USGS TECHNICAL PROCEDURE HP-12, R3

Method for Collection, Processing, and Handling of Drill Cuttings and Core from Unsaturated-Zone Boreholes at the Well-Site, NTS

1.0 PURPOSE.

1.1 To assure the accuracy, validity, and applicability of the methods used to collect, process and handle drill cuttings and core from the unsaturated-zone boreholes at the well-site, this procedure provides a guide for USGS personnel and contractors to perform the described activity. From this procedure, the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) can evaluate these activities for meeting requirements of the NNWSI Project, and competent, trained personnel can reproduce the work.

1.2 This procedure describes the components of the work, the principles of the methods used, and their limits. It also describes the detailed methods to be used for calibration, operation and performance verification of any equipment. In addition, it defines the requirements for data acceptance, documentation, and control; and it provides a means of data traceability.

2.0 SCOPE OF COMPLIANCE.

2.1 This procedure applies to all USGS personnel and their contractors who may perform work referred to in Para. 1.1, or use data obtained from this procedure if it is deemed to potentially affect public health and safety as related to a nuclear waste repository.

2.2 All data derived from this procedure that are presented to support licensing of the NNWSI Project repository, and any equipment calibrations or recalibrations that may be required shall be in accordance with this technical procedure. Variations are allowed only if and when this procedure is formally revised, or otherwise modified, as described in Section 8.

3.0 PERSONNEL RESPONSIBILITIES. The Principal Investigator (PI) is responsible for assuring full compliance with this procedure. Per QMP-2.02 and QMP-2.03, the PI shall require that all personnel assigned to work under this procedure shall have the necessary technical training, experience, and personal skills, to adequately perform this procedure; and they shall have a working knowledge of the USGS QA Manual. Responsibilities of others including the reviewer(s), contributing investigators, Branch/NHP Chief, QA Office and the Chief, Branch of NNWSI are as described in Para. 4.3, QMP-5.01.

4.0 DETAILED PROCEDURE. This procedure establishes methods for the collection, processing, and handling of drill bit cuttings and core samples from unsaturated-zone boreholes at and near Yucca Mountain, Nevada Test Site.

4.1 Objective: To describe a procedure for the collection, handling, and processing of drill cuttings and core from unsaturated zone boreholes.

4.2 Methods Used: The following definitions will be used in this procedure:

- Brass-Liner - A protective, hollow cylinder made of brass, used inside the drive-core sampling tube to enclose the sample. It may be segmented transversely or split longitudinally.
- Brass-Liner Extruder - Pneumatic device used to remove brass-liners from drive-core sampling tube.
- Core - A cylindrical sample of rock taken from a formation for purposes of examination and analysis.
- Core Index - A calculated measurement of the integrity of a length of drilled core (Attachment A).
- Cuttings - Fragments of rock resulting from drilling or augering.
- Cuttings Return Line - The return drilling-fluid line carrying cuttings from the drill hole to the cyclone separator.
- Cyclone Separator - Collecting device attached to the end of the cuttings return line. It is equipped with a valve at the bottom from which cutting samples are collected.
- Drive-Core Sampler - A tubular sampling device connected to drill pipe. It has a hardened-steel shoe for "driving" the sampler into undisturbed, poorly-consolidated material at the bottom of the borehole.
- Humidified Glove Box - Any glove box containing sponges partially immersed in water to increase the humidity of the atmosphere inside the glove box.
- Lexan Liner - A clear plastic inner sleeve which can be used when rotary core drilling.
- Rotary Core Barrel - A device used with a special bit to cut core from the formation.
- Run - An attempt to drill and recover a length of core; also the core recovered during an attempted core run.
- Sieving - The operation of sorting the fine sized materials from the coarser sized materials using a wire mesh sieve.
- User - An investigator or investigating laboratory assigned by the Project Chief to carry out tests or measurements on samples as determined by the Project Chief.

- Well-Site Logbook - Cloth bound, ruled notebook kept in the USGS trailer at the well-site. Entries related to drilling and sampling are made by the project workers in the well-site logbook.

4.2.1 Well-Site Logbook - The well-site logbook is a cloth bound, ruled notebook. The pages in the notebook are numbered sequentially starting with the number one on the first ruled page. The well-site logbook is kept in the USGS trailer at the well site. The well-site logbook is part of the permanent borehole record; therefore, all entries shall be legible and concise. Information concerning sample collection and sample distribution shall be recorded in the well-site logbook by the project workers. Any occurrences which affect the drilling operation are also recorded in the well-site logbook by the project workers. The well-site logbook is delivered to the Project Chief at the completion of the borehole for inclusion in the raw data package (NNWSI-USGS-QMP-17.01).

All entries in the well-site logbook are to be made using black ink. If it is necessary to delete or correct any well-site logbook entries, it shall be done by drawing a single line through the entry being deleted. The project worker making the deletion shall initial and date the deletion. If there is a correction to be made, it will be added to the well-site logbook at this time.

Project workers are required to sign into the well-site logbook. They will do this by printing their name, initialing that entry, and designating the organization they work for. This entry is made on the inside of the front cover of the well-site logbook. This entry is an acknowledgement that the project worker has read and understands the procedures and guidelines for the work performed at that borehole. A copy of all site-specific criteria, procedures, and instructions will be posted in the well-site logbook.

A new page in the well-site logbook is started at the beginning of each day. The date is written at the top of the page. As project workers report to or leave the drill site, they sign in and out by entering the time and their name in the well-site logbook. This entry shall be initialed by the project worker. All entries in the well-site logbook are preceded by the time the entry is made.

4.2.2 Lithologic Log - A lithologic description of the core and cuttings samples will be compiled as in NWM-USGS-GP-19, R0 (Para. 4.2.2.1).

4.2.3 Drill Bit Cuttings - General types and use of samples, approximate number of samples, and approximate sampling depths are determined by the Project Chief and are described in the Drilling Program for the borehole. More specific criteria concerning sampling depths, number and types of samples and processing and division of samples for different uses (users) are determined by the Project Chief and are posted in the well-site logbook before any samples are collected from the borehole. Any deviations from these specific criteria necessitated by unforseen variations in lithology or borehole conditions shall be recorded in the well-site logbook by the site hydrologist. All completed original data sheets are delivered to the

Project Chief for inclusion in the raw data package (NNWSI-USGS-QMP-17.01).

4.2.3.1 Collection of Samples - Lithologic, water-content and psychrometer, leach, and tritium samples are collected from the cyclone separator by a project worker. The cyclone separator shall be completely empty prior to drilling a sample interval. REECo shall mark one-foot depth lines on the casing so that the project worker collecting the cuttings can determine the depth of the borehole. When the depth interval for a cuttings sample has been drilled, the project worker empties the cuttings from the cyclone separator into the cuttings sample containers and puts the lids on these containers.

a) A paper can is used for the collection of lithologic samples. The project worker shall label the lid and side of the paper can with an indelible felt-tipped marker. The label shall consist of the borehole designation and the depth interval of the sample. The paper cans containing the lithologic samples are placed in the wooden or plastic lithologic sample crates. The lithologic sample crates are taken to the USGS trailer at the end of each drilling shift by a project worker.

b) A single mason jar is used to collect the gravimetric water-content sample (NWM-USGS-HP-32) and the thermocouple psychrometry sample (NWM-USGS-HP-55). The mason jar lids help to reduce the potential for water loss from the sample.

   The lid of this mason jar is labeled by attaching a piece of duct tape to it. The project worker indelibly labels the duct tape with the depth interval of the sample.

   The contents of this mason jar are processed in the USGS trailer and are then divided for the water-content sample and the psychrometry sample. The labeled mason jar containing the water-content sample and the psychrometry sample is placed in an ice cooler chest for temporary storage at the cyclone separator. The mason jars containing samples which are in the ice cooler chest are periodically taken to the USGS trailer for processing by a project worker.

c) The salt-leaching sample and the tritium sample are collected in mason jars. A separate mason jar is used for each sample. The mason jar lids help to reduce the potential for water loss from the sample.

   The mason jars containing the salt-leaching sample and the tritium sample have a duct tape label attached to the lid and the side of the mason jars. The duct tape is labeled by a project worker using an indelible felt-tipped marker. The label will consist of the borehole designation, the depth interval of the sample, and the sample use designation ("Leach" for the salt-leaching sample and "Tritium" for the tritium sample).

The labeled mason jars containing the Leach and the Tritium samples are placed in the ice cooler chest for temporary storage at the cyclone separator. The mason jars containing samples which are in the ice cooler chest are periodically taken to the USGS trailer for processing by a project worker.

4.2.3.2 Sample Processing - Processing of lithologic, water-content, psychrometry, leach, and tritium samples includes sieving, packaging, labeling, and sealing of samples for different uses. Specific details concerning sample processing and use, such as sieving into coarse and fine fractions, are determined by the Project Chief and are clearly noted in specific sampling and processing criteria posted in the well-site logbook.

a) The lithologic samples require no processing at the well-site.

b) Water-content and psychrometry samples are processed in a humidified glove box to reduce the potential for water loss from the samples. This work is done by the project workers.

c) Samples for gravimetric water-content are placed in a moisture can. The moisture can is indelibly labeled with a numeric designation on the lid. This numeric designation corresponds to the depth interval of the sample. After the lid is placed on the moisture can, it shall be removed from the humidified glove box by a project worker. The sample is now ready for the gravimetric water-content determination (see NWM-USGS-HP-32).

d) Samples for thermocouple psychrometry (see NWM-USGS-HP-55) are placed into small glass bottles. The small glass bottles have a duct tape label attached to them. The label includes the borehole designation, the sample depth interval, the sample type, and the date the sample was processed. The labeling is done by a project worker using an indelible felt-tipped marker. After the lid is placed on the small glass bottle, a project worker removes it from the humidified glove box. The lid of the bottle is taped shut with duct tape and is sealed by immersing it in melted bees' wax.

e) The salt-leaching samples and the tritium samples are processed by taping the lids of the mason jars containing the samples using electrician's tape. This is done in the USGS trailer by a project worker. The mason jars with the taped lids are then sealed by partially immersing them in melted bees' wax.

