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**CREW AND THERMAL SYSTEMS DIVISION
NASA-LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS**

**DESERT RESEARCH AND TECHNOLOGY STUDY
(D-RATS)
PARTICIPATION GUIDEBOOK
FOR
PRINCIPAL INVESTIGATORS (PI's)**

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DESERT RATS (D-RATS) PARTICIPATION GUIDEBOOK FOR PRINCIPAL INVESTIGATORS

PURPOSE:

The purpose of this guidebook is to provide practical information so that principal investigators, their teams, and their hardware are prepared for Desert Research and Technology Studies (D-RATS) field tests and are able to successfully and safely perform in the field. Information that has been included are things that oftentimes were learned the hard way by previous D-RATS and written down in 'Lessons Learned'. Other information included are things that have been requested by several previous participants that they found useful. However, this is not an exhaustive document. If you have additional questions or, after participating in a Desert RATS field test, have constructive comments, please contact us using one of the methods below:

Questions? Comments? Please contact:

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This includes information on how to get involved with D-RATS and important test preparation deadlines.

2. Logistics information for Flagstaff

Shipping address
Travel information
Hotel information

3. General daily schedule:

For every thing there is a time to get up, a time to test, and a time to rest.

4. Living like a D-RAT: Desert climate tips:

If you don't want extra crispy fried nose and ears, here's what to do.

5. Things to bring:

Because we don't have them, because you're sure to need them, or because we might want to borrow them

6. D-RATS Etiquette:

Ask first, put it back where you found it, and all of those other things your mother was always pestering you about.

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Overall test schedule, year and program specific (TBD annually)

1.0 DESERT RATS EXPERIMENT REVIEW BOARD

1.1 PURPOSE

The purposes of the Experiment Review Board (ERB) are to:

1. ensure that your hardware has achieved the level of maturity necessary for field testing,
2. coordinate your hardware and objectives with the overall D-RATS field test schedule, and
3. identification of requirements for integration between or with other systems or elements of D-RATS planned activities.

1.2 HARDWARE MATURITY

It was been observed in previous tests that hardware providers often underestimate the rigors of the field. It is not beneficial to send hardware to the field that is not ready. Immature and ill-prepared hardware does not test well in the field, resulting simply in an unnecessary loss of time, effort, and funding.

The ERB is composed of personnel experienced in field testing. The board will determine whether or not hardware has achieved the operational maturity necessary for field test participation. You will be asked to provide documentation, a demonstration, or other means of verifying hardware readiness. The board members are listed below.

Desert RATS Experiment Review Board Members

NASA D-RATS Test Director	Joe Kosmo
NASA D-RATS Test Coordinator	Barbara Romig
Frequency Manager and Information Systems Lead (Communications & IT)	Marc Seibert
NASA Distant Learning Network/Media Outreach	Heather Paul/JSC

A few basic ‘rule of thumb’ questions that can be used to check your hardware maturity are:

1. Is it ‘plug and play’ ready?
 meaning - connections are simple and rugged
 interfaces are straight-forward, well-labeled and rugged
2. Can a test subject use it?
 In other words, its use requires only a short familiarity and training session, because that is likely all they’ll have time for.
3. If you drop it; leave it out in the sun, wind, and dirt; let an engineer touch it, will it still work? Again, field hardening and ruggedness are key.

If you have any questions regarding what constitutes hardware readiness or proofs of hardware readiness for your specific hardware, please contact the D-RATS Mission Manager or Test Coordinator.

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1.3 ERB HARDWARE DEADLINES

The D-RATS field test requires a high-level of coordination. Test coordination starts approximately 8 months prior to the test date. Dry runs are performed approximately 4 months before the field test. Oftentimes it is necessary or very helpful to have PIs' functional hardware available for the dry runs. The following hardware deadlines have been established by the ERB.

