Aspects of Vulnerability to Droughts and Floods in the Upper Thames Watershed: Perspectives from the Upper Thames River Conservation Authority Stakeholder Engagement

CFCAS project:
Assessment of Water Resources Risk and Vulnerability to Changing Climatic Conditions

Project Report VI.

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I. INTRODUCTION

The study "Assessment of water resources risk and vulnerability to changing climate conditions" supported by the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), explores the implications of climate change for floods and droughts in the Upper Thames Watershed in southwestern Ontario. The study develops climate change scenarios using downscaling methodology. These scenarios are applied in event-based and continuous hydrologic models developed for the watershed. Then the implications of those scenarios on extreme events such as droughts and floods are assessed. In addition, the study seeks to investigate the current risks of and vulnerability to drought and floods and those in the future due to climate change; water management strategies to reduce climate vulnerability are also identified. Relevant outcomes in these areas from the study include:

- interaction with stakeholders to identify vulnerabilities to extreme events,
- identification of proactive planning and resource protection measures to deal with climate change,
- development of hazard risk management strategies that include strategies and mitigation measures for floods and droughts, and robust management under changing climate, and
- marketing of project products including conservation and planning communication tools.

Assessment of risks and vulnerability and development of response strategies benefit from engaging stakeholders including those who have professional expertise and responsibilities, those representing vulnerable groups or activities, and those engaged in policy-making.

A key stakeholder group for this study is the Upper Thames River Conservation Authority (UTRCA), an organization mandated to manage the resources of the Upper Thames River watershed for multiple issues including drought and floods. A half-day, facilitated meeting was held at the UTRCA offices on November 24, 2004 to engage the professionals in the organization. Its objective was to formulate an understanding of the hazard context for the UTRCA: what are the impacts from drought and floods; where do the impacts occur; what are the responses to impacts; and what are the management issues and information needs?

This report describes the stakeholder engagement methodology and summarizes key vulnerabilities to drought and flood in the watershed identified through the discussion. Areas in the watershed that demonstrate current vulnerability to floods and drought that would be good candidates for more detailed case studies are also identified.

II. STAKEHOLDER ENGAGEMENT METHODOLOGY

Professionals from the UTRCA, with expertise in engineering, hydrogeology, planning, ecology and communication, were assembled for the stakeholder engagement (see Appendix A). First, a presentation provided an overview of the study's components, its main tasks and outcomes. The presentation was also used to describe key concepts such as an adaptation policy framework, social and biophysical vulnerability, and perspectives on determining vulnerability (see Appendix B). Second, a facilitated, three-round dialogue was used to engage the UTRCA participants. They were asked to respond to the following topic areas using their expertise and knowledge of the Upper Thames watershed:

- impacts of droughts and the responses undertaken,
- impacts of floods and the responses undertaken, and
- areas within the Upper Thames watershed that demonstrate sensitivity to drought or flood that might be good case study sites to explore the issues in more detail.

For each round, participants were given index cards and asked to write down their two top concerns regarding the topic. Progressing around the table until there were no more unused ideas, each participant was asked to read out and explain his or her response; other participants could then add to the discussion by offering their ideas and further examples. The discussion was recorded by the facilitator on a flip chart, and by the other researchers. The same method was used in each round discussing one of the three topics. The various notes were collated and discussed by the researchers in a subsequent meeting, to produce this summary.

III. EXPLORING VULNERABILITY TO DROUGHT AND FLOODING

A great deal of discussion was generated on the impacts of and adaptation to drought hazard by the UTRCA participants because they recognized it as an impact area that they had less experience with compared to flooding. With climate change there is a likelihood of more frequent droughts. The participants were enthusiastic about exploring the topic.

In rounds 1 and 2, the discussion was framed by the following questions:

• When drought and flooding occur in the UTRCA:

– What are the impacts?

– Where do the impacts occur?

– Who are affected?

•What responses are undertaken?

• What are some of the key management issues that remain?

III.1 Perspectives on Drought

Key droughts, as identified by the UTRCA participants, occurred in the watershed in 1963-1964, 1988-1989, 1998-1999, 2001, 2002, and 2003. A critical outcome of drought is that flow in rivers, streams, and creeks within the watershed decrease.

Municipal water supply and demand.

- Reduced water supply may require changes in supply source. The preferred management response is to increase water conservation, but an issue is the expectation that there will be a growth in capacity of water supply with an increase in demand for water.

Changes in perspectives on urban aesthetics are required.

