

**Oregon Parks and Recreation Commission**

**September 20, 2023**

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Agenda Item: 6a

**Action**

Public Comment Allowed: **Yes**

Topic: Natural Areas Registration – Fossil School District Public Fossil Beds

Presented by: Noel Bacheller

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**Background:** The Oregon Natural Areas Plan lists the rare species, ecosystems, and geological features present in Oregon and where they are represented by protected lands. OPRD maintains the Oregon register of State Natural Areas and is responsible for processing nominations and petitions received to voluntarily add lands to the register.

“Registration” and “dedication” are two vehicles for inclusion of properties on the register, with dedication being the more permanent arrangement. Privately owned lands that are protected through registration or dedication receive a waiver of land use conversion property taxes. Publicly-owned lands are registered because of ecological value without receiving a tax benefit. In all cases of registration, or dedication, the subject properties are required to be of high or unique ecological value.

The types of habitat that are eligible for inclusion on the register are described and cataloged in the State Natural Areas Plan as “ecosystem elements”. When enough examples of a particular ecosystem element are registered, that type is considered adequately represented and further registrations are no longer allowed for that element. Find more information about the Natural Areas Program from the Oregon Natural Areas Plan at

[https://inr.oregonstate.edu/sites/inr.oregonstate.edu/files/2015\\_or\\_natural\\_areas\\_plan.pdf](https://inr.oregonstate.edu/sites/inr.oregonstate.edu/files/2015_or_natural_areas_plan.pdf)

Per legislation, the steps in processing registration nominations are as follows: OPRD Stewardship staff and the Oregon Biodiversity Information Center (or a convened review board, at OPRD discretion) collaboratively review petitions for meeting the requirements of the State Natural Area Plan. If the subject property meets the requirements and intent of the Plan, OPRD Stewardship staff bring the proposal for registration to the Parks Commission for final decision regarding registration.

Oregon Paleolands Institute approached OPRD and Oregon Biodiversity Information Center staff in 2022 and 2023 with a proposal to register the active public fossil digging area behind Wheeler High School in Fossil, Oregon. The School District has provided a landowner consent letter. The area proposed for registration contains layers of rock of the Bridge Creek Flora unit of the larger John Day Fossil Beds geological formation. The site is on a hillside adjacent to the sports fields that has been excavated for ancient fossils for many years. The site is of scientific value and is a source of hobby fossil collecting by the general public. Fossil excavation by the public is done for a fee that provides financial support to school programs.

Oregon Paleolands Institute is seeking registration to recognize the site's natural heritage value and to attract grant funding to help develop methods for collaborative scientific data recovery and long-term strategic planning for the site.

The attached maps, photos, and Department of Geological and Mineral Industries (DOGAMI) report provide more background on the site and its values. Also included is a memo restating and interpreting the rules with respect to this proposal.

This registration proposal is different from anything the program has registered before. All other registrations of properties under this program have been predominantly natural, and encompass unique habitats and species. This site does not contain any significant natural habitats or species, and is very disturbed due to the history of public fossil digging. The rules for registrations do allow for registrations of fossil sites and geological formations, but the language around eligibility is not precise with regard to eligibility requirements and allowable uses. The other registered fossil sites on the natural areas register (all within the John Day Fossil Beds National Monument) do not allow unmanaged public digging and also contain high quality natural habitats and species of conservation priority.

**Prior Action by the Commission:** None.

**Action Requested:** Staff recommend that the Commission declare the site eligible and provisionally register the property for a five-year period to allow for development of a sustainable management plan and strategy for scientific data recovery.

**Attachment:** Registration background

**Prepared by:** Noel Bacheller

OREGON PARKS AND RECREATION DEPARTMENT  
OREGON REGISTER OF NATURAL HERITAGE RESOURCES  
SUMMARY FORM

1. NATURAL AREA NAME: Fossil School District Public Fossil Beds
2. LOCATION: Wheeler County, Township 21 South, Range 33 East, Willamette Meridian. Section 6
3. SIZE: 3 acres
4. OWNERSHIP: Fossil School District 404 Main St. Fossil Oregon 97830 541-763-4384
5. CONSENT OF OWNER (PRIVATE), DATE: Aug 2022
6. REGISTER CATEGORY: Private Natural Area with Public Access
  
7. PRINCIPAL NATURAL HERITAGE RESOURCES:  
Bridge Creek Formation of the John Day Fossil Beds:  
Outstanding geological formation. Offers location to collect Metasequoia, Oregon's official state fossil. See Oregon Geology newsletter Volume 68 number 1, 2007
  
8. SPECIAL SPECIES: Fossilized plant material from 30 million years ago includes, metasequoia, sycamore, maple, pine relatives.
  
9. EVALUATION OF CRITERIA FOR REGISTRATION
  - A. PRIORITY IN PLAN: Recognizing these fossil beds meets Goal number one of the 2003 Natural Heritage Plan: to create a system of areas representing the full range of Oregon's Natural Heritage resources to be used for research, education and interpretation.
  
  - B. ADEQUATE REPRESENTATION: The site is along a cut bank adjacent to the North of Fossil School District's sports field.
  
  - C. DEGREE OF DISTURBANCE: This site has some disturbance due to the fact that acquiring fossils requires individuals to dig with hand tools. A 2007 publication of Oregon Geology (Oregon Department of Geology and Mineral Industries) (DOGAMI) of a preliminary investigation of the Fossil Resources around the town of Fossil indicate that the fossil resources on school property are much larger than the exposed collection area. DOGAMI estimated 68,000 dump truck loads of fossils are likely on the site. Visitors are limited to removing 2 handfuls of material per visit at the site.
  
  - D. VIABILITY: Estimated resources made by DOGAMI in 2007 indicate over 68,000 dump truck loads available on school property. Additional beds have been identified on Wheeler County and City of Fossil properties within 1 mile.
  
  - E. UNIQUE GEOLOGICAL VALUES: The Bridge Creek formation of the John Day Fossil beds provides a glimpse into a 30 million year old temperate forest. Fossils are located in tuffaceous siltstone and sandstone.
  
  - F. PRIORITY FOR SPECIAL SPECIES: The Bridge Creek Formation of the John Day Fossil Formations on the John Day River Basin continues to reveal new find of new species regularly. It

is a portion of the greatest assemblage of the Age Of Mammals on Earth and a location where citizens can collect the Oregon State Fossil, Metasequoia.

G. SPECIAL SPECIES PROTECTION CAPABILITY: Fair

Fossil School District Public Fossil Beds Summary Form Page 2

H. MANAGEABILITY: The site is on Fossil School District private lands and will continue to be monitored by the District. The school district is developing a Memorandum of Understanding with the Oregon Paleo Lands Institute, 333 W. Fourth St, Fossil Or, which manages a fine visitor center approximately 10 blocks from the fossil beds. This MOU includes sharing information on using the collection area and interpreting finds for visitors.

10. SPECIAL REMARKS OR COMMENTS: The Oregon Paleo Lands Institute has been offering interpretation and guidance for the beds for over a decade.

