SWIFT CURRENT CREEK
Watershed Stewards

Swift Current Creek Watershed


SWA, 2010


AAFC, 2010

Drought and Excessive Moisture Preparedness Plan

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Swift Current Creek Watershed Drought and Excessive Moisture Preparedness Plan

In 2009 the Swift Current Creek Watershed (SCCW) Protection Plan identified a key action item to coordinate and design a drought preparedness and excessive moisture management plan for the Swift Current Creek Watershed. The recommendation was to develop water supply availability information, identify communities at risk, and organize drought preparedness and excessive moisture workshops by 2010. The management plan was to be implemented in consultation with Saskatchewan Watershed Authority, Agriculture and Agri-Food Canada, Agri-Environment Services Branch, Swift Current Creek Watershed Stewards and Saskatchewan Ministry of Agriculture.

1.1 Swift Current Creek Watershed Overview

The Swift Current Creek Watershed is approximately 5,592 km^2 and begins northeast of Eastend near the Cypress Hills and empties into the South Saskatchewan River north of Stewart Valley (SCCWAC, 2009). Rock Creek, Jones Creek, Bone Creek, Duncairn Dam and Lac Pelletier are included in the Swift Current Creek Watershed (Figure 1).

Spring runoff and ground water springs form the Swift Current Creek system, in which landowners and residents rely on the water provided by the creek for water supply, irrigation, livestock production and recreation (SCCWAC 2009). Historically, this area is typically very dry. Water quality and

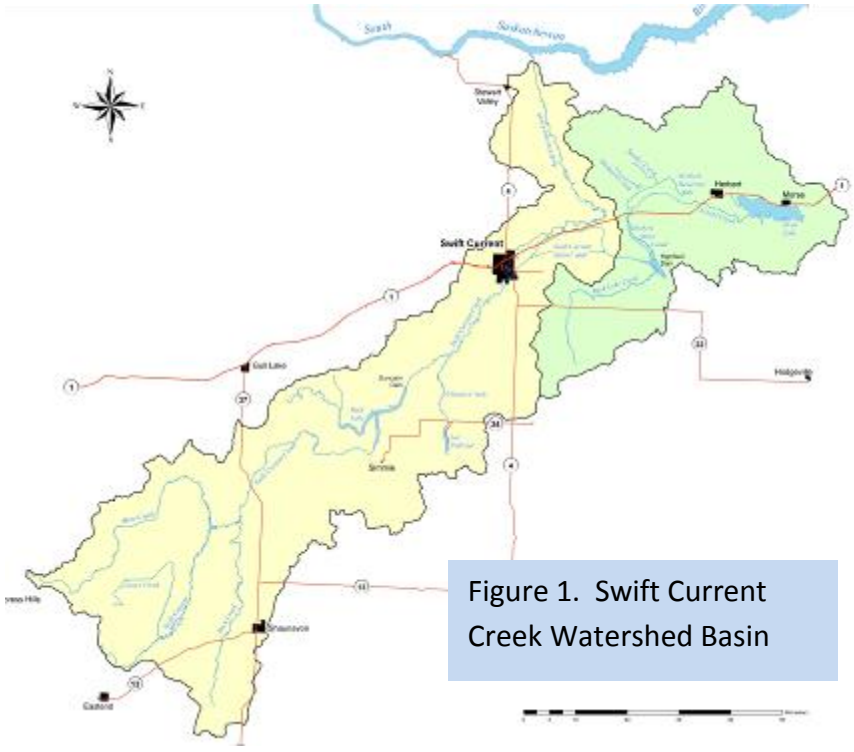


Figure 1. Swift Current Creek Watershed Basin

supply for the area is threatened by external factors including climate change, water-demand growth, extended hydrological droughts, and excessive moisture events.

There is a broad consensus that global temperatures are rising. The implications for Saskatchewan are not yet well understood – however, warmer winters, increased drought risk, and more extreme precipitation and temperature events are expected (Sauchyn and Kulshreshtha, 2008). Water supplies may be affected resulting in reduced summer flow, increase in frequency and magnitude of flooding and drought, and changes to groundwater recharge and discharge (SWA, 2005).

1.2 What is Drought?

Drought is considered to be one of the most complex but least understood of all natural hazards, affecting more people than any other hazard (Sivakumar and Wilhite, n.d., as cited in Hagman, 1984). Drought originates from a reduction in the amount of precipitation over an extended period of time, resulting in a water shortage, usually a season or more in length (Sivakumar and Wilhite, n.d.). Droughts are unique in their intensity, duration and spatial extent. Drought is a slow-onset, creeping natural hazard that is a normal part of climate; it results in economic, social and environmental impacts (Sivakumar and Wilhite, n.d., as cited in Wilhite, 2000).

The onset and cessation of drought is difficult to predict, as is the severity of a drought. Human activities and a specific area's water supply characteristics influence sensitivities to drought in a given watershed. Droughts can be categorized as meteorological, hydrological, agricultural or socioeconomic, each of which results in different impacts (Wilhite, 1996; V. Wittrock, personal communication, January 12, 2011). Appendix I. describes each type of drought in detail.

The greatest natural disasters in Canada (in terms of economic costs) have been attributed to drought, specifically the 1930s drought and 1999-2004 drought. The 2001-2002 drought, which largely occurred in Saskatchewan and Alberta, resulted in a national loss of $6 billion in GDP and the loss of 41,000 jobs (Wheaton *et al.,* 2008).

Drought conditions can impact communities and individuals in a variety of ways. In the Swift Current Creek Watershed drought-related impacts include land degradation, water shortages and irrigation deficits, feed shortages, unstable economics (lower crop yields, crop damage/failure), soil moisture shortages and increased stress.

Effective drought management has three major components (Sivakumar and Wilhite, n.d.):

- Monitoring and early warning,
- Risk and vulnerability assessment and
- Preparedness, response and recovery

Previous attempts to manage drought have been borne from a reactive, crisis-management approach which inherently results in costly remedies (Wilhite and Knutson, n.d.). The goal is to reduce drought vulnerability by identifying relevant impacts and assess their underlying causes.

1.3 What is Excessive Moisture?

Too little water can be just as damaging as too much water, which may negatively impact water supplies, agriculture and ecosystems

(SWA, 2010). Increased variability and changes in the frequency and severity of extreme events such as droughts and floods is occurring. A broad suite of management practices is required in preparing for such extreme events (Pittman, 2010a).

Heavy precipitation events result in crop damage, soil erosion, and the inability to cultivate land. Excessive moisture can adversely affect the quality of surface and groundwater, as well as contaminate water supplies.

1.4 About This Plan

The Swift Current Creek Watershed group held three workshops facilitated by Saskatchewan Watershed Authority and the Swift Current Creek Watershed Stewards on March 24, 2010, December 1, 2010, and January 12, 2011. The goal was to identify the vulnerability and resilience of various watershed stakeholders through numerous workshop activities, including mapping areas of highest concern, construction of timelines showing drought and excessive moisture events and adaptations, scenario-based discussion, and adaptation planning. The workshops' are an important element in preparedness, response, and recovery planning, which will help to increase the Swift Current Creek Watershed's capacity to deal with drought and excessive moisture events and lead to more resilient urban and rural communities.

This plan involves identify issues and action items within the SCCW, then prioritizing each issue. The purpose of the plan is to provide a strategic plan in dealing with Drought and Excessive Moisture for the SCCW and offer a starting point for engagement throughout federal and provincial agencies.

1.5 Planning Approach

Representatives from local governments, individual licensees and users, agricultural producers, and urban and rural municipalities participated in the SCCW workshops. The goal of the workshops was to share ideas, and information and knowledge, across multiple stakeholder groups to develop a preparedness plan for the watershed. Various workshop activities were undertaken to facilitate vulnerability assessment and adaptation planning (Figure 2). Ideas and knowledge obtained from the workshops were ultimately incorporated into the plan.