- During drought, lawn watering bans are put into force and lawns turn brown due to insufficient water. An important issue is modifying the urban aesthetic for green lawns where the demand for this use competes with other water needs.

The source of municipal water supply (e.g., ground water, stream, or Great Lake) affects demand and drought management.

- Water users who receive water from the Great Lakes (i.e., London) have different perceptions of the availability of water supply than rural ground water or stream users. Communities supplied by the Great Lakes perceive that there is a limitless supply of water; this perception makes water conservation and drought management initiatives difficult to implement successfully. Communication, which develops awareness that the Great Lakes water supplies are limited and water use and conservation are a shared responsibility, needs to be enhanced.

Legislation can influence water supply choices.

- External influences such as legislation and liability for water supply as a result of Walkerton may result in numerous municipalities with ground water under direct influence (GUDI) switching their municipal drinking water source to the Great Lakes as it may cost more in the long run to test and treat ground water sources, as required by Ontario government (post-Walkerton), than to pipe water from a Great Lake.

Water conservation has a positive influence on base flow.

- Stratford has decreased its water use by 10 to 15 % by increased investment in conservation measures, resulting in more base flow.

The water taking permit process needs to be reviewed.

- Water taking permits need to be revisited as the regulatory framework is not being enforced and many water users are not in compliance.

Expectation for "green" golf courses needs to be modified.

- Golf courses during the 1999 drought made a business decision to take water because there is the expectation from users that golf courses will be green. However, the public perceived that the golf courses were overusing water and in some cases were affecting private homeowners' water levels.
- An educational message - a "green experience" is not necessary for golfing - needs to be communicated to golfers and golf operators that would allow for changes in types of turf and the play area.
- Golf courses in the headwater areas of the Upper Thames are increasing their permit for water supply to entrench their present "right" to water and hedge against water supply shortages in the future.
- In the London area, water from the Thames River is extracted for watering golf courses rather than using costly treated municipal water.

Irrigation practices need to be more efficient.

- Water taking for farming can affect the ecological needs of water.

- Irrigation may not be as efficient as possible. Irrigation Advisory Committees have been established in areas (e.g., Long Point Area) where there are multiple demands on water supply.

Tile drainage on agricultural lands can exacerbate drought effects.

- Tile drainage affects hydrology and exacerbates low moisture conditions during a drought, contributing to crop losses. Tile drainage is used to extend growing conditions and promote earlier access onto the fields in the spring by enhancing runoff. However, tile drainage can reduce ground water recharge during the short, key period of spring melt, reduce soil moisture reserves and rapidly remove water from the field after a precipitation event.

Water demand for aggregates should be considered.

- Aggregate operators often need to drain water in order to mine for aggregates. Water is used for washing the mined aggregate. There is a need for storage.

Selected species are at risk to drought.

- Under low flow conditions, water temperature may increase. The warm-water fish community is resilient, but cold-water species are at risk. Some areas with permanent flow under normal conditions can become intermittent during droughts. Fish kills can result, with the resultant loss of other species in the food chain.
- Drought-adapted species are preferred and niches change. West Nile disease is a concern and requires more education. It is not known if there will be new species or what to do with new species due to climate change.

The natural heritage in the watershed is vulnerable to drought.

- Drought can alter surface and ground water drainage to wetlands; they can dry out changing their ecological functions and areal extent. If a wetland dries too much, it may no longer be considered a wetland and no longer fall under the provincial wetland policy.

Reservoir operation for streamflow augmentation.

- Reservoirs are used to augment streamflow during the summer. Management of reservoirs can affect their use for recreation; water levels affect water-based activities. For example, in June and July the reservoirs are operated to almost full level. During the flood of July, 2000 since the system was filled to near capacity, it was vulnerable to flooding while in 1999, Wildwood Reservoir was 1.5m below average affecting recreational use.

Drought reduces water quality.

- When there is less base flow, septic tank waste, manure runoff and nutrients have more of an impact on water quality.

III.2 Perspectives on Floods

The direct impact of floods is less wide-spread than that of droughts, being restricted to the flood plain. Geographical variation in the generation of floods and impacts was noted: a small headwater stream may experience flooding from a small, isolated thunderstorm, whereas the effect is barely noticeable as that peak flow is integrated downstream. This variability, especially in summer, makes flood prediction, monitoring, and response difficult.

Time of year can affect the amount of flood damage experienced.