4.2.3.3 Boxing of Samples -

a) Drill cuttings samples are boxed by a project worker at the drill site. Cuttings samples are separated and boxed according to sample type.

b) The paper cans which contain the lithologic samples are boxed in the wooden or plastic lithologic sample crates by the project worker collecting the samples at the cyclone separator.

c) The gravimetric water-content samples are discarded after the water-content determination is completed (see NWM-USGS-HP-32).

d) The thermocouple psychrometry samples are boxed in the cardboard boxes that the small glass bottles were originally packaged in. These boxes are only intended for transporting the samples from the USGS trailer to the Unsaturated Zone Testing Laboratory (UZTL) (Test Cell C). The boxes are labeled with the borehole designation and the type of sample. A photocopy of the "Cuttings Sampling Record" is included in the cardboard box with the samples (see Para. 4.2.3.4, "Cuttings Records").

e) The mason jars containing the salt-leaching samples and the tritium samples are boxed in the cardboard core boxes at the USGS trailer. The salt-leaching samples and the tritium samples are segregated into separate boxes. The shallowest depth interval is boxed first. Following samples are boxed sequentially by increasing depth interval. A photocopy of the "Cuttings Sampling Record" is included in the cardboard core box with the samples (see Para. 4.2.3.4). The ends of the cardboard core boxes are labeled with the borehole designation, the box number, and the type of sample (LEACH or TRITIUM). Labeling is done by a project worker using an indelible felt-tipped marker.

4.2.3.4 Cuttings Records -

4.2.3.4.1 Cuttings Sampling Record - The "Cuttings Sampling Record" (Attachment B) shall be completed whenever the cuttings samples are brought to the USGS trailer from the cyclone separator. A project worker completes the entries on the "Cuttings Sampling Record" using black ink. All deletions and corrections will be made in the same manner as in the well-site logbook.

a) The "Cuttings Sampling Record" form will be kept at the USGS trailer until the form is completely filled, the drill hole is completed to total depth, or drilling operations are suspended. The records are then delivered to the Project Chief for his/her inspection. These records are part of the permanent record for the borehole and are filed according to instructions of the Project Chief. The originals of the "Cuttings Sampling Record" shall be updated to reflect any changes in the "Sample Transport/Location" and "Sample Removal" columns. The project worker who does this shall initial and date the entry in the "Remarks" column.

b) A photocopy of the "Cuttings Sampling Record" shall be included in each cardboard core box and cardboard box containing samples. These photocopies will have the entries for the sample depths contained in those boxes; all other entries on the photocopy will be diagonally lined out. Entries will be made on these photocopies to indicate that samples have been removed for or returned from testing by the users. These

entries will be made by the individual who removes or returns the samples. That person will complete the "Sample Removal" column ("Date" and "Int'ls") and the "Personnel Identification" section. A project worker or the individual removing or returning the sample will amend the original form to show these entries. This entry will be dated and initialed in the "Remarks" column by the person making the entry.

c) A photocopy of the "Cuttings Sampling Record" shall accompany all samples transported from the USGS trailer at the well-site. The photocopy shall contain entries for all samples being transported. If samples are being delivered to different designations, more than one set of photocopies may be required to accompany the samples. Any entries on the photocopies which do not apply to samples being transported will be lined out by a project worker. The "Sample Transport/Location" column ("Date" and "Int'ls") shall be completed for the samples as they are transported and stored at different locations.

d) The project worker transporting the samples and the project worker or individual receiving the samples at the storage location will date and initial the appropriate entries on the photocopies of the "Cuttings Sampling Record" which accompanied the samples being transported will remain with the samples at the storage location. Whenever the samples are transported the photocopies will accompany the samples and the appropriate entries will be made by the project workers. When the samples are stored at the Sample Management Facility (SMF), the photocopies will be filed at the SMF.

e) The original "Cuttings Sampling Record" forms will be updated to reflect all additions made on the photocopies concerning the "Sample Transport/Location" entries. This will be done by a project worker. The project worker making these additions will date and initial the entries in the "Remarks" column.

f) Completion of the "Cuttings Sampling Record" is described in Para. 4.2.7.1.

4.2.3.4.2 NNWSI Core Box/Sample Record - The "NNWSI Core Box/Sample Record" (Attachment C) is completed whenever a core box is completely filled with samples. The work is done in the USGS trailer by a project worker using black ink. All deletions and corrections will be done in the same manner as in the well-site logbook.

a) The "NNWSI Core Box/Sampling Record" shall be transported with and stored at the same location as the core box it represents.

b) The "Core Box Location" section, the "Core Box Transportation" section, and the "Sample Removal" section will be updated to reflect any changes in the status of these sections. A project worker or a representative of the user shall complete the entries in these sections.

c) These records are part of the permanent borehole record and will be filed in accordance with NNWSI-USGS-QMP-17.01 when they are completed.

4.2.3.5 Transportation of Samples -

a) The cuttings samples will be transported to the appropriate destinations by the project workers. The project workers who transport the samples shall indicate this by completing the appropriate sections on the "Cuttings Sampling Record" (Para. 4.2.3.4.1) and the "NNWSI Core Box/Sample Record" (Para. 4.2.3.4.2).

b) All full wooden or plastic lithologic sample crates are taken to the Core Library by a project worker at the end of a drilling shift. When the borehole is completed to total depth or if drilling operations are suspended, all crates containing any samples are delivered to the SMF by a project worker.

c) At the end of a drilling shift, a project worker will transport all full cardboard core boxes which contain leach and tritium cuttings in mason jars and all full cardboard boxes which contain psychrometry samples to the UZTL (Test Cell C) or to the SMF.

d) When the borehole is completed to the total depth or if drilling operations are suspended, all cardboard boxes containing any samples are delivered to the UZTL (Test Cell C) or to the SMF by a project worker.

4.2.4 Drive-Core - Approximate sampling depth intervals for drive-core are determined by the Project Chief and are listed in the Drilling Program. Specific criteria for the division and assignment of drive-core for different uses are determined by the Project Chief and are posted in the well-site logbook. All completed original data sheets are delivered to the Project Chief for inclusion in the raw data package (as per NNWSI-USGS-QMP-17.01).

4.2.4.1 Collection of Drive Core -

a) The drive-core sampling tube is tripped out of the hole by REECo at the wellhead. A project worker shall check the drive-core sampling tube to determine if there is any sample in it. If there is no sample in the drive-core sampling tube, the Site Hydrologist must decide whether to attempt to take another drive-core or to hammer drill. If there is some sample in the drive-core sampling tube, the project worker will proceed with the collection procedures.

b) A project worker shall place a plastic bag over the top end of the sampling tube to reduce water loss. Another plastic bag is placed over the shoe and bottom end of the sampling tube to reduce water loss and to catch any sample that spills out of the sampling tube while REECo loosens the shoe.

c) When the shoe is loosened enough to be removed by hand, a project worker carries the drive-core sampling tube to the USGS trailer for processing. REECo shall inform a project worker of the depth interval of the drive-core sample.

4.2.4.2 Processing of Drive Core

a) The drive-core is processed by the project workers. The work is done in the USGS trailer. Processing of the drive-core samples consists of assigning and packaging different drive-core sample segments for different uses. Specific details concerning the division and assignment of drive-core for different uses are determined by the Project Chief and are recorded in the well-site logbook for each borehole by a project worker.

b) For the purposes of disassembly, when the drive-core sampling tube is brought into the USGS trailer, the project workers will unscrew the shoe from the sampling tube. Any sample which is in the shoe will be placed in the plastic bag which was covering it. This plastic bag is stored in the humidified glove box for possible sample distribution. The plastic bag covering the top end of the sampling tube is removed and the drive-core sampling tube is placed in the brass-liner extruder with the bottom end of the sampling tube towards the humidified glove box.

c) The brass-liner extruder and the humidified glove box are positioned in the USGS trailer so that the brass-liners can be extruded directly from the sampling tube into the humidified glove box.

d) A project worker, using a steel measuring tape graduated in tenths of a foot, measures the amount of core in the drive-core sampling tube.

e) The drive-core sampling tube is secured in the brass-liner extruder. A project worker operates the brass-liner extruder while another project worker handles the brass-liners as they are extruded into the humidified glove box.

f) As the brass-liners are extruded from the sampling tube into the humidified glove box, the project worker who is working the glove box places plastic caps on the ends of the brass-liners. The bottom end of a brass-liner is capped first as it is extruded from the sampling tube and then the top end is capped after the brass-liner is removed from the sampling tube. The plastic cap which is placed on the top end of the brass-liner shall be marked with an "X" to indicate the top of the sample.

g) The project worker places the capped brass-liners bottom end down in the humidified glove box. The capped brass-liners are arranged sequentially in the order that they were removed from the sampling tube.

h) The "Schematic Drive-Core Record" (Para. 4.2.7.3) is completed by a project worker while the brass-liners are in the humidified glove box.

i) The brass-liners are assigned for different tests according to specific criteria in the well-site logbook. The sample assignments are recorded on the "Schematic Drive-Core Record."

j) The brass-liner designated for the gravimetric water-content samples and the thermocouple psychrometry sample is not removed from the humidified glove box. It is processed in the humidified glove box by a project worker (per Para. 4.2.4.2.1).

k) The project workers remove (except for the brass-liner containing the gravimetric water-content sample and psychrometry sample) the brass-liners from the humidified glove box. The brass-liners are removed sequentially in the order that they were removed from the sampling tube. The project workers tape the caps onto the brass-liners using duct tape. The removal sequence of the brass-liners is maintained during taping.

l) A project worker shall label the capped brass-liners using an indelible felt-tipped marker. The labeling is done on the duct tape which is attached to the capped brass-liners. The borehole designation, the depth interval of the sample, a downhole arrow, and the sample assignment designation are included on the label.

m) When all of the capped brass-liners have been taped and labeled, a project worker seals them by immersing them in melted bees' wax. After the bees' wax on the capped brass-liners has hardened, the project workers box the samples (see Para. 4.2.4.3).

