



After the flood: Investigations of impacts to archaeological resources from the 2013 flood in southern Alberta

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The Bow River flood study: A tale of past, present, and future

Brian Vivian^a, Michael C. Wilson^a, and Lindsay Amundsen-Meyer^a

^a Lifeways of Canada Limited, #105-809 Manning Road NE, Calgary, Alberta, Canada, T2E 7M9

ABSTRACT

In 2013 and 2014, Lifeways of Canada completed an assessment of the impacts of the 2013 flood of the Bow River on palaeontological and archaeological resources. Over the two years, a 164-kilometre stretch of the river was studied, extending from the mouth of Grand Valley Creek downstream to the western boundary of the Siksiká First Nation. Assessment studies focused on visually assessing erosional exposures observed along this stretch of the river and documenting historic resources when found. These studies resulted in the discovery and documentation of approximately 50 archaeological sites and palaeontological finds, of which well over half are newly discovered sites. Analysis of the location and character of these finds sheds light on the nature of human occupations along the Bow River and highlights how critically endangered early post-glacial sediments are in the valley.

KEYWORDS

Bow River, palaeontological, archaeological, erosion, exposure, historic resources, palaeoenvironmental, glacial, Pleistocene

1. Introduction

Significant palaeontological and archaeological finds were exposed by the catastrophic June 2013 Bow River flood. These finds stand as a lasting legacy of the flood event, which brought international attention to Calgary and other communities along the Bow River. Now, four years after this dramatic flood event, we can appreciate the efforts Albertans made to save their communities, and the need to plan for future flood events. Local and national news coverage focused on the impact of this disaster, the cleanup efforts that followed, and the Calgary Stampede working to host their annual rodeo, *Come Hell or High Water*. While steps have been taken to assess the impacts of the 2013 flood and actively mitigate the impacts of future flood events, little public attention has been given to the quiet efforts to protect the endangered historic resources present along the river.

For two years following the flood, a team of archaeologists and earth scientists from Lifeways of Canada

Limited (Lifeways), working under contract to Alberta Culture and Tourism, scoured banks of the Bow River from Cochrane to Carseland to find and document historic resources (Vivian and Amundsen-Meyer 2015; Wilson 2015). The success of this project is evident in the discovery of nineteenth century campsites, earlier First Nations camps and bison kills, and Ice Age finds dating to more than 10,000 years in age. This ongoing project, to find and document these sites before they are washed away, stands as one of the positive steps taken by the Government of Alberta to address the impacts of the 2013 flood. The patterns of their occurrence and exposure as outlined below will help us predict and, hopefully, reduce or mitigate the impacts of future floods.

The June 2013 flood event was a classic example of flooding brought about by sustained rains coinciding with the peak of spring runoff from snowmelt. Historic records and evidence from ancient river deposits indi-

cate that such flood events are not unusual up and down the eastern slopes of the Rocky Mountains in Alberta. Along the Bow River, the period from 1875 to 1902 saw three major summer floods at Calgary. There was another such flood in 1932, which inundated the Sunnyside area and overtopped Memorial Drive on the north side of the Bow (see Osborn 1975, 1987; Osborn and Rajewicz 1998). Flooding at Calgary commences at discharge values above $\sim 705 \text{ m}^3/\text{sec}$, or cubic metres per second (cms) ($\sim 25,000 \text{ ft}^3/\text{sec}$ or cfs). The biggest recorded flood is that of 1897, which is estimated to have been $\sim 2,265 \text{ cms}$ ($\sim 80,000 \text{ cfs}$). The flood of 1902 was $\sim 1,555 \text{ cms}$ ($\sim 55,000 \text{ cfs}$), and that of 1932 was $\sim 1,515 \text{ cms}$ ($53,600 \text{ cfs}$). The 2013 flood reached a maximum discharge of $1,740 \text{ cms}$ ($61,450 \text{ cfs}$). While it was smaller than the 1897 flood, its impact on riparian lands was considerable, and in several places as many as 50 lateral metres of the riverbank were eroded away. It is these erosional surfaces that revealed ancient bone and fossil finds that archaeologists and palaeontologists have strived to locate before the river again floods.

The impact of the June 2013 flood and the degree of erosion along the Bow River became immediately evident as high waters began to recede. In the weeks that followed, an increase in observations and public reports of bones being washed out along the riverbanks provided an indication of the degree to which the flood had impacted historic resources adjacent to the river. In response to these impacts, Alberta Culture and Tourism issued a contract to complete a survey study along the Bow River to record impacts upon historic resources there. The goals of this baseline survey and assessment were to provide detailed descriptions of the

cutbanks exposed by the flood's erosional forces, revisit and assess known historic resource sites, identify and record newly exposed historic and palaeoenvironmental resources, and provide recommendations for the long-term management, protection, and study of these resources. We completed this baseline work in 2013 and 2014.