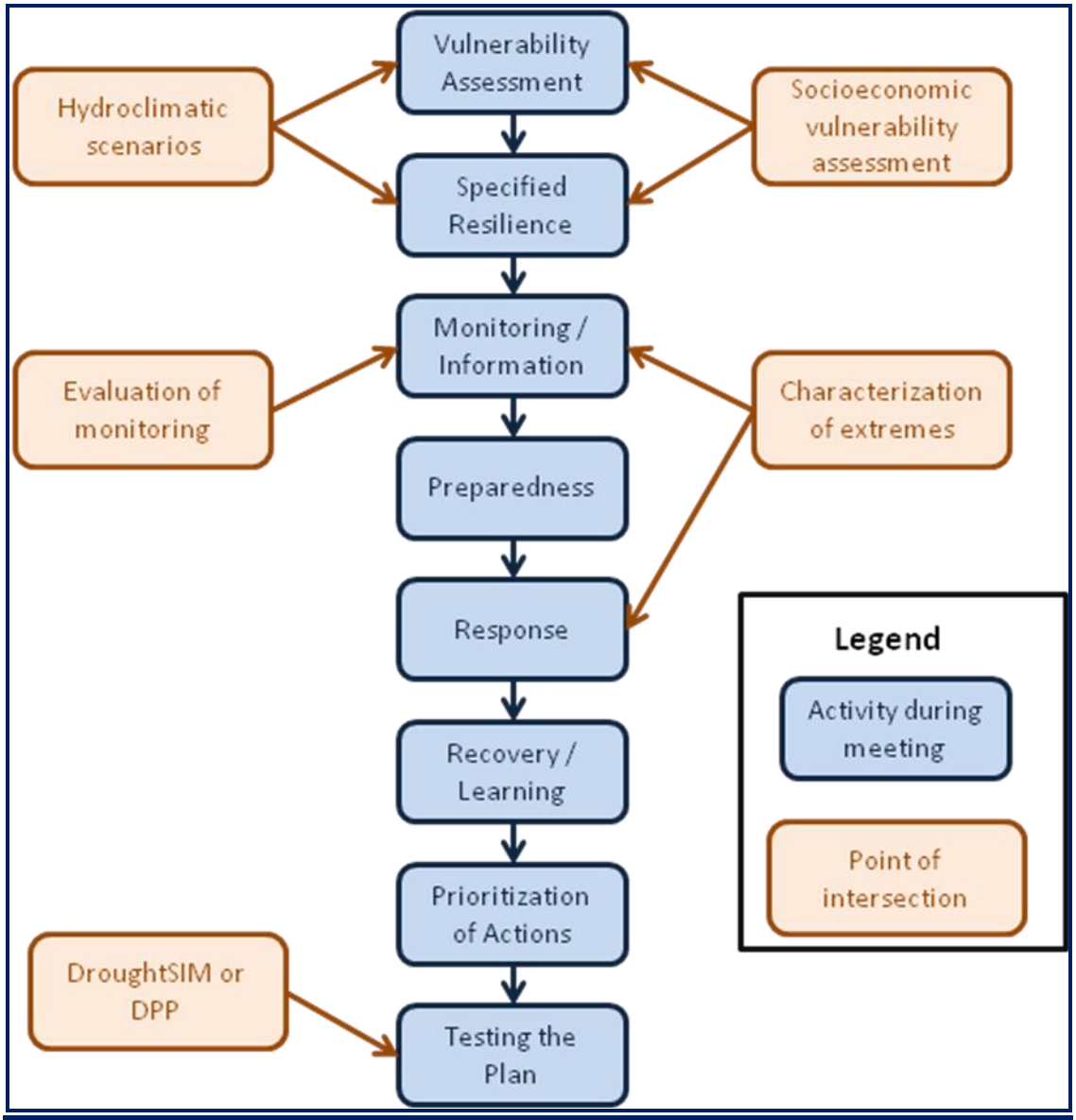


Figure 2. Preparedness Planning Approach

II

Vulnerability Assessment

Preparing for drought and excessive moisture events involves looking at the past and understanding where vulnerabilities lie. Preparing for such events involves discussion during normal conditions, rather than at the onset of drought and excessive moisture events.

The vulnerability of any system is a function of an area's exposure, sensitivity and adaptive capacity to an event, such as drought and excessive moisture, and its' capacity to cope, adapt, or recover from the impacts (Pittman *et al.*, 2010; ICLEI 2010; Ford and Smit, 2004; Smit and Wandel, 2006). Understanding the SCCW vulnerabilities will help decision makers in developing suitable adaptation actions (ICLEI, 2010).

Exposure and sensitivity of a system are virtually inseparable and are one component in assessing vulnerability (ICLEI, 2010; Smit and Wandel, 2006). Determining the SCCW exposure-sensitivity involves asking questions to understand whether the area is subject to any existing stress and whether a drought or excessive moisture event will exacerbate that stress (ICLEI, 2010).

Adaptive capacity refers to a system or community's potential or ability to plan for, cope, and adjust to changes and stresses with minimal disruption or additional cost (ICLEI, 2010; Ford and Smit, 2004; Smit and Wandel, 2006). The ability to undertake adaptations is influenced by economic wealth, technology, equity of access to resources, knowledge and skills, and social capital and institutions (Pittman *et al.,* 2010; ICLEI, 2010; Smit and Wandel, 2006; Ford and Smit, 2004). Adaptive capacity varies from country to country and community to community (Smit and Wandel, 2006).

The Swift Current Creek Watershed's capacity to cope with drought and excessive moisture event's, varies over time in response to social, economic, political and future environmental changes (Ford and Smit, 2004). An increase in the frequency of event's, near the upper limit of the coping range, may decrease a system's adaptive capacity and inhibit coping ability, adaptation or recovery of that system (Smit and Wandel, 2006).

By increasing the SCCW adaptive capacity, it's vulnerability to current and future drought and excessive moisture events will be reduced (ICLEI, 2010). The goal of this analysis is to identify current and past exposures and sensitivities that the Swift Current Creek Watershed has experienced. Once these conditions have been identified,

analyst's and decision-makers can identify potential future exposures and sensitivities, and plan for, or respond to these conditions (Smit and Wandel, 2006).

The following section features current vulnerabilities experienced within the Swift Current Creek Watershed, and are separated into five subsections: (1) participatory mapping; (2) timeline; (3) drought and excessive moisture characterization; (4) scenario planning; and (5) information requirements of stakeholders.

2.1 Participatory Mapping

Maps and diagrams are an important part of any planning activity (IIED, 1991). Participatory mapping is the creation of maps by local communities and stakeholders, with the involvement of organizations such as government, universities, and non-government organizations (IFAD, 2009). Generally, mapping and timeline initiatives are conducted by outsider groups and the maps created contribute to an outsider's agenda (IFAD, 2009).

Participatory mapping provides valuable visual representation of what stakeholders perceive as its place, and features they feel are significant (i.e. beaver dams, culverts, flooding activities, washouts etc.) (IFAD, 2009; IIED, 1991). The process of participatory mapping contributes to community cohesion, and may stimulate stakeholders to engage in land and resource-related decision-making. This process raises awareness of land-related issues and ultimately empowers local communities and stakeholders (IFAD, 2009).

Participatory mapping has proved to be an effective way for communities to demonstrate to external agencies what the community values, and the communities' relationship and interactions with the landscape (IFAD, 2009).

During the mapping exercise with the Swift Current Creek Watershed, participants were grouped and asked to identify areas and infrastructure previously affected by flooding and drought, and delegate areas of highest concern for future events. Figure 3. identifies areas throughout the watershed that stakeholders have identified are of concern, or particular importance.

