

CityLinks Coastal Engineering Curriculum: *Managing the impacts of manmade and climate related coastal erosion*

Introduction

CityLinks™ is a program of the International City/County Management Association (ICMA) that allows city officials in developing and transitioning countries to draw on the resources of local governments around the world to find sustainable solutions tailored to the real needs of their communities. CityLinks works to improve the capacity of cities to provide quality services to residents, create a better living space for the community, and sustain those improvements after the specific CityLinks project ends.

Made possible through a five-year agreement (2011-2016) with the U.S. Agency for International Development (USAID), the CityLinks program is implemented by ICMA and its partners with a focus on urban climate change mitigation and adaptation, food security, and water and sanitation access.

This curriculum was part of a pilot partnership between Durban South Africa and Dar es Salaam Tanzania. The city of Durban has been a leader in coastal management with regard to climate change. Through CityLinks ICMA was able to facilitate knowledge sharing activities between the two cities both struggling with rapid growth, coastal erosion, and climate change. This partnership also collaborated with the Durban Adaptation Charter (DAC) which provided the knowledge and expertise for conscientious coastline management.

This course was designed specifically for city engineering staff in coastal communities in Tanzania. This was born out of a clear demand for civil engineers to better understand their changing coastal landscape as a result of climate change, infrastructure interventions, and overall development. The two day course was given by Dr. Andrew Mather a coastal engineer from Durban, South Africa. Dr. Mather is a contributing author and member of the [World Association for Waterborne Transport Infrastructure](#) that published the report [Countries in Transition: Coastal Erosion Mitigation Guidelines](#).

The curriculum is supplemented by the report [Countries in Transition: Coastal Erosion Mitigation Guidelines](#). While this curriculum was designed for Tanzania, the CityLinks team can work with Dr. Mather to facilitate this in other developing country contexts. We welcome the opportunity to speak with interested parties on adapting this framework to meet specific local needs.

Format	Theme	Concept	Topic	Sub-Topic	Activity		
DAY 1							
					Ice breaker: Participants pair up and introduce themselves to each other and then introduce each other to the group with a focus on their localized coastal issue.		
Lecture	Coastal Processes	Overview of Coastal Area Terminology					
		Meteomarine Forcings	Waves		Visuals of waves, breaker types, etc.		
			Water Levels	Tides and storm surge			
			Currents	Ocean circulation			
				Tidal currents			
		Climate Forcings	Sea Level Rise		Visuals of local impacts		
			Temperature Changes				
			Precipitation Changes				
			Wind Patterns				
			Ocean Acidification				
		Beach Materials and Origins	River Materials	Cohesive materials	Physical examples passed around and visuals provided		
				Non-cohesive materials			
			Materials Supplied by Erosion	Wave action			
				Storm surge			
				Wind action			
		Coral and Sand Supply					
		Coffee/Tea Break					
		Sand Transport	Long shore transport		Google/GIS images over time demonstrating transport		
			Cross shore transport		Participant name a location of where they		

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			Equilibrium profiles		have concern and bring it on Google Maps or if available, provide GIS maps from the municipality to show areas of concern.
		Coastal Classification	Exposed littoral dune coast vs. exposed littoral cliff coast	Moderately exposed littoral dune coast	
				Moderately exposed littoral cliff coast	
			Protected or Marshy Coast		
			Tidal Flat Coast		
			Monsoon or Swell Coast		
			Muddy Coast with Mangrove Vegetation		
			Coral Coast		
			Special Coastal Form Elements	Deltas	
				Sand spits	
				Barrier islands and tidal inlets	
				Lagoons	
				Bay beaches	
Lunch Break					
		Causes of Coastal Erosion	Natural Causes	Chronic	
				Acute	
			Human Causes	Coastal structures and littoral transport	
				Passive protection structures	
				Reclamation Projects	
				Sand Mining	
				Wakes from fast ferries	
		Coral Mining and Dredging			
		Causes of Coastal Flooding	Natural Causes	Extreme events	
				Long term trends	
			Human Causes	Extreme events	

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				Long term trends			
		Investigating Coastal Erosion Problems	Collection of Existing Data	Spatial Data	Visual examples are provided and a brief discussion around the data quality considerations for informed decision making.		
				Meteorological and hydrodynamic data			
			Field Surveys and Recordings				
			Numerical Modelling	2-d			
				1-d			
			Physical Modelling				
DAY 2							
Lecture	Coastal Engineering	Understanding Challenges and Local Conditions	Problem Identification	Chronic vs. Acute			
			Assessing Risk		Risk classification		
					Land Use		
					Protection Status		
		Protection Options	Passive (hard) solutions	Pros and Cons	Visual examples of successful and unsuccessful hard and soft interventions. Discussions around budget approximations and financing for different solutions		
			Active (soft) solutions	Pros and Cons			
		Climate Change Considerations	Sea Level Rise		Global data resources if no local projections are complete		
			Retreat	Setback Lines			
		Coffee/Tea Break					
				Comparing Solutions	Level of Protection		
					Sustainability		
					Regulatory Framework Considerations		
		Economy					

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Discussion	Localized Challenges	Local Coastal Processes	Potential Engineered Solutions	Hard	Each municipality presents on a coastal concept in their community and participants brainstorm the pros and cons of different engineered solutions. Visual support through GIS data or Google Maps.
				Soft - Green infrastructure	
		Private Sector Involvement	Economic Development		Local examples of development that took coastal engineering concepts into considerations
			Port Considerations		Examples of impacts ports can have on coastal processes
		Citizen Engagement			Examples of locally successful citizen engagement strategies are presented and participants brainstorm ways to translate this into awareness around climate change coastline management.
Working with Elected Leadership			Discussions around supportive elected leadership and how visuals and other decision support tools can help lead to more informed decision making around coastline management.		
Case Study	Demonstration	Lunch Break			
		Causes of Coastal Erosion	Protection Option Implemented		Participants are presented with a local case study in the classroom with visualizations over time of the erosion occurring. Participants then visit a local site that has or is experiencing severe coastal erosion. Trainer facilitates a discussion around the protection options that were implemented why they were or were not successful and what can be done in the future specifically regarding climate forcings. When choosing a case study, the trainer will look for an area with several decades of erosion that has undergone several different engineered solutions.