SAN JUAN RIVER WATERSHED

2011 Landslide Assessment Update

prepared for

The San Juan Round Table

by

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1. Introduction

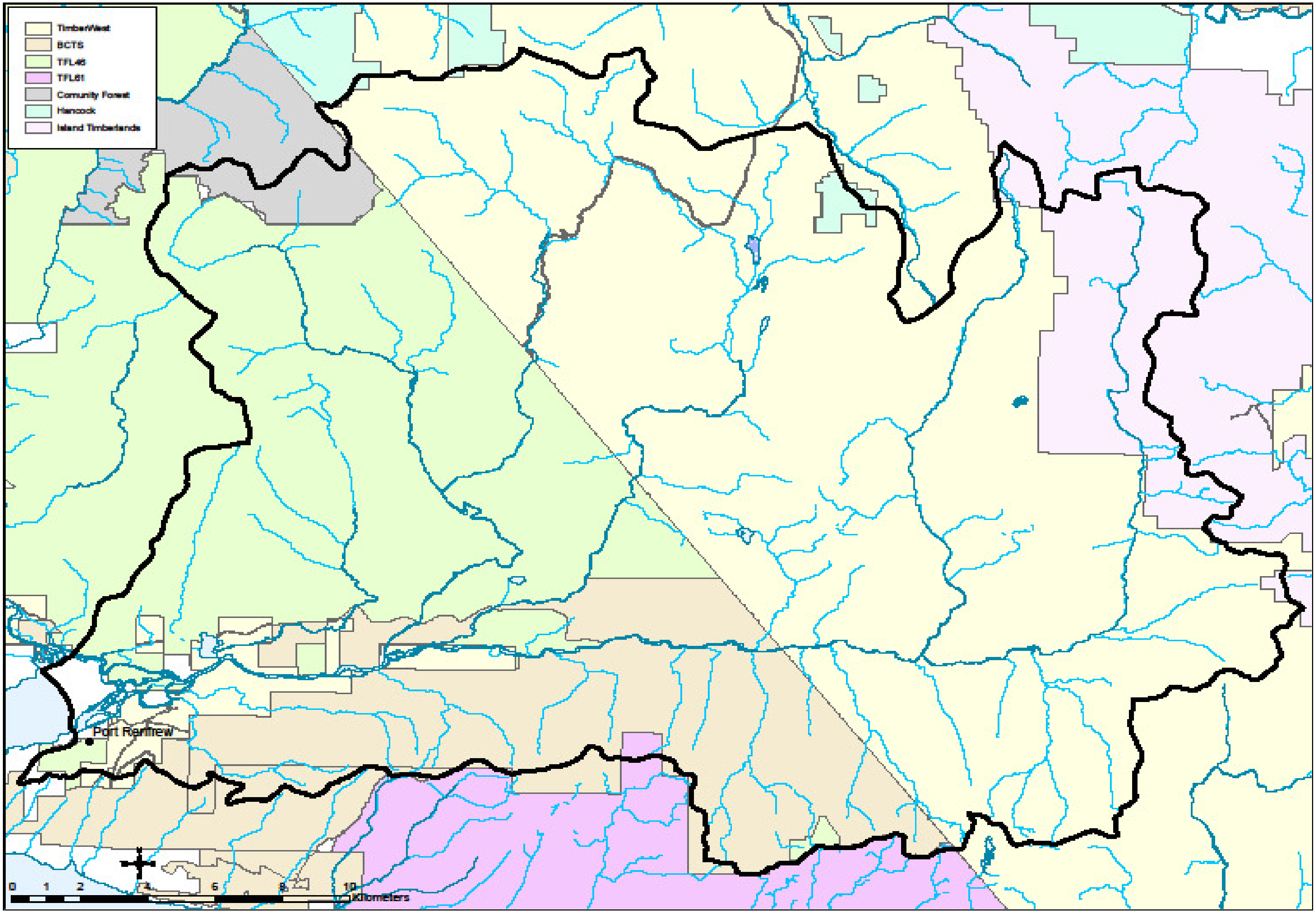
In 1996 **Chatterton Geoscience Ltd.** completed a terrain study in the San Juan River drainage. The results of that study are summarized in a report to the San Juan Steering Committee entitled ***SAN JUAN RIVER WATERSHED Landslide, Gully and Terrain Assessment*** (Chatterton, A.N. 1996). A significant component of that study was to complete a landslide inventory in the watershed and to assess the relative potential for identified landslides to deliver sediment to fish habitat. In early 2012 **Chatterton Geoscience Ltd.** was contracted by **TimberWest Forest Corporation** on behalf of the **San Juan Steering Committee** to undertake a similar study of landslides in the watershed using 2011 high resolution digital photography of the watershed. The overall purpose of the 2012 study was to provide a retrospective view of San Juan drainage landslides over the last 16 years.