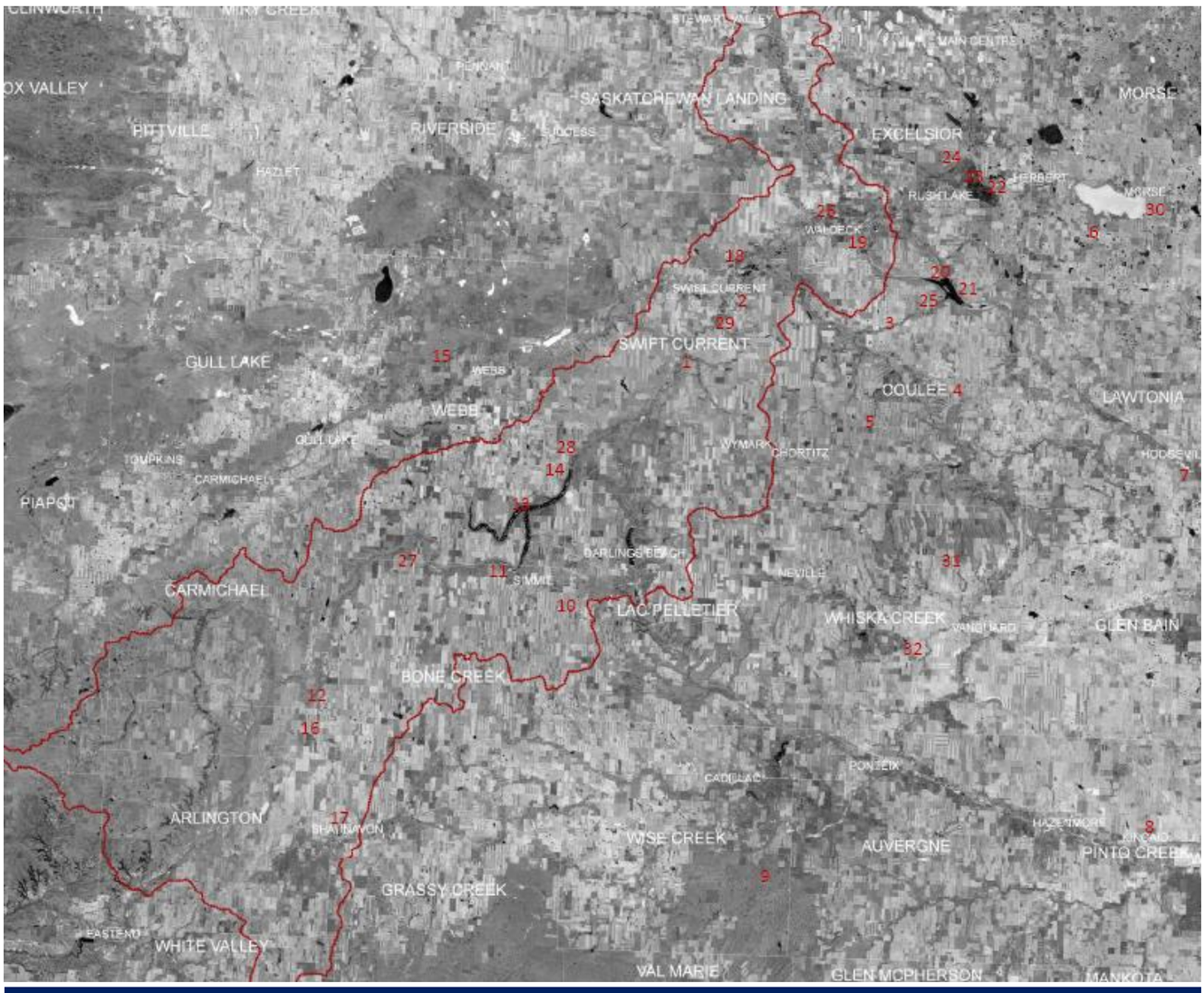


Figure 3. Swift Current Creek Watershed Mapping, December 1, 2010

Table 1. Participatory Mapping Exercise of Swift Current Creek Watershed, December 1 , 2010

1	Swift Current - Well went dry (1988) 30 test holes	18	High water levels (2010) Storm system couldn't cope
2	Sixth Avenue - ice jam, erosion	19	Canal off creek fills Highfield
3	Typically this area is drier	20	Dam (July 1991) couldn't hold water, irrigated land flooded
4	Wetter area		
5	Wind farm	21	Winterkill - fish died (2009)
6	Reed Lake (2010) Small lake kept filling	22	Potential flood area - 2011? Water drains east
7	Hauling water for cattle (2007)	23	Drought years - Highfield cannot provide enough water
8	Drinking water and wells went dry (2007)		
9	Sandy soil, usually drier (2010) dry this year	24	Did not irrigate and good to above average yields observed
10	Upsizing culverts, gravel roads washed out	25	Highfield development
11	Ferguson Bay water 0.5 miles	26	Irrigation
	from beach (1997)	27	Full Supply Level (2010)
12	Rainbow Bridge (2010) High water levels	28	Spillway and Bank upgraded (2008-2009)
13	Reid Lake/Duncairn Reservoir	29	Wymark Creek Bridge (1997) flooded
14	Dam	30	Floods 1991, 1993, 1995, 1997, 1998, algae and water quality issues
15	Community Pasture - Lack of water since 2007		
		31	Rain storm in Vanguard 13" in 12 hours
16	Swift Current Creek dry - fish caught in pools	32	High spring runoff (Winter 2006-2007)
17	Very wet (2010)		

Areas identified on the Swift Current Creek Watershed map include frequently flooded areas, irrigation areas, dams and areas previously affected by drought (Table 1).

2.2 Timeline

A timeline of drought and excessive moisture events was constructed through group discussion to document past impacts from, and adaptation to these events (Table 2).

Table 2. Timeline of Events in the Swift Current Creek Watershed 1930 to 2010

1930	Plow and thrasher era - no straw, pulverized.
1950s	Irrigation development, flooding of flat land, alkali issues.
1951	Duncairn dam almost washed away.
1952	Eastend almost washed away.
1950s-1960s	Widespread drought. Trees and shelterbelts planted to catch snow and wind.
1970	Heavy snowfall, many calves lost.
1976	Cattle walking over corrals because of high snow levels.
1978	May - Five day blizzard.
1982	May 25th, 1.5 feet of snow - blizzard.
1988	Very dry. PFRA dugout program. Many dugouts created when the area was already dry.
1991	Very wet. Two to three inches of rain in spring.
1996	Wet winter snow.
1997	Large flooding in spring due to fast thaw. Gravelbourg almost flooded out. Flow kept going all night.
1999	Introduction of PFRA shallow pipelines.
2000	Rained approximately 13 inches within 14 hours in Vanguard area. Water diverted into Old Wive's Basin.
2001	Widespread drought.
2002	Little moisture until July. Rained hard in August.
2005	Improvements in watering techniques. Fencing off dugouts and using solar and remote watering systems.
2007	Duncairn dam was opened due to fast runoff from rapid thaw.
2008	Very few sloughs in spring.
2010	Dry spring. July - dugouts began to fill.
2010	Maple Creek and area - record flooding.

2.3 Drought and Excessive Moisture Characterization

Virginia Wittrock from the Saskatchewan Research Council (SRC) presented information to help characterize drought and excessive moisture events within the Swift Current Creek Watershed. Work done through SRC attempts to compare and contrast dry and wet patterns within the SCCW to aid in risk management and planning strategies for future extreme events. Table 3. compares the top ten extreme drought and excessive moisture events within the Swift Current Creek Watershed between 1901 to 2005 using both the Palmer Drought Severity Index (PDSI) and the Standard Precipitation Index (SPI).

The Palmer Drought Severity Index (PDSI) is primarily a hydrological drought index which is used to quantify excessive moisture and drought. Values are calculated based on soil water content, temperature data and daily/monthly precipitation information. PDSI values are beneficial as the values have a "long-term memory" built into the model and are helpful when looking at long-term trends (Wittrock *et al.,* 2011).