Months prior to the scheduled field test	Principal Investigator's Responsibilities
ASAP	Notify D-RATS Test Coordinator of interest in /intention of participation
8 months (if we test in Sept, T-8 mos. is January)	<p>Provide a written, detailed technical overview of all proposed test activities, including the following:</p> <ul style="list-style-type: none"> -Identification of all experimental equipment to be tested or required for test support -Identification of ANY safety concerns associated with your testing or hardware -Identification of any requirements for interface, integration, or interaction with other non-experimenter supplied equipment <p>For example:</p> <ul style="list-style-type: none"> You need to work with suited subjects. You can only test on certain days No other electronic equipment can be powered up. You need TBD Watts of electricity <ul style="list-style-type: none"> -Identification of any RF, wireless, and communication systems and their frequencies for test frequency management purposes <li style="padding-left: 20px;">This also includes any requirements for suit communication loop radio needs. -Identification of all personnel involved with the proposed experimental activities and their specific roles
~4 months (if we test in Sept, T -4 mos. is April)	<p>Provide evidence that a successful level of laboratory-based testing has been achieved and is ready for dry run activities at JSC</p> <p>Provide a Hazard Analysis Report (HAR) for all hardware systems that are to be tested in the field. Contact the D-RATS Mission Manager or Test Coordinator for format and content information.</p>
1 month (if we test in Sept, T -1 mos. is July)	<p>Provide a final 'state of readiness' (SOR) presentation on the proposed experiment/hardware to the ERB.</p> <p>At this point, the ERB will make a GO/NO GO decision for participation in the field test.</p>

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The more information that you can provide, especially regarding interfaces and integration, the better. Additionally, the earlier the information is provided regarding experiment constraints that have impacts on the scheduling of activities during the specific time-period of field testing, the more likely that the test schedule can be coordinated to accommodate those constraints.

1.4 SAFETY INFORMATION

A final assessment of **ALL safety issues**, concerns, preventative measures, etc, associated with your hardware, must be communicated to the ERB in the 'state of readiness' (SOR) presentation. The Hazard Analysis Report (HAR) shall be an integral part of the SOR presentation.

1.5 TEST SITE LOCATIONS

Please review Appendix A: Test Site Locations and Descriptions. This list includes current and previously utilized test site locations. If you have any test objectives that would be best met at test site locations other than those specified for this test year, please notify the D-RATS Mission Manager or Test Coordinator. We will determine if it will be possible to accommodate this request.

1.6 FLAGSTAFF LOGISTICS INFORMATION

At a minimum and at the latest, the SOR presentation should include the following logistics information:

- Need for secure stowage (see Section 2.1)
- List of hardware that must be shipped to Flagstaff (see Section 2.2)
- Alternate test site requirements (see Appendix A)
- Final list of personnel traveling and arrival/departure information and contact information

2.0 LOGISTICS INFORMATION FOR FLAGSTAFF

The field test team operates out of Flagstaff, Arizona, and has conducted testing at the various locations. (see Section 3.3) This section covers information regarding how to get people in and out of Flagstaff and where to put them while they're there.

2.1 LOGISTICS BASE

The United States Geological Survey (USGS) serves as the logistics base for the D-RATS field tests. We have maintained a good working relationship with them by being polite, low-maintenance guests. However, if you do need something, coordinate with the D-RATS Test Coordinator/Barbara Romig.

If you need secure stowage, include that information in your 'state of readiness' presentation to the ERB. The USGS is a fenced facility and locked cage space can be made available if needed.

The USGS is located at 2255 N Gemini Drive, Flagstaff, AZ 86001.

2.2 SHIPPING

If you need to ship anything to Flagstaff:

- A. Include that information in the final presentation to the ERB 1 month prior to the field test.
- B. Coordinate with the D-RATS Test Coordinator/Barbara Romig.
I will notify USGS to expect your shipment. However, it is your responsibility to ensure that your hardware is at the test on time.

For your convenience, the shipping address for the USGS is given below:

Attn: Jeff Coleman
Bld 5
2255 N Gemini Drive
Flagstaff, AZ 86001

2.3 GETTING TO FLAGSTAFF

Many participants fly to Phoenix and drive up to Flagstaff. The drive from Phoenix to Flagstaff takes about 2.5 hours. There is an airport in Flagstaff, Pulliam Airport, located southeast of town. America West flies into Flagstaff, however, service is limited.

2.4 HOTEL INFORMATION

Flagstaff has a wide range of hotels. Many of the hotels are located near Northern Arizona University. For easier access to area test sites, it is convenient to stay north of the University, closer to I-40. However, Flagstaff is not a large city and the difference is only 15 minutes or so.