4.2.4.2.1 Water-Content and Psychrometry Samples:

a) The brass-liner designated for the gravimetric water-content sample and the thermocouple psychrometry sample is processed in the humidified glove box by a project worker. The Project Chief may require that the sample be sieved into coarse and fine particle size fractions. If this is the case, details of the sieving will be recorded in the specific processing criteria posted in the well-site logbook.

b) The contents of the brass-liner are placed in a moisture can for the gravimetric water-content sample (see NWM-USGS-HP-32) and in a small glass bottle for the thermocouple psychrometry sample (see NWM-USGS-HP-55).

c) The lid of the moisture can is labeled with an alpha-numeric designation which corresponds to the depth interval of the sample (as per NWM-USGS-HP-32) by a project worker using an indelible felt-tipped marker. The small glass bottle containing the thermocouple psychrometry sample is labeled,

taped, and waxed according to the instructions in Para. 4.2.3.2.

4.2.4.3 Drive Core Sample Boxing - The drive-core samples are boxed in the cardboard core boxes at the USGS trailer by a project worker (see Attachment D).

a) The drive-core samples in brass-liners are boxed sequentially by increasing depth interval starting in the upper left-hand corner of the cardboard core boxes.

b) A run-block, a 2-inch 2x4 wrapped with duct tape and indelibly labeled with the borehole designation, the core run number, the depth interval of the core run, the amount of core drilled, and the amount of core recovered, shall precede the first drive-core sample from a core run placed into the cardboard core box (see Attachment D).

c) Following the placement of the run-block in the cardboard core box, the project worker proceeds with boxing the core run. Samples from more than one core run can be contained in the same cardboard core box. Samples from one core run can be contained in more than one cardboard core box.

d) If core was lost (less core recovered than was drilled) a core lost block (2-inch 2x4 wrapped with duct tape and indelibly labeled with the amount of core lost) is placed in the cardboard core box following the last piece of drive-core in that particular core run.

e) A starting block (2-inch 2x4 wrapped with duct tape and indelibly labeled with the starting footage in the cardboard core box) and an ending block (2-inch 2x4 wrapped with duct tape and indelibly labeled with the ending footage in the cardboard core box) are placed in the upper left-hand and the lower right-hand corners of the cardboard core box (see Attachment D).

f) Where samples of drive-core have been removed by a project worker for testing, a sample-block (2-inch 2x4 wrapped with duct tape and indelibly labeled with the sample type designation and the depth interval of the sample) is placed in the proper sequence to indicate that a drive-core sample has been removed (see Attachment D).

g) Drive-core samples and rotary core samples (Para. 4.2.5) can be contained in the same cardboard core box.

h) A project worker will label the ends of the cardboard core boxes. The labeling is done with an indelible felt-tipped marker and includes the borehole designation, the core box number, the beginning footage, and the ending footage contained in the core box (see Attachment D). Before the lid on the cardboard core box is closed, a project worker shall complete the "Drive-Core Sampling Record" (Attachment E) and the "NNWSI

Core Box/Sample Record" (Attachment C). A photocopy of the "Drive-Core Sampling Record" is included in the cardboard core box (Para. 4.2.4.4).

i) Samples of drive-core which were removed at the USGS trailer for gravimetric water-content (see NWM-USGS-HP-32) are placed into paper cans when the gravimetric water-content for the sample has been completed. This is done by a project worker at the USGS trailer. The lid and side of the paper can are labeled with the borehole designation, the sample depth interval, and the sample destination. Labeling is done with an indelible felt-tipped marker.

j) These samples are then boxed in cardboard core boxes at the USGS trailer. The paper cans are boxed starting with the shallowest depth interval and are boxed sequentially by increasing depth interval.

k) The ends of the cardboard core boxes are labeled with the borehole designation, the core box number, and the sample type designation. The cardboard core box is labeled by a project worker at the USGS trailer using an indelible felt-tipped marker.

l) A project worker will complete the entries on the "Drive-Core Sampling Record" (Attachment E) to indicate that these samples have been returned. These drive-core samples are available for lithologic studies.

m) The thermocouple psychrometry samples are boxed in the same manner as in Para. 4.2.3.3 of this procedure.

4.2.4.4 Drive-Core Records - The drive-core records shall be completed whenever drive-core samples are brought to the USGS trailer.

a) A project worker shall complete the entries on the "Schematic Drive-Core Record" (Attachment F) and the "Drive-Core Sampling Record" (Attachment E) using black ink. All deletions and corrections will be made in the same manner as in the well-site logbook.

b) The "Schematic Drive-Core Record" and the "Drive-Core Sampling Record" will be kept at the trailer until the forms are completely filled, the drill hole is completed to total depth, or drilling operations are suspended. The records are then delivered to the Project Chief. These records are part of the permanent record for the borehole and are filed according to instructions of the Project Chief.

c) The originals of the "Drive-Core Sampling Record" shall be updated to reflect any changes in the "Sample Transport/Location" and "Sample Removal" columns. The project worker who does this shall initial and date the entry in the "Remarks" column.

d) Prior to removal, a photocopy of the "Drive-Core Sampling Record" shall be included in each cardboard core box and cardboard box containing samples. These photocopies will have the entries for the samples contained in those boxes; all other entries on the photocopy will be diagonally lined out. Entries will be made on these photocopies to indicate that samples have been removed for or returned from testing by the users. These entries will be made by the individual who removes or returns the samples. That person will complete the "Sample Removal" column ("Date" and "Int'ls") and the "Personnel Identification" section. A project worker or the individual removing or returning the sample will amend the original form to show these entries. This entry will be dated and initialed in the "Remarks" column by the person making the entry.

e) A photocopy of the "Drive-Core Sampling Record" shall accompany all samples transported from the USGS trailer at the well-site to a new location. The photocopy shall contain entries for all samples being transported. If samples are being delivered to different locations, more than one set of photocopies may be required to accompany the samples.

f) Any entries on the photocopies which do not apply to samples being transported will be lined out by a project worker.

g) The "Sample Transport/Location" column ("Date" and "Int'ls") shall be completed for the samples as they are transported and stored at different locations. The project worker or individual receiving the samples at the storage location will date and initial the appropriate entries on the photocopies of the "Drive-Core Sampling Record."

h) The photocopies of the "Drive-Core Sampling Record" which accompanied the samples being transported will remain with the samples at the storage location. Whenever the samples are transported, the photocopies will accompany the samples and the appropriate entries will be made by the project workers. When the samples are stored at the SMF, the photocopies will be filed at the SMF. The original "Drive-Core Sampling Record" forms will be updated to reflect all additions made on the photocopies concerning the "Sample Transport/Location" entries. This will be done by a project worker. The project worker making these additions will date and initial the entries in the "Remarks" column.

i) The "Schematic Drive-Core Record" shall be completed in black ink by a project worker. This is done while the capped brass-liners are in the humidified glove box. All deletions and corrections will be made in the same manner as in the well-site logbook.

j) The "NNWSI Core Box/Sample Record" (Attachment C) shall be completed whenever a core box is completely filled with samples.

k) The work shall be done in the USGS trailer by a project worker using black ink. All deletions and corrections shall be made in the same manner as in the well-site logbook.

l) The "NNWSI Core Box/Sampling Record" shall be transported with and stored at the same location as the core box it represents. The "Core Box Location" section, the "Core Box Transportation" section, and the "Sample Removal" section will be updated to reflect any changes in the status of these sections. A project worker or a representative of the user shall complete the entries in these sections. These records are part of the permanent borehole record and will be filed accordingly when they are completely filled.

m) Completion of the "NNWSI Core Box/Sampling Record" is described in Para. 4.2.7.2.

4.2.4.5 Transportation -

a) At the end of a drilling shift, a project worker will transport all full cardboard core boxes containing drive-core samples to the Unsaturated Zone Testing Laboratory (Test Cell C) or the SMF.

b) The full cardboard boxes of thermocouple psychrometry samples and the full cardboard core boxes of paper cans (gravimetric water-content samples) are taken into the Unsaturated Zone Testing Laboratory (Test Cell C) by a project worker.

c) When the borehole is completed to the total depth or if drilling operations are suspended, all boxes containing any samples are delivered by the project workers to the Unsaturated Zone Testing Laboratory (Test Cell C) or the SMF.

d) The project worker who transports the drive-core samples from the USGS trailer to the Unsaturated Zone Testing Laboratory (Test Cell C) or the SMF shall document this by dating and initialing the proper column on the "Drive-Core Sampling Record" (Para. 4.2.7.4) and the "Rotary Core Sampling Record" (Para. 4.2.7.6).