The Standard Precipitation Index (SPI) quantifies meteorological drought and is valuable in identifying emerging droughts earlier than the PDSI index, as previous moisture conditions are not taken into account. SPI is generally used in short-term, month-to-month analysis. SPI does not incorporate temperature, which is critical when monitoring agricultural drought (Wittrock *et al*., 2011). PDSI values range from ≤ -5 (Exceptionally Dry) to ≥5 (Exceptionally Wet). SPI values range from ≤-2.5 (Exceptionally Dry) to ≥ 2.5 (Exceptionally Wet).

Table 3. Top 10 Extreme Years. Palmer Drought Severity Index (PDSI) and Standardized Precipitation Index (SPI) for the Swift Current Creek Watershed (1901-2005 Agriculture Year)

Palmer Drought Severity Index (PDSI)				Standardized Precipitation Index (One Month Extremes)					
Drought		Excessive Moisture		Drought			Excessive Moisture		
Year	Value	Year	Value	Year	Month	Value	Year	Month	Value
1937	-6.5	1954	6.8	1967	6	-3.9	1927	5	3.1
1931	-6.0	1966	6.7	1959	12	-3.5	1971	1	2.9
1988	-5.9	2004	5.8	1973	1	-3.5	1986	9	2.8
1919	-5.9	1951	5.6	1985	6	-3.3	1967	1	2.7
1946	-5.8	1953	5.6	1952	12	-3.1	1955	7	2.7
1936	-5.6	1916	5.5	1917	11	-3.1	1993	8	2.7
1949	-5.4	1965	5.4	1961	8	-2.9	1977	12	2.6
1905	-5.3	1991	5.1	1903	12	-2.9	1904	3	2.6
1961	-5.2	1907	5.1	2001	8	-2.9	1938	2	2.6
1914	-4.6	1975	5.0	1952	5	-2.8	1964	12	2.5

Wittrock *et al.* (2011) incorporated new categories for extreme events within the Swift Current Creek Watershed, as such extreme values were not represented in the current model. Additional categories included were (see Figure 4):

- PDSI 6.0 to 7.0
  (Very Exceptionally Wet)

- PDSI -6.0 to -7.0
  (Very Exceptionally Dry)

- SPI 3.0 to 3.5
  (Very Exceptionally Wet)

- SPI -3.0 to -3.5
  (Very Exceptionally Dry)

- SPI -3.5 to -4.0
  (Extremely Exceptionally Dry)

Figure 4. compares the wettest year (1954) and driest year (1937) within the Swift Current Creek Watershed Basin using the PDSI method. The wettest month (May 1927) was compared to the driest month (June 1967) using the SPI index. Wittrock *et al.'s* (2011) additional PDSI and SPI categories were overlaid on the SCCW map (Figure 4).

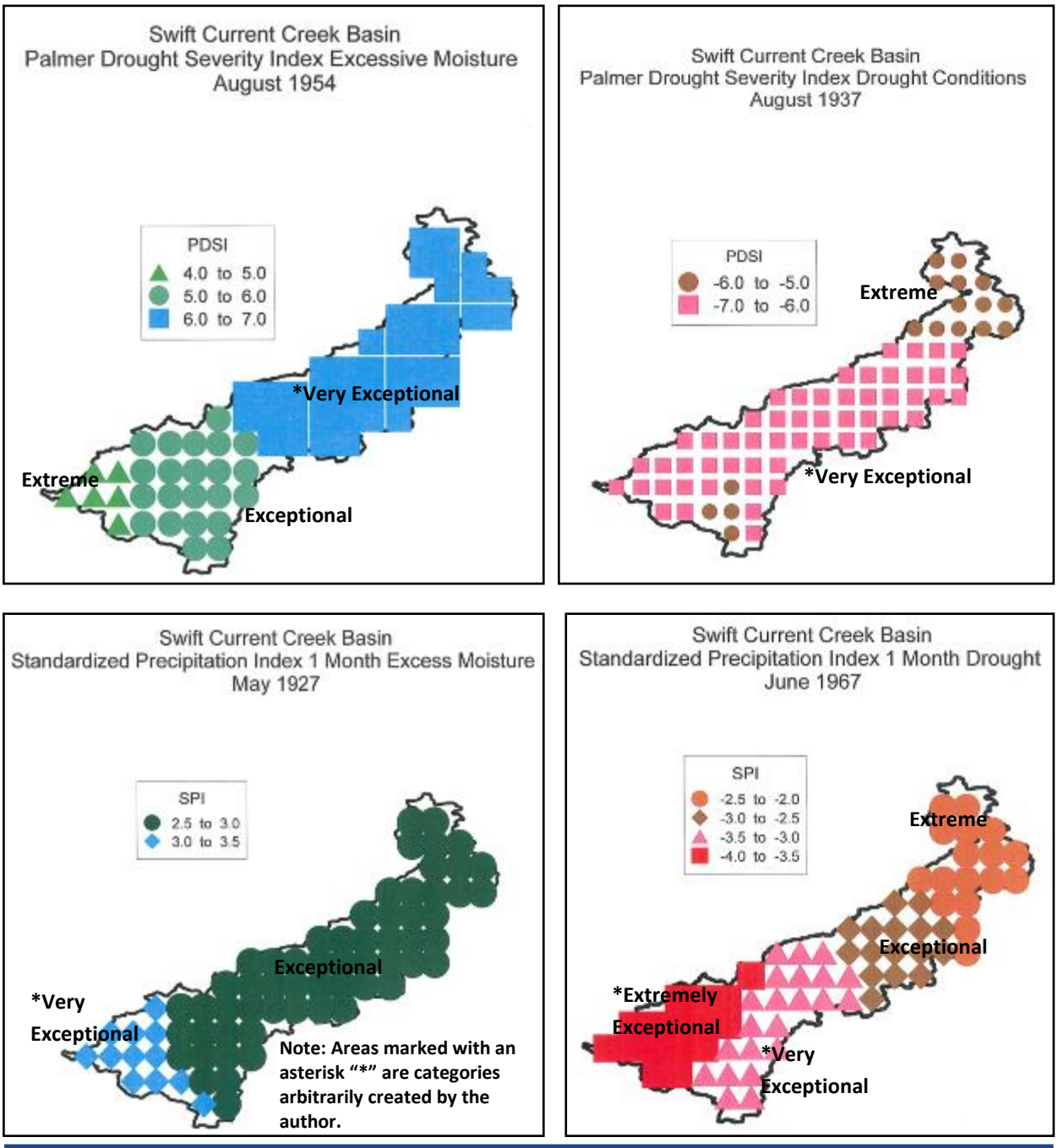


Figure 4. Comparison of Swift Current Creek Basin PDSI Wettest Year (1954) and Driest Year (1937) and SPI Wettest Month (May 1927) and Driest Month (June 1967)

These maps indicate the spatial variability within the watershed. The PDSI excessive moisture map shows that the "very exceptional" region is in the northeastern portion of the watershed while the southwest is categorized as "extreme". The PDSI drought conditions map illustrate that most of the watershed was under "very exceptional" drought conditions with the exceptions of extreme conditions in the northeastern and southern corners.

The one month SPI excessive moisture month illustrates the entire watershed was coping with excess moisture conditions, with the southwestern corner dealing with "very exceptional" conditions. The one month SPI drought of 1967 illustrates the variability that can occur during a drought event. The northeastern section of the watershed was under "extreme" drought conditions while the southwestern quarter of the watershed was under "extremely exceptional" conditions. This illustrates the potential impacts of the drought may have been greater in the southwestern portion than the northeastern region of the watershed. A more comprehensive analysis of the watershed can be found in Wittrock *et al.,* 2011.

