

To: John Riddell and Gregory Winters, Novatech Engineering Consultants Ltd.

Date: October 5, 2009

From: Josh Wiebe, M.Sc. (Eng.) and John Parish, P.Geo.

Project: 03-09-02

Subject: Erosion Hazard Limit for Karson Kartage Konstruction Head Office in Carp, ON

INTRODUCTION

Novatech Engineering Consultants Ltd. is preparing a development plan for the existing Karson Kartage Konstruction Head Office site in the Town of Carp (**Figure 1**). A conservative belt width of 20 times the bankfull stream width had previously been delineated and is now limiting the capacity for development on these lands. PARISH Geomorphic Ltd. has been retained to complete an Erosion Hazard Limit study to refine the hazard allowance as defined in *Understanding Natural Hazards* (Ontario Ministry of Natural Resources, 2001) and the *Technical Guide – River & Stream Systems: Erosion Hazard Limit* (Ontario Ministry of Natural Resources, 2002).



Figure 1: The Carp River and the Town of Carp showing the location of the proposed development and stream reach used for analysis.

REACH DELINEATION

The geomorphic characteristics of a channel can change along a creek or stream. In order to account for these changes, channels are separated into reaches – normally several hundred metres to several kilometres in length. A reach displays similarity with respect to its physical characteristics, such as channel form, function, and valley setting. Delineation of a reach considers sinuosity, gradient, hydrology, local geology, degree of valley confinement, and vegetative control following the protocols outlined in *Geomorphological Protocols for Subwatershed Studies* (PARISH Geomorphic Ltd., 2001). One reach was delineated for the study area and is indicated in **Figure 1**. At the downstream reach break the surficial geology changes from offshore marine sediments and alluvial sediments to reworked marine sediments (Geological Survey of Canada, 2003).

MEANDER BELT WIDTH DELINEATION

A meander belt width assessment was conducted in 2008 by PARISH Geomorphic Ltd. for a residential property located upstream of the study site, which also included the Karson Kartage Konstruktion property (see PARISH Geomorphic Ltd., 2008). Although this section of the Carp River was straightened prior to the earliest aerial image obtained for this study (1964), meander scars were visible in the photographs. Considering the past alterations to the channel planform and the valley topography, the meander belt axis was centred on the historical channel alignment. The meander belt width was determined to be 165 metres plus a 10% setback on either side to a total width of 198 metres. This value approximately coincided with the 100-year flood line at the residential property.

EROSION HAZARD LIMIT

The Erosion Hazard Limit method is applied to the Karson Kartage Konstruktion property using procedures outlined in the Ministry of Natural Resources' *Technical Guide—River and Stream Systems: Erosion Hazard Limit* (2002). Using this method, the surrounding landform is simplified as either a confined or unconfined system. The Erosion Hazard Limit is defined differently for each system.

For confined systems, the erosion hazard limit is defined by:

Toe erosion allowance (from Table 2, OR 100 times the average annual recession rate of the toe) OR as determined by a valid study, plus stable slope allowance (suggested 3:1) OR as determined by a valid study, plus erosion access allowance 6 metres OR as determined by a valid study. (MNR, 2001).

For unconfined systems the erosion hazard limit is defined by:

Flooding hazard limit OR meander belt allowance (20 times the bankfull channel width centred over the meander belt axis) OR as determined by a valid study, plus erosion access allowance (6 metres OR as determined by a valid study). (MNR, 2001).

In unconfined systems, the meander belt allowance is used to limit development in areas where the river is likely to migrate over the planning period. In confined systems, valley walls limit the potential for channel migration and bank toe erosion and slope failures present a greater hazard risk.

The Carp River is partially confined by an approximately 2m-high valley wall along the Karson property and is unconfined to the south. As such, the erosion hazard limit for confined systems is applied to the Karson property.

TOE EROSION ALLOWANCE

The surficial geology at the property is listed as “Offshore Marine Sediments - Erosional Terraces” while the area to the south is mainly “Alluvial Sediments - Floodplains, sand, silt, clay” with some areas of “Offshore Marine Sediments - Marine Deposits, clay, silt” (Geological Survey of Canada, 2003).

A minimum toe erosion allowance of 5-8m is required for clay-silts, and 8-15m for sand-silts, when there is evidence of active erosion and the river is within 15m of the slope toe (from Table 2 in MNR, 2001).

To determine the average annual channel migration rate, aerial photographs from 1964, 1978, and 2002 were georectified using GIS software and Ontario Basic Mapping (OBM) control points (building corners, road intersections, etc.). The location of the stream centerlines were traced from the images (see **Figure 2**). The distances between historical channel locations were measured at 18 locations, every 70m along the channel. Yearly channel migration rates were calculated by dividing the average change in channel position by the time period (m/yr). The 100-year migration rate was obtained by multiplying the yearly migration rate by 100 years. The results of these calculations are summarized in **Table 1**.