- Summer flooding causes more debris damage in the Upper Thames watershed because the flood plain is used: docks are in place, cattle are in fields, canoes and other recreation equipment are in the flood plain. In contrast, during spring floods the flood plain is not occupied and these damages are reduced.
- In spring, fish spawning and egg-laying turtles are vulnerable to flooding.
- In the summer, the reservoirs are full for augmentation; they are vulnerable to flooding.

Property damages from flooding affect real estate.

- Increased frequency of flooding affects incidence of flooding in streets and basements and sewage back-up. Changes in the susceptibility to flooding affect real estate; many low- to mid-value residential areas are vulnerable to flooding.

Flood design specifications need to be continually updated.

- City of Stratford's 5-year flood event design specifications have been updated and the older areas now do not meet the "new" updated design changes.
- Major design standards have established the 100-year to 250-year event for overland relief flow and the street drainage system.
- Local drainage planning and regulations based on "old" lines need to be redrawn and continuously updated. Planners need tools that are flexible for the uncertainty of change; flood lines are currently envisioned as "hard lines", but there should be some free board for climate change.

Density of precipitation and streamflow observing network influences ability to respond to flooding.

- Potential increase in intense local precipitation events may not be captured because of the lack of gauging stations or low density of gauging stations in certain portions of the watershed. For example, small tributaries in the watershed are vulnerable to an increase in thunderstorms. The town of Punkeydoodles Corners near Waterloo has very little time to react to a potential flooding incident because of the rapid response of the streamflow to precipitation within the watershed and the lack of gauges to pick up the streamflow response.

Water quality deteriorates during flooding.

- Water quality is affected by flooding with an increase in sediment loading and stream-side and bottom disturbance.

Weather forecasting and weather warnings are important.

- There are demands for improved forecasting and prediction needs for different systems such as convective, frontal, and lake breeze. There are questions of how to incorporate weather warnings in forecast messages in meaningful and understandable ways.

Frequency and size of flooding events are crucial considerations.

- Frequent, small flooding events can be as significant as infrequent large flooding events. For example, flood-prone areas include Highway #2 near Pittock Dam, where businesses are flooded, and Adelaide and Windemere Streets in London.
- If there is an increase frequency of back-to-back storms, there is nowhere for the runoff to go because the outlets are already full or overcharged.

Flooding protection.

- There is a perception that most occupied parts of the watershed are well-protected from flooding due to dikes and dams. But, that perception may not be entirely correct. For example, in St. Mary's only one side of an area is dyked while the other area is vulnerable to flooding.

Flood forecasting and monitoring is a challenge.

- Staff resources are required to model changes due to population growth, shifts in land-use patterns, and climate change. There is a need to continually remap and communicate. There is significant investment required to keep up with the changes and there is not necessarily more service to the community. There is a cost to maintain the status quo that municipalities and the Province need to recognize.

IV. CASE STUDY DESIGN – IDENTIFYING AREAS WITHIN THE WATERSHED THAT DEMONSTRATE VULNERABILITY

The UTRCA identified several locations where case studies could be undertaken to understand vulnerability in more detailed fashion (see Figure 1 for location of areas within the watershed).

- Avon River - would be a good case study for flooding although there is currently a litigation underway that could hamper access to information. Small reservoir, ground water, rural and urban components
- Avon River in Stratford - marginal flood plain
- Upstream of Mitchell
- West Perth
- Embro
- Ingersoll - issues with quarries
- Dorchester - ground water supply problem
- Dingman Creek - agriculture, wetlands, groundwater
- St. Mary's - ground water
- Trout Creek - trout streams
- St. Mary's - golf course issues
- South end of London
- London - sub-watersheds aggregated downstream and effect on London

- Fanshawe Dam - upstream drainage into dam

Data availability:

- There would probably be good socio-economic data for London.
- There would be better volume and peak information from the modelling further downstream, e.g., towards, London
- Best contacts would be on the Avon River
- Storm sewer data available for Avon River in Stratford

Other issues to consider:

- What place could be used so that information could be transferred elsewhere?
- Scale issues, particularly the differences in exposure to extreme events according to geographic location within the drainage network
- Upstream and downstream issues, and the integration of extreme events down the drainage network
- Use "what if" scenarios with stakeholders to identify potential impacts, responses, and adaptations
- Will the physical models provide scenarios appropriate to the scale of the sub-watersheds?
- Pose questions to municipalities, and note how responses change as move downstream and how view issues differently
- Urban vs. rural