4.2.5 Split Core Barrel Rotary Core - Approximate sampling depth intervals for rotary core are determined by the Project Chief and are listed in the Drilling Program. Specific criteria for the division and assignment of rotary core for different uses are determined by the Project Chief and are posted in the well-site logbook. All completed original data sheets are delivered to the Project Chief for inclusion in the raw data package (per NNWSI-USGS-QMP-17.01).

4.2.5.1 Rotary Core Sample Collection Using the Split Core Barrel - The split core barrel is brought to the surface and placed in the core barrel rack by REECo. A project worker shall check the split rotary core barrel to determine if there is any sample in the barrel. If there is no sample in the split core

barrel, the Site Hydrologist must decide whether to attempt to cut another core or to hammer drill. If there is some sample in the split core barrel, the project worker will proceed with the collection procedures.

a) The latching head and the core catching shoe are removed by REECo. The tape around the split core barrel shall be cut along one seam by REECo.

b) A project worker then delivers the split core barrel to the USGS trailer. REECo shall inform a project worker of the depth interval of the rotary core run.

4.2.5.2 Processing - The split core barrel rotary core is processed by a project worker. The work is done in the USGS trailer. Processing of the rotary core samples consists of photographing the rotary core, and assigning and packaging different rotary core sample segments for different uses.

4.2.5.2.1 Photographing:

a) The opened split core barrel and its contents are photographed in the USGS trailer by a project worker using a Polaroid camera with color film.

b) When the split core barrel is opened in the USGS trailer, a project worker measures the length of core in the split core barrel with a steel measuring tape, graduated in tenths of a foot, to determine the amount of core recovered.

c) A run-block (Para. 4.2.4.3) is labeled and is included in the photographs of the rotary core. A wooden block wrapped with duct tape with a downhole arrow indelibly marked on it is also included in the photographs of the rotary core. The downhole arrow is oriented so that it is pointing downhole. More than one photograph may be required to document the entire rotary core run.

d) The rotary core is photographed starting at the top of the core run and proceeding to the bottom of the core run. The project worker taking the photographs writes the photograph sequence number, his/her name, the borehole designation, core run number, and the depth interval cored on the photograph.

e) The photographs are attached (paper clipped) to the "Schematic Rotary Core Record" (Attachment G) and transported to the Unsaturated Zone Testing Laboratory (Test Cell C).

4.2.5.2.2 Handling:

a) After the rotary core run has been photographed, the project workers set aside the run-block and the downhole arrow block and place the split core barrel with the core in it in the humidified glove box.

b) A project worker, using a steel measuring tape graduated in tenths of a foot, will measure the rotary core for sample use assignment (Para. 4.2.5). The rotary core sample assignments are entered on the "Schematic Rotary Core Record" (Para. 4.2.7.5) by a project worker. The "Core Index Data Sheet" (Para. 4.2.7.6) shall also be completed at this time.

c) The rotary core samples that have been designated for gravimetric water-content and thermocouple psychrometry are placed in plastic bags and removed to another humidified glove box in the USGS trailer. A project worker processes these samples as in Para. 4.2.4.2.1, with the exception that a portion of the rotary core sample may have to be broken to allow for packaging in the small glass bottle.

d) This is accomplished by a project worker using a hammer and a metal plate in the humidified glove box. The project worker places the rotary core sample on the metal plate and chips off pieces by striking it with the hammer. These pieces can be further broken by striking them with the hammer.

4.2.5.2.3 Packaging the Core:

a) The remaining rotary core samples are processed in the humidified glove box by a project worker. The processing consists of packaging the rotary core samples in either split PVC pipe and PVC caps or by wrapping the rotary core in aluminum foil. The method of packaging used depends on the condition of the rotary core and is determined by the project workers who are processing the rotary core samples.

b) When using the split PVC pipe and PVC caps, the rotary core segments are processed in the humidified glove box. The project worker will begin at the top of the core run (shallowest depth interval) and work towards the bottom of the core run. The split PVC pipe is cut to approximately the same length as the rotary core sample being packaged in it. The project worker places the sample in one half of the split PVC pipe and places the other half on top of it. The PVC caps are placed on the ends.

c) The downhole orientation of the sample shall be maintained during packaging and a downhole arrow shall be indelibly marked on the split PVC pipe by a project worker.

d) After the PVC caps are placed on the ends of the split PVC pipe, the sample is replaced in the split core barrel in the sequence from with it was removed.

e) The packaged rotary core samples will be removed from the humidified glove box for taping and labeling by a project worker.

f) When packaging the rotary core samples in aluminum foil, the project worker starts at the top of the core run and works

towards the bottom of the core run. The rotary core samples must be removed from the humidified glove box for this packaging.

g) A sheet of aluminum foil approximately 2 inches longer than the rotary core sample is placed on a flat working surface to receive the rotary core sample. A project worker removes the rotary core sample from the humidified glove box and places it on the sheet of aluminum foil. The project worker will maintain the downhole orientation of the sample during this procedure.

h) Once on the sheet of aluminum foil, the core sample is rolled up in the aluminum foil. The ends of the aluminum foil around the sample are crimped and tamped down with a 2-inch wooden 2x4.

i) A project worker shall tape and label the sample after it is wrapped in aluminum foil and the ends have been crimped and tamped.

4.2.5.2.4 Taping and Labeling:

a) The packaged rotary core samples are taped and labeled in the USGS trailer by a project worker. Duct tape or masking tape are used to seal all seams on the packaged samples.

b) The sample packages are labeled using an indelible felt-tipped marker. The labeling is done on the duct tape or masking tape used to seal the seams of the sample packages. The borehole designation, depth interval of the sample, the sample designation, and a downhole arrow are included on the label.

c) When the rotary core samples are taped and labeled, they are immersed in melted bees' wax by the project workers.

d) When the bees' wax coating the samples is hardened, the project workers box the samples.

4.2.5.3 Boxing - Rotary core samples are boxed in the same manner as the drive-core samples (Para. 4.2.4.3). The gravimetric water-content samples and the thermocouple psychrometry samples are boxed in the same manner as the drive-core samples (Para. 4.2.4.3).

4.2.5.4 Rotary Core Records -The well-site entries on the rotary core record forms will be made in black ink by the project workers at the USGS trailer.

a) The "Schematic Rotary Core Record" (Attachment G), the "Core Index Data Sheet" (Attachment A), and the "Rotary Core Sampling Record" (Attachment H) will be kept at the USGS trailer until they are completely filled, the drill hole is completed to total depth, or the drilling operations are suspended. The records are then delivered to the Project Chief.

b) A photocopy of the "Rotary Core Sampling Record" will accompany all samples transported from the USGS trailer to the Unsaturated Zone Testing Laboratory (Test Cell C). The photocopy shall contain the entries for all samples being transported.

c) The "Schematic Rotary Core Record" (Attachment G) is completed in the same manner as the "Schematic Drive-Core Record" (Para. 4.2.4.4).

d) The "Core Index Data Sheet" (Attachment A) is completed in black ink by a project worker. This is done while the rotary core is in the split core barrel in the humidified glove box. All deletions and corrections shall be completed in the same manner as in the well-site logbook.

e) Completion of the "Core Index Data Sheet" is described in Para. 4.2.7.7.

f) The "Rotary Core Sampling Record" (Attachment H) is completed in black ink by a project worker. This is done after the rotary core samples are packaged, taped, and labeled. All deletions and corrections shall be completed in the same manner as in the well-site logbook.

g) The "NNWSI Core-Box/Sample Record" (Attachment C) is completed whenever a core box is completely filled with samples. The work is done in the USGS trailer by a project worker using black ink. All deletions and corrections will be made in the same manner as in the well-site logbook.

h) The "NNWSI Core Box/Sampling Record" shall be transported with and stored at the same location as the core box it represents. The "Core Box Location" section, the "Core Box Transportation" section, and the "Sample Removal" section will be updated to reflect any changes in the status of these sections. A project worker or a representative of the user shall complete the entries in these sections. These records are part of the permanent borehole record and will be filed according to Para. 7.0 when they are completely filled.

i) Completion of the "NNWSI Core-Box/Sample Record" is described in Para. 4.2.7.2.

4.2.5.5 Transportation - Rotary core samples are transported in the same manner as the drive-core samples (Para. 4.2.4.5).

4.2.6 Lexan Liner Rotary Core - Approximate sampling depth intervals for rotary core are determined by the Project Chief and are listed in the Drilling Program. Specific criteria for the division and assignment of rotary core for different uses are determined by the Project Chief and are posted in the well-site logbook. All completed original data sheets are delivered to the Project Chief for inclusion in the raw data package (per NNWSI-USGS-QMP-17.01).

