SEDIMENTARY BEDFORMS OF RACCOON CREEK-BELOIT, WISCONSIN

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INTRODUCTION

The purpose of this study is to determine factors governing the development of ripples on the bed of Raccoon Creek in the Chamberlin Springs area of southern Wisconsin, latitude 42°, 31' North, longitude 89°, 6' West. The height and wavelength of the ripples were measured, and compared to the water depth, velocity, and discharge. Five sampling locations were chosen and a map constructed to show their relative positions. General sediment samples were collected on three occasions at each site, along with specific samples from the crests and troughs of the ripples, and were subsequently subjected to grain size analysis.

MATERIALS AND METHODS

Velocity and depth measurements were taken at each of the five sites with the use of a Pygmy meter. Spacing of the readings was between 30 and 50 centimeters at each cross section. Each of the five sites were mapped along Raccoon Creek and were within a distance of 34 to 65 meters of one other. Wavelength and height measurements of ripples were carefully taken by using standard metric rulers.

Sediment samples were taken by using a piston-type bed-material sediment sampler, US BMH-53 (for the general site), and a pipette for the specific sediment samples (i.e. samples from the troughs and crests of the ripples). Grain size analysis for each sample was completed by first drying each sample at 110° centigrade and then by using a RoTap to sieve the samples.

The following references were used generally for my research: Folk, R.L., 1974, Tucker, M.E., 1981, 1982.

DISCUSSION

Ripples are formed in fluvial environments by transportation of sediment and they are especially useful when studying sedimentation and stratigraphy. Rippled layers of sediments are commonly preserved in the geologic record and provide excellent bed form geometry that is easier to examine than that of larger scale cross stratification. The layer directly below a rippled surface possesses stratification that can commonly be interpreted as the result of the moving bed forms. In addition, ripples and their related stratification may provide a very detailed record for studying hydrodynamics.

Ripple formation results from mainly two factors: velocity of the stream and grain size of the sediment. If for example, there is a slight increase in wavelength with increasing flow velocity, the main control on ripple size is the grain size of the sediment. Coarser sand gives way to larger ripples (i.e. larger wavelength). The ripples studied here, which are formed by the current of the water, are formed in sediments which for the most part, are not coarser than 0.6mm (coarse sand). Ripples which are formed in sediments finer than 0.6mm in diameter, form asymmetrical ripples almost immediately (Collinson and Thompson, 1982, p.59-68). The average grain size of the sediment forming the ripples being studied here is between 3.0 phi and 1.0 phi (0.125mm to 0.50mm). This means that most of sediments are of fine to medium sand.

There is no significant difference between the sediments in the trough of the ripple and the crest. However, it seems as though there are coarser sediments caught in the trough. Perhaps this is because the grains in the troughs are closer packed, while the packing is looser in the crests. The grain size analyses show no distinct increase of coarser sediment within the troughs. The mean grain size, represented by cumulative curves (although not shown here), is still fine to medium sand (3.0 phi to 1.0 phi (0.125mm to 0.50mm)).

Ripples with highly sinuous crests such as these, usually have asymmetrical profiles. They have steeper concave-upward lee faces and more gently sloping convex-upwards stoss sides. This is the result of the currents flowing in one direction only (Collinson and Thompson, 1982, p.59-68). Research done on similar environments has shown that as the velocity increases, ripples become more rounded and flatter, and the wavelength increases somewhat. However, an increase in wavelength only reflects the measurements of the third day of data gathering (07/30/91)-seven days after a rainfall. It has also been shown that the height of ripples formed at low velocities appears to be smaller (lesser). The data here suggest that both the height and the wavelength tend to increase at lower velocities. These parameters may be controlled by sediment size and seem especially true for the first day of data (07/17/91). The grain size at the lower velocities is coarser than 1.0 phi (0.50mm), and as stated before, coarser sediment forms larger ripples.

tions were unexpected observations only found upon careful analysis of the small scale gage height recording. There is no agricultural irrigation system in this region and also no pubic or industrial wells were observed in the Ladd Creek watershed.