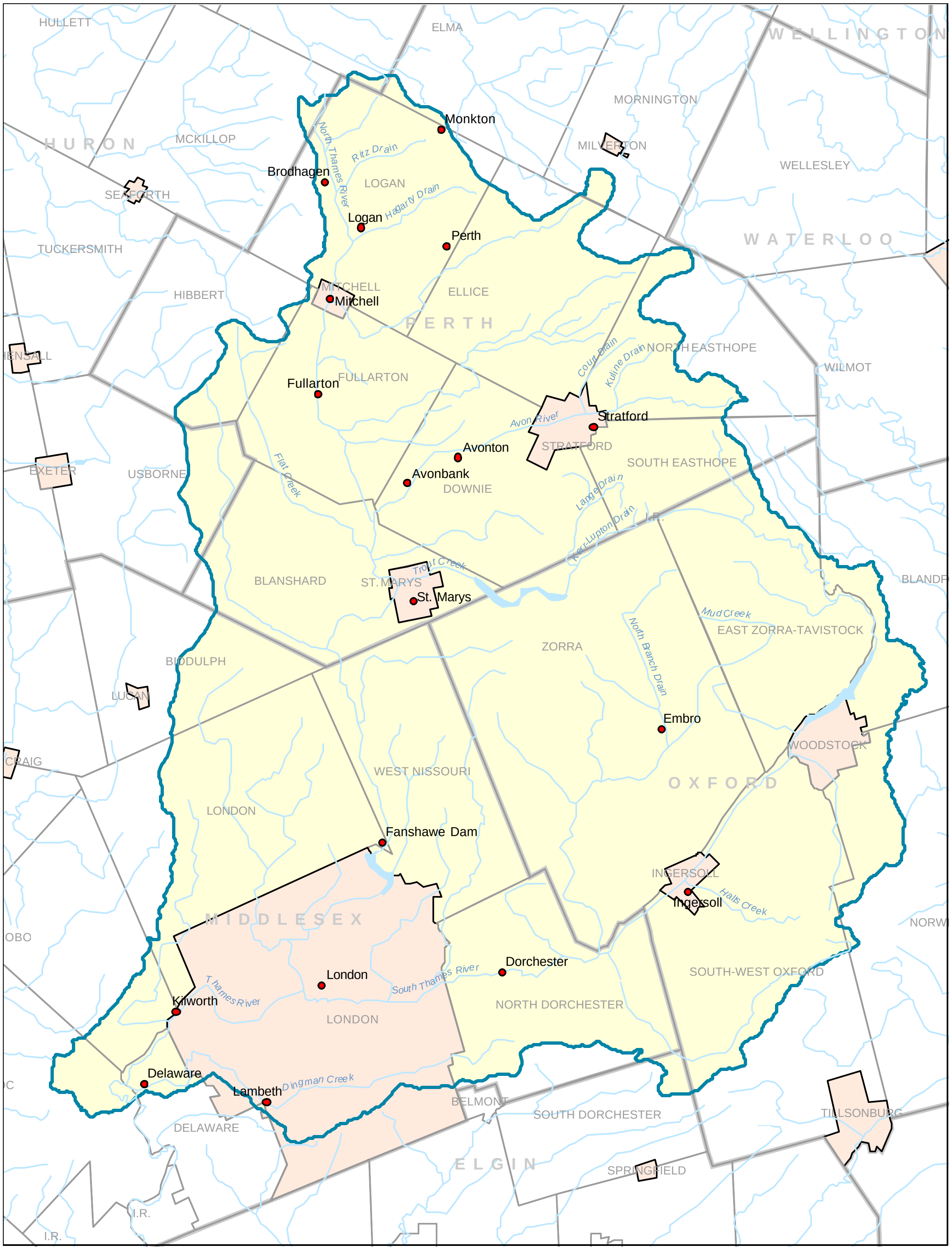