4.2.6.1 Rotary Core Sample Collection

Using the Lexan Liner - The inner core barrel is brought to the surface and placed in the core barrel rack by REECo. A project worker shall check the inner core barrel to determine if there is any sample in the lexan liner. If there is no sample in the lexan liner, the Site Hydrologist must decide whether to attempt to cut another core or to hammer drill. If there is a sample in the lexan liner, the project worker will proceed with the collection procedures.

a) The latching head and the core catching shoe are removed by REECo. The lexan liner with the core sample is removed from the inner core barrel and placed in the core barrel rack. Temporary caps are placed on the ends of the lexan liner which contains the core sample.

b) A downhole arrow shall be marked on the lexan liner by a project worker using an indelible felt-tipped marker. The axis (shaft) of the downhole arrow shall run the entire length of the lexan liner. The arrow point (tip) shall be at the bottom of the lexan liner.

c) A project worker then delivers the lexan liner to the USGS trailer. REECo shall inform a project worker of the depth interval of the rotary core run.

4.2.6.2 Processing - The lexan liner rotary core is processed by a project worker. The work is done in the USGS trailer. Processing of the rotary core samples consist of photographing the rotary core, and assigning and packaging different rotary core sample segments for different uses.

4.2.6.2.1 Photographing:

a) The capped lexan liner and its contents are photographed in the USGS trailer by a project worker using a Polaroid camera with color film.

b) A project worker measures the length of core in the lexan liner with a steel measuring tape, graduated in tenths of a foot, to determine the amount of core recovered.

c) A run-block (Para. 4.2.4.3) is labeled and is included in the photographs of the rotary core. A downhole arrow is marked on the lexan liner by a project worker using an indelible felt-tipped marker. More than one photograph may be required to document the entire rotary core run.

d) The rotary core is photographed starting at the top of the core run and proceeding to the bottom of the core run. The project worker taking the photographs writes the photograph sequence number, his/her name, the borehole designation, core run number, and the depth interval cored on the photograph.

e) The photographs are attached (paper clipped) to the "Schematic Rotary Core Record" (Attachment G) and transported to the Unsaturated Zone Test Laboratory (Test Cell C).

4.2.6.2.2 Handling:

a) After the rotary core has been photographed, the run-block is set aside in preparation of dividing the lexan liner for rotary core sample assignments.

b) A project worker, using a steel measuring tape graduated in tenths of a foot, will measure the rotary core for sample use assignments (Para. 4.2.5). The rotary core sample assignments are entered on the "Schematic Rotary Core Record" (Para. 4.2.7.5) by a project worker. A mark will be placed on the lexan liner indicating where the lexan liner should be cut for the division of the rotary core into sample segments. The mark shall be made on the axis (shaft) of the downhole arrow and shall be an arrow point (tip); the end of which indicates where the lexan liner is to be cut. This is done by a project worker using an indelible felt-tipped marker. The "Core Index Data Sheet" (Para. 4.2.6.6) shall also be completed at this time.

c) The rotary core samples that have been designated for gravimetric water-content and thermocouple psychrometry are placed in plastic bags and put in a humidified glove box in the USGS trailer. A project worker processes these samples as in Para. 4.2.4.2.1, with the exception that a portion of the rotary core sample may have to be broken to allow for packaging in the small glass bottle.

d) This is accomplished by a project worker using a hammer and a metal plate in the humidified glove box. The project worker places the rotary core sample on the metal plate and chips off pieces by striking it with the hammer. These pieces can be further broken by striking them with the hammer.

e) The rotary core samples for gravimetric water-content and thermocouple psychrometry should be taken from an area of the core run where broken core is available. This could require that the lexan liner be cut (Para. 4.2.6.2.3). If possible, this process should be in conjunction with the cutting of the lexan liner for additional rotary core sample selection. It may also be possible to collect the gravimetric water-content and thermocouple psychrometry samples from the top or bottom of the core run.

4.2.6.2.3 Dividing and Packaging the Core:

a) The remaining rotary core samples are processed in the USGS trailer by a project worker. The processing consists of dividing the lexan liner into sample segments, capping and sealing the sample segments.

b) The project worker will begin at the top of the core run (shallowest depth interval) and work towards the bottom of the core run. Any empty lexan liner at the top of the core run is removed first. As the lexan liner is cut, the exposed ends are immediately capped. As the sample segments are cut and capped, the downhole orientation and the sample sequence are maintained.

c) After the lexan liner containing the rotary core sample is cut and capped, a project worker will tape and label it.

4.2.6.2.4 Taping and Labeling:

a) The capped lexan liner segments which contain core samples are taped and labeled in the USGS trailer by a project worker. Duct tape or masking tape is used to seal the caps on the lexan liner. A piece of duct tape or masking tape is used to label the lexan liner.

b) The lexan liners are labeled using an indelible felt-tipped marker. The labeling is done on the duct tape or masking tape on the lexan liners. The borehole designation, depth interval of the sample, the sample designation, and a downhole arrow are included on the label.

c) When the lexan liners are taped and labeled, the caps are sealed.

d) The samples are then boxed by a project worker.

4.2.6.3 Boxing - Rotary core samples are boxed in the same manner as the drive-core samples (Para. 4.2.4.3). The gravimetric water-content samples and the thermocouple psychrometry samples are boxed in the same manner as the drive-core samples (Para. 4.2.4.3).

4.2.6.4 Rotary Core Records - lexan liner rotary core records are completed in the same manner as the split barrel rotary core records (Para. 4.2.5.4).

4.2.6.5 Transportation - Rotary core samples are transported in the same manner as the drive-core samples (Para. 4.2.4.5).

4.2.7 Completion of Forms -

4.2.7.1 "Cuttings Sampling Record" (Attachment B) - The following information is required:

Drill-hole No.: The complete drill-hole designation shall be entered here.

Page ---- of ----: The page number of the form, starting with one, is entered. The second blank will be filled in after the borehole is completed and the total number of pages is known.

Depth Interval: The depth interval, in feet, is entered. The project worker making the entries will place his/her initials and the date of the entry on the "initial" line.

Type of sample: A check mark is placed in the appropriate box to indicate that a particular sample was collected at that depth interval.

Box No.: The number of the cardboard core box where the sample is stored is entered here. The psychrometry sample entry in this column will not be made at the well-site. It will be made after the thermocouple psychrometry sample is tested and reboxed at the Unsaturated-Zone Testing Laboratory (Test Cell C).

Sample Transport/Location: The project workers who transport the samples from the USGS trailer at the well-site will acknowledge that they did so by completing the first arrow column for the samples they transported. The project worker or individual who receives and handles the samples at the UZTL (Test Cell C) or the SMF will date and initial the proper column under this heading. The same project worker who transports the samples can also receive the samples.

Sample Removal: The proper user symbol is place in the box to indicate any samples removed for testing. The individual removing the sample will place their initials and the date of the sample removal in the "Removal" column. The "Returned" column is completed by the individual returning any removed samples.

Remarks: Any information that the project worker feels is of significant importance in connection with the "Cuttings Sampling Record" shall be recorded in the "Remarks" column.

User Symbol Key: The user symbols and the organization they represent are listed here.

Personnel Identification: Any person who initials the form must print their name and place their initials here. If more space is needed, the back of the form can be used.

4.2.7.2 "NNWSI Core Box/Sample Record" (Attachment C) - The following information is required:

Drill Hole: The complete drill hole designation shall be entered.

Core Box Number: The complete core box number (designation) is entered here.

Depth Interval: The depth interval, in feet, is entered.

Core Box Location: This section documents where the core box is located.

The DATE, LOCATION, RECEIVED BY, and REMARKS columns are completed by the person taking possession of the core box at a temporary or permanent storage location.

Core Box Transportation: This section documents when, where and by whom the core box was transported. The DATE, TRANSPORTED, TRANSPORTED BY, and REMARKS columns are completed by the person who transports the core box from one location to another location.

Sample Removal: This section lists the samples by depth interval, which are contained in the core box. The DEPTH INTERVAL entries are made at the well-site by a project worker. The SAMPLE TYPE, USER, REMOVED, and RETURNED columns are completed by the individual who is removing or returning samples. The individual who removes or returns samples will date and initial the proper column to indicate this.

4.2.7.3 "Schematic Drive-Core Record" (Attachment F) - The following information is required:

Drill Hole: The complete drill hole designation shall be entered here.

Page ---- of ----: The page number of the form, starting with one, is entered. The second blank will be completed after the borehole is completed to total depth and the total number of pages is known.

Run No.: The number of the core run goes here.

Date: The date the drive-core was collected is entered.

D, (ft): The length of drive-core drilled is recorded.

R, (ft): The length (amount) of drive-core recovered is entered here.

Start (ft): The starting footage of the drive-core interval is recorded.

Schematic Diagram: This diagram (Attachment F) represents the brass-liners in the drive-core sampling tube. This portion of the record is completed by drawing lines which will divide the schematic into sections representing the brass-liners. The sections which represent the brass-liners are labeled with the depth interval and sample designation. An "X" is used to indicate where there is no sample in the brass-liners.

End (ft): The bottom footage of the drive-core interval is entered.

Initials: The project worker making the entries on the "Schematic Drive-Core Record" initials the record here.

4.2.7.4 The "Drive-Core Sampling Record" (Attachment E) shall be completed in black ink by a project worker. This is done after the capped brass-liners are taped and labeled. All deletions and corrections will be made in the same manner as in the well-site logbook.

Drill Hole No.: The complete drill hole designation shall be entered here.

Page ---- of ----: The page number of the form, starting with one, is entered. The second blank will be filled in after the borehole is completed to the total depth and the total number of pages is known.

Run No.: The number of the drive-core run is recorded.

Cored Interval (feet): The length of drive-core drilled (D.), the length of drive-core recovered (R.), and the project worker's initials are recorded in this column.