2.4 Scenario Planning

Scenario planning is a method used for imagining possible futures by considering various uncertainties (Peterson *et al.,* 2003; Schoemaker, 1995). The purpose of scenario planning is to improve a community's ability to quickly respond to a variety of futures and avoid potential traps and benefit from potential opportunities (Peterson *et al.*, 2003). Generally, there are two common errors in decision making – underprediction and overprediction of change – scenario planning attempts to compensate for this and allows us to chart a middle ground (Shoemaker, 1995).

Building scenarios involves anchoring each scenario in the past, and determining what issues may significantly affect the area - including economic, political, technological, and industry factors (Schoemaker, 1995). Scenario planning provides a forum for policy creation and evaluation, when stakeholders are involved in the process (Peterson *et al.*, 2003). Scenario planning is an effective coping method when control is difficult and uncertainty is high, factors which are evident in managing drought and excessive moisture events within the watershed.

During the second workshop on December 1, 2011, various issues affecting the Swift Current Creek Watershed were identified through mapping and timeline exercises. Participants were separated into two breakout groups and discussed three scenarios which could potentially affect the SCCW (Figure 5 and Table 4).

- **Scenario 1 – What would happen if a wet year like 2010 happened twice in 5 years?**
  - What would the impacts be?
  - Who would be most vulnerable? And why?
  - What could be done to prepare for this scenario?
- **Scenario 2 – What would happen if a long-term drought (lasting longer than previously experienced) occurred?**
  - What would the impacts be?
  - Who would be most vulnerable? And why?
  - What could be done to prepare for this scenario?
- **Scenario 3 – What would happen if it switched back and forth from wet to dry years very quickly?**
  - What would the impacts be?
  - Who would be most vulnerable? And why?
  - What could be done to prepare for this scenario?

Figure 5. Scenario Assessment Discussion Questions

Table 4. Scenario One	Vulnerability	Adaptation
What would happen if a wet year like 2010 happened twice in 5 years?	• Problems with hay quality • Stressful, long haying season • Rural areas more affected than urban areas • Ranchers may be better able to handle the rain – grass acts as a buffer, except quality decreases and quantity increases • Ranchers need to successfully get through calving season • Timing of rain depends on impact and vulnerability • Start seeding earlier • More inoculants (ie. $5/bale - less expensive than silage) • Silage companies difficult to hire • Cities would require increased budgets for repairs and snow removal (i.e. heaving sidewalks) • Large scale economic problems • Learn how to grow rice • Timing is a major concern • Poor quality crops	• Change calving cycle • Stockpile feed • Ranchers may need to test hay and buy protein blocks • Programs valuable (GPS, AEGP, Dugouts), but band-aid programs are not valuable • Proactive programs needed, not reactive like droughts, excessive moisture acres • Resentment – unequal treatment when some RMs receive funding but not others • Agriculture Culture = Government Programs (CAIS, Quota System, CWB, Subsidize consumers – lower food prices, Supply and Demand, Middle Men and Processing) • Producers need more control of marketing (CWB, more control - options for cattle) • Government Programs; guarantee you will always get the same as did before – not business sense – you should want your business to grow and profit • Keep off-farm jobs • 8+ tonnes per acre -could afford to do silage

Table 4 cont'd. Scenario Two	Vulnerability	Adaptation
What would happen if a long-term drought (lasting longer than previously experienced) occurred?	• Price increase could influence stocking rates • Irrigators – rely on water • Ranchers may not have enough water to maintain grazing on native pasture • May sell some of your herd, rancher's risk decreasing herd genetics • Cattle will not walk one mile for water – must haul water • Overgrazing	• Usually have 0.5 year surplus -Stockpile 2 years • Defer grazing – and employ grazing management system • Create dugouts • Haul cattle to other areas of SK and MB to graze • Sell part of your herd • Use a variety of feeds • Increase dam size • AESB divesting irrigation projects • Southwest fairly drought-proof (ie. pipelines, irrigation projects, dugouts, soil conservation)
Scenario Three	**Vulnerability**	**Adaptation**
What would happen if drought and excessive moisture events switched back and forth from wet to dry years very quickly?	• Longer duration is more devastating than high frequency • Depends on the stage of your career • Markets dictate what happens • Cropping practices – large scale change doesn't occur • Predictions aren't advanced enough	• Plan for normal precipitation • Have 2-year supplies • Good management

The scenario planning exercise identified vulnerabilities associated with each potential scenario and possible adaptations stakeholders could foresee to mitigate impacts of such events (Table 4).

2.5 Information Requirements

During the third workshop, participants were asked to complete a questionnaire to help decision makers understand the diversity of groups and what information may be valuable to them (Appendix IV).

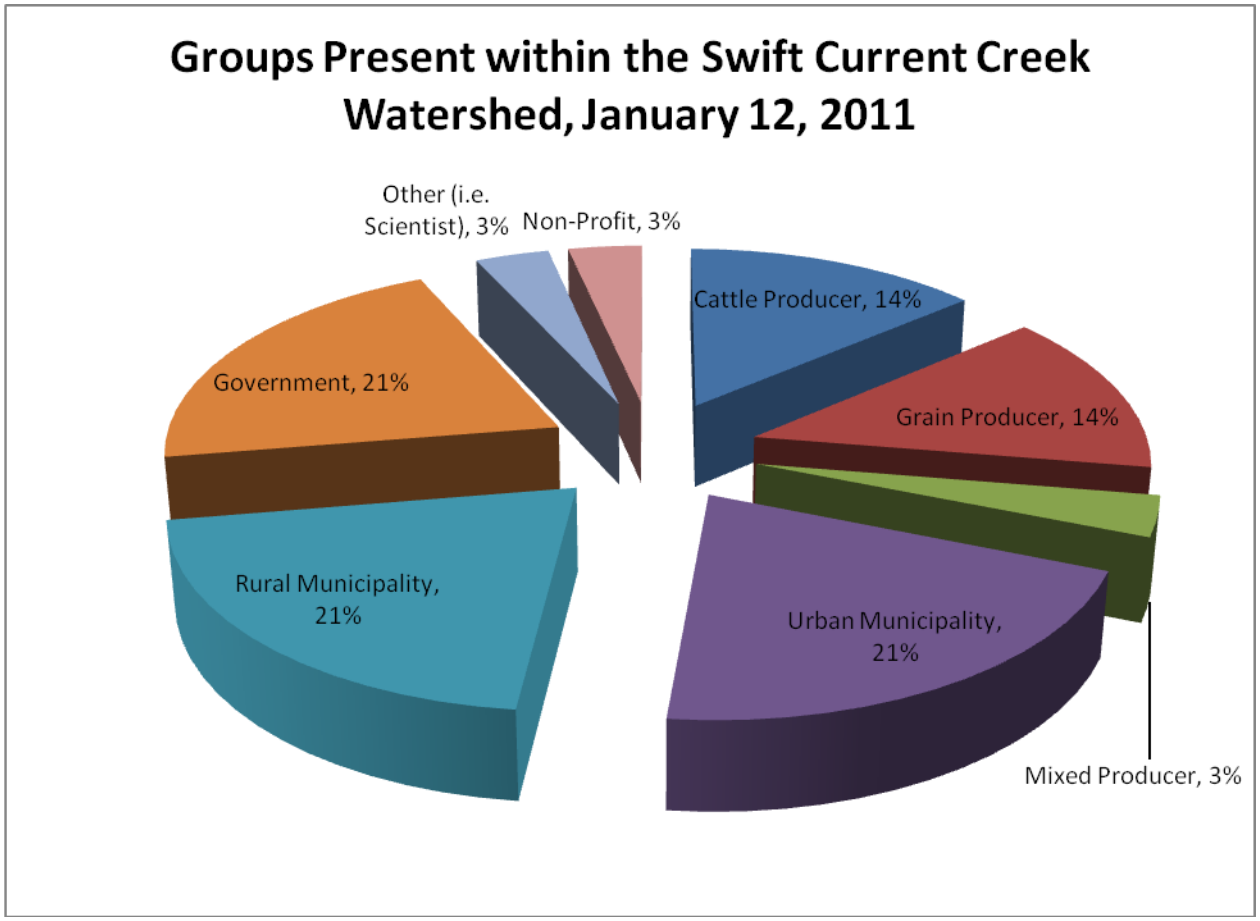


Figure 6. Representative User Groups Present (Workshop Two) within the Swift Current Creek Watershed, January 12, 2011

The majority of the representative user groups present within the Swift Current Creek Watershed were Urban, Rural and Government Groups (each 21% respectively) and Cattle and Grain Producers (each 14% respectively) (Figure 6).