3.0 RATS 2005 GENERAL DAILY AND OVERALL TEST SCHEDULE

The schedule given below is the general template for a regular test day. However, Distance Learning Network (DLN) events, night runs, bad weather, test constraints, hardware malfunctions, and other special events all may result in deviations from the standard daily schedule. You will be provided with a schedule before the test that will indicate pre-determined deviations from this standard daily schedule. Additional deviations will be communicated at real-time test tag-ups, which occur at a pre-test briefing in the morning, at mid-day, and at a post-test briefing in the afternoon. Remember, '**Rigid Flexibility**' is a good motto for the fluid world of field test, because things will change. Changes will be communicated as best we can.

3.1 DAILY SCHEDULE

NOTE: THERE IS A 2 HOUR TIME DIFFERENCE BETWEEN HOUSTON AND FLAGSTAFF in September (e.g. 1100 in Houston is 0900 in Flag)

AZ time:

- 0700** EVA team Departs for test site {Please carpool to minimize the numbers of vehicles and traffic at the test site. Drive distances to the test site locations are given in Appendix A}
- 0800** Arrive at test site
Set up and prep for test
- 0830** Daily morning tag up
Following tag up run test
- 1200-LUNCH** [Generally, remoteness of test site locations require plans to bring your own food and drinks.]
- 1300** Mid-day tag up
Following tag up prep for and run test
- ~1700** Activities at test site complete
Post-test tag-up
Return to USGS (if necessary)
Prep for next day

However, the schedule departs from this standard at the following times:

Due to a night traverse the night before, may start an hour later

Due to Distance Learning Network events

These deviations are discussed at team briefings, as described in Section 3.0.

In case of inclement weather, the D-RATS Mission Manager, or his representative, will contact you. However, we almost always go out to the test site to see what it is like there before we delay or cancel testing.

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3.2 OVERALL FIELD TEST SCHEDULE

The schedule as referenced in Appendix A will be developed annually based on the specific test objectives as planned for the analog scenario of activities and gives an overview schedule for the representative period of time to be spent in the field. Specific directions to the selected test site location will be given to appropriate test teams who will be conducting exercises at this location. Only those test teams who have specific test objectives at a particular location during specified test days shall be authorized to participate. This is necessary to reduce both vehicular and personnel traffic at the test site. Additionally, please carpool to help further alleviate this problem.

4.0 LIVING LIKE A D-RAT: DESERT CLIMATE TIPS

Like the Boy Scout motto declares, you should ‘Be Prepared!’ when in the desert. Morning temperatures can be below freezing, while daytime temperatures can range into the upper 90’s. There are wind gusts up to 35 mph that blow dust into every crevasse, dust devils that blow through camp knocking everything over, sudden downpours from thunderstorms, lightning, humidity below 10%--and that’s all before lunch. You never know what you’re going to be subjected to by Mother Nature while in northern Arizona. However, the following information should help you be prepared for whatever whims strike her fancy.

4.1 BASICS

The basic address concerns regarding **DEHYDRATION**, sunburn, exposure, and walking on rough terrain.

Each person should have:

2-4 L OF WATER PER DAY **MOST IMPORTANT!!!**

Lunch & snacks (energy bars)

Hat with a bill or brim

Sunglasses

Sunscreen

Chap-stick (lip balm)

Sturdy shoes or boots

Jacket & poncho

Long pants/trousers

Access to a First Aid Kit

Dehydration is a serious problem, especially since the effects potentially will be combined with altitude sickness symptoms. Flagstaff is at an elevation of about 7,000 feet and most test sites are at about 4,000-5,000 feet above sea level. Houston is located at 40 feet elevation and it does take some time for lowlanders to acclimate. One of the best methods to alleviate altitude sickness symptoms is to be hydrated. Further, since most of us don’t normally spend our routine office work day out in the wind, sun, and very low humidity, it is easy to become dangerously dehydrated without being aware of it until you feel bad. Take care of yourself and your teammates by watching for symptoms of dehydration, which include the following:

a flushed face

dry, warm skin

small amounts of dark, yellow urine

dizziness, made worse when you stand

persistent fatigue/lethargy

dry mouth with thick saliva

extreme thirst

weakness

cramping in the legs and arms

headache

weakness

nausea.

REMEMBER, drink 2-4 L of water every day!