Based on the positive results of a pilot study in the fall of 2013, the study area on the Bow River was extended to follow the river from Grand Valley Creek, upstream from Cochrane, down to the western boundary of the Siksiká First Nation. In total this study covered a distance of approximately 164 kilometres along the river. The survey team included trained archaeologists and palaeontologists, and professional river guides who navigate waters of the Bow River for a living. The study commenced with the team of three or four individuals floating down-river, stopping to directly examine the shores wherever significant erosional cutbanks were present. In places, erosion washed away huge swaths of land, such as at Inglewood where 20 to 50 metres of the land surface were lost along a 200-metre stretch of the riverbank (Figure 1). Elsewhere, new river channels were incised into the floodplain terraces marking the valley floor. As may have been expected, flood impacts were found to be most obvious in urban areas where developments had placed barriers to restrict river flow or to confine the river channel.

2. Historical background

Historic resources of the Bow River have a long history of research. In 1857, as a member of the Palliser Expedi-



Figure 1. Example of flood damage observed at Inglewood.

tion, Sir James Hector (1861; Spry 1968) observed silt and gravel terraces of the Bow River, which he incorrectly surmised represented shorelines of a former glacial lake or sea that he thought had covered much of the Canadian prairies. In the following years, George Dawson, an early Director of the Geological and Natural History Survey of Canada, continued to champion an incursion of Arctic Ocean waters as an explanation for the fine sands and clays seen across southern Manitoba, and the gravel fills observed along margins of Bow River (cf. Dawson 1885, 1891, 1897; Dawson and McConnell 1895), though others held differing views. Members of the Manitoba Scientific and Historical Society visited the Bow River in 1883, as recorded in the first issue of the *Calgary Herald* newspaper. Resulting from this visit, J.H. Panton (1884) reasoned that the terraces were alluvial fills originating from the Bow River, which had formerly been larger than it was in the present day. As the 1884 publication was not widely available, Panton's brief but insightful discussion of the Bow River terraces was overlooked for a century, though by the early 1900s researchers did reject the marine hypothesis for deposits to the east on the prairies.

Regional studies were interrupted by two World Wars and the Great Depression, so it was not until the 1950s and 1960s that concerted efforts were again made to describe the Quaternary deposits along the Bow and other rivers in southern Alberta. In the absence of radiocarbon dating, simplistic interpretations had been made, as had already been done in Europe, equating valley-fill gravel deposits with glacial episodes (as “outwash”), and times of incision (downcutting) with interglacial or interstadial episodes. During this period, Archie Stalker (1968) defined the Bighill Creek Formation on the basis of exposures he observed at the Clarke and Griffin gravel pits at Cochrane, within the Bow River valley about 20 kilometres west-northwest of Calgary. In reference to a classic model of glacial outwash, Stalker reasoned that these gravels were deposited by very turbulent water in braided channels that often shifted course, which he subsequently linked to a supposed glacial stillstand near the Rocky Mountain front in the Canmore area, between about 11,300 and 10,000 radiocarbon years ago. His definition of the formation also included higher terraces on the valley wall upslope from the gravel pits at Cochrane.

Stalker's hypothesis fueled an explosion of scientific inquiry into the age and origin of sediments along the Bow River and how the varied landforms within the river valley (and the valley itself) came to be. Geologists, geophysicists, geographers, geomorphologists, palaeontologists, and archaeologists alike from the University of Calgary, the Geological Survey of Canada, Parks Canada, the Archaeological Survey of Alberta, the Alberta Research Council, and else-

where have all assisted in addressing questions as to the age and geological history of the river and associated landforms found within the Bow River valley. Resulting from this collective research, a general model for the Bow River has emerged (see Jackson et al. 1982; Wilson 1983; Wilson and Churcher 1984; Moran 1986; Osborn and Rajewicz 1998) in which the current Bow River reoccupied a bedrock-cut valley that was formed in earlier, pre-glacial times. The Laurentide and Cordilleran Ice Sheets flowed across southern Alberta approximately 18,000–14,000 years ago, meeting at a north-south line running through the Calgary area. The old valley was filled with a mix of till, fine silts, and coarse gravels from glaciation as well as the glacial lakes and rapid meltwater discharges that characterized the end of the Last Glacial. Stalker's uppermost terraces at Cochrane were re-interpreted to represent stages of a delta built by rapid meltwater drainage through Bighill Coulee into a glacial lake that occupied the Bow Valley (Glacial Lake Calgary). It follows that the Bighill Creek Formation of the lower terraces is a different deposit, inset into these earlier, deltaic deposits of the high terrace surfaces. The discovery of assorted vertebrate fossil finds, dating between 10,000 and 11,000 years ago, place the age of these Bighill Creek Formation gravels in early post-glacial times (Wilson and Churcher 1984). Other, independent evidence showed that mountain glaciers had retreated to cirques in the upper Bow River valley by 11,000 years ago, and not to a stillstand area at the mountain front near Canmore, as originally suggested by Stalker (Jackson et al. 1982; Beaudoin 1984; Reasoner and Hickman 1989; Reasoner et al. 1994). This meant that the animals of the Bighill Creek gravels lived not in a near-glacial environment but in a warmer setting after ice retreat.