The SCCW workshop attendees were asked to identify what information may be beneficial to them (Appendix IV). Figure 7. compares preferred information requirements from all user groups within the SCCW.

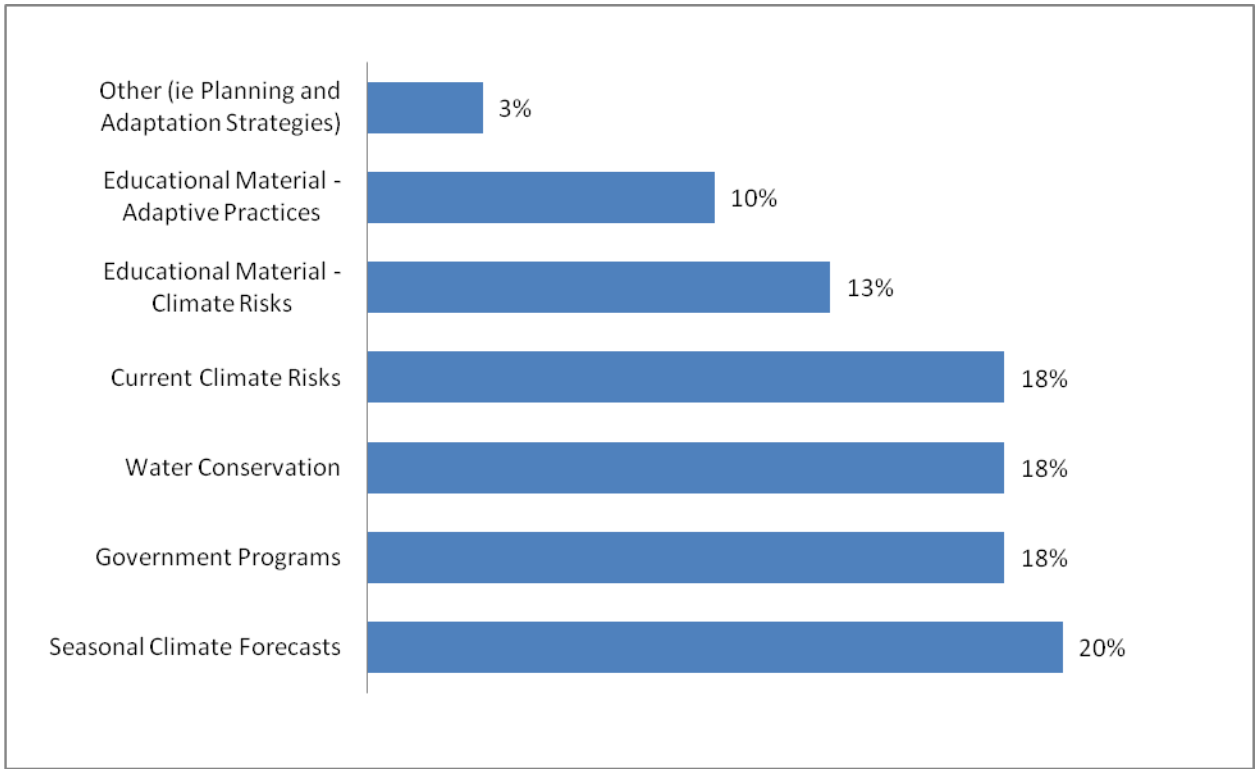


Figure 7. Comparison of Preferred Information Requirements for All User Groups within the Swift Current Creek Watershed January 12, 2011

User groups identified Information Regarding Seasonal Climate Forecasts as the most important information requirement, followed by Information Concerning Current Climate Risks, Water Conservation and Government Programs (Figure 7).

Table 5. compares preferred information requirements from each user group within the SCCW.

Table 5. Comparison of Preferred Information Requirements of Each User Group within the Swift Current Creek Watershed

	USER GROUP							
INFORMATION REQUIREMENTS	Cattle Producer	Grain Producer	Mixed Producer	Urban Municipality	Rural Municipality	Government	Non-Profit	Other
Information on Government Programs	14%	29%	25%	25%	25%	13%	33%	14%
Information on Water Conservation	21%	21%	25%	15%	25%	13%	0%	14%
Seasonal Climate Forecasts	14%	29%	25%	15%	20%	22%	0%	14%
Information on Current Climate Risks	7%	7%	0%	25%	10%	26%	33%	14%
Educational Materials (EM) on Climate Risks	14%	0%	0%	15%	5%	17%	0%	14%
Educational Materials (EM) on Adaptive Practices	29%	14%	25%	0%	15%	4%	0%	14%
Other	0%	0%	0%	5%	0%	4%	33%	14%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Cattle Producers identified educational materials on adaptive practices as preferred information, while Grain Producers, Urban and Rural Municipalities, and Non-Profit groups expressed a high interest in the need for information on government programs. Urban Municipalities, Government and Non-Profit groups also expressed an interest on current climate risk information.

III

Adaptation Planning and Actions

Adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC) as "an adjustment in natural or human systems in response to actual or expected climatic stimuli (variability, extremes, and changes) or their effects, which moderates harm or exploits beneficial opportunities" (UKCIP, n.d., as cited in IPCC TAR, 2001).

Good adaptation practices are founded on the engagement of informed stakeholders and community, with the willingness and ability to adapt (UKCIP, n.d.).

Within the Swift Current Creek Watershed the process of building adaptive capacity involves understanding the nature of issues and risks within the watershed, (which were identified by the community and stakeholders during the vulnerability exercises), then assessing the situation (coping capacities and thresholds), and finally identifying potential adaptive responses (UKCIP, n.d.).

Participants were organized into two breakout groups during workshop two, and discussed three vulnerability issues within the SCCW (Table 6):

- Municipal Preparedness
- Awareness/Education on benefits of being proactive; and
- Agriculture

Table 6. Key Municipal, Educational and Agricultural Issues Affecting the Swift Current Creek Watershed

Action Item #	Issue Municipal	Priority Low	Medium	High	Preparedness	Response	Recovery
1	Refresher course on Emergency Management Organization (EMO)				X		
2	Water supply planning				X		
3	Water bans in drought should be standard					X	
4	Monitoring creeks during excessive moisture events				X	X	
5	Safety issues for excessive moisture				X	X	
6	Redundancy – water supply system				X		
7	Identification of roles				X	X	X
8	Define drought and excessive moisture triggers				X	X	
9	Coordination of municipalities – watershed groups, SC Municipal government communities, effective communities				X		
10	Risk management				X	X	
11	Municipalities' emergency response plan – should incorporate landowner's downstream				X	X	
12	Identifying high risk areas for landowners and city (i.e. ice jams, low areas)				X	X	
13	Action plan for different types of drought (hydrological, meteorological, mechanical)				X		
14	Conserving water program. Odd/even days for water use, low flush toilets				X	X	X
15	Shallow, buried pipeline for untreated water for watering lawns				X		X
16	Construct agreements for sharing RM's equipment during emergencies				X	X	
17	Stockpile resources – carry over. i.e. Water pipelines, develop one good pipeline (community well)				X		X
18	Crisis line/drought management – prior to drought				X	X	X
19	Sandbagging – where do people find supplies to make them and have a stockpile of sandbags				X	X	
20	Crop planning – type of seed to use/crop based on forecast for year				X		
21	Longevity programs				X	X	X
22	When does government step in? (SUMA, SARM)					X	
23	Tying programs to science				X		

