

# **Geo-Cells**

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## **Background**

The Drumheller area is part of the Badlands of south-eastern Alberta and is characterized by an arid to semi-arid climate. Vegetation cover is sparse or completely absent. The area geology consists of relatively weak bedrock of the Oldman Formation, of Late Cretaceous age, and consists of alternating layers of non-marine sandstones and shales, with coal seams and occasional scattered dinosaur fossils. Large rivers, such as the Red Deer River, have cut deeply into the bedrock leaving steep valley walls. The exposed bedrock is visible as horizontal bands of different color and texture which dominate the landscape. Rainfall is infrequent but can be intense, which results in severe erosion conditions which are unique to the region. Deep erosion channels, scour and sink holes can be readily seen along highway ditches.

In the past, eroded ditches and gullies have been repaired using a range of techniques. Erosion control matting, rock ditch checks, straw bales, gully filling, and even extending guardrails to prevent vehicles running into the gullies, have been used to combat erosion problems. The results have been poor or only achieve temporary success. The conventional philosophy is to establish a vegetation cover to protect the soil from erosion. However, this is not possible due to arid conditions. The maintenance process of in-filling erosion gullies is repeated often annually which quickly exhausts the maintenance budget. A more robust and permanent solution is required to provide a long lasting erosion control.

In recent years, several ambitious remediations have been completed along highway ditches in the Drumheller area (Highways 27, 56 and 9). These included construction of gabion-lined channels, drop structures and burying 150 mm polyethylene pipe at some ditch sections. So far these repairs have been successful, but with a big price tag.

## **Cellular Confinement System**

A suitable erosion control measure that was considered to be a cost-effective alternative to gabions is the Cellular Confinement System (with proprietary names such as Geoweb, GeoCel and Geo Cell). This is especially cost-effective in areas where rocks are rare and the cost of transporting and placing the rocks is expensive. The geo-webs or geo-cells are manufactured from high density polyethylene (HDPE) panels that are UV stable and chemically inert. Once laid, expanded in the ditch, and pinned in place, gravel can be filled into the cells and smoothed. Geo-cells are manufactured by a number of manufacturers, with varying depths (typically 10 cm, 15 cm and 20 cm). The web joints are thermally bonded and once gravel has filled the cells, the whole mattress forms a robust mat unit that can resist heavy runoff erosion. For approximate comparative purposes, the cost of geo-cell installation is \$25 per m<sup>2</sup> versus gabions installation of \$50 per m<sup>2</sup>. The geo-cell cost advantage can be even more significant if gabion rock is not readily available near the project site.

## **Construction on Highway 837:02 and Highway 841:02**

Two major erosion problem sites were identified by Klohn-Crippen Engineering during their annual inspection of geo-technical hazard sites in the summer of 2001. These two sites, along Highway 837:02 and Highway 841:02 presented serious environmental and safety concerns.



Subterranean erosion channel is formed below the east ditch in Hwy 837:02



Deep erosion gully is formed in the west ditch in Hwy 841:02

Rather than in-filling the erosion gullies as done several times previously, an erosion control design was requested from the consultant. The consultant presented several alternatives, including geo-cell and gabion-lined channels. At Alberta Transportation's request it was decided to pursue the geo-cell alternative at a trial site since the department had no experience with geo-cell technology. If geo-cells turn out to be a successful alternative to gabion channels, the department can install it in other locations with confidence.

Ledcor, the maintenance contractor for the Drumheller area installed the geo-cell in October, 2002, under the supervision of department operations personnel. Construction was quite straightforward. First, the gullies were in-filled, the channels shaped and graded to the design grade and width. Geotextile was laid, the geo-cell extended over the geotextile, and pinned into the channel bed. Gravel was then placed into the geo-cell open matrix, and levelled. Check weirs constructed of gabions were also installed along steeper portions in order that runoff velocity would be further reduced. Gabion baskets and ripraps were also placed at the inlets and outlets of culvert pipes to reduce scouring.



Geo-Cell webs are stretched and laid on geotextile



Geo-Cell – filled with gravel and sand and levelled



Geo-Cell (brown gravel) channel

The following table summarizes potential cost savings in the maintenance of the ditches in these two highway sections before and after geo-cell construction. Based on these values, the Geo-Cell technology could pay for itself, through maintenance cost savings, in about four years.

<b>Location</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002 (geo-cell Construction)</b>
Highway 837:02	700 m <sup>3</sup> fill	300 m <sup>3</sup> fill	-	\$22,578
Highway 841:02	-	300 m <sup>3</sup> fill	-	\$39,900
Annual cost to place fill in both locations	\$17,074	\$11,652	Nil *	\$62,478

\* No major maintenance work was done in 2001. Review consultant's recommendation and geo-cell design.

The results and performance of the geo-cells are not yet known but will be closely monitored and evaluated by Central Region staff.

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