# Assessment of sediment transport and sedimentation in a dry environment, Oman

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**Introduction**

Monitoring and assessing sediment transport in a dry environment is essential to understanding the interaction between the hydrology of the ephemeral stream (Wadi) and the geomorphology of the channel bed and its impacts in the dry dam reservoir. The dry channel bed exposed directly to high shear stress occurs during sharp and rapid hydrographs of a flash flood, thereby high sediment transport and supply (Hooke, 2019). The fluvial processes play a significant role in the deformation of the channel beds associated with per flood events. However, this process has less impact in the channel embankments and more stabilized in some mountains Wadi systems. Based on field investigation, several mountainous ephemeral streams in the arid region have flatbed topography with alluvial fans and wide channels at the outlet of catchments. Consciously, these areas have been urbanized with changed in the channel criteria, as result increase the channel degradation. Moreover, the downstream lack of bank-stabilizing, that increasing the vulnerability level of flood risk. In general, dams are constructed in the wadi system for multiple functions, for instance, flood control and groundwater recharge. The dry dam reservoirs suffering from several problems as result of sedimentation, such as storage capacity losses, reservoir bed clogging, and downstream channel degradation. Approximately 1% of dam capacity is lost per flood event in the Wadi Assarin (Al-Mamari et al., 2022). While the annual soil loss in Japanese reservoir rangs from 1.0 to 0.1 % (Sumi & Kantoush, 2018). In the arid region, Wadi flash floods are common, but their occurrence and processes are not scientifically understood.   However, quantifying sediment yield is challenging, and our scientific understanding of sediment yields in arid environments remains incomplete due to the lack of observed data and in-depth research. Therefore, this research aims to analyze and understand the impacts of flash flood magnitudes in the sediment dynamics by calculating values of difference of multi cross-section surveys for different flash floods.

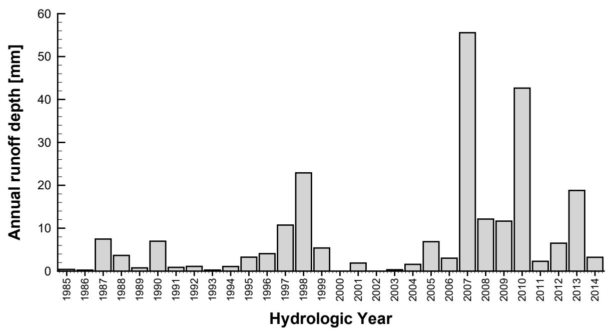


Figure 1. Annual runoff depth in the Wadi Samail catchments at the downstream gauging station.

The Wadi Samail catchment is the second largest catchment in Oman, with a drainage area of 1670 Km$^2$ and two main types of channel bed materials: gravel and sand. The catchment is set entirely within a high drainage network and topographic altitudes. In the last decade, the flash floods frequency with extreme events were increased in the Wadi Samail as shown in figure1.

Eleven cross-section campaign were established from 1997 to 2010 with three topography section for each period. Additionally, multiple floodmarks were collected through the reach using leveling instrument. All floodmarks collected from the both side of wadi reach and crest-stage indicators (CSI) that installed near monitoring point to compute the peak discharge using the slope-area method (Dalrymple & Benson, 1967). The flow velocity calculated based on the Manning equation, the slope between three cross-sections, the lowest elevation points in each cross-section, and n values of 0.038. There are possible ranges of uncertainty of collecting elevation values between cross-sections and floodmarks, these uncertainties are associated with the accuracy of the leveling instrument. The floodmarks heights and water gradients have checked by fixed CSI and water level transducer. The average width of the cross-sections is about 115 m. The fluvial process was detected by the changes in the channel bed elevation. The average velocities of these flash flood events ranged from 1.3 to 3.68 m/s.

The total average erosion and deposition of channel bed level change values equal 2.3 and 2.5 m, respectively, through all cross-sections with an average discharge 446 $m^3/s$ were calculated. The average flow velocity estimated by using Manning equation is about 2.1 m/s, which is relatively high for dry channel bed that consequncely cause high sediment transport. Figure 2 show the major morphology changes in the channel bed level that had a high deposition process with the flow discharge renge below 250 $m^3/s$. While the deposition pattern is dominate higher than the erosion process due to the small flood discharge that happen between the two cross-section surveys, which significantly influence the bedload movement. In 2007, the strongest tropical cyclone, GONU, hit Oman and caused sever damages to the infrastructures and properties. As result this high flood discharge of 1393 $m^3/s$ causes massive erosion with about 8 m in the total channel bed level changes. The soil lost from the watershed due to erosion is transported through the drainage network and temporarily deposited in various stages and locations. In general, the erosion and deposition process in the wadi system fluctuated from floods to floods, and the results did not show a strong trend pattern of channel bed level change.

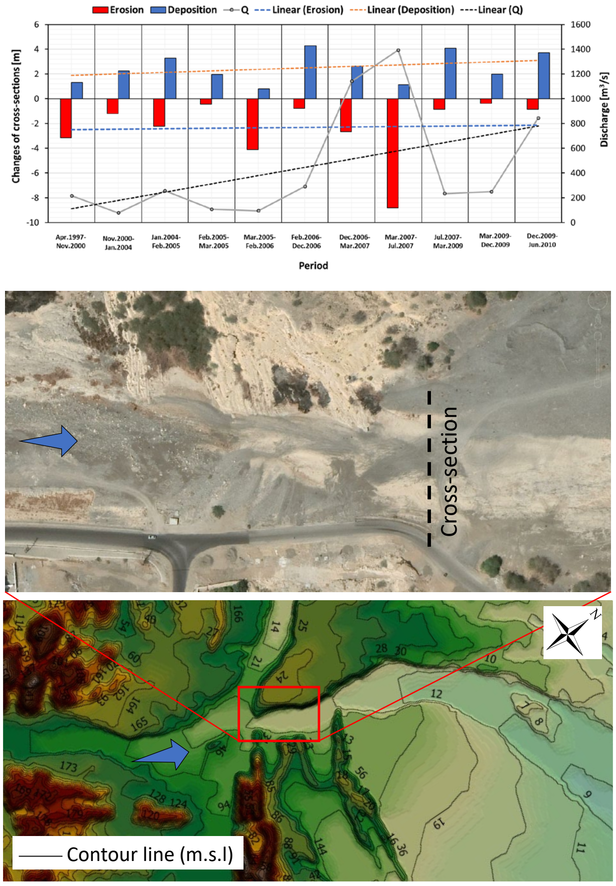


Figure 2. Dry channel bed level changes for multi cross-sections surveys from 1997 to 2010 catchments at the downstream of Wadi Samail

## References


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