Conclusions

Because of the summer season the watershed was flowing at minimum flow rates. The lack of precipitation events allowed the observation of base flow conditions and of the watersheds reaction to a singular event. It is shown that the Sharon Wastewater Treatment Plant makes up only a very small part of the total hydrograph recorded at the main station as seen in figure 3.

It has been shown that fluctuations are occuring in both of the major tributaries, not just in one of them, as a result of the Sharon Plant. The fluctuations in Ladd Creek are far more comparable to the main station fluctuations than the Upper Little Turtle fluctuations. They are similar in pattern and consistency. It is also peculiar that the Ladd Creek hydrograph peaks at noon and is low at midnight because it rules out the simple explanation of daily evapotranspiration, especially in a dry hot summer. Therefore, the daily fluctuations in the main station hydrograph of the Little Turtle Basin are coming from the Ladd Creek tributary, exact cause unknown.

References

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RESULTS

Figures 1 and 2 show how the average height and average wavelength are affected by the average velocity. Thus, each line represents one of the five sites. The three points on each line indicate the average of measurements at a site each day when data was obtained. Data were collected on three days: July 17, 1991, July 23, 1991 and July 30, 1991. July 17th represented a day when the stream was at equilibrium and July 23rd was two days after a rainfall.

Note: There are no velocity data for Site 5, July 17th, because of incomplete measurements.

Figure 3 shows a grain size analyses which illustrates the abundance of grains in each grade size (and representative of the mean or average grain size of the sediment forming the ripples being studied here). The graph is representative of site 2.