The San Juan Stewardship Roundtable consists of a diverse group of stakeholders with a specific interest in San Juan River watershed issues as they relate to fish and fish habitat. Membership is open to all levels of government, non-government organizations, not for profit societies and the private sector and provides a forum for sharing information and resources but unto itself does not have regulatory authority. The core group of founding members includes:

- Pacheedaht First Nation
- Fisheries and Oceans Canada
- B.C. Ministry of Environment
- San Juan Enhancement Society
- Sport Fishing Advisory Board
- B.C. Living Rivers Trust Fund
- Port Renfrew Chamber of Commerce
- M.C. Wright and Associates
- TimberWest Forest Products
- Teal Jones Company
- B.C Timber Sales

Forestry operations are widespread throughout the entire watershed with forestry tenure holders and landowners being represented on the Roundtable. The attached Figure 1 outlines the distribution of forestry tenures within the watershed.

Figure 1: San Juan River Forestry Tenure Distribution



2.0 1996 Study

2.1 Objectives

The objectives of the 1996 study were to:

i. Complete the reconnaissance level Terrain Stability Mapping for those portions of the San Juan River Watershed for which no stability mapping was available. This mapping was to be conducted at a terrain survey intensity level (TSIL) D as described in the Forest Practices Code of British Columbia – Mapping and Assessing Terrain Stability Guidebook (1995)

ii. Conduct a reconnaissance level inventory of landslides and gully features in the San Juan River watershed using the most recently available colour air photographs.

2.2 History

The steps taken to achieve these objectives were to:

- Review existing information including existing terrain mapping, terrain stability mapping and Northwest Hydraulics Consultants Ltd. 1994 instability feature mapping.
- Complete terrain and terrain stability air photo interpretation for that portion of the San Juan River watershed for which the mapping was unavailable using the following air photos :

Source	Year of photography	Approximate scale
TimberWest Forest	1995	1:20,000
MacMillan Bloedel	1995	1:20,000
Pacific Forest Products	1992	1:15,000

The 1995 1:20,000 scale photographic coverage (TimberWest Forest and MacMillan Bloedel) was used where available while the 1992 photos were used for those areas not covered by 1995 photography.

- Complete preliminary landslide/gully feature mapping and database preparation utilizing the available air photo coverage.
- Field truth of more than 10% of the mapped terrain polygons and mapped landslide/gully features.
- Correct and finalize the landslide/gully database.
- Transfer all mapped terrain stability polygons and landslide/gully features onto 1:20,000 scale topographic maps.
- Edit completed terrain stability and landslide/gully feature mapping.
- Prepare report.

3.0 2012 Study

3.1 Objectives

The objectives of the 2012 study are to:

i. Conduct a reconnaissance level re-inventory of landslides in the San Juan River watershed.

ii. Compare the findings of the 2012 study with the landslide component of the 1996 study.

3.2 Methodology

The steps taken to achieve these objectives were to:

- Review existing file information with respect to the 1996 study and review of the 1996 study report.
- Complete a landslide re-inventory using 2011 high resolution digital aerial photography as follows:

Source	Year of photography	Approximate scale
TimberWest Forest	2011	1:40,000

  This 2011 digital photography can be viewed in stereo on a high resolution computer screen using 3-D viewing software and glasses. Features are mapped using a mouse and input directly to an ArcMap GIS map while individual landslide attributes are input to an accompanying database using the same software. Although the original scale of the 2011 photography was 1:40,000, an initial evaluation of the photography and 3-D mapping software indicated that the viewing resolution exceeded that of the photography used in the 1996 study.

  This re-inventory includes an assessment of all of the landslides identified in the 1996 study including current indicators of their post-slide stabilization and/or reactivation. Further to this, the re-inventory identifies any additional landslides that have occurred since the 1996 study and identifying a window of time within which these new landslides would have occurred. This latter information was made possible by the existence of orthophoto coverage for the watershed for the years 1995, 1999, 2002, 2005 and 2007 as well as the air photography and orthophoto coverage for 2011.
- Complete the updated landslide mapping and database preparation utilizing the available digital stereoscopic and ArcMap technologies.
- Correct and finalize the landslide database.