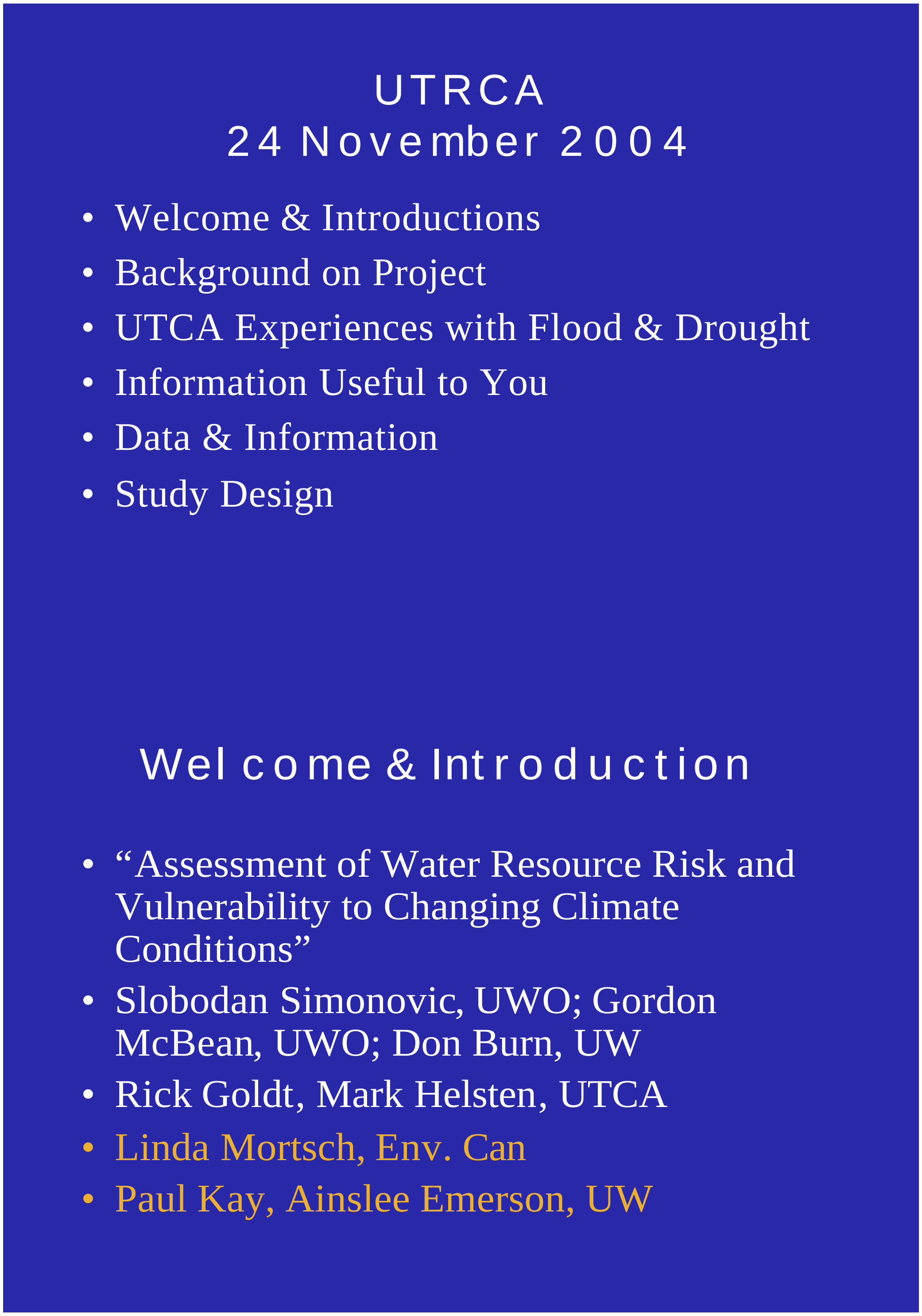