Additionally, it wouldn’t hurt for your team to put together a small first aid kit that could include medicines for headaches, allergy symptoms, and small cuts and

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scrapes. In case the need for trained medical support arises, a NASA medical technician usually accompanies the team. His primary purpose is to address medical emergencies associated with the test subjects, but he also supports the entire test team as required. Also, please let him know of any pre-existing physical or medical conditions you might have so that he can be properly informed of your particular medical situation.

In addition to the rough terrain, long pants (trousers) and sturdy boots address another hazard inherent to the test environment: the indigenous life. We have seen scorpions, snakes, tarantulas, lizards, vultures, and coyotes. Prickly cacti are hard to see, but are all around. They are real hazards. Proper work clothes and hiking shoes help prevent inadvertent problems. Overall, just be aware that you are in an unfamiliar environment so attention and care is required.

4.2 OPTIONAL ITEMS

These are things that make the day pass more enjoyably.

For your additional comfort:

Chair

Tables

Tent/sun canopy

Flashlight (**Required** for all personnel participating in night test activities, preferably with red lens to protect night vision)

Snacks

Pocket knife

Tarps or containers for equipment in case of rain

Garbage bags

5.0 THINGS TO BRING

The simple answer is, “Bring everything that you need.” Each team should expect to be self-sufficient. Over 13 years of field testing and uncounted trips to the JSC Rock Pile, the EVA team has compiled an 18-page list of everything we need for the field test, down to gray tape and our NASA badges so that we can get back in the gate when we get home. There is some gear without which we might as well turn around and head home. The equipment checklist is double-checked before we head out to the desert. Thus, if we packed it, we need it. Similarly, if you need it, pack it. A good way to check if you have everything you need is to pack your hardware up, take it down the hall, across campus, or outside and go through your full test procedure from set-up to shutdown. If you reach for a zip-tie and it’s not there, add it to your equipment checklist. Another good motto for field testing is, “Expect the unexpected.” Keep that motto in mind as you make your equipment list. Don’t forget to bring emergency **SPARES AND REPAIR SUPPLIES**. If you have a critical component in your system, if at all possible, make sure have a spare component along in the field.

Here is a list of basics that most folks have needed in the field:

a. Power source

Depending on how much you need, this can be a supply of 9V batteries, a 12 V battery, or a generator

b. Battery charging capability

If you have rechargeable batteries, don’t forget the chargers!

Also think about how many batteries you need throughout the day and how often, how long etc. it takes to recharge your batteries.

c. Tools

Including Allen wrenches, screw drivers (small ones too), needle nose pliers, cross-cutting pliers

d. Velcro, zip ties, tape

Other things that are helpful are chairs, tables, and a canopy/shade that you can use to set-up a workspace. Please plan on being self-sufficient. However, we’re all in this together and want everyone to be successful. If you need something that you just don’t have, ask around and you’ll be surprised at what people have available. If a habit isn’t made out of borrowing gear, folks are happy to help out when you need it.

6.0 D-RATS ETIQUETTE

There are a lot of people in the field. Most of these people have worked long and hard hours to get there. All of those people are working long and hard hours while there. All of these people care deeply about the success of their hardware or experiment. All of them are good, smart, talented people who deserve respect, even if they smack their chewing gum in your ear in the most grating of ways.. The point is that nerves can become frayed in the field and it's the little things that can make them snap. The field test is a great experience and can remain so for everyone throughout the entire test IF you remember those things your Mom taught you about being nice. I don't know about you, but when I get tired and stressed I get cranky, and need to keep these in mind.

Ask before you borrow something.

If you do borrow something, return it promptly. Let the person you borrowed it from know that you returned it, and put it back where you found it or put it where they ask you to return it.

Be a good neighbor

Be aware of test activities. There is a lot going on. Be careful so that you don't interfere with someone's data collection.

Be aware of camera locations and try to avoid blocking camera views

Be aware of how much dust, noise, etc your activities may produce and try to minimize the impact to those around you.

Be respectful, polite, nice, cheerful, positive, helpful...