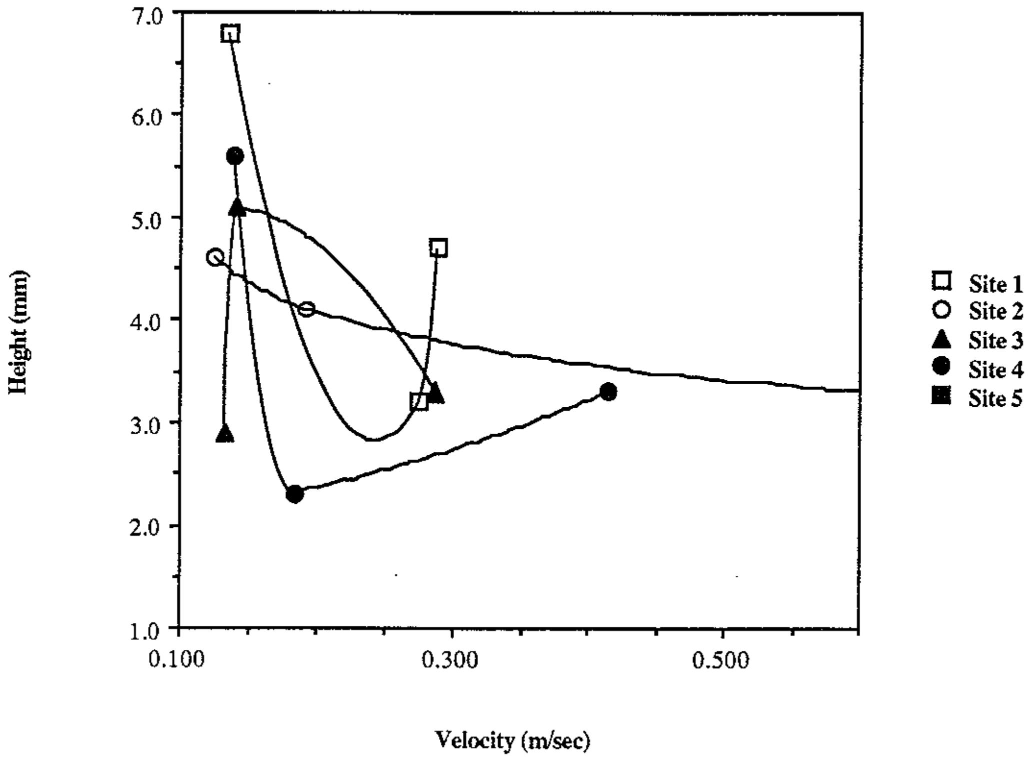

Figure 1

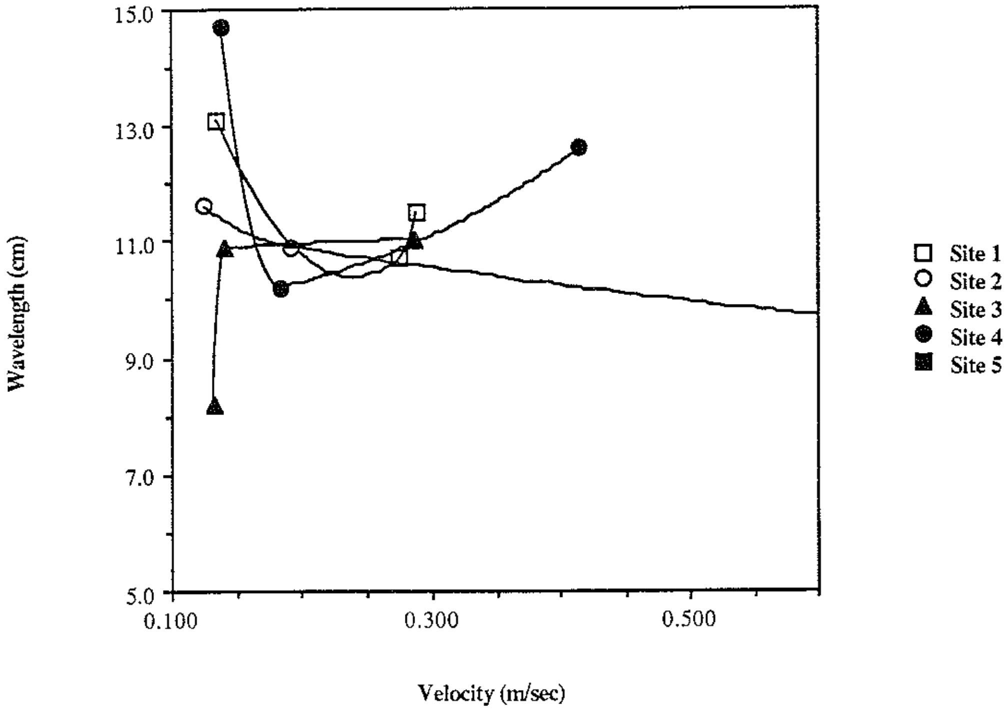

Figure 2

Figures 1 and 2 represent graphs of the average velocity versus (1) average height of the ripples and (2) average wavelength of the ripples. The last point (July 30, 1991) for site 2 is not shown here so that the x-axis may be expanded. The last point for site 2 does exist. However, because it expresses a much higher velocity reading, it requires a much larger maximum for the x-axis. If the maximum were larger, it would be harder to visualize each line showing data individually.

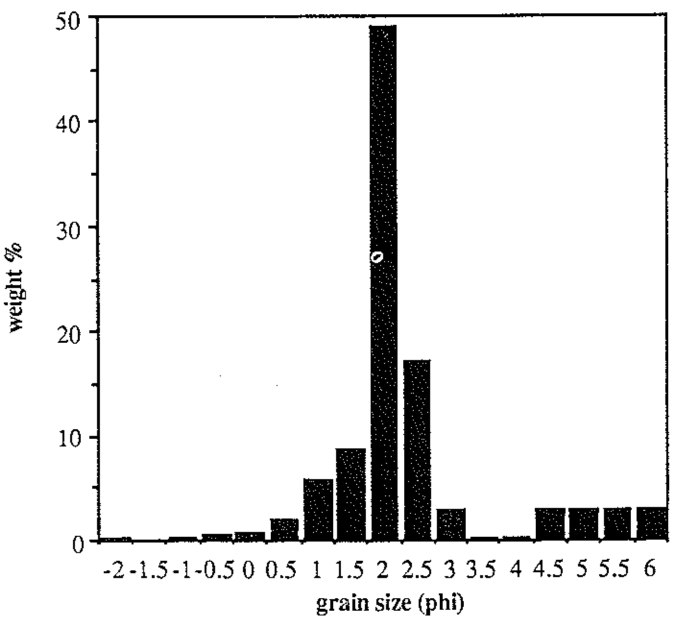

Figure 3

Figure 3 is a histogram representing the grain size distribution at site 2 on July 17, 1991.

