

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF LAND MANAGEMENT  
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In Reply Refer To:  
1610, 8270 (240) PEMS TRANSMISSION 10/18/2007  
Instruction Memorandum No. 2008-009  
Expires: 09/30/2009To: All State Directors  
From: Assistant Director, Renewable Resources and Planning  
Subject: Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands**Program Areas:** Paleontological Resources Management, Resource Management Planning, Lands and Realty Management, Minerals Management, Range**Purpose:** This Instruction Memorandum (IM) transmits the Bureau of Land Management (BLM) classification system for paleontological resources on public lands. The classification system is based on the potential for the occurrence of significant paleontological resources in a geologic unit, and the associated risk for impacts to the resource based on Federal management actions. Copies of the classification system and implementation guidance are attached.**Policy/Action:** The Potential Fossil Yield Classification (PFYC) system will be used to classify paleontological resource potential on public lands in order to assess possible resource impacts and mitigation needs for Federal actions involving surface disturbance, land tenure adjustments, and land-use planning. Implementation of the PFYC system will not mandate changes to existing land use plans, project plans, or other completed efforts. Integration into plans presently being developed is discretionary. All efforts subsequent to issuance of this IM should incorporate the PFYC system. This system will replace the current Condition Classification in the Handbook (H-8270-1) for Paleontological Resource Management.**Timeframe:** This guidance is effective immediately for all BLM offices.**Background:** This classification system for paleontological resources is intended to provide a more uniform tool to assess potential occurrences of paleontological resources and evaluate possible impacts. It uses geologic units as base data, which is more readily available to all users. It is intended to be applied in broad approach for planning efforts, and as an intermediate step in evaluating specific projects. This is part of a larger effort to update the Handbook H-8270-1 (General Procedural Guidance for Paleontological Resource Management) Chapter III (Assessment & Mitigation) and Chapter II.A.2 and will be incorporated into that Handbook update.**Impact on Budget:** Costs for the initial classification of geologic units for those States that have not already determined the classification will be borne by each Office. Implementation of the PFYC system will have no additional costs.**Manual/Handbook Affected:** Supersedes H-8270-1 (General Procedural Guidance for Paleontological Resource Management) Chapter II.A.2.**Coordination:** The classification system is the product of the BLM's regional paleontologists, other BLM employees, and outside reviewers. This system is very similar to the Forest Service's Fossil Yield Potential Classification and will enable closer coordination of paleontological resource management between the agencies.**Contact:** For questions regarding application of this policy and guidance, please contact Lucia Kuizon, National Paleontologist, at (202) 452-5107 or lkuizon@blm.gov.Signed by:  
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## 2 Attachments:

- 1 – The Potential Fossil Yield Classification (PFYC) System (4 pp)
- 2 – Guidance for Implementing the PFYC System (5 pp)

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## Potential Fossil Yield Classification (PFYC) System.

Occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

Using the Potential Fossil Yield Classification (PFYC) system, geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. It is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions.

The descriptions for the classes below are written to serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual units or preservational conditions should be considered when determining the appropriate class assignment. Assignments are best made by collaboration between land managers and knowledgeable researchers.

**Class 1 – Very Low.** Geologic units that are not likely to contain recognizable fossil remains.

- Units that are igneous or metamorphic, excluding reworked volcanic ash units.
- Units that are Precambrian in age or older.

(1) Management concern for paleontological resources in Class 1 units is usually negligible or not applicable.

(2) Assessment or mitigation is usually unnecessary except in very rare or isolated circumstances.

The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is non-existent or extremely rare.

**Class 2 – Low.** Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils.

- Vertebrate or significant invertebrate or plant fossils not present or very rare.
- Units that are generally younger than 10,000 years before present.
- Recent aeolian deposits.
- Sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration).

(1) Management concern for paleontological resources is generally low.

(2) Assessment or mitigation is usually unnecessary except in rare or isolated circumstances.

The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities would be managed on a case-by-case basis.

**Class 3 – Moderate or Unknown.** Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.

- Often marine in origin with sporadic known occurrences of vertebrate fossils.
  - Vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently; predictability known to be low.
- (or)
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.

**Class 3a – Moderate Potential.** Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.

**Class 3b – Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant finds. The units in this Class may eventually be placed in another Class when sufficient survey and research is performed. The unknown potential of the units in this Class should be carefully considered when developing any mitigation or management actions.