Even when you may not feel like it, or that annoying jerk doesn't deserve it

6.1 COMMUNICATIONS PROTOCOL

----If you are given a suit communications radio to use during a suited subject test, please review this section-----

When the test includes suited subjects, their safety and health are the NUMBER 1 priority. In order to monitor the subjects' status, it is **MANDATORY** that the suit technicians, at a minimum, are able to communicate with the subject. Be aware, that with the current simplex suit communication system, if one person is talking, no one else can be heard. Therefore, the first rule of Suit Radio Usage is:

RULE #1: TALK ON THE LOOP ONLY WHEN ABSOLUTELY NECESSARY

What this works out as, in a practical manner, is that the D-RATS Test Coordinator will let you know when it is okay for you to interact with the test subject. If the subject, suit technicians, Mission Manager, or Test Coordinator indicate that they need the loop, stop talking.

RULE #2: Refer to Rule #1

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If you can handle Rule #1, you'll get along fine. However, there are two additional protocols to follow. First, when speaking on the loop, please follow this format:

- a. "The name of the person you want to talk to"
- b. "Your name"
- c. Wait for a go ahead from the person you're calling
- d. Go ahead with your conversation
- e. End your statements with "Over"

(Just think "Houston, Tranquility Base here. The Eagle has landed. Beep.")

Secondly, please take good care of your radio. After a test is completed, please return the radio to the communication station or lead communication system technician.

7.0 INFORMATION TO SUPPLY TO D-RATS TEST COORDINATOR

Most of this has been covered above, however, because this information is so important to field test team coordination, it is consolidated and reiterated here.

7.1 TRAVELING TEAM MEMBER INFORMATION

Provide the D-RATS Test Coordinator/ Barbara Romig with the following information for each of your team members who will be traveling to the field:

Name
Affiliation
Role/Responsibility
Office Phone
Cell Phone (optional)
Date/time arriving in Flag
Date/time departing Flag
Hotel in Flagstaff

The cell phone numbers are optional, but the Test Coordinator must have a way to reach the Principal Investigator or lead traveler, if the PI is not traveling.

NOTE: It is helpful if you give us a call or leave a message at the hotel when you arrive in Flagstaff.

7.2 STATE OF READINESS PRESENTATION INFORMATION

From section 1.3, the 'state of readiness' presentation contains the following information:

- Test safety issues
- List of equipment being shipped to USGS
- Need for secure storage
- Special arrangements that you need help with or that we should be aware of
- Test date, scheduling, location constraints

APPENDIX A

TEST SITE LOCATIONS AND DESCRIPTIONS

REMOTE FIELD EVA TEST SITE LOCATIONS AND DESCRIPTIONS
(FLAGSTAFF, AZ AREA LOCATIONS)

CINDER LAKE SITE: N 35 degrees, 19 minutes, 21 sec.
W 111 degrees, 31 minutes, 5 sec.

Description of Location:

Test site is located in Holocene cinder beds erupted approximately 900-1100 years B.C.E. in association with the formation of the Sunset Crater Cinder Cone, which lies several kilometers to the north. The test area consists of flat-lying coarse grained cinders erupted from a line of fissures to the east, probably in a rare Plinian event of basaltic composition. This has resulted in a terrain of flat to hummocky topography which overlies the pre-existing alluvial surface. Craters emplaced in the area during Apollo training suggest that the cinders are 5-10 m thick, depending on the roughness of pre-existing topography.

Approximate Distance From USGS/Flagstaff : 15 miles

METEOR CRATER SITE : N 35 degrees, 1 minute, 17.7 sec.
W 111 degrees, 1 minute, 40 sec.

Description of Location:

Test site is located on the rim of a mid-late Quaternary impact crater which formed when an iron-nickel bolide impacted into Mesozoic sediments, primarily the Moenkopi Shale, Kaibab Limestone and Coconino Sandstone. The test site is located within the ejecta blanket, with flat to hummocky terrain created by emplacement of impact fragmented and shocked Kaibab limestone. Boulders up to 2-3 m in size are found, although the majority of the surface consists of smaller, <0.25 m cobbles of primarily Kaibab Limestone in a matrix of shocked and comminuted limestone and sandstone.

Approximate Distance From USGS/Flagstaff : 40 miles

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BAR-T-BAR RANCH SITE : N 35 degrees, 02 minutes, 31.54 seconds
W 111 degrees, 02 minutes, 6.15 seconds

Description of Location:

Test site is located north the rim of a mid-late Quaternary impact crater which formed when an iron-nickel bolide impacted into Mesozoic sediments, primarily the Moenkopi Shale, Kaibab Limestone and Coconino Sandstone. The test site is located in a mostly flat to hummocky terrain of primarily Moenkopi Shale, which is nearly flat lying. The variable nature of the Moenkopi is evident, as 1-3 m high hummocks are armored by thin (<1 m thick) beds of indurated shale, which is in turn interbedded with layers of less indurated fine sand/clay sediments that have eroded away.