Figure 1. Location of candidate case study areas.

Appendix A: List of Participants

Participant	email	Interests
UTRCA		
Chris Harrington	harringtonc@thamesriver.on.ca	
Mark Helsten	helstenm@thamesriver.on.ca	Engineer:
Jeff Brick	brickJ@thamesriver.on.ca	Planner: preventative approaches
Terry Chapman	chapmant@thamesriver.on.ca	
Linda Nicks	nicksl@thamesriver.on.ca	Hydrogeologist: water quantity & quality
Teresa Hollingsworth	hollingsworktht@thamesriver.on.ca	Community
John Schwindt	schwindtj@thamesriver.on.ca	Sensitive fish populations
Tara Tchir	Tchirt@thamesriver.on.ca	Ecologist: landscape, wetlands
Chris Tasker	Taskerc@thamesriver.on.ca	Engineer: operation & maintenance of dams
Rick Goldt	goldtr@thamesriver.on.ca	Hydrologist: flooding
University of Waterloo/Environment Canada		
Paul Kay		
Ainslee Emerson		
Andrea Hebb		
Linda Mortsch		Facilitator

Appendix B: Presentation at Stakeholder Engagement



Components of Study

- Hydrologic modelling component
- Climate change – weather generator
- Assessment of risk and vulnerability
  - Physical changes
  - Social vulnerability
    - definition
    - impacts
    - people, activities
  - Adaptation
  - Stakeholder engagement
- Case Study
- Communication

Tasks of Study

1. Hydrologic model for simulating hydrologic processes at different temporal and regional scales
2. Stochastic model for the generation of spatially distributed weather data
3. Approach providing a link between large and local scale weather scenarios
4. Methodology for general assessment and management of hydrologic risks and climatic vulnerability
5. Methodology for assessment flood risk under present and future climate conditions
6. Standardized database for the case study
7. Calibrated functional models useful for water management applications in the case study
8. Assessment of present/future water resources risk and climatic vulnerability for the case study
9. Water management strategies to reduce climate vulnerability for the case study
10. Workshop
11. Final report and communication plan
12. Web page for the dissemination of the results

Outcomes

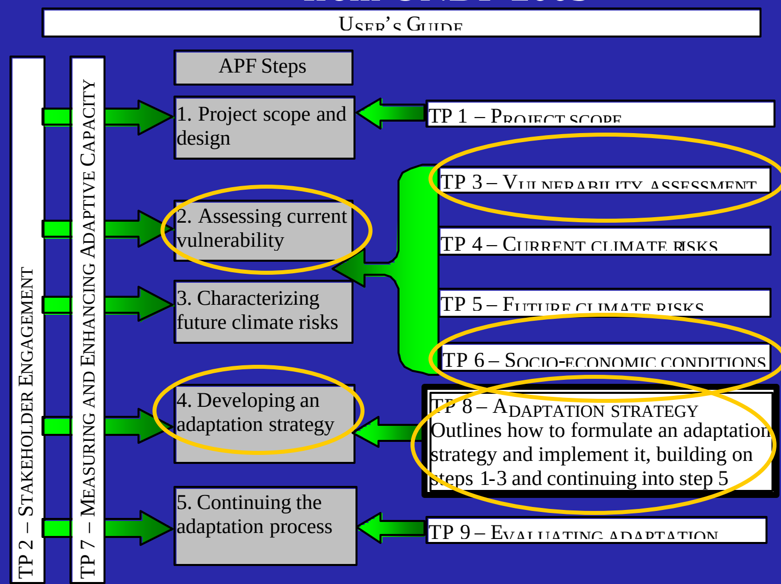
- interacting with stakeholders to identify vulnerabilities to extreme events in the case study area
- proactive planning and resource protection to deal with climate change
- development of hazard risk management strategies
  - Strategies and mitigation measures for floods and drought
  - Robust water management under changing climate
- marketing of project products – conservation and planning communication tools

Who are the stakeholders?

- Four types:
  - Expertise in climatic, hydrologic & socio-economic conditions (researchers, resource managers)
  - Relevant local, regional (and national) policy-makers
  - “Vulnerable” group/activity representatives
  - Those who can influence adaptation
- water uses – recreation, agriculture, municipal water supply, habitat
- urban & rural

Adaptation Policy Framework

from UNDP 2003



Social Vulnerability

- Review of the literature regarding climate change and vulnerability reveals that the multiple ways in which the word "vulnerability" is used lead to radically divergent policies and implications
- Vulnerability analyses adopt two different approaches to explain the conflicting use of the term "vulnerability"

1. Starting Point/End Point

(Kelly & Adger, 2000; Schjolden, 2003; O'Brien, 2001)

Starting Point: Vulnerability ? Adaptability

Independent Variable Dependent Variable

End Point: Adaptability ? Vulnerability

Independent Variable Dependent Variable

2. Biophysical and Social Vulnerability

(Brooks, 2004; Kelly & Adger, 2000)

<u>Biophysical Vulnerability</u>: likelihood of and/or exposure to a hazard (i.e. a physical manifestation of climatic variability or change)

<u>Social Vulnerability</u>: set of socioeconomic factors that determine people's ability to cope with stress or change

Flood and Drought in UTRB

- Impacts
  - where, who, what
- Responses
- Key management issues remaining

Information Required by UTRCA

- What information do you need to deal with
  - drought
  - flood

Data and Information Available

- GIS
- reports
- key legislation
- identification of stakeholders
- current communication and outreach

Study Design

- Basin-wide vs case study
- Suggested case studies
- Stakeholder process
  - who
  - how
- Resource people
  - UTRCA
  - elsewhere