(1) Management concern for paleontological resources is moderate; or cannot be determined from existing data.

(2) Surface-disturbing activities may require field assessment to determine appropriate course of action.

This classification includes a broad range of paleontological potential. It includes geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options as well, and could include pre-disturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action, and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

**Class 4 – High.** Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface disturbing activities may adversely affect paleontological resources in many cases.

*Class 4a* – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from surface disturbing actions. Illegal collecting activities may impact some areas.

*Class 4b* – These are areas underlain by geologic units with high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 4 is moderate to high, depending on the proposed action.

(2) A field survey by a qualified paleontologist is often needed to assess local conditions.

(3) Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered.

(4) Class 4 and Class 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application.

The probability for impacting significant paleontological resources is moderate to high, and is dependent on the proposed action. Mitigation considerations must include assessment of the disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the surface disturbing action will usually be necessary. On-site monitoring or spot-checking may be necessary during construction activities.

**Class 5 – Very High.** Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation.

*Class 5a* – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from surface disturbing actions. Unit is frequently the focus of illegal collecting activities.

*Class 5b* – These are areas underlain by geologic units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 5 areas is high to very high.

(2) A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments. Mitigation will often be necessary before and/or during these actions.

(3) Official designation of areas of avoidance, special interest, and concern may be appropriate.

The probability for impacting significant fossils is high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can reasonably be expected to occur in the impacted area. On-the-ground surveys prior to authorizing any surface disturbing activities will usually be necessary. On-site monitoring may be necessary during construction activities.

## **Guidance for implementing the Potential Fossil Yield Classification (PFYC) System**

### **Introduction**

The Potential Fossil Yield Classification (PFYC) system will aid in assessing the potential for discovery of significant paleontological resources or the impact of surface disturbing activities to these resources.

It is intended to assist in determining proper mitigation approaches for surface disturbing activities, disposal or acquisition actions, recreation possibilities or limitations, and other BLM-approved activities. It will provide consistent information for input and analysis during planning efforts. The PFYC system can also highlight the areas most likely to be a focus of paleontological research efforts or illegal collecting. It is hoped that this system will allow BLM to direct management efforts toward potentially significant areas and reduce efforts in areas of lower potential.

This classification system was originally developed by the Forest Service's Paleontology Center of Excellence and the Region 2 (FS) Paleontology Initiative in 1996. Modifications were made by the BLM's Paleontological Resources staff in subsequent years.

Paleontological resources are closely associated with the geologic rock units containing them; that is, fossils are found more frequently in some rock units than others. The management of paleontological resources can thus be tied to the geologic units present at or near the ground surface, with greater management emphasis aimed at higher potential geologic units.

### **Uses**

This PFYC system is utilized for land use planning efforts and for the preliminary assessment of potential impacts and proper mitigation needs for specific projects. It is intended to provide a tool to assess potential occurrences of significant paleontological resources. It is meant to be applied in broad approach for planning efforts, and as an intermediate step in evaluating specific projects.

There are five Classes with Class 1 being Very Low Potential and Class 5 being Very High Potential. Although granite, lava beds, and other igneous or metamorphic rock types are usually considered to be void of any fossils, outcrops of these rocks may have fissure fillings, cave-like structures, sinkholes, and other features that may preserve significant paleontological resources or information, so the potential is not zero; therefore Class 1 is applied to these rock types usually considered not to contain fossil resources.

It is intended that this system replace the current Condition Classification in the Handbook (H-8270-1), for Paleontological Resource Management. In general, the following is a comparison of the Condition Classification rankings to the new PFYC Classes:

<b>Condition (from H-8270-1)</b>	<b>PFYC Class (this Instruction Memorandum)</b>
Condition 1 – Areas known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. (Note: this refers to known localities or groups of localities)	PFYC Class 4 (High) or Class 5 (Very High), based on geologic unit.
Condition 2 – Areas with exposures of geological units or settings that have high potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils.	PFYC Class 3 (Moderate), Class 4 (High), or Class 5 (Very High), based on geologic unit.
Condition 3 – Areas that are very unlikely to produce vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils.	PFYC Class 1 (Very Low) or Class 2 (Low).