Approximate Distance From USGS/Flagstaff : 40 miles

SP MOUNTAIN SITE : N 35 degrees, 35 minutes, 19 sec.
W 111 degrees, 38 minutes, 13.6 sec.

Description of Location:

Test site is located on a mid-late Quaternary (approximately 70,000 years old) basaltic lava flow that issued from the base of a prominent cinder cone approximately 0.5 km south. The cinder cone is remarkably symmetric, and is the most prominent local terrain feature. The lava flow is largely infilled by post-eruption, probably aeolian sediment, but there are significant patches of coarse rubble and squeeze-ups that reflect the original topography of the lava flow.

Approximate Distance From USGS/Flagstaff : 50 miles

MOENKOPI PLATEAU SITE: N 36 degrees, 4 minutes, 55.2 sec.
W 111 degrees, 18 minutes, 19.8 sec.

Description of Location:

Test site is located in relatively flat-lying Upper Triassic Redbeds of the Chinle Formation, composed of interbedded siltstone, sandstone, mudstones and conglomerates that weather in a badland erosional style. Occasional mega-fauna and flora (primarily Reptilia, Amphibia, and early Dinosauria sp., fish, aquatic invertebrates and large tree trunks) may be found.

Approximate Distance From USGS/Flagstaff : 70 miles

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WARD TERRACE SITE : N 36 degrees, 4 minutes, 55.2 sec.
W 111 degrees, 18 minutes, 19.8 sec.

Description of Location:

Test site is located in relatively flat-lying Lower Jurassic Redbeds of the Kayenta Formation, composed of interbedded siltstone, sandstone, mudstones and conglomerates. Variations in the sediment type and induration have created a small, amphitheater-like valley in cliff/slope terrain. Total relief in the area is on the order of 10-20 m.

Approximate Distance From USGS/Flagstaff : 70 miles

JOSEPH CITY SITE : N 35 degrees, 00 minutes, 10.8 sec.
W 110 degrees, 19 minutes, 40.1 sec.

Description of Location:

Test site is located in a relatively flat-lying Upper Triassic blue-gray beds of the Chinle Formation, composed of interbedded siltstone, sandstone, mudstones and conglomerates that weather in a badland erosional style. The specific test area is eroded hummocks of Petrified Forest Member, with grey, green and tan mudstones eroding to form a surficial soil composed primarily of loose bentonitic/montmorillonitic clay. Occasional mega-fauna and flora (primarily Reptilia, Amphibia, and early Dinosauria sp., fish, aquatic invertebrates, and large tree trunks) may be found.

Approximate Distance From USGS/Flagstaff : 80 miles

LITTLE PAINTED DESERT OVERVIEW SITE:

N 35 degrees, 9 minutes, 21.6 sec.
W 110 degrees, 28 minutes, 24.9 sec.

Description of Location:

Test site is located in relatively flat-lying Upper Triassic blue-gray and red beds of the Chinle Formation, composed of interbedded siltstone, sandstone, mudstones and conglomerates that weather in a badland erosional style. Occasional mega-fauna and flora (primarily Reptilia, Amphibia, and early Dinosauria sp., fish, aquatic invertebrates and large tree trunks) may be found.

Approximate Distance From USGS/Flagstaff : 110 miles

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PETRIFIED FOREST NP SITE : N 35 degrees, 4 minutes, 26.8 sec.
W 109 degrees, 46 minutes, 3.5 sec.

Description of Location:

Test site is located in relatively flat-lying Upper Triassic Redbeds of the Chinle Formation, composed of interbedded siltstone, sandstone, mudstones and conglomerates that weather in a badland erosional style. Significant mega-flora, mostly in form of agatized tree trunks, abound, although some Reptilia, Amphibia, and early Dinosauria sp., fish and aquatic invertebrates may be found as well.

Approximate Distance From USGS/Flagstaff : 125 miles

APPENDIX B

TEST SCHEDULE – TBD ANNUALLY