Box No.: The number of the cardboard core box where the sample is located.

Sample Transport/Location: The project workers who transport the samples from the USGS trailer at the well-site will acknowledge that they did so by completing the first arrow (⟶) column for the samples the transported. They will enter the data and their initials.

Sample Removal: The proper user symbol is placed in the box to indicate any samples removed for testing at the USGS trailer. The individual removing the sample will date and initial the "Removal" column. The "Returned" column is completed by the individual returning any samples that were removed. The samples are placed in the proper depth sequence in the cardboard core boxes.

Remarks: Any information that the project workers feel is of significant importance in connection with "Drive-Core Sampling Record" shall be recorded in the "Remarks" column.

User Symbol Key: The user symbols and the organization they represent are listed here.

Personnel Identification: Any person who initials the form must print their name and place their initials here. If more space is needed, the back of the form can be used.

4.2.7.5 "Schematic Rotary Core Record: (Attachment G) - The following information is required:

Drill Hole: The complete drill hole designation shall be entered here.

Page ---- of ----: The page number of the form, starting with one, is entered. The second blank will be completed after the

borehole is completed to total depth and the total number of pages is known.

Run No.: The number of the core run goes here.

Date: The date the rotary core was collected is entered.

D. (ft): The length of rotary core drilled is recorded.

R. (ft): The length (amount) of rotary core recovered is entered here.

Start (ft): The starting footage of the rotary core interval is recorded.

Schematic Diagram: This diagram (Attachment G) represents the core in the rotary core barrel. This portion of the record is completed by drawing lines which will divide the schematic into sections representing the core sample segments. The sections which represent the core samples are labeled with the depth interval and sample designation. An "X" is used to indicate where there is no sample in the core barrel.

End (ft): The bottom footage of the rotary core interval is entered.

Initials: The project worker making the entries on the "Schematic Rotary Core Record" initials the record here.

4.2.7.6 "Rotary Core Sampling Record" (Attachment H) - The following information is required:

Drill Hole No.: The complete drill hole designation is entered.

Page ---- of ----: The page number of the form, starting with one is entered. The second blank will be filled in after the borehole is completed to the total depth and the total number of pages is known.

Run No.: The number of the core run is recorded.

Cored Interval (feet) and Initials: The depth interval of the core run is entered. The project worker making the entries records his/her initials in this column.

D. (ft): The amount (length) of the rotary core run is recorded.

R. (ft): The amount (length) of rotary core recovered is recorded.

Sample Depth Interval (feet): The depth interval of the sample (Sample Assignment) is recorded here.

Sample Assignment: A check mark is placed in the proper column to indicate which type of sample is assigned to the sample depth interval.

Box No.: The cardboard core box number in which the sample is stored is entered.

Sample Transport/Location: The project workers who transport the samples from the USGS trailer at the well-site will acknowledge that they did so by completing the first arrow (⟶) column for the samples the transported. They will enter the date and their initials.

Sample Removal: The proper user symbol is placed in the box to indicate any samples removed for testing at the USGS trailer. The individual removing the sample will date and initial the "Removal" column. The "Returned" column is completed by the individual returning any samples that were removed to the proper depth interval sequence in the cardboard core boxes.

Remarks: Any information that the project workers feel is of any significant importance in connection with the "Rotary Core Sampling Record" shall be recorded in the "Remarks" column.

User Symbol Key: The user symbols and the organization they represent are listed here.

Personnel Identification: Any person who initials the form must print their name and place their initials here. If more space is needed, the back of the form can be used.

4.2.7.7 "Core Index Data Sheet" (Attachment A) - The following information is required:

Core Hole: The complete drill hole designation is recorded.

Page ---- of ----: The page number of the form, starting with one, is entered. The second blank will be completed after the borehole is completed to total depth and the total number of pages is known.

Run: The core run number is recorded.

Interval: The depth interval of the rotary core run is recorded.

Recovery: The length (amount) of rotary core recovered.

Loss: The length (amount) of rotary core lost from the core run. This is determined by subtracting the amount of core recovered from the length of the rotary core run.

Broken: Broken is any core in pieces less than 0.33 feet in length. This total amount (length) of broken core in the core run is recorded.

Joints: The number of joints is recorded. Only open, natural joints which occur between pieces of core which are 0.33 feet or longer in length are counted as joints for this calculation.

CI: The core index number is entered here. This number is derived by using the formula at the bottom of the "Core Index Data Sheet."

Initials: The project worker making the entries on the form records his/her initials.

Remarks: Comments about the type of joints, the lithology of the core run, and any other information that the project workers feel is important are recorded in this column.

4.3 Alternative Method(s) Considered: Core and cuttings can be handled and processed in various ways. The process described in this procedure has been found to be productive, desirable, and convenient.

4.4 Materials/Equipment Required: All equipment and materials used in this procedure are commercially available.

- o Aluminum foil
- o Bees' wax
- o Black ink pens
- o Brass-liners
- o Brass-liner extruder
- o Cardboard core boxes
- o Duct tape/masking tape
- o Electrician's tape
- o Glove box
- o Hammer
- o Hot plate and bucket
- o Ice cooler chest
- o Indelible felt-tipped markers
- o Lexan liners
- o Mason jars with lids
- o Metal plate
- o Moisture cans
- o Paper cans
- o Plastic bags
- o Plastic caps
- o Polaroid camera with color film
- o PVC caps
- o PVC pipe
- o Small glass bottles
- o Sponges
- o Steel measuring tape graduated to 0.1'
- o Wire mesh sieve
- o Wooden block (2 inch 2x4)
- o Well-Site Logbook
- o Drill Cuttings Sampling Record
- o Drive-Core Sampling Record
- o Schematic Drive-Core Record
- o Core Index Data Record

- o Rotary Core Sampling Record
- o Schematic Rotary Core Record
- o NNWSI Core Box/Sample Record
- o Copy of HP-12, R3

4.5 Assumptions Affecting the Procedure: In drilling, coring, and sampling of the unsaturated-zone boreholes, it is assumed that both the cuttings and the core are obtained by REECo in accordance with an approved procedure.

4.6 Data Information: Data generated by application of this procedure consist of sample/cuttings identification information, dates, (collection, transfer, etc.) and participants names, as described in Attachments A through H.

4.6.1 Quantitative/Qualitative Criteria - Proper completion of all attachments to this procedure provides the objective criteria by which completion and adequacy of implementation of this procedure may be evaluated.

4.7 Limitations: Proper implementation of this procedure with respect to sample identification, handling, etc. is dependent upon the project personnel. All depth measurements of the borehole are made by REECo. The length of core recovered is determined by a project worker using a steel measuring tape graduated in tenths of a foot. The length of core samples is determined by a project worker and is measured to a tenth of a foot.

4.8 Other: This procedure interfaces with NWM-USGS technical procedures HP-55, HP-61, and HP-136.

5.0 CALIBRATION REQUIREMENTS. Calibration is required as a part of this technical procedure. When calibrations are required, all instruments and methods when applicable, will be calibrated in compliance with the Instrument Calibration Procedure (NNWSI-USGS-QMP-12.01) prior to obtaining data that will be cited to support licensing the NNWSI Project.

5.1 Calibration Responsibility: The PI is responsible for calibrations required by this procedure. Calibration will be in accordance with procedures described or referenced in Para. 5.2. Maintenance of all calibration records described in Para. 5.3 may be done by a contributing investigator under the direct supervision of the PI.

5.2 Calibration Procedure: The steel measuring tape requires calibration.

5.2.1 Calibration of the steel measuring tape is detailed in NWM-USGS technical procedure HP-61.

5.3 Calibration Records: Calibration data will be entered in a notebook or other organized documentation. A field notebook will be used if the test equipment is used in the field. These notebooks or other documents shall be maintained as described in the Document Control Procedure (NNWSI-USGS-QMP-6.01) and stored in accordance with the QA Records Management Procedure (NNWSI-USGS-QMP-17.01). Minimum data will include instrument type, its identification and location, cali-

bration procedure used, its date, the standard used, its range and accuracy, recalibration due date, responsible division subunit, any pertinent observations and the name of the person calibrating the instrument. Calibration entries shall be signed and dated by the person performing the calibration and filed with the QA Office.

5.4 Labeling of Equipment Calibration Status: In compliance with NNWSI-USGS-QMP-12.01, a sticker will be affixed to each piece of equipment used in this procedure denoting the calibration status according to one of the following three categories:

a) Equipment identification, date calibrated, date recalibration is due, procedure number and calibrator;

b) Equipment identification, "OPERATOR TO CALIBRATE", and the procedure number; or

c) Equipment identification and "NO CALIBRATION REQUIRED".

6.0 IDENTIFICATION AND CONTROL OF SAMPLES. Samples will be collected as part of this procedure.

6.1 Sample Identification: As part of the data records and documentation, and in compliance with QMP-8.01, all samples will be identified as follows: as described in paragraph 4.2 et seq. Note that the forms described herein substitute for sample information forms (SIFs).

6.2 Control and Storage: In compliance with QMP-8.01, the collected and identified samples shall reside in the custody of the USGS Project Chief who shall store them as described in paragraph 4.2 et seq.

6.3 Special Treatment: No special treatment other than as described in paragraph 4.2 et seq. is required.

7.0 QUALITY ASSURANCE RECORDS. All information collected and recorded under this procedure that is to be used in support of the NNWSI Project licensing process is required to be a part of the official USGS record. Input needed to process the information as a record includes: title or description, subject, originator, date of the document, and whether it is an original, a revision or an addendum.