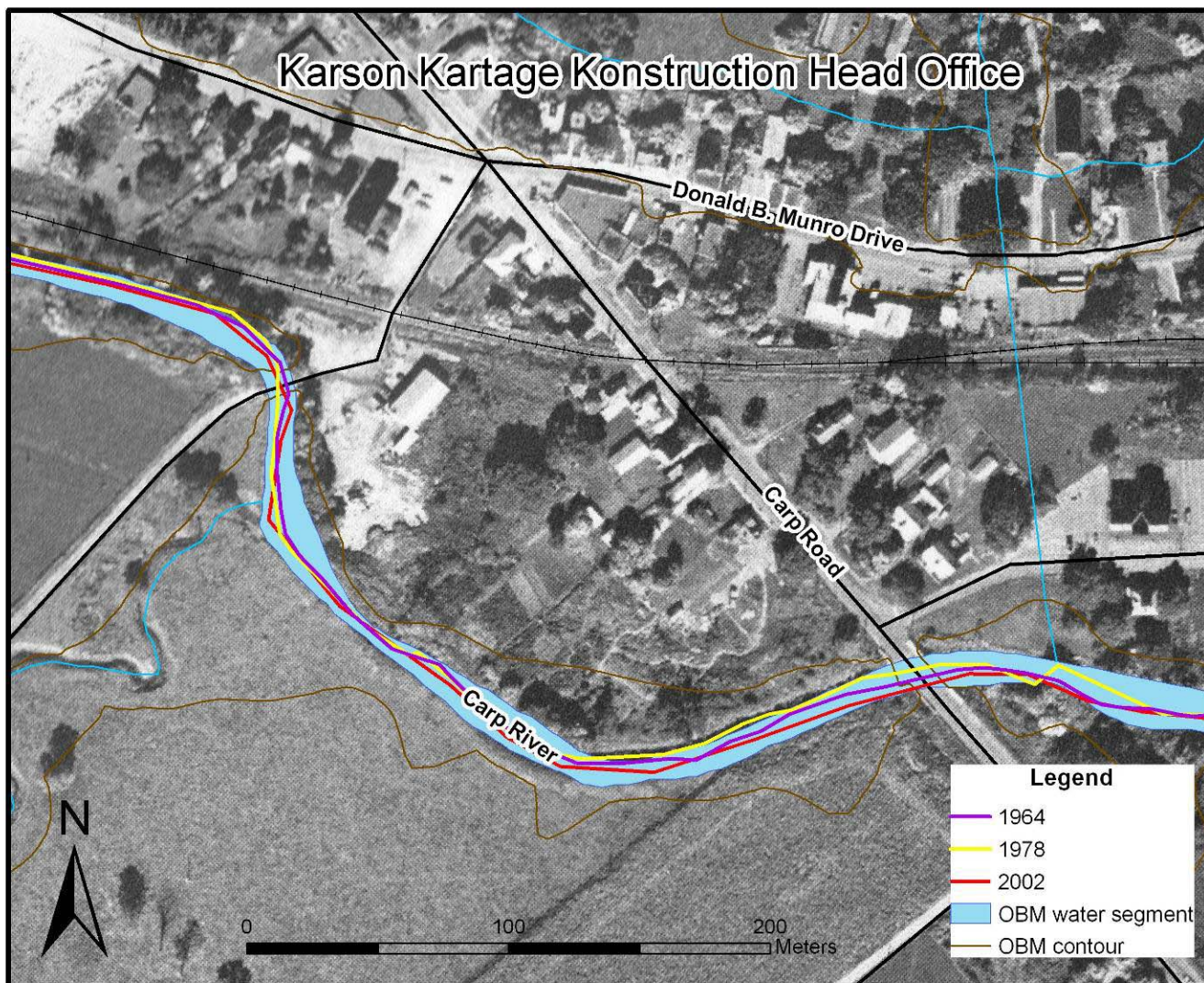


Figure 2: Overview of the Karson Kartage Konstruktion site with the location of the historical channel centrelines, and Ontario Basic Mapping water segments as marked.

Table 1: Historical channel migration rates

	1964 to 1978	1978 to 2002	1964 to 2002
Average channel migration (m)	2.1	3.2	3.0
Average migration/year (m)	0.15	0.14	0.08
100-year migration (m)	14.7	13.5	8.0

The average channel migration is slightly smaller for the period from 1964 to 2002 than for the periods from 1964 to 1978 and 1978 to 2002. However, the average annual recession rate is to be calculated “based on 25 years of data to determine the toe erosion allowance over a 100-year planning horizon” (MNR, 2001). Based on this study, the toe erosion allowance is 13.5m. This value is to be measured perpendicular from the bankfull edge of channel, and does not include the stable slope allowance or the erosion access allowance. The erosion access allowance is to ensure access for people and vehicles during

an emergency. Consultation with the MVCA may allow for this allowance to be included within the parking lot area.