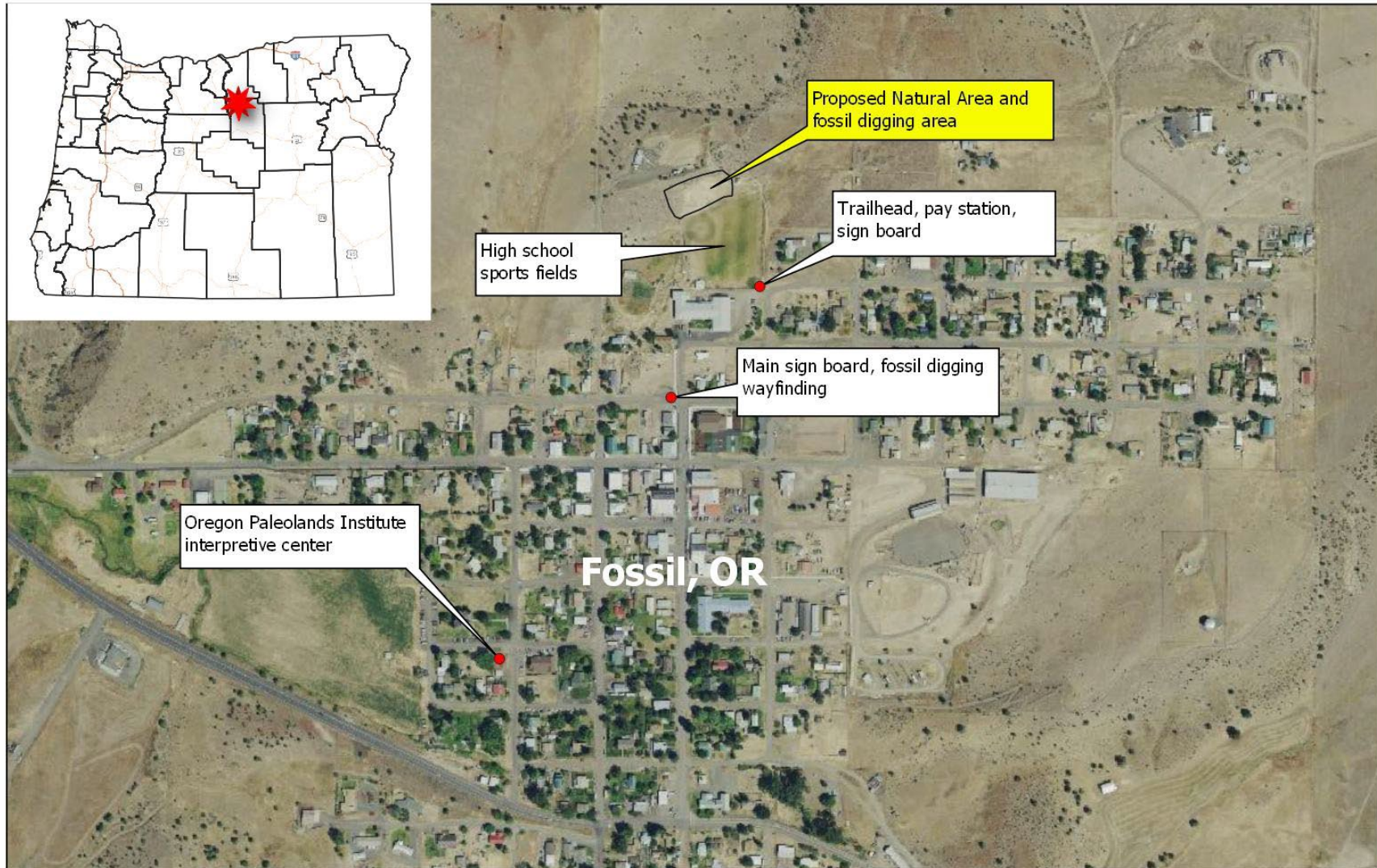
12. DATE OF ORBIC STAFF APPROVAL: \_\_\_\_\_

13. SOURCES OF ADDITIONAL INFORMATION: Oregon Biodiversity Information Center, Mailstop: INR, PO Box 751, Portland, OR 97207. Fossil School District 404 Main Street, Fossil Oregon 97830 541-763-4383, Oregon Paleo Lands Institute, 333 West 4<sup>th</sup> St, Fossil Oregon 97830 [www.oregonpaleolandscenter.com](http://www.oregonpaleolandscenter.com), Department of Geology and Mineral Industries, *Oregon Geology* 2007, V 68, No. 1, *Journal of Paleontology* V. 33 Page 125-139. 1959, *USGS Bulletin John Day Basin Flora*, 1902, *Bridge Creek Flora*, University of California Press page 195.

14. VALUE OF NATURAL AREA IN LAY TERMS: Located in the City of Fossil, the County seat of Wheeler County the area includes local signage directing fossil collectors. It is one of the few fossil beds in the Western United States where citizens can collect and retain plant fossil from the Age Of Mammals. It is an assemblage of the Bridge Creek Flora of the John Day Fossil Beds. It is often visited by families. Fossils were reported collected by Merriam near the City of Fossil in 1900.

Fossil Proposed Natural Area

Oregon Parks and Recreation Dept.  
725 Summer St. NE, Suite C  
Salem OR, 97301



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EPSG:6557  
NAD83(2011) / Oregon GIC Lambert (ft)



NJB 07/27/2023  
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proposed natural area.gqz





**School District Registration Permission Letter:**

RE: inclusion of Fossil Beds into Registry

March 10 , 2023

Dear Oregon Natural History Registry Managers,

We have been working with Jeffrey Kee at the Oregon Paleo Lands Institute to consider having the public fossil collection area on Fossil School District property, In the City of Fossil, Wheeler County Oregon, included into the Register of Natural Heritage Resources in Oregon.


We believe the site on our property is an important part of Oregon and its' citizens natural heritage. Families have been collecting 30 million year old leaf fossil in the area for decades. Samples have even been taken to Japan to share with students there.

We acknowledge that inclusion into the registry will likely raise awareness of the site and afford us additional support to make improvements, improve visitor experiences and enhance District students educational opportunities.

We also understand that we can request that the site be removed from the Registry at any time by written request from the site owner, Fossil School District.

The Fossil School District would like to request that the collection area North of the ball fields on private School District property be included into the Oregon State Register of Natural Heritage Resources.

We appreciate your consideration.

  
Superintendent Fossil School District \_\_\_\_\_

Office

404 Main St.

Fossil Oregon 97830. 541-763-4384

Superintendant Jon MCMurray: [jmcmurray@fossil.k12.or.us](mailto:jmcmurray@fossil.k12.or.us)

Jeffrey Kee, President Oregon Paleo Lands Institute  
333 4th Street, Fossil Oregon 97830  
503-939-7939

**School District Policy:**

The district will provide management services for the fossil beds behind Wheeler High School to ensure their continuation as a future scientific resource for mankind and scientific study.

There will be no camping on school grounds, whether in tents, vehicles or open air.

The school will provide tools at the beginning of the year for public use but tools may not always be available due to breakage or loss.

Patrons will be expected to contribute a donation for the opportunity to dig. These donations will go to support activities such as athletics, music and reading programs or other extracurricular activities.

Patrons will be expected to keep the grounds clean and tidy (to facilitate this garbage cans will be provided) and will not leave tools or other items on the hill or on the athletic fields.

There will be no smoking or alcohol allowed on school grounds, this includes the fossil beds.

There will be a limit of five (5) fossils that an individual may take from the beds.

Patrons will not throw rocks on the athletic field for the safety of athletes and physical education students.

Crude language and behavior will not be tolerated on school grounds, including the fossil beds.

Patrons of the fossil beds will not disturb students in classes, whether inside or outside the school.

Any dogs or other animals on the field or the fossil beds will be expected to be cleaned up after by their owners.

We intend for these beds to be used by as many patrons as possible, therefore, we must limit the length of stay for any patron to a maximum of three days, though their housing must be off-site.

This policy will be posted at the informational kiosk at the bottom of the hill below the high school and at the entrance of the fossil beds.

