.71	2207	DPN 323	Loc corrected by 79CW256	P 580
91	Highline Canal	1	1	San Miguel River	43	NE	NE	SW	30	46	N	13	W	N	1	35.00	C	2	01/27/1942	11/01/1939	02/18/1939	32811.32555	4641	DPN 365	Loc corrected by 79CW256	P 580

APPENDIX VII

Contaminant Locations at Colorado School of Mines and The Denver Radium Site

A. Low-level radioactive waste materials at the Colorado School of Mines, Golden, Colorado, are located at Engineering Hall and also believed to be located at the Research Institute Building and certain open lands. The total volume of materials is unknown at this time.

B. The Denver Radium Site, Denver, Colorado, is comprised of twenty-nine (29) properties. The total volume of low-level radioactive waste materials at the Denver Radium Site is estimated to be 106,483 - 200,000 cubic yards.