Specific palaeontological finds at Calgary pertaining to this time include the poorly documented discovery of a partial mammoth tusk in Bowness in 1957 (where the Bighill Creek Formation gravels also occur; Wilson 2015) and one or two mammoth teeth reportedly found “during the making of a cut for the Canadian Northern Railroad” before 1914 (Hay 1924:121). The CN cuts were in southeast Calgary west of the river, where gravels of the Bighill Creek Formation again likely occur. Bones reported from the Bighill Creek Formation exposed in the now-exhausted Clarke and Griffin Pits in Cochrane include bison (*Bison antiquus*), horse (*Equus* sp., cf. *E. conversidens*), large bighorn sheep (*Ovis canadensis*), caribou (*Rangifer tarandus*) and mammoth (*Mammuthus* sp.). Radiocarbon dates of these materials, ranging in age from ca. 11,400 to 10,000 ¹⁴C yr BP (radiocarbon years before present), firmly fix the context of these gravel deposits (Wilson and Churcher 1984). In southeast Calgary, a large bison horn core and a second partial cranium, a camel humerus (*Camelops* sp.), and a partial bison postcranial skel-

eton were recovered from the Gallelli Gravel Pit (now Quarry Park) (Wilson and Churcher 1978; Wilson et al. 2008). Further downstream, other finds of bison, camel, and horse bones dating to this early post-glacial period have been reported from the Bonnycastle Pit (now the Burnco Indus Pit), and a very large bison horn core was recovered from Gray's Pit at Carseland (Wilson 1983, 2015). Generous cooperation over the years from gravel pit operators has been crucial in the recovery and documentation of many of these finds.

The radiocarbon age of the palaeontological fossil bones recovered from the Bighill Creek Formation gravels closely corresponds with the earliest human occupations of southern Alberta documented in the archaeological record. While evidence of these early occupations is rare within the Bow River valley, many archaeological sites, dating to ca. 3,000 to 4,000 years ago or later, have been found up and down the valley. These range from large buffalo kill sites, to smaller butchering or processing camps and stone circles that mark where large winter camps were established. Many of these sites were recorded in the 1960s and 1970s by James Rogers and other students from the University of Calgary who undertook an archaeological survey in advance of proposed plans to construct a dam and reservoir on the Bow and Highwood Rivers. More sites, some as old as 8000 ^{14}C yr BP, were discovered in the 1970s and 1980s when Michael Wilson (1983) undertook his doctoral studies of the archaeology and geology of the Bow River valley at Calgary. More recently, the expansion of Calgary, construction of the Deerfoot Freeway, and growth of developments such as Douglasdale, Valley Ridge, Quarry Park, and East Village have resulted in numerous historic resource studies. Most of these have had success in documenting evidence of human encampments from by-gone years, long buried in the ground, both within the valley and in the adjacent uplands.

3. Archaeological and palaeontological finds on the Bow River

Assessment of newly formed erosional exposures following the 2013 floods resulted in the detailed documentation of approximately 50 archaeological sites and palaeontological finds along the Bow River (Figure 2). Nearly half of these sites were previously unknown. A few important examples of historic resources documented in 2013 and 2014 are discussed below.

Significant highlights of the field results include the aforementioned exposure at Inglewood, where the remains of a camp hearth along with an assortment of bone and stone artifacts provide evidence of early encampment dating to approximately 2,000 to 3,000 years ago. Further downstream,



Figure 2. Project team assessing recent erosional exposures of probable Bighill Creek Formation gravels on the Bow River.

a large bison kill site, known as the FM Buffalo Jump (EfPk-2), was severely damaged by erosion that cut into the riverbank and exposed multiple layers of bison bone and refuse. The FM Buffalo Jump, well known locally to those who fish on the Bow River, represents a classic jump where First Nations peoples stampeded herds of buffalo over a cliff. At the base of this cliff, a dense litter of bone extends over 150 metres along the river's shoreline, while just upstream, the remains of numerous campfire hearths and trash pits, filled with broken and butchered bison bones and fire-broken rocks, show evidence of where inhabitants systematically stripped and dried the meat and prepared the hides needed to support day-to-day living (EfPk-1). Recognizing the importance of this FM Ranch Campsite, which dates to ca. 1,000 years ago, Alberta Culture and Tourism has designated it as a Provincial Significant Historic Resource.