Approved 11/15/2022



## Preliminary assessment of the extent of the leaf fossil beds at Wheeler High School, Fossil, Wheeler County, Oregon

by Mark L. Ferns<sup>1</sup>, Jason D. McClaughry<sup>1</sup>, and Ian P. Madin<sup>2</sup>

### EXECUTIVE SUMMARY

At the request of the Oregon Paleo Lands Institute Board, geologists from the Oregon Department of Geology and Mineral Industries (DOGAMI) undertook a preliminary investigation of the extent of the fossil beds at Wheeler High School in the town of Fossil, Wheeler County, Oregon. The investigation included several days of fieldwork, a magnetometer survey, chemical analysis of lava flows, and water well drilling log analysis. Our findings include:

- The fossil beds exposed north of the football field slope southwest at 20° to 30°, which means that they are at depths of almost 60 m (200 ft) below the surface beneath the existing high school building.
- The beds are probably cut off by a fault that runs east to west beneath the football field and have probably been displaced to even greater depths on the south side of the fault.
- There is probably little additional fossil resource available on school property adjacent to the currently exposed deposits.
- Thick soil and colluvium appear to cover bedrock on most slopes in the area; shallow excavations may be required for new fossil discoveries.
- The fossil beds at the high school likely extend east and west onto private property but would require excavation to reveal.
- Fossil beds occur adjacent to the Wheeler County Waste Transfer Facility.
- Water well data and some field evidence suggest that fossil beds may be present south and east of the County Fairgrounds in Fossil.

Our conclusion is that it is unlikely to be possible to develop additional fossil resources on the high school property beyond the existing beds. These findings are preliminary; extensive additional fieldwork and drilling are needed. A more cost effective strategy may be to prospect for additional fossil beds on nearby public property at the fairgrounds or at the waste transfer facility. A detailed map of the distribution of fossil-bearing layers in the existing deposit, along with a program to manage excavation spoils, would give an improved understanding of the volume and geometry of the fossil deposits and help conserve the resource to extend the life of the public fossil collecting program.

<sup>1</sup> Oregon Department of Geology and Mineral Industries, Baker City Field Office, 1510 Campbell Street, Baker City, OR 97814-2109

<sup>2</sup> Oregon Department of Geology and Mineral Industries, 800 NE Oregon Street #28, Suite 965, Portland, Oregon 97232

### INTRODUCTION

Staff from the Oregon Department of Geology and Mineral Industries (DOGAMI) conducted short field visits to the Wheeler High School leaf fossil locality in Fossil, Oregon, in November 2004 and January 2005. The visits were at the request of Richard Ross, the Director of the Oregon Paleo Project, in response to questions raised by potential funding organizations. The curator for the Wheeler High School locality, Karen Masshoff, accompanied DOGAMI staff in the field. The purpose of the visit was threefold: 1) to determine, if possible, whether a sufficiently large fossil resource remains on school property to support further development; 2) to provide guidance for the Oregon Paleo Lands Institute Board regarding the steps needed to fully determine the size, physical location, geologic character, and significance of the fossil resource; and 3) to identify other areas in and around the town of Fossil where similar paleontological resources may occur.

Present site development plans assume that the same fossil leaf beds excavated on the ridge north of the high school football field are present beneath the football field. The initial DOGAMI visit noted indirect geologic evidence for a fault that probably truncates the southward extension of the fossil beds beneath the football field. A ground magnetometer survey to determine if there is geophysical evidence for the suspected fault, coupled with cursory examination of water well logs in the area, indicates a strong probability that a large fault is present. The overall geologic structure of the area, together with a few field observations, suggests that the fossiliferous layers may be present on the hill to the southeast of the fairgrounds. Additional exposures of fossiliferous layers were observed at the Wheeler County Waste Transfer Facility.

### BACKGROUND

One of Oregon's most accessible fossil collecting sites is located on the Wheeler High School grounds. School groups and hobbyists have collected a large variety of plant fossils from this central Oregon site since its discovery in 1949. The locality contains plant macrofossils (including leaves, stems, and fruits) that make up the well-known Bridge Creek flora (Chaney, 1925). Most Bridge Creek flora sites are located in the John Day Fossil Beds National Monument and as such are not open to public collecting. The Wheeler High School site is one of the few fossil collecting sites in central Oregon that is currently open to the general public. If sufficient fossil-rich material remains after more than 50 years of use, then the high school site would

(Leaf beds, continued from page 34)

be an ideal place to develop educational, collecting, and curatorial facilities.

### SITE GEOLOGY

The fossil beds at Wheeler High School, herein referred to as the "Fossil High" leaf beds, are shown as a small inlier of John Day Formation rocks surrounded by older Clarno Formation rocks on Robinson's (1975) large-scale reconnaissance map of the John Day Formation. Younger, tilted Miocene Columbia River Basalt flows overlies more steeply dipping strata of Clarno and John Day formations just west of Fossil, forming the northwest limb of a broad, east- to northeast-trending fold. The Fossil High leaf beds dip to the south. Where exposed, the local base of the John Day Formation north of Fossil is marked by thick-bedded, pumice-lapilli tuff as much as 200 m (600 ft) thick that is correlative with member "g" of the John Day Formation (Robinson, 1975). A rhyodacite flow overlies the lapilli tuff north of Fossil (Robinson, 1975).

The Fossil High leaf beds are exposed on the south side of a 15 m (50 ft) high northeast-trending ridge located at the north end of the high school football field. The ridge is here referred to as the "gun club ridge" (Figures 1 and 2). The gun club ridge is separated from the main mass of the John Day Formation to the north by landslide- and colluvium-mantled low hills and by ridges of tilted and deeply eroded lava flows. A speculative north-northeast trending fault separates the ridge from lava flows of the Clarno Formation on the west.

Exposures of leaf beds on the gun club ridge extend over an area of about 0.012 km<sup>2</sup> (3 acres) on Wheeler County School District property (Figure 2). Excavation sites are scattered along the steep, south side of the gun club ridge and extend upslope to a fence line that runs east-



Figure 1. View northwest from the Wheeler High School football field to "gun club ridge" in Fossil, Oregon. The discovery site for the "Fossil High" leaf beds was located near the upper right hand corner of the white building.

west beneath the crest of the ridge. Spoil from past digs mantles the slope and obscures the extent of excavated ground. An alkali basalt flow crops out along the south face at the east end of the gun club ridge and can be traced westward along the ridge crest, north of the fence line. The lava flow underlies the fine-grained, fossil-bearing sedimentary rocks. Rounded basalt and rhyolite clasts scattered along the contact suggest that a thin gravel layer separates the fossil-bearing rocks from the lava.

Manchester and Meyer (1987) showed that the fossil leaf beds are layered strata with apparent dips to the southwest. Beds in pits (Figure 3) open in 2004 have strikes ranging from N 84° W to N 86° E with dips of 20°–30° S.

Along the south side of the gun club ridge, most of the current dig sites are in thin-bedded, tuffaceous siltstone or fine-grained sandstone. Plant fossils occur along bedding planes in gray or grayish-white siltstone. Although not enough material is exposed to be certain, it appears that leaf-bearing layers are relatively thin and form fossil-rich zones less than 0.3 m (1 ft) thick. Exposures are insufficient to determine if excavations exploit fossil-rich horizons or a single fossil-rich horizon offset by small faults. Manchester and Meyer (1987) noted that the beds are cut by many vertical fracture planes, which may indicate that the Fossil High leaf beds are disrupted by small faults.