CONCLUSIONS

1. The mean or average grain size of the sediment forming these ripples is 3.0 phi to 1.0 phi (0.125mm to 0.50mm), fine to medium sand.
2. Wavelength and height of the ripples are not so much affected by the velocity of the water, as by the grain size of the sediment.
3. These ripples are the result of a unidirectional current flow.

ACKNOWLEDGEMENTS
I would like to thank Dr. Richard C. Stenstrom, Dr. Mack Gipson, Jr., Steve Burrell and Dr. Donald H. Zenger for their assistance in this study.

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CONTRIBUTION OF STORM SEWER RUNOFF TO THE TRACE METAL CONTENT OF THE ROCK RIVER, BELOIT, WISCONSIN

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INTRODUCTION

The City of Beloit, situated on the southern boundary of state of Wisconsin, rests on the flood plain of the Rock River. All the storm water runoff from the city enters the Rock River directly through storm sewers or via one of the near-by tributaries which join the river just below the Illinois-Wisconsin state line.

The Rock River is used primarily for recreational activities and hydro-electric power generation. The small reservoir above the Wisconsin Power and Light Blackhawk Generating plant is used heavily by boating enthusiasts and fishermen. The greater portion of residential storm sewer lines empty into the river above the dam. The downtown and industrial zones discharge primarily into the swifter waters below the dam.

Runoff from streets, parking lots, and industrial sights is known to be a contributor of hazardous pollution to river systems. Nearly all the major factories in Beloit have been built on the Rock River or one of its tributaries. These industries are primarily foundries and smelting facilities which discharge their waste water directly into the Rock River. In addition, overland and interflow contributions to the river often pass through the contaminated soils of the industrial sector.

The primary purpose of this study was to assess the potential contribution of trace metals by the City of Beloit during precipitation events. Two sets of water samples were taken during the study. The first set was taken to determin background concentrations of trace elements in the river. High background concentrations might indicate that industrial discharge plays a greater role in contaminating the river. The second set of samples was taken directly from sewer discharge during and shortly after a precipitation event to determine contribution of storm sewer runoff.

PROCEDURES

The sample bottles used for this study were standard 1 qt. "milk" bottles. The bottles were thoroughly washed and rinsed with distilled water. They were then rinsed with concentrated nitric acid to reduce the chances of contamination by the lab water supply.

The first group of samples was taken at two sites. The upstream sight was located just above the Beloit College Limnology Lab. This sight was chosen because it is above all city storm sewer outflows, and should represent water flowing into Beloit. The standard EWI (Equal Width Increment) sampling method was used. Samples were taken using a depth integrating sampler suspended from the bow of a Jon boat. The river at this location was approximately 325 meters wide. 10 samples were taken at 30 meter intervals, starting at 12.5 meters from shore. At each interval, the boat was anchored and the sampler was lowered and raised by a hand-cranked winch. In addition, three pH measurements were taken to determine the potential of the water to mobilize trace elements.

The downstream sight was located on the north side of the Shirland Avenue bridge. This sight was chosen because it is below all of the cities sewer outflows. EWI sampling method was again used. The depth integrating sampler was suspended from the bridge using a tripod crane and winch. The river was much narrower at this location, only 75 meters wide, so only 5 samples were taken. Samples were taken every 15 meters, starting 7.5 meters from the shore. PH readings were taken here as well.

The second group of samples was taken directly from five storm sewer outflows that were above river level. Due to variable outflow conditions at different sampling sights, samples were taken by dipping sample bottles under the outflow until bottles were approximately three quarters full.

All water samples attained were then prepped for ICaP analysis. The Inductively Coupled Argon-Plasma Atomic Emission Spectrometer analysed the water samples for 16 different elements, Ca, Al, Mg, Na, K, Fe, Mn, Ba, Co, Cr, Cu, Pb, Zn, Cd, Ni, and Si.

DISCUSSION

The water analysed from the upstream cross-section showed concentrations below detection limits for most of the heavy metals. Fig. 1, calcium, sodium and magnesium were relatively much higher, but well within expected parameters for natural waters. Results for each interval were within one part per million, indicating that the samples