Table 6. Cont'd. Key Municipal, Educational and Agricultural Issues Affecting the Swift Current Creek Watershed								
	Issue	**Priority**						
Action Item #	**Awareness/Education**	**Low**	**Medium**	**High**	**Preparedness**	**Response**	**Recovery**
24	Need a better way to get information to people				X	X	X
25	Potentially create a site where you enter questions/concerns and you can receive advice				X	X	X
26	Advertisements, mail-outs, radio, newspapers. Workshops are good but attendance is limited				X	X	X
27	Cross-organization knowledge				X	X	X
28	Climate/weather forecasting information				X	X	X
29	Weatherbug – expand crop reporting data in real-time				X	X	X
30	What drought and excessive moisture programs are available for people?				X	X	X
31	Swift Current Creek Watershed website				X	X	X
32	Program – Farm Ranch Water Infrastructure				X	X	X
	Issue	**Priority**						
Action item #	**Agricultural**	**Low**	**Medium**	**High**	**Preparedness**	**Response**	**Recovery**
33	More hydrometric stations for real-time data				X	X	X
34	Increase number of climate stations				X	X	X
35	Increase Weatherbug participants				X	X	X

This portion of the plan attempts to rate potential adaptations (action items) identified by stakeholders during the discussion sessions, as low (green), medium (yellow), or high (red) priority. The adaptations outlined in Table 6 were then recognized as part of a preparedness, response or recovery item in the occurrence of a potential drought or excessive moisture event.

IV

Future Refinements

Adaptation will involve a mixture of response strategies which may require a 'sequential approach': building climatic resilience; increased preparedness and planning (living with the potential risks); and to a certain extent - some acceptance of loss (UKCIP, n.d.).

The goal of this plan was to identify current and past exposures and sensitivities that people within the Swift Current Creek Watershed encounter, examine how the community deals with these conditions or risks, and identify processes and factors which may constrain their choices (Smit and Wandel, 2006). Once these conditions are identified, analysts and policy makers can help the SCCW plan-for (preparedness), and respond-to (response), these conditions and potentially determine future vulnerability (Smit and Wandel, 2006).

Adaptation must evolve with internal and external circumstances in order for adaptation to be continually effective. The viability of the watershed's adaptive responses will be challenged - as climate, technological innovations, increased scientific understanding, and socio-economic's are constantly changing. As such, adaptive planning and responses will need to be reassessed periodically within the watershed.

By adopting a continuous improvement approach and incorporating lessons-learned from previous adaptation efforts - the Swift Current Creek Watershed will be better prepared in the event of future drought or excessive moisture events.

Appendix I
Glossary of Terms

Definitions for terms used in this plan are included below. Many of the terms used in the plan have a variety of definitions, depending on the discipline used; however, for the purpose of this plan, the definitions have been adapted to the natural hazard of drought and excessive moisture.

Adaptation: "an adjustment in natural or human systems in response to actual or expected climatic stimuli (variability, extremes, and changes) or their effects, which moderates harm or exploits beneficial opportunities" (UKCIP, n.d., as cited in IPCC TAR, 2001).

Adaptive Capacity: refers to a system or community's potential or ability to plan for, cope, and adjust to changes and stresses with minimal disruption or additional cost (ICLEI, 2010; Ford and Smit, 2004; Smit and Wandel, 2006).

Agricultural Drought: characterized by a lack of water to grow a particular type of crop or support livestock. Defining factors include not only the amount of precipitation received, but the correct use of available water. Agricultural drought generally occurs after a meteorological drought and before a hydrological drought (Econnics, 2010).

Drought: drought originates from a reduction in the amount of precipitation over an extended period of time, resulting in a water shortage, usually a season or more in length. Droughts differ in intensity, duration and spatial extent (Knutson *et al.*, 1998).

Excessive Moisture: periods of flooding due to heavy precipitation events or spring runoff which may disrupt social and environmental systems (Pittman, 2010b).

Hydrological Drought: occurs when low precipitation results in low water levels in lakes, rivers, reservoirs and aquifers. Generally, a hydrological drought follows a meteorological drought. Water uses that depend on ground and surface water levels such as urban water use, recreational and industrial water use, and ecosystems are affected by hydrological droughts (Econnics, 2010).

Meteorological Drought: occurs when precipitation in a certain area, within a particular time period, is compared to the average rainfall for that same area. Soil moisture is depleted during a meteorological drought and impacts crop production (Econnics, 2010).

Preparedness: process of performing pre-disaster activities to ensure a level of readiness to respond in the event of a drought or excessive moisture emergency (Knutson *et al.*, 1998).

Recovery: activities undertaken to promote the rebound of social and environmental systems following an extreme event (Pittman, 2010b).

Response: activities undertaken to reduce the negative consequence of the impacts from drought and excessive moisture events (Pittman, 2010b).

Risk: the possibility of adverse effects as a result of drought or excessive moisture events based on the temporal and spatial severity of the event and one's corresponding vulnerability (Knutson *et al.*, 1998).

Socio-economic Drought: occurs when a weather-related shortfall in water supply results in the inability to meet the demand for economic goods. The severity and impact of Socio-Economic Drought is affected by water demand (Econnics, 2010).

Vulnerability: the susceptibility of a population or the environment in the event of drought or excessive moisture (Knutson *et al.*, 1998).

Vulnerability Assessment: framework for identifying a population or environments' susceptibility and the underlying causes of drought-related impacts (Knutson *et al.*, 1998).

Appendix II
Resources

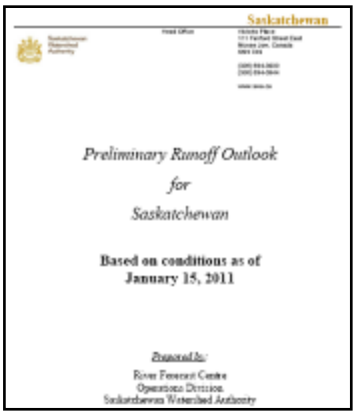
Provincial Government Resource Websites

Farm and Ranch Water Infrastructure (Government of Saskatchewan)
A province-wide Farm and Ranch Water Infrastructure Program will support the development of secure water sources in Saskatchewan to expand the livestock industry, encourage rural economic activity and mitigate the effects of future drought. http://www.agriculture.gov.sk.ca/FRWIP_2009

Provincial Disaster Assistance Program (PDAP) (Government of Saskatchewan)
Provides financial assistance in certain circumstances where there has been a natural disaster, such as flooding, tornadoes, plow winds and severe weather.
http://www.cpsp.gov.sk.ca/Default.aspx?DN=4c191c20-5666-48fd-b412-979717005ef2

Free testing of flood-impacted drinking water wells (Saskatchewan Watershed Authority)

Offers free testing of drinking water wells affected by flooding. http://www.gov.sk.ca/news?newsId=503d61fe-9281-4b4b-b582-a6fcdb23c452



2011 Preliminary Spring Runoff Outlook (Saskatchewan Watershed Authority)

SWA has compiled detailed information on potential spring runoff conditions for the province. http://www.swa.ca/WaterManagement/Documents/ProvincialForecast2011Jan15th.pdf

Stream Flows and Lake Levels (Saskatchewan Watershed Authority)

Real-time information on stream flow and water level data is collected at hydrometric stations throughout the province of Saskatchewan to monitor water conditions in Saskatchewan. http://www.swa.ca/WaterManagement/StreamFlowsAndLakeLevels.asp

Flooding Preparedness (Government of Saskatchewan)

Documents and related links to assist homeowners in flood preparation, disaster cleanup, emergency measures and disaster assistance. http://www.health.gov.sk.ca/flooding-preparedness