Near McKinnon Flats, approximately 54 kilometres southeast of Calgary along the Bow River, a grooved stone maul and complete bison skull (Figure 3) were found associated with large cobblestones indicative of a buried stone circle or tipi ring. As this reach is the furthest east that pine and Douglas fir occur along the Bow River, it is significant that historic records indicate the Blackfoot knew this area as "*Pine Cañon*" (according to wording and translation provided on Dawson's 1884 map [Dawson 1885]). Another First Nations campsite recorded nearby revealed evidence of a campfire and butchered bones. Here the discovery of a musket ball places the age of this site to be only 150 to 200 years old. Although this site is not as old as many found, it is one of the rare finds associated with a relatively brief period of time during which European trade goods became available to native societies, yet local populations still followed a traditional way of life in hunting buffalo and camping wherever they wished on the prairie.



Figure 3. Late Holocene bison skull found buried at an archaeological site.

Upstream, one of the most important finds was a fossil bison cranium (*Bison antiquus*) discovered in an erosional exposure west of Home Road, in northwest Calgary (Figure 4). Radiocarbon dating of this find places the age of the skull to about $10,840 \pm 50$ ^{14}C yr BP (Beta-372155) (Jass et al. 2016). This date is consistent with the other Ice Age fossil finds recovered from the Bow River valley, and this discovery assists in pinning down the location of these discontinuous, seldom-exposed, early post-glacial gravel deposits. A large gravel deposit associated with a high terrace just downstream from Policeman's Flat, south of Calgary, is believed to be of the same age, although no fossil finds were recovered here to confirm the hypothesis.

Palaeontological finds that date to more recent times include a partial bison skull from near the mouth of Horse Creek (near Cochrane), and several bison bones collected from a trench on St. George's Island (Calgary Zoo). A radiocarbon date of 160 ± 30 ^{14}C yr BP (Beta-397884) indicates the Zoo's island was flooded about 160 years ago, well be-



Figure 4. Brian Vivian with *Bison antiquus* skull recovered from near Home Road, northwest Calgary.

fore the very large floods of the late nineteenth and early twentieth centuries (Wilson 2015). Such palaeoenvironmental data are essential to modern planners as they strive to understand and model extents of flooding on the Bow River. Evidence of changes in the Bow River streamflow is also seen near the mouth of Fish Creek, where a buried lens of clays and peaty silts indicates backswamp sediments that likely formed in an old oxbow channel, and are now exposed along the current riverbank. The molluscs, pollen, and sediments that remain preserved in this backswamp deposit are from a climatic regime different from that of today and further study will help inform reconstructions of local conditions on the river over 3,000 years ago.

4. Discussion and conclusions

How local human populations responded to these environmental changes can be seen in the diversity and locations of archaeological sites recorded along the Bow River. It is telling that few sites of any antiquity are found on the lowest terrace levels above the river, and sites older than 4,000 years in age are rare in the river valley. In part, this is due to the lack of riverside exposures of older land surfaces, which are typically found at slightly higher elevations above and back from the river. As the river continues to erode laterally during flood events, more of these early deposits will likely be exposed. This pattern in site age and distribution is also thought to represent a cultural change which saw people shift toward a greater use of the river valley over time.

While these results have contributed greatly toward our understanding of the natural history and human use of the Bow River, they also serve to highlight how fragile these non-renewable historic resources are on a regional scale.

In places, the remnants of campsites and buffalo kill sites that have remained intact for 3,000 or 4,000 years are being washed away by changes in river flow and channel location. It is clear that archaeological and palaeontological sites are restricted to specific landforms but it was surprising to discover how localized the Bighill Creek Formation gravels are: whereas it was formerly believed that these early post-glacial gravels were fairly continuous down the Bow River valley, results of this survey have illustrated that they are actually localized to a series of “spots” along the river where conditions were right for their deposition and subsequent preservation. The deposits have also been extensively impacted by urban development and decades of gravel mining, but these impacts are also what brought the resources to scientific attention. These findings illustrate how critically endangered are these sediments and the rare Pleistocene fossils they contain. To lose these resources would be to lose our only local window on the world as it was 10,000 to 12,000 radiocarbon years ago, so continued collection of bones and contextual information will be vital as the varied impacts continue.

This study of palaeontological and archaeological finds exposed by the 2013 Bow River flood has made a significant contribution to our understanding of the human and natural history of the river as it flows through the heart of southern Alberta. Erosional forces of the flood exposed sediments, fossils, and archaeological finds that had been buried for thousands of years. The resulting survey and assessment study of the flood impacts to historic resources has led to the recording of many previously unknown sites and fossil finds. Agencies can now develop more effective strategies for monitoring these resources, predicting impacts, and even mitigating some damage in the future. In this way, the catastrophic flood of 2013 has provided a unique opportunity that has advanced our understanding and appreciation of the Bow River, its history, its resources, and its enduring power.

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