Specific items from this procedure that will constitute a record are all data and samples collected and data recorded under paragraph 4.2 et seq. of this procedure will be used in support of Quality Levels I and II for NNWSI and are required to be a part of the official record. Attachments A through H, inclusive, will also become part of the official record. Information needed to store and process the data or samples as a potential record includes: title or description of data or samples, originator, and the date of the record.

7.1 Notebooks or other organized documentation will be prepared as appropriate by the PI or a contributing investigator to record data from this procedure and shall include any information considered by the originator to be pertinent. When data are kept in loose-leaf form, each page will be numbered consecutively and chronologically. All

documents will be signed or initialed and dated by the investigator on a daily basis when entries are made. Any revisions will be lined out, initialed, and dated.

7.2 All data collected and the applicability of methods used in this procedure will be reviewed and cosigned by a peer or supervisor of the investigator knowledgeable with the objectives of this procedure in accordance with NNWSI-USGS-QMP-6.01, Para. 4.2.2; and as such are acknowledged by both the investigator and the reviewer to be acceptable and meaningful data that meet appropriate quantitative and qualitative acceptance criteria. Unacceptable data shall be identified appropriate to the form of the data.

8.0 MODIFICATIONS. When field modifications become necessary, per Para. 4.8, QMP-5.01, the PI shall fully document the changes, submit the documentation for the same review signature and distribution process as for the original procedure, and indicate whether the change should result in a subsequent revision to the technical procedure. The documentation will be reviewed within 30 days.

9.0 REFERENCES CITED. There are no references cited for this procedure.

10.0 ATTACHMENTS. The following attachments are included with this technical procedure for the purpose of examples as described:

Attachment A - Core-Index Data Sheet
Attachment B - Cuttings Sampling Record
Attachment C - NNWSI Core Box/Sample Record
Attachment D - Run-Block Labeling, Core Boxing and Core Box Labeling
Attachment E - Drive Core Sampling Record
Attachment F - Schematic Drive-Core Record
Attachment G - Schematic Rotary Core Record
Attachment H - Rotary Core Sampling Record

11.0 APPROVAL. This technical procedure shall become effective upon its approval as noted by completion of all the following signatures and dates.

Prepared by: M. P. Chornack	4/27/88 Date
Technical Reviewer: A. L. Flint	4/27/88 Date
NHP QA Coordinator: K.W. Causseaux	6/8/88 Date
for Acting NHP Chief: D. C. Gillies	6/8/88 Date
Chief, Branch of NNWSI: L. R. Hayes	5/2/88 Date
for Quality Assurance: J. R. Willmon	6-8-88 Date

CORE - INDEX DATA SHEET

Page ________
of ________

CORE HOLE ______________

QAP NWM - USGS - HP - 12

Run	Interval	Recovery	Loss	Broken	Joints	CI	Initials	Remarks

$$\text{CI (CORE INDEX)} = \left[\frac{\text{(feet broken)} + \text{(feet core loss)} + (1/3 \text{ joints})}{\text{drilled interval}}\right] \times 100$$

developed by the
U.S. Geological Survey

[illegible] [illegible]

DRILL - HOLE NO.______________

CUTTINGS SAMPLING RECORD

Page _____ of _____

Depth Interval (feet)	Type of sample (✓ if collected)	(✓)	Box No.	Sample Transport / Location → Date	→ Int'ls	Test Cell Date	Test Cell Int'ls	→ Date	→ Int'ls	Core Lib. Date	Core Lib. Int'ls	Sample Removal User Symbol	Removed Date	Removed Int'ls	Returned Date	Returned Int'ls	Remarks
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																
	LITHOLOGY		X	X	X	X	X					X	X	X	X	X	
________	WATER CONTENT		X	X	X	X	X	X	X	X	X	●			X	X	
	PSYCHROMETRY																
________	TRITIUM																
Initials	LEACH																

User Symbol Key

- ● USGS/NHP
- ● USGS/Reston
- ■ H&N
- ▲ Core Lab Denver
- ○ USGS/Geochem
- ○ USGS/Menlo Park
- ✱ H&N/Bulk Density

Personnel Identification

Name	Initials	Name	Initials

NWM-USGS-HP-12, R3
Attachment B

NNWSI CORE BOX/SAMPLE RECORD

NWM-USGS-HP-12, R3
Attachment C

DRILL HOLE **CORE BOX NUMBER**

CORE BOX LOCATION

DATE	LOCATION	RECEIVED BY (NAME AND INITIALS)	REMARKS

CORE BOX TRANSPORTATION

DATE	TRANSPORTED FROM / TO	TRANSPORTED BY (NAME AND INITIALS)	REMARKS

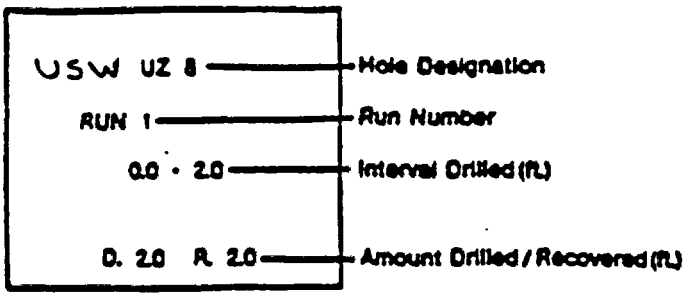
SAMPLE REMOVAL

DEPTH INTERVAL	SAMPLE TYPE	USER	REMOVED DATE	REMOVED INITIALS	RETURNED DATE	RETURNED INITIALS	REMARKS

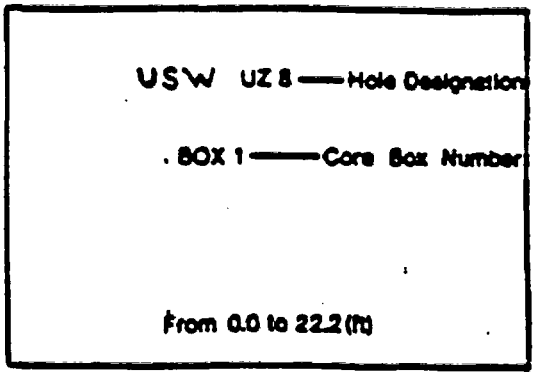
For Additional Space Use Reverse Side

RUN-BLOCK LABELING, CORE BOXING, AND CORE-BOX LABELING

Page ____ of ____



RUN - BLOCK

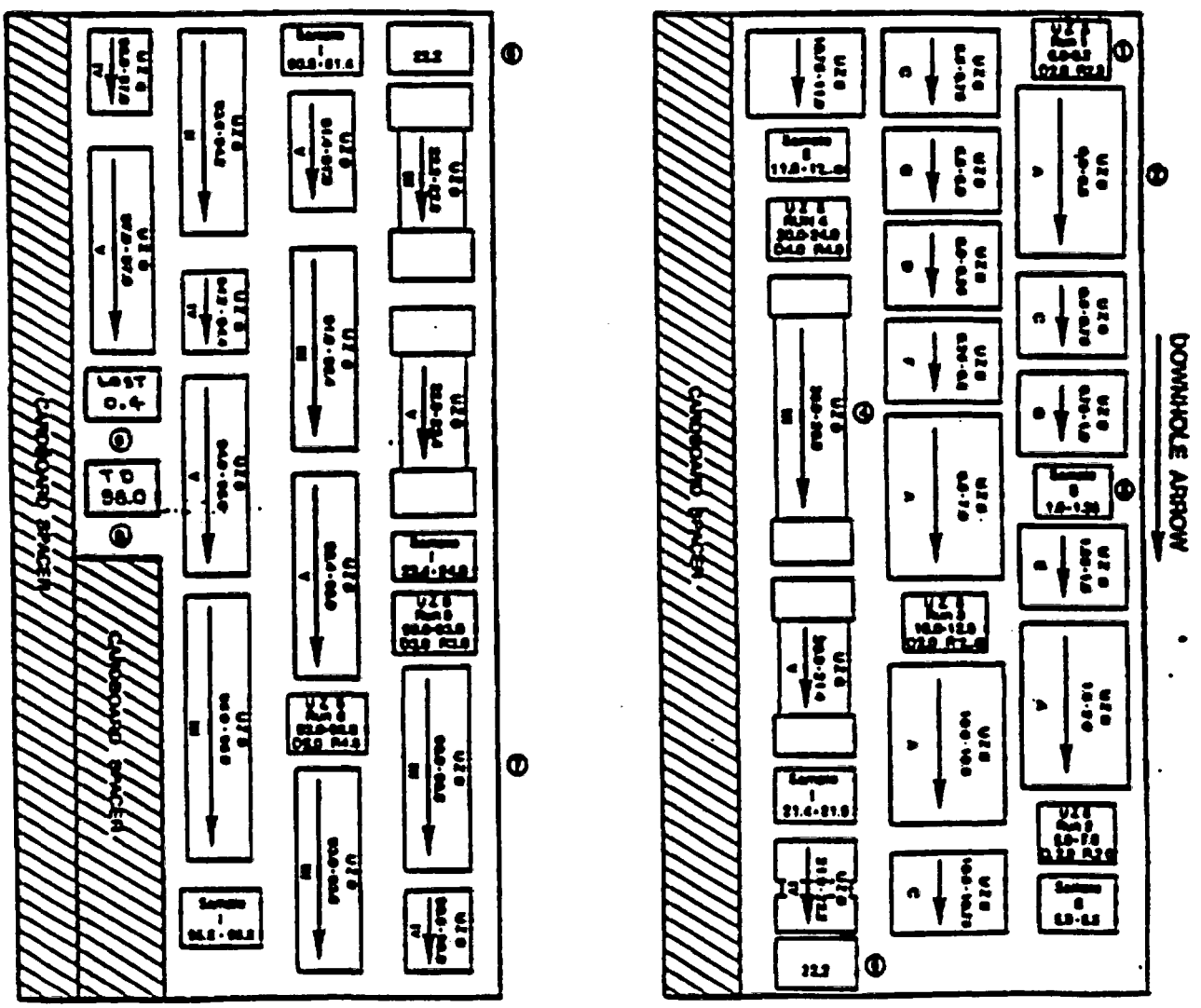


CORE - BOX LABELING (RIGHT END)