Crop Reporter (Government of Saskatchewan)

Volunteer Crop Reporters fill out a weekly online summary and report crop conditions and precipitation for their areas. Reporting begins April 1st and runs for approximately 27 weeks. A regional crop report is released weekly.
http://www.agriculture.gov.sk.ca/Crop-Report

Current News/Information (Government of Saskatchewan)

- Strong Uptake for Emergency Flood Damage Reduction Program
  http://www.gov.sk.ca/news?newsId=efd27cc6-9f3f-4228-9d91-0e223e8e7ea7

- Province Releases Details of $22 Million Emergency Flood Damage Reduction Program
  http://www.gov.sk.ca/news?newsId=a21f4d25-0afc-4561-9e1c-e02c2156d7c1

Federal Government Resource Websites

Real-time Hydrometric Data (Environment Canada)
This site provides public access to real-time hydrometric (water level and streamflow) data collected at over 1700 locations in Canada.
http://www.wateroffice.ec.gc.ca/text_search/search_e.html?search_by=p&region=SK

The Weather Office (Environment Canada)
Provides historical, current conditions and forecasts.
http://www.weatheroffice.gc.ca/canada_e.html

AESB Water Supply and Drought Monitoring – Drought Watch (Agriculture and Agri-Food Canada)
http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1256658312655&lang=eng
Information and maps which provide users with an overview of the risk of drought in Canada.

Drought Management Information (Agriculture and Agri-Food Canada)
Extensive information on managing drought in regards to crops, livestock, pests, pasture management and water.
http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1256665877504&lang=eng

Managing Wet Soils (Agriculture and Agri-Food Canada)
This webpage, located on Agriculture and Agri-Food Canada's Internet site provides information on Impacts of Excess Soil Moisture and Cover Crops.
http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1195497988026&lang=eng

Environment Canada Seasonal Forecast (Environment Canada)
Provides monthly and seasonal forecasts, information on El Nino and La Nina, climatology of temperature and precipitation.
http://www.weatheroffice.gc.ca/saisons/index_e.html

Snow Water Equivalent Mapping (Natural Resources Canada)
Displays recent information of snow cover across Canada and North America.
http://atlas.nrcan.gc.ca/auth/english/maps/environment/climate/snowcover/snowdepth

Additional Resources

Irrigation Saskatchewan
Provides links to three websites - Irrigation Crop Diversification Corporation, Saskatchewan Ministry of Agriculture and Saskatchewan Irrigation Projects Association – which provide information on irrigation systems, scheduling, crop varieties and news and events.
http://www.irrigationsaskatchewan.com/ICDC/icdc_index..htm

Drought Research Initiative (DRI)
The Drought Research Initiative was a five year program (2005-2010) to coordinate and integrate drought research in Canada through combining university and provincial/federal government researchers with expertise in various aspects of droughts including atmospheric, hydrologic, land surface and predictive aspects. http://www.drinetwork.ca/

National Drought Mitigation Center (NDMC) University of Nebraska – Lincoln
The NDMC employs preparation and risk management rather than crisis management in helping people and institutions deal with drought. The NDMC site provides information on monitoring, drought planning, and impacts and mitigation.
http://www.drought.unl.edu/

National Integrated Drought Information System (NIDIS) U.S. Drought Portal
The U.S. Drought Portal is a system used to provide early warning data on drought and help individuals and organizations to plan and manage for the impacts of drought. The system also provides agencies and stakeholders with information on potential risks, impacts and comparison models for previous and potential droughts.
http://www.drought.gov/portal/server.pt/community/drought_gov/202;jsessionid=0559F10E8EC21CA540B604A9F2BEF6E1

Weatherfarm

Provides online information for Western Canadian producers providing real-time weather and farm-management information.
http://www.cwb.ca/public/en/farmers/weather/stations/

Weatherbug

Provides online information for current weather and local forecast.
http://weather.ca.weatherbug.com/SK/Regina-weather.html?zcode=z6286&lang_id=en-ca

ICLEI Adaptation Handbook – Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation

ICLEI is an international association of local governments that provide technical consulting, training and information which work towards sustainable development at the local level.
http://www.iclei.org/index.php?id=10832

SaskAdapt – Saskatchewan's Climate Change Impacts and Adaptation Information Center (Prairie Adaptation Research Collaborative)

Provides the latest Saskatchewan and Prairie-specific science and information to help residents, government and business organizations make decisions on adapting to climate change.
http://www.parc.ca/saskadapt/introduction

Drought Preparedness Planning: The Ten Step Process (2007 National Drought Mitigation Center)

A ten step process which provides a checklist of key elements of a drought plan. http://www.p2pays.org/ref/50/49988.pdf

University of Nebraska-Lincoln - Drought Monitor

Provides forecasts, current conditions and drought monitoring within the United States.
http://www.drought.unl.edu/dm/index.html

British Columbia Drought Response Plan

Drought response plan which addresses preparedness, response and recovery for the province of British Columbia.
http://www.env.gov.bc.ca/wsd/public_safety/drought_info/cabinet/bc_drought_response_plan_june-2010.pdf

Living with Drought (Australian Government)

Australian weather, seasonal climate information, climate data, information on living with drought.
http://www.bom.gov.au/climate/drought/livedrought.shtml

Appendix III
Swift Current Creek Watershed Workshop One

Swift Current Creek Watershed Stewards

Drought Preparedness Workshop Summary

March 24, 2010, Palliser Pavilion, Swift Current, SK.

Coping with drought

Past drought impacts:

- Unstable economics, water shortages (irrigation deficits), feed shortages, soil moisture shortages, and increased stress

Past management strategies:

- Off-farm income (one or both spouses), increased storage/reserves (water and feed), herd sizing, minimum tillage, continuous cropping, crop rotations, grazing management, pipelines, irrigation, shelter belts, custom grazing, social networks, water hauling, loans, shallow wells, dugouts, dams, crop and forage varieties, water use restrictions and water conservation.

Preparing for the future...

There were numerous strategies for improving drought preparedness identified by workshop participants. The following is a brief summary of these strategies:

- Educate the public on the importance of water conservation and use efficiency
- Develop contingency plans for the future that include water conservation and considerations for other extreme water-related events, such as flood.
- Explore the potential of using existing infrastructure more efficiently

Presentations

Dr. David Sauchyn	Drought preparedness: the paleoclimate perspective
Dr. Herb Cutforth	Climate trends for southwest Saskatchewan: 1910 to 2009
Monica Hadarits	Rural community vulnerability to extreme climatic events
Bob Springer	Rangeland management for drought
Dr. Mike Shellenberg	Planning ahead for drought




Appendix IV
Information Requirements Questionnaire

INFORMATION REQUIREMENTS QUESTIONNAIRE

1. Which group(s) do you represent? (Please choose all that apply)
    a. Cattle producer ___
    b. Grain producer ___
    c. Mixed producer ___
    d. Urban municipality ___
    e. Rural municipality ___
    f. Government ___
    g. Other:_____ ___

2. What information would be valuable to you? (Please choose all that apply)
    a. Information on government programs ___
    b. Information on water conservation ___
    c. Seasonal climate forecasts ___
    d. Information on current climate risks ___
    e. Educational materials on climate risks ___
    f. Educational materials on agronomic practices ___
    g. Other: _____ ___
    h. Other: _____ ___
    i. Other: _____ ___
    j. Other: _____ ___
    k. Other: _____ ___

3. Are you interested in the following: (Please choose all that apply)
    a. Volunteer crop/climate reporting ___
    b. Volunteer drought and other climate impact reporting ___

Appendix V
Swift Current Creek Watershed Issues Template

How can we address the issues?

	Issue:		
	Action items	**Priority (high, medium, low)**	**Who should work on this?**
1			
2			
3			
4			
5			
6			
7			

Appendix VI
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