**Assignment of Classes**

A separate class ranking is assigned to each recognized geologic formation or member present at the surface. Deposits of young alluvium (post-Pleistocene) or thick soils can often be ignored. However, geologic mapping may not separate the older Pleistocene alluvium which, may contain significant vertebrate fossils, and thus these units need to be carefully considered. Available geologic mapping, depending on map scale, may combine multiple formations or units. In these cases, the assigned classification should use the highest class of those included units. For ease of application, the classifications should be integrated into a Geographic Information System (GIS) based geologic map.

The classification is initially determined by the Regional Paleontologist; the State Office Paleontology Lead in collaboration with the Regional Paleontologist; or by knowledgeable individuals from a paleontology museum, university paleontology department, or consulting firm working under a formal agreement. Several States have already completed an initial classification and are incorporating the system into new planning and mitigation efforts.

To maintain consistency in planning efforts, mitigation requirements, and other management approaches, the classification should be applied to each formation on a state-wide basis, and even across State boundaries. But in some situations, geologic characteristics within formations may change across the State or region and may alter the potential for fossil occurrence. These differences may be a characteristic of the formation, be variable in occurrence, and unmappable at a workable scale; or may indicate a regional gradient, where a formation is highly fossiliferous in one portion of the State, but has lowered potential in another area. A variable occurrence in potential may be included in the general information about the formation. A regional gradient can be addressed by assigning a different class for separate areas.

Multiple class assignments for an individual formation should be applied in consultation with the State Office to maintain consistency across Field Office boundaries.

Over time, additional information may be acquired or developed that may suggest that a change in the class assignment is appropriate, especially from the Unknown Class (3b) to a higher or lower class. The classification should reflect the most current information, and recent research or discoveries may indicate a change is warranted. However, any changes should be measured against existing applications or use of the current classification, such as usage in Resource Management Plans (RMPs) or other planning or management documents.

### **Application**

In planning documents and other general applications, these classes allow for uniform discussion of the paleontologic resource, potential adverse impacts, and management approaches. Assessment of general conditions, such as acres or percentages of each class, or spatial identification of important areas can be determined and presented in simple manner. Identification of areas of potential concern with other resources can be identified using GIS mapping or explained in the text body in simple fashion.

The PFYC classes may also be utilized to assess the possibility of adverse or beneficial impacts from land tenure adjustment (disposal or acquisition) proposals prior to on-the-ground surveys.

A primary purpose of the PFYC is to assess the possible impacts from surface disturbing activities and help determine the need for pre-disturbance surveys and monitoring during construction. This assessment should be an intermediate step in the analysis process; and local conditions such as amount of exposed bedrock should be considered when final mitigation needs are determined. The determination should also be supplemented by occurrences of known fossil localities and local geologic and topographic knowledge.

### **Mitigation Needs Assessment**

Impacts of most surface-disturbing activities, and the need for mitigation efforts, are addressed by the local Field Office. Some larger actions, such as major pipeline projects, may be handled by the State Office, or even as multi-State projects. In all these cases, the assessment of impacts to paleontological resources and need for mitigation can be addressed in similar fashion through a progression of steps. The following outlines the general steps used to apply the PFYC system to this mitigation process.

- 1. Identify the proposed action and affected area.** Consider the area directly impacted by the action, as well as areas that may be impacted by vehicle drive ways, equipment parking, storage areas, and increased access. Also consider the depth of disturbance to determine possible subsurface impacts.



**2. Identify the potential impacts to paleontological resources.** Determine the geologic units that may be impacted and the associated PFYC classes, and consult other sources of information about known localities or paleontological research that may have been done previously.

Based on the PFYC class and any additional resource information, determine the probability of impacting significant paleontological resources. If known localities are in the area of possible impact, determine if those localities can be avoided by altering the proposed action, such as repositioning a well pad location or rerouting a pipeline around a locality.

**3. Determine the need for field survey or other mitigation efforts.** On-the-ground field surveys, on-site monitoring, spot-checking at key times during construction, or locality avoidance are all possible mitigation approaches to lessen adverse impacts.

- If the PFYC class for the impacted area is Class 1 or 2, and there are no known localities within the area, no further assessment is typically needed.

- If a Class 3a (Moderate Potential) unit underlies the area, the local geologic conditions should be considered, as well as any known localities in the region. It may be necessary to consult with the Regional Paleontologist or other qualified paleontologist to assess the local conditions.