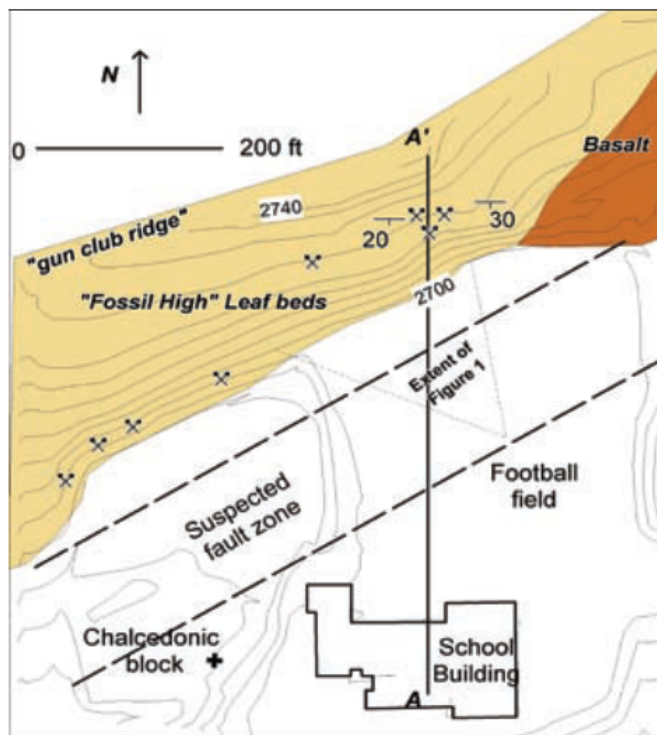


Figure 2. Geologic sketch map of the south flank of the "gun club ridge" near Wheeler High School, Fossil, Oregon, showing "Fossil High" leaf beds in tan and underlying lava flow in brown. Strike and dip symbols indicate slope of beds; prospect symbols indicate recent excavations. Location of suspected fault zone shown by heavy dashed lines, field of view of photo in Figure 1 shown by fine dashed lines. Contours at 1.6 m (5 ft) intervals were provided by Rowall Brokaw Architects, Eugene, Oregon.



(Leaf beds, continued from page 35)

At the east end of gun club ridge the Fossil High leaf beds overlie a weathered alkali basalt flow (Figures 2 and 4), which is approximately 20 m (60 ft) thick in a nearby water well (Figure 8, well WHEE-50122). Similar appearing tuffaceous siltstone beds with leaf fossils were found on strike overlying a lava flow 600 m (1800 ft) to the east, at the Wheeler County Waste Transfer Facility. Although the base of the lava flow is not exposed on the school property, the flow at the Wheeler County Waste Transfer Facility overlies massive claystone. It is unclear as to whether the claystone is part of the John Day Formation or, as mapped by Robinson (1975), is part of the underlying Clarno Formation. Retallack and others (1996) showed a thick sequence of claystone, with interbedded mafic lava flows, beneath the "Slanted Leaf Beds" elsewhere in the John Day Formation.

Because the rocks that overlie the Fossil High leaf beds have been removed by erosion or faulting along the gun club ridge, the true thickness of the beds cannot be determined. The leaf fossils may have been overlain at some time by a pumice lapilli tuff that marks the base of the John Day Formation north of Fossil (Robinson, 1975). The sandstone-siltstone dominated unit with the leaf fossils apparently becomes coarser grained up-section. Overlying, coarser-grained, tuffaceous sandstone beds exposed on the west end of the gun club ridge contain desiccated woody material (note that the log of well WHEE-50122, Figure 8, shows 12 m [35 ft] of "coal-like rock" overlying the alkali basalt, perhaps correlative with the woody strata). If the Fossil High leaf beds were formed by the same processes that formed the "Slanted Leaf Beds" in the John Day Fossil Beds National Monument, the leaf beds are probably about 15 m (50 ft) thick.



Figure 3. Plant fossils are found in white to gray, fine-grained tuffaceous siltstone and fine-grained sandstone of the "gun club ridge" behind Wheeler High School, Fossil, Oregon, that here dip to the south. Discarded siltstone fragments are fossiliferous. Rock hammer for scale.

## CORRELATION

The Fossil High leaf beds are one of several sites from which the distinctive Bridge Creek flora have been collected (Manchester and Meyer, 1987). The Bridge Creek flora sites are included within the middle Big Basin Member of the John Day Formation as defined by Bestland and others (2002). In addition to flora similarities, correlation is based on radiometric ages of associated ashes. McIntosh and others (1997) reported a  $^{40}\text{Ar}/^{39}\text{Ar}$  date of  $32.58 \pm 0.13$  Ma from sanidine crystals in the fossil-bearing tuffaceous shale in the Fossil High leaf beds. This age date is consistent with other age dates from the Bridge Creek flora site in Painted Hills Unit of the John Day Formation, including 31.8 Ma and 32.3 Ma K-Ar ages (Evernden and others, 1964; Manchester and Meyer, 1987) and  $32.99 \pm 0.11$  Ma and  $32.66 \pm 0.03$  Ma  $^{40}\text{Ar}/^{39}\text{Ar}$  ages (Retallack and others, 1996). Bestland and others (2002) reported a slightly older  $33.6 \pm 0.19$  Ma  $^{40}\text{Ar}/^{39}\text{Ar}$  date from the "Slanting Leaf Beds" in the John Day Fossil Beds National Monument Clarno Unit.

## STRUCTURE

Preliminary site development plans assume that the Fossil High leaf beds continue to the south, beneath the north end of the existing football field. Whether there are any deposits accessible at reasonable depths depends on the structure of the leaf beds and the shape of the prefill slope beneath the football field.

The foot of the gun club ridge west of the football field is fairly steep, and therefore the fill is probably close to 3 m (10 ft) thick against the foot of the slope. The log of well WHEE-50122 indicates that soil cover is at least 3 m (10 ft) thick in the eastern extension of the swale occupied by the football field, so it is likely that any Fossil High leaf beds beneath the football field are at least 6 m (20 ft) deep.

The situation is complicated by the likely structure of the beds. There are two possible models. In one model the beds are simply tilted; in the other model the beds are tilted and faulted. The measured dip (tilt) of the Fossil High beds along the gun club ridge ranges from  $20^\circ$  to  $30^\circ$  S (Figure 2). As shown in the cross section in Figure 4, this means that the beds beneath the high school will be approximately 60 m (200 ft) deep. Given the steepness of the slope, it is unlikely that any of the fossil beds underlie the football field at accessible depths, except perhaps at the very northern edge.

The structural model shown in Figure 4 assumes a constant tilt of the beds and no other change or interruptions. Although not seen in outcrop, fragments of silicified siltstone and fault breccia along the road at the west edge of the school property suggest that a northeast-trending fault (Figure 5) may extend between the gun club ridge and the high school building, following the course of the small swale. A large block of chalcedonic quartz exposed in the flat to the west and below the high school is evi-

(Leaf beds, continued from page 36)