KEY TO CORE BOXING ILLUSTRATION

1. RUN - BLOCK
2. DRIVE - CORE IN BRASS LINER
3. SAMPLE - REMOVAL BLOCK
4. ROTARY - CORE IN PLASTIC PVC PIPE
5. ENDING FOOTAGE IN CORE - BOX BLOCK
6. BEGINNING FOOTAGE IN CORE - BOX BLOCK
7. ROTARY - CORE IN ALUMINUM FOIL
8. LOST CORE BLOCK
9. TO [illegible] BLOCK IN CORE BOX

CORE BOXING ILLUSTRATION



Numbers in circles refer to "Key To Core Boxing Illustration"

DRIVE CORE SAMPLING RECORD

DRILL HOLE NO. ________________

Page _____
of _____

Run No.	Cored Interval (feet)	Sample Interval (feet)	SCMT No.	Test Seq.	Box No.	Sample Transport / Location								Sample Removal					Remarks
						→		Test Cell		→		Core Lib.		User Symbol	Removed		Returned		
						Date	Int'ls	Date	Int'ls	Date	Int'ls	Date	Int'ls		Date	Int'ls	Date	Int'ls	
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																
			6																
	D.		5																
	R.		4																
			3																
	INT'LS		2																
			1																

User Symbol Key

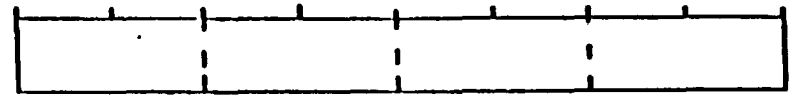
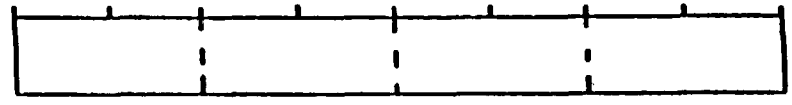
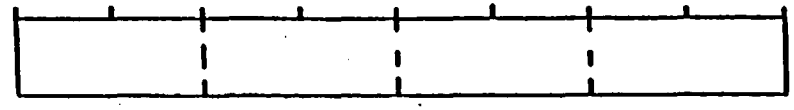
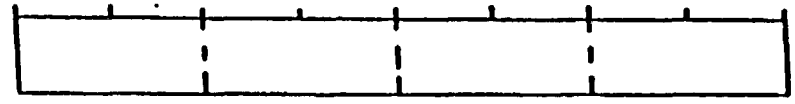
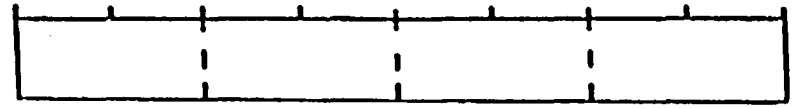
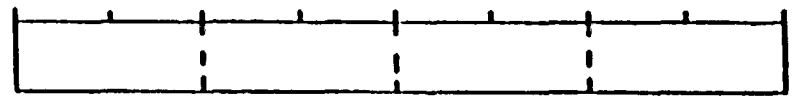
- ● USGS/NHP
- ● USGS/Reston
- ■ H&N
- ▲ Core Lab. Denver
- ○ USGS/Geochem
- ○ USGS/Menlo Park
- ✱ H & N / Bulk Density

Personnel Identification

Name	Initials	Name	Initials

SCHEMATIC DRIVE CORE RECORD

DRILL HOLE _____ PAGE ___ OF ___

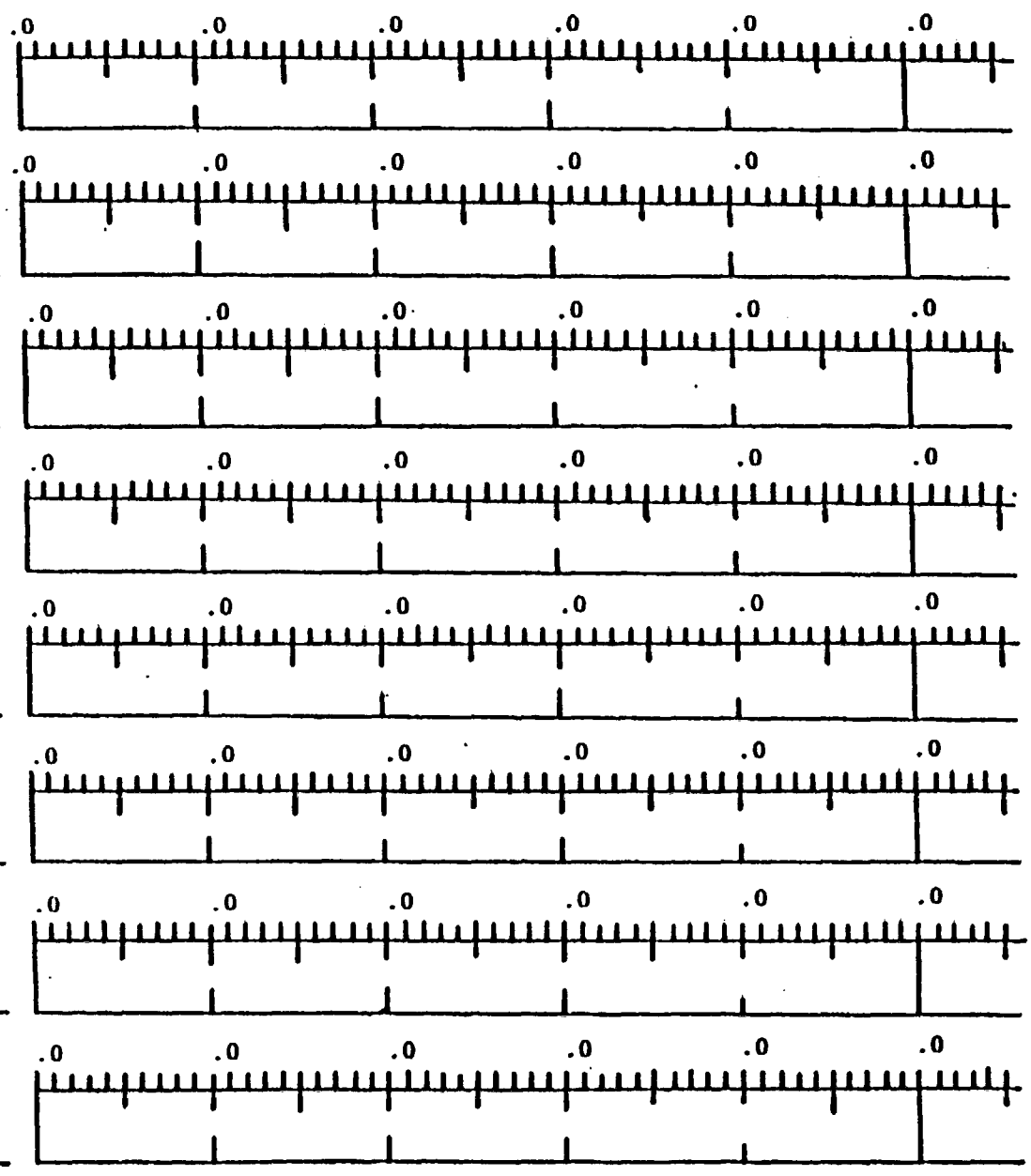
RUN NO.	DATE	D. (ft)	R. (ft)	START (ft)		END (ft)	INITIALS
							
							
							
							
							
							
							
							

NWM-USGS-HP-12, R3
Attachment F

SCHEMATIC ROTARY CORE RECORD

DRILL HOLE _____ PAGE ____ OF ____

RUN NO.	DATE	D. (ft)	R. (ft)	START (ft)	END (ft)	INITIALS



NWM-USGS-HP-12, R3
Attachment G

DRILL HOLE NO. ____________

ROTARY CORE SAMPLING RECORD

Run No.	Cored Interval (feet) (Int'ls)	D. (ft)	R. (ft)	Sample Depth Interval (feet)	Sample Assignment					Box No.	Sample Transport / Location								Sample Removal					Remarks
					I	II	III	IV	V		→		Test Cell		→		Core Lib.		User Symbol	Removed		Returned		
					✓	✓	✓	✓	✓		Date	Int'ls	Date	Int'ls	Date	Int'ls	Date	Int'ls		Date	Int'ls	Date	Int'ls	

User Symbol Key

● USGS/NHP	O USGS/Geochem
● USGS/Reston	O USGS/Menlo Park
■ H&N	✕ H & N / Bulk Density
▲ Core Lab. Denver	

Personnel Identification

Name	Initials	Name	Initials