- If a Class 3b (Unknown Potential) unit underlies the area, it may be appropriate to require an on-site preliminary assessment by a qualified paleontologist.

- If the area is a Class 4b (buried bedrock with High Potential) or Class 5b (buried bedrock with Very High Potential), an assessment of the possible impacts to bedrock units must be made. If the proposed action will not penetrate the protective soil or alluvial layer, a pre-work survey or monitoring during the activity may not be necessary. If the potential exists to remove the protective layer and impact the bedrock unit below, it may be prudent to require a pre-work field survey and/or on-site monitoring during disturbance or spot-checks at key times. Because the bedrock unit is typically buried for much of the area in question, a pre-work survey may not always be necessary, as the fossil material may not be visible. However, it may then be more important to have an on-site monitor during disturbance or spot-checks at key times.

- If it is a Class 4a (exposed bedrock with High Potential) or Class 5a (exposed bedrock with Very High Potential) area, it will be necessary in most (Class 4a) or almost all (Class 5a) situations to require a pre-activity field survey of the areas directly and indirectly impacted.

Larger projects may impact multiple geologic units with differing PFYC Classes. In those cases, field survey and monitoring may be applied at differing levels. For example, surveys may be appropriate only on the Class 4 and 5 formations and not the Class 2 formations along a pipeline project. Careful mapping and detailed field notes should reflect the differing survey/monitoring intensities, and should be included in the consultant's report to BLM.

**4. Conduct Pre-work Field Survey.** Field surveys are almost always needed for Class 4 and 5 units, especially exposed bedrock areas (Class 4a and 5a). Class 3 units may or may not require a survey. Local conditions, such as vegetated areas or pockets of bedrock exposure, may affect the need and intensity of field surveys.

The consultant is required to submit a report of findings after completion of the field survey. In addition to standard reporting information, the report should contain the consultants' recommendations for further mitigation, and this recommendation should be considered when determining the need for and type of on-site monitoring or locality avoidance.

**5. Monitor during disturbance activities.** Those areas that have been determined to have a Very High potential (Class 5) for adverse impacts should typically be monitored at all times when surface-disturbing activities are occurring. If the area has a High potential (Class 4), it may be appropriate to examine the exposed unit, including the spoil or storage piles, only at key times. These times are dependent on the activity, but typically are: when bedrock is initially exposed, occasionally during active excavation, and when the maximum exposure is reached and before backfilling has begun. This monitoring and spot-checking must be performed by a permitted paleontologist or their BLM-approved representative. The monitor has the authority to briefly pause any activity to inspect a possible find. These pauses are intended to allow for identification of possible fossil resources and should only last a few minutes to a couple hours.

**6. Evaluate significant finds.** If significant paleontological resources are discovered during surface disturbing actions or at any other time, the proponent or any of his agents must: (a) stop work immediately at that site; (b) contact the appropriate BLM representative, typically the project inspector or Authorized Officer, as soon as possible; and (c) make every effort to protect the site from further impacts, including looting, erosion, or other human or natural damage. The BLM or designated paleontologist will evaluate the discovery and take action to protect or remove the resource within 10 working days. Work may not resume at that location until approved by the official BLM representative. In some cases, such as recovery of a dinosaur, further activity at that site may be delayed until the discovered fossils are recovered, or until the project is modified to avoid impacting the find. Because of the potential for lengthy delays, the BLM should assure that the project proponent understands this possibility prior to approval to begin work.

These steps are included here to provide general guidance, and it may be appropriate to modify or skip them for various situations. However, a brief discussion of the background and reason for modification should be placed in the project file.

For all surface-disturbing activities occurring within Class 3 or higher units, a stipulation should be included in the permitting document.

### **Further Information**

Detailed information on the geologic units and paleontological resources within a State can often be obtained from State geological surveys, geological or paleontological museums, geology departments at universities or colleges, paleontological permittees or other researchers or within the BLM from Regional Paleontologists or knowledgeable Geologists.

Scientific publications, such as professional journals or State geological survey reports, often contain general and detailed information about paleontological and geological resources relevant to fossil potential and occurrences for specific areas. Current and past paleontological permittee reports usually include precise locality data and maps, and often contain discussions of findings and their significance.