SITE VISIT

Field reconnaissance was completed by Parish Geomorphic on April 29, 2009 to assess site conditions. The Carp River was walked the length of the Karson Kartage Konstruction property. The water level at the time of the visit was 0.75 to 1.25m below the bankfull level. Photographs of the site are shown in **Figures 3 and 4**.



Figure 3: Looking downstream, partially confined conditions on right bank



Figure 4: Looking upstream, unconfined floodplain on left bank

RECOMMENDATIONS

It is recommended that the erosion hazard limit for a confined system be applied to the Karson Kartage Konstruction property as per the analysis in this memorandum. This replaces the 20-times-bankfull-width meander belt allowance that was previously defined. All structures should be located above the 100-year flood line. All other services should be located the toe erosion allowance (13.5m) plus the stable slope allowance (suggested 3:1 slope) from the bankfull water edge. Consultation with the MVCA may allow for the erosion access allowance to be included within the parking lot area. The toe erosion allowance (13.5m), stable slope allowance (6m), and erosion access allowance (6m) are delineated in **Figure 5**. In this figure, the three lines are offset from the Ontario Basic Mapping (2007) stream layer for the Carp River. It should be noted that the OBM stream layer overlaps with the property line in some locations, and that this line could be refined from a more accurate bankfull edge of water field survey.

Respectively submitted,

Josh Wiebe
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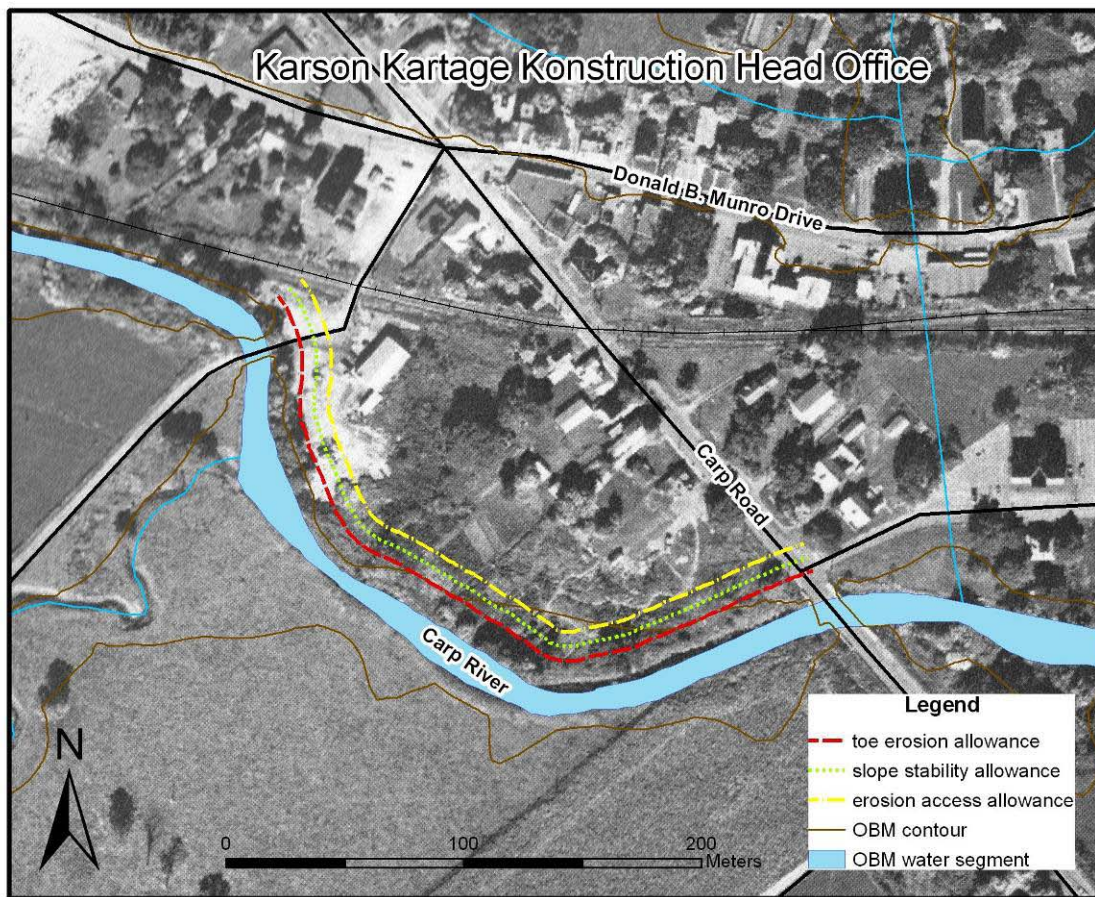


Figure 5: Karson property with the erosion hazard limit as marked (toe erosion allowance + slope stability allowance + erosion access allowance).

REFERENCES

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