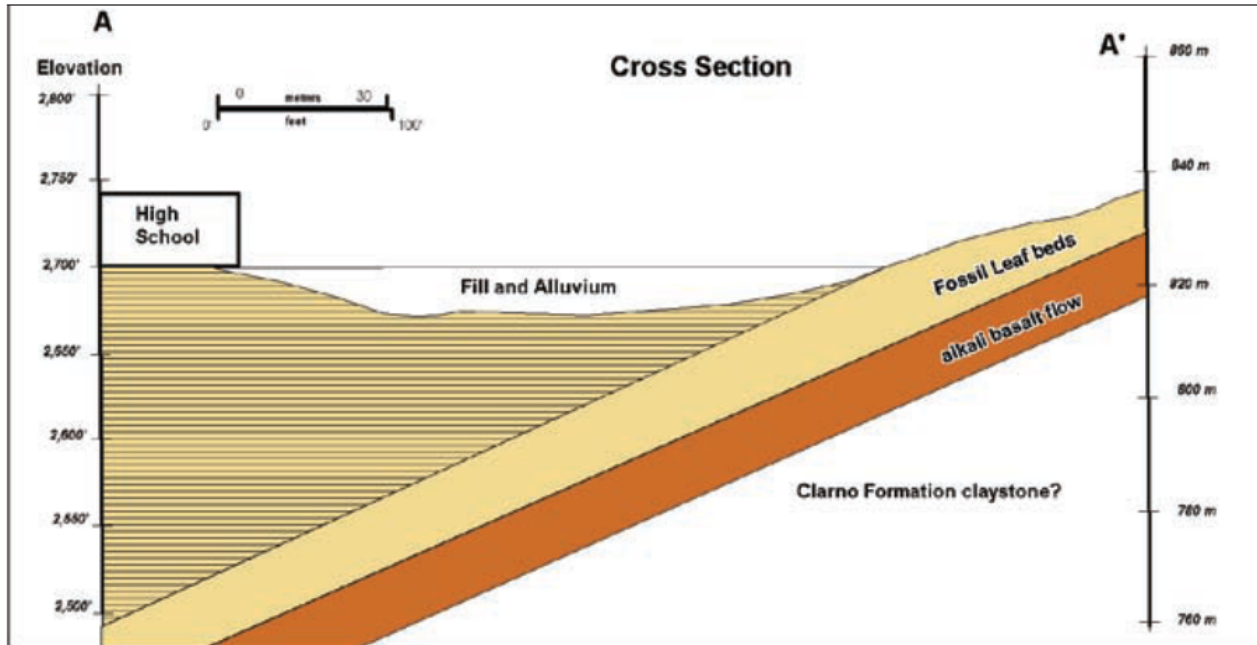


Figure 4. Cross section across the central part of the "gun club ridge" behind Wheeler High School, Fossil, Oregon, showing relationships between the "Fossil High" leaf beds (tan, no pattern) and underlying alkali basalt flow (brown) and overlying nonfossiliferous beds (tan with horizontal lines). Claystones beneath the alkali basalt are tentatively correlated with the Clarno Formation. The section is drawn such that the leaf beds are not faulted and are about 12 m (40 ft) thick. The number and thickness of individual fossil-bearing horizons within the leaf beds is not known. See Figure 2 for location of the A-A' section line.

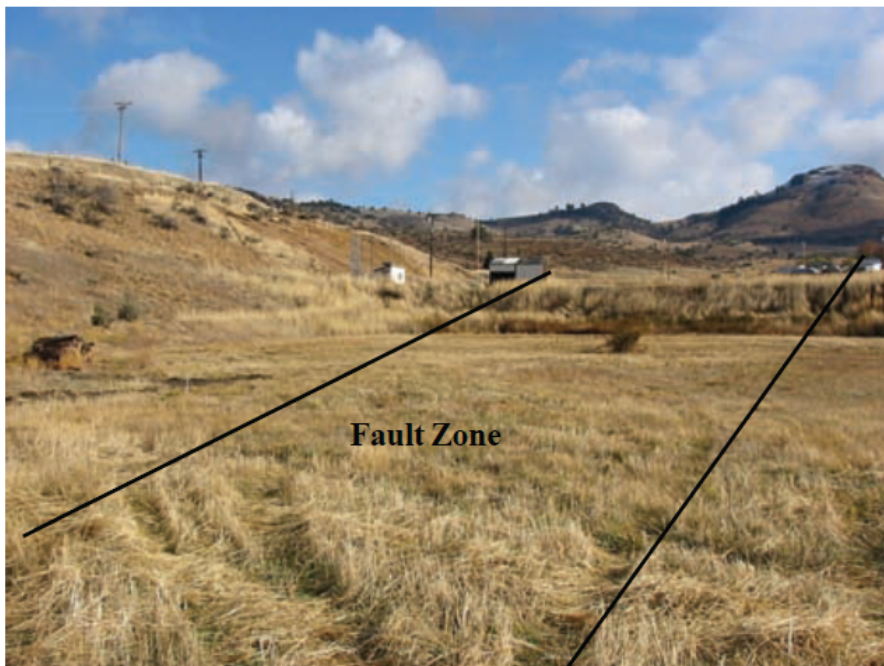


Figure 5. Looking northeast from the low area west of the Wheeler High School, Fossil, Oregon, football field and across the suspected fault to the face of the "gun club ridge."

dence of the type of hydrothermal alteration that is expected along a fault zone.

Figure 6 is a cross section showing the fault model. In this case, a fault zone cuts off the Fossil High leaf beds beneath the football field, and offsets the beds down on the south side to even greater depths than the tilted beds would have reached. In addition to making the beds deeper, the fault zone would likely disrupt the beds beneath the football field, again reducing the likelihood of finding a significant new fossil resource.

In order to test the fault hypothesis, we conducted a ground magnetometer survey in January 2005. Results of the survey (Figure 7) show a strong linear break between relatively highly magnetized rocks (red and orange) and less magnetized rocks (greens and blues) that coincides with the suspected fault trace. Basalt flows are typically strongly magnetic, while siltstone and sandstone are not, so this pattern suggests an abrupt edge to the basalt flow exposed in the gun club ridge. The magnetic pattern indi-



(Leaf beds, continued from page 37)

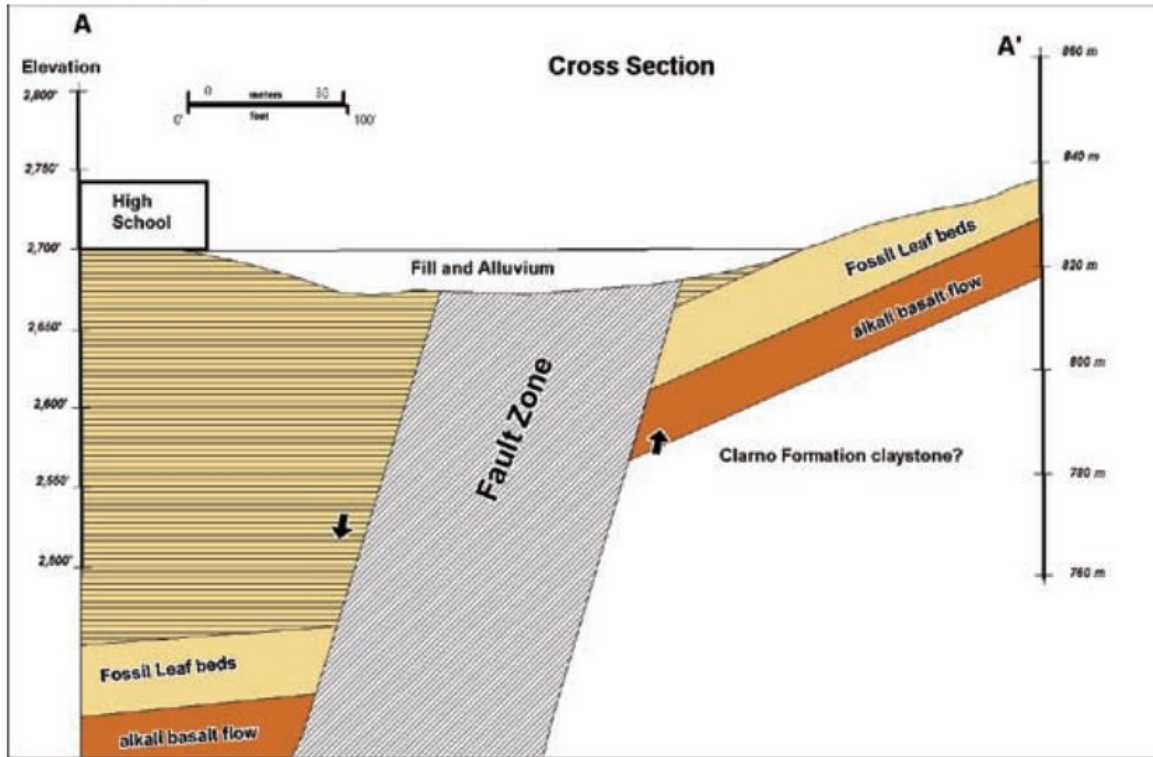


Figure 6. Cross section A-A' as in Figure 4, with a fault zone cutting off the "Fossil High" beds beneath the Wheeler High School football field. Line of section shown on Figure 2.

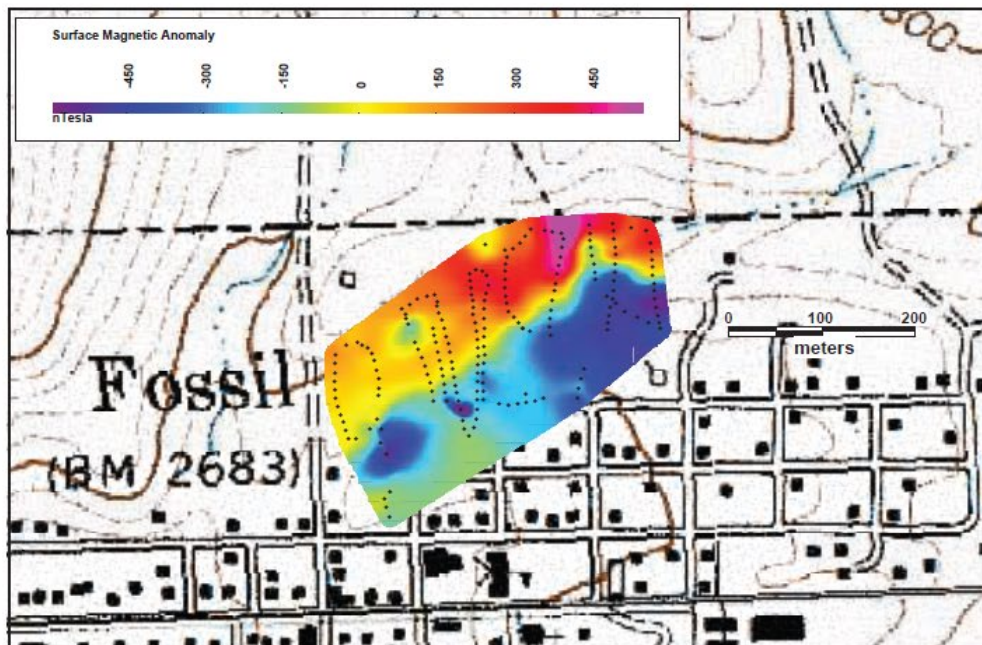


Figure 7. Ground magnetic anomaly map of the Wheeler High School area, Fossil, Oregon. Ground stations shown as black diamonds. More highly magnetized areas are shades of red and orange. Less highly magnetized areas shown in green and blue. Sharp break in color represents areas with strong magnetic gradients. Linear gradients such as this one are often associated with faults.

(Leaf beds, continued from page 38)



Figure 8. Map of the town of Fossil, Oregon. Water wells used to create the cross section in Figure 9 are blue dots, labeled with Oregon Water Resources Department log identification numbers, except new city well, which has no formal log yet. Red diamonds are locations of geochemically analyzed basalt samples (see Table 1). Base map is U.S. Geological Survey digital raster graphic (DRG) of the Fossil North 7.5' quadrangle.

icates that a northeast-trending fault with substantial offset extends between the Fossil High beds and the high school building.

To further test the hypothesis that a fault cuts off the Fossil High beds, we located and interpreted the drillers logs of several water wells to try to build a geologic cross section through the town of Fossil. Figure 8 shows approximate locations of the wells used and the line of section that was chosen. The new Fossil city well was located by global positioning system coordinates as was well WHEE-50122. The remaining wells were located to the nearest city block by address. Figure 9 shows the interpreted cross section. In this model, the sequence of the Fossil High beds and the underlying alkali basalt and clay stone layers is broken into a northern block that is tilted to the south and a southern block that is tilted to the north. Geochemical analysis of the basalt (Table 1, Figure 8) from

directly beneath the fossil beds, and from exposures just south of the fairgrounds indicates a high likelihood that the basalt flows are the same in both blocks. This model strongly supports the hypothesis that the Fossil High beds are cut off by a fault just north of the high school and raises the possibility that similar fossil beds may be present near the surface in the slopes south and east of the fairgrounds. Field reconnaissance around the fairgrounds indicated that tuffaceous sandstone and siltstone including some carbonized wood fossils are present.

The combination of field evidence at the high school and the strong linear magnetic gradient argue for the existence of a fault. The cross section derived from the water wells is consistent with the presence of a fault. In order to be absolutely certain that the Fossil High beds are cut off by a fault, further exploration in the form of deep excavations or drilling is needed.

Table 1. Geochemistry of basalt samples in Fossil localities; data not normalized.

Sample <sup>†</sup>	Whole-Rock Major Element Oxides, wt. %											LOI*, wt. %
	SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	
Fos-210	45.98	3.97	14.67	3.44	9.96	0.20	4.94	8.39	3.41	1.17	0.93	2.51
Fos-212	46.37	4.04	14.49	7.68	5.02	0.17	3.24	8.92	3.50	1.29	0.98	4.11

Sample <sup>†</sup>	Trace Elements, parts per million																		
	Rb	Sr	Y	Zr	V	Ni	Cr	Nb	Ga	Cu	Zn	Co	Ba	La	Ce	U	Th	Sc	Pb
Fos-210	17	577	34	283	262	31	49	25	27	39	123	50	355	24	52	2	3	21	4
Fos-212	20	605	35	292	250	34	44	25	25	32	128	46	375	26	55	1	1	19	4

\*LOI is loss on ignition.

†See Figure 8 for sample locations.



(Leaf beds, continued from page 39)

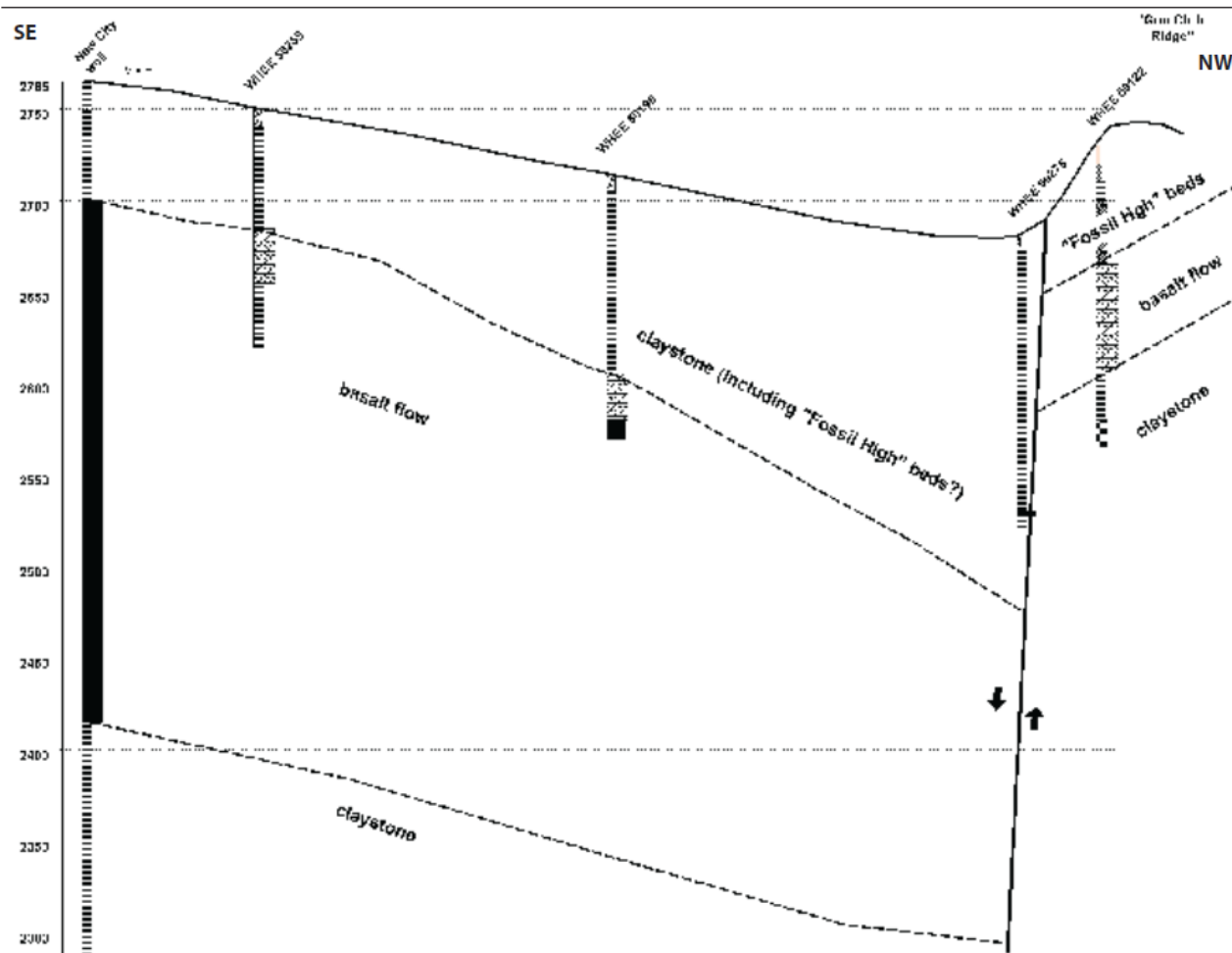


Figure 9. Geologic cross section from the new Fossil city well to "gun club ridge" behind Wheeler High School. See Figure 8 for location of line. SE is southeast; NW is northwest.

**DISCUSSION AND RECOMMENDATIONS**

Our preliminary study suggests that the fossil resource in the Fossil High beds on the high school grounds is probably largely limited to the existing exposures along the gun club ridge. Discovery of a fault that very likely runs between the high school building and the gun club ridge means that the Fossil High beds cannot be expected to extend beneath the north end of the football field for any distance. Even if there is no fault, the relatively steep tilt of the beds means that they are likely to be inaccessibly deep on most of the school property.

Beyond the simple survey that we performed, a definitive answer to the extent of the Fossil High beds beneath the football field would require drilling a series of shallow (< 30 m [100 ft]) core holes in the northwest corner of the field. Although drill core would be more useful in determining the character of the fossil beds, information can be obtained more cheaply by using a reverse-circulation drill rig that provides clean cuttings. Costs for core drilling can

easily run several thousand dollars per hole, with substantial additional cost involved in analyzing and interpreting the core or cuttings.

The swale west of the football field could also be tested by drilling. Based on the way the Fossil High leaf beds dip to the south, the wood-bearing tuffaceous sandstone exposed on the west end of the ridge probably overlies the siltstone and fine-grained sandstone that contained the productive leaf-bearing horizons above the football field. However, as noted in the discussion of the fill and alluvium in the swale now occupied by the football field, there may be as much as 3 m (10 ft) of overburden covering fossil bearing beds in the swale.

Another issue to be addressed is whether more than one fossil-rich horizon occurs in the Fossil High leaf beds. This requires development of detailed stratigraphic sections and could be accompanied by 1) detailed mapping and trenching on the slope north of the football field or 2) detailed logging of drill core or cuttings. The cheapest approach would be to excavate a shallow backhoe trench

*(Leaf beds, continued from page 40)*

down the face of the gun club ridge and then systematically map and log it. Trench excavation costs would be minimal, but logging would require several weeks of a geologist's time.

A detailed and systematic geologic survey of the City of Fossil and adjoining area might result in discovery of additional Birch Creek flora localities near town. In the limited time DOGAMI staff spent in the area, one additional leaf locality was found near the Wheeler County Solid Waste Transfer Facility. Indications of siltstone and some carbonized wood around the fairgrounds also suggest that further deposits might be located there.

A detailed geologic study would include field mapping and correlation of well cuttings, well logs, and surface outcrops. Preliminary steps to acquire and preserve data are being taken. At the time of the initial visit, a water well drilling rig was in the process of being set up at the county fairgrounds. Karen Masshoff was able to contact the driller and ensure that cuttings were saved for future examination. It is also important to note that most of the slopes in the area are mantled with colluvium (loose rock fragments mixed with clay and sand) and soil deposits many feet thick. This means that shallow excavations will be needed in most instances to uncover new deposits.

Costs for exploration for further deposits could range from relatively minor (a few days of surface mapping work, or backhoe trenches at the fairgrounds) to substantial (several diamond core holes at the high school). Given the strong evidence for a substantial fault at the high school, pursuing other local deposits may be a more cost-effective approach.

Despite the geologic limitations of the site, it is important to note that there remains a substantial amount of material in the currently known Fossil High beds. On the basis of our mapping of the site there are at least 437,000 cubic m<sup>3</sup> (680,000 yd<sup>3</sup>) of material available if one were to excavate off the top 3 m (10 ft) of the deposit. This is equivalent to 68,000 standard dump trucks worth of material, and should last for decades with proper management. The slope will become dangerously steep long before the deposit is exhausted, so the real challenge for the future may be to manage the excavations and spoils. Spoils from past digging cover much of the slope, and removing and stockpiling the material may improve digging conditions. As the stockpiled spoils weather, they are likely to continue to yield fossils. An important part of managing the excavation would be to know whether the entire deposit was fossiliferous or just a few thin layers. In this case, a detailed stratigraphic study by trenching or drilling would be needed.

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## Wheeler High School Fossil Beds natural areas program eligibility review notes

**Green highlight** = specific, key passages related to this proposal

**Red text** = staff interpretation and commentary

From the Natural Areas Plan:

*“There are two main guidelines for including geological features and formations in the list of Geologic Types:*

- 1. Certain geologic types, for instance fragile volcanic features and paleontological sites, are vulnerable to destruction and can be protected by effective natural area management.*
- 2. Other geological types are a prominent component of our natural heritage and should be recognized for their educational and interpretive values. This could be accomplished through recognition of the finest features on the State Register of Natural Resources.*

*The Natural Areas Program functions to both formally recognize the geologic formations and features and to help protect them through natural area conservation. As is the case for species and ecosystems, priorities for protection or representation are based on the presence of a potential or actual threat to the formation or feature, as well as the rarity and/or the significance of the formation or feature. Geologic types are included in a list for an ecoregion if its occurrences are endemic to, representative of or particularly important in the ecoregion.*

*A geologic type may not require inclusion in a formally designated natural area for it to be considered protected. For instance, geological values are an important factor in the management of many areas designated for recreation, such as Wild and Scenic Rivers, Wilderness Areas, or State and National Parks. However, some geological features, such as fossil locales or ash flows, can be quite sensitive to disturbance. In these areas, the use of designations designed to represent ecosystems and species is desired.”*

The Natural Areas Plan indicates that protection is a goal in the designation of fossil sites, but also recognizes opportunity for education and recreation. The language here indirectly suggests the need for a management plan to address impacts from human use and mitigation measure that could be applied to limit damage and maximize heritage value. Properly managed excavation, education, interpretation, curation of findings, etc would appear to be consistent with the natural areas plan if it can be done in a way that limits inappropriate uses and unmanaged incremental destruction of the resource without scientific, educational, and interpretive benefit.

Definition of a “Natural Area” under 736-045-0011(13)

The property in question does meet the definition of a natural area (in a way we are not accustomed to seeing them from other registrations and dedications)

“Natural area” means a unit of land or water or both that may be considered for dedication under ORS 273.563 to 273.591 and that has substantially retained its natural character, or, if altered in character, shall in addition to its natural heritage resource values, be valuable as

habitat for plant and animal species or **for the study and appreciation of natural features**. This includes areas in the process of being restored.

736-045-0300 Rules for registering new areas:

The commission, department, the committee upon request pursuant to OAR 736-045-0100(6)(b), and the Institute for Natural Resources pursuant to ORS 352.808(2)(g) will use the following criteria in evaluating a candidate natural area proposed for inclusion in or removal from the Register:

- (1) The priority for protection in the plan of the primary natural heritage resources objective and other natural heritage resources in the candidate natural area;  
**This particular site is within an ecosystem element currently identified as being filled by the John Day Fossil Beds Sheep Ridge Unit. Duplicates are not prohibited.**

- (2) Whether the natural heritage resource occurrence(s) is an adequate representative of the type; or whether the site can feasibly be restored to provide adequate representation of the ecosystem type, including habitat for at-risk species;  
**The language here is targeted towards habitats and species rather than fossil quarries, but the intent appears to be transferrable. "Adequacy" is questionable due to unmanaged history of excavation and placement of overburden. Accessibility and quantity of remaining easily-accessible, undisturbed fossiliferous material available for science, education and interpretation is uncertain from the materials available. The DOGAMI report supplied by the applicant says:**

**"there remains a substantial amount of material in the currently known Fossil High beds. On the basis of our mapping of the site there are at least 437,000 cubic m<sup>3</sup> (680,000 yd<sup>3</sup>) of material available if one were to excavate off the top 3 m (10 ft) of the deposit. This is equivalent to 68,000 standard dump trucks worth of material, and should last for decades **with proper management.****

**The slope will become dangerously steep long before the deposit is exhausted, so the real challenge for the future may be to manage the excavations and spoils. Spoils from past digging cover much of the slope, and removing and stockpiling the material may improve digging conditions."**

- (3) The extent to which each natural heritage resource has retained its natural character, and processes *i.e.*, a measurement of the degree of human-caused disturbance; or, the degree of feasibility of restoring the target natural character and processes;  
**The site is significantly disturbed from a long history of fee-based personal excavation (that the landowner letter seems to indicate will continue after any registration). More detail is needed on post-registration management.**
- (4) The health and viability of the natural heritage resource occurrence(s), *i.e.*, the ability of each natural heritage resource occurrence to perpetuate itself or its natural sequence of development in the candidate natural area;  
**The language here is targeted towards habitats and species rather than fossil quarries, but the intent appears to be transferrable. The fossiliferous strata that are currently accessible are**

highly disturbed. Heavy equipment operation and excavation may be required to expose more of the fossil-bearing rock. Sustainable viability of the resource for education, science, and interpretation will depend on management.

- (5) The number of natural heritage resources that will be adequately represented in the candidate natural area;  
This site would only be designated based on the rock itself. There are no significant vegetation or wildlife species or habitats present.
- (6) The degree of uniqueness and educational and natural interpretation values of a geologic resource(s);  
There is definite educational, scientific, and interpretive potential at the site. This potential is currently not formalized, and excavation appears to be relatively unmanaged and unmonitored. The applicant indicates that they hope to bring DOGAMI into the cataloguing and study of fossils people find when they pay to excavate fossils for their personal collections.
- (7) The priority of protection given in the plan to each special species of plant or animal; NA
- (8) The contribution the particular candidate natural area will make to the protection of the special species; NA
- (9) Manageability, i.e., the capability of the candidate natural area to be managed to protect and maintain the natural values, as well as to make it available and useful for its designated purposes;  
Management methodology is not given in the application materials. It may be status quo; i.e., people pay to dig and have relative free rein to dig and take fossils for personal use. If there are still significant undisturbed, accessible fossiliferous strata present, a management plan could describe how those resources would be excavated systematically and how overburden would be placed to maximize the value of the site for education, interpretation, and science and minimize destruction without benefit beyond personal collections.
- (10) Whether there are alternative methods of accomplishing the same purposes of this division; and
- (11) The cost effectiveness of including a candidate natural area in the register.

#### **736-045-0305 Oregon Register of Natural Heritage Resources: Procedures for Registering**

The department and the Institute for Natural Resources will review and provide recommendations on proposals for registration and dedication of natural areas for the register, together with field evaluation, maps and sufficient data to complete the register file. Pursuant to OAR 736-045-0100(6)(b), the director may also request that the committee review a nomination for the register.

- (1) A proposal for the register of private land shall include the written permission for registration of the landowner.
- (2) The department shall share the proposed plan with the county assessor for the appropriate county;
- (3) The commission may place a natural area onto the register or remove a natural area from the register. The department will provide recommendation to the commission for its consideration.
- (4) A voluntary management agreement may be developed between the department and a private landowner or agency of a natural area on the register. When the department determines a candidate natural area is not yet an adequate representative of the target element and the area is proposed for or

undergoing active restoration, the department will require a basic management plan as a component of the registration petition. The management plan shall outline threats to maintaining or achieving target element representation, as well as the methods of protecting or restoring them and their natural ecological processes. The management plan shall include activities to be encouraged, allowed or proscribed, and options for management agreements involving outside parties.

This proposed natural area appears to fall into the category of sites that are not yet managed as protected natural areas that provide long term stewardship, education, and scientific value. A management plan could establish the targets for balancing educational and scientific value with paid personal souvenir collecting.

(5) The commission may provisionally register a site proposed for or under active restoration that does not yet adequately represent the target element(s). As a condition of the commission's provisional registration, the land owner shall provide a detailed management plan to the department or committee (if convened) to assess and approve. This detailed management plan may build upon or replace the basic management plan required as a condition of proposal for provisional registration under 736-045-0305 (4) and shall include metrics of restoration success. Owners of land provisionally registered under this section have five years to pursue restoration; thereafter, the department will reevaluate the registration using the restoration metrics included in the detailed management plan to assess restoration success and provide a recommendation to the commission during the reevaluation. The commission may:

Although the wording of this section is phrased around natural areas in the normal sense of natural habitats rather than extractive uses, the spirit of the language likely still applies. If the commission determines that the way the site is currently being managed does not fit with the natural areas program, it could require a management plan that would make the site's management consistent with the program goals. This would involve a provisional registration that would be revisited later to determine whether the stewardship needs are being met.

(a) Fully register the provisional site if it provides adequate representation of the ecosystem(s), or

(b) If the provisional site does not provide adequate representation of the ecosystem element(s):

(A) Renew the provisional registration, or

(B) Terminate the registration.

(6) The department shall distribute a list of natural areas on the register to county assessors annually.

(7) The commission may enter onto the register any candidate natural area that a federal or state agency establishes by public hearing and dedicates under this division.