- Prepare report comparing landslide conditions within the watershed the times of the 1996 and 2012 and provide a brief discussion of this comparison. In order to facilitate this comparison, the 2012 study was to be completed for the same watershed and sub-basin areas using the same mapping and interpretive criteria.

There was no field truthing component to the 2011 study.

4.0 Landslide Inventory

4.1 Mapping Criteria

In the 1996 study, active landslides in the San Juan River watershed were mapped using features readily identifiable on 1:20,000 scale colour air photographs. The minimum size of landslide feature that could be recognized reliably and repeatedly and mapped on a 1:20,000 scale topographic map was approximately 60 m in length and 5 m in width. Although some features smaller than this could be identified on the 2011 digital air photos these were not mapped in order to facilitate the comparison between the two studies. It was not necessary for a mapped landslide to be considered an active sediment source for it to be included in either study's landslide inventory. In order for a landslide to be mapped, however, the presence of unvegetated ground surface and/or seral brush species was necessary. Consequently several historic natural landslides which have been inactive over the period of harvesting activity in the watershed have not been mapped. These inactive historic landslides were considered stable for the purpose of this inventory.

The travel path of each landslide was identified with a line starting at the slide initiation point and traveling downslope to a point where the unvegetated ground surface and/or the seral brush species were no longer observable. The exception to this was when a landslide travelled downslope to a major, low gradient stream channel with a floodplain where landslide related disturbance was difficult to distinguish from other floodplain processes. In many instances where these landslides entered a confined permanent stream channel the runout zone of the slide was extended well beyond that which would be considered natural for a landslide and incorporates other fluvial disturbance and erosion processes. In these instances these runout zones would be more accurately described as a "zone of impact". These "zones of impact" were, however included in the inventory because of their potential influences on fish habitat and populations and difficulties in distinguishing between landslide and fluvial processes.

4.2 Project Area

The 1996 project covered the approximately 73,000 ha of the San Juan River watershed exclusive of the Gordon River drainage. The project area was subdivided into 21 (Figure 2) numbered sub-basins for the purpose of discussion and reporting. In order to facilitate the objective of comparing the landslide information from the 2012 study with that of the 1996, the same overall study area and the associated sub-basins were used for the 2012 study as shown in the following Table 1:

Table1: San Juan River Watershed Sub-basins

Watershed Number	Watershed Name	Approximate Area (ha)
1000	Lower San Juan	8825
1001	Murton	290
1002	Falls	700
1003	Mosquito	1375
1004	Bavis	1070
1005	Red	1115
1006	Sam	435
1007	Three Arm	2010
1008	Blakeney	2000
1009	Dent	750
1200	Renfrew/Granite	5525
1300	Lower Harris	1810
1301	Hemmingsen	6890
1302	Upper Harris	6945
1400	Lower Lens	8390
1401	Hillcrest	2610
1402	Upper Lens	2540
1500	Fleet	7770
1600	Upper San Juan	8580
1601	Williams	2350
1602	Floodwood	1010

Figure 2: **San Juan River Watershed Sub-basins**

4.3 Landslide Classification and Attributes

For each landslide identified in the two studies, several associated attributes were identified. These attributes, and their associated database codes shown in brackets, are detailed as follows:

4.3.1 Landslide type

Landslides identified in the two studies area have been classified as follows:

- **debris slide** (**DS**) - Shallow landslides initiating on steep angled slopes and terminating on similar steep angled slopes were characterized as debris slides. Debris slides tend to be relatively short. Road sidecast failures make up the majority of debris slides. These slides tend to be unconnected to natural water courses.
- **debris avalanche** (**DA**) - Debris avalanches also initiate on steep slopes but travel downslope to a termination point on more gentle terrain. Debris avalanches generally have a higher water content than debris slides. The lateral limits of the debris avalanches mapped are unconfined by gully or channel sidewalls. Often debris avalanches are connected to major stream channels by way of small tributary and ephemeral streams. The main volume of debris from the debris avalanches mapped often do not reach major stream channels. It is expected, however, that fine sediment from debris avalanches does flow to these major stream channels
- **debris flow** (**DF**) - Debris flows are by far the most common type of landslide mapped. Debris flows can initiate in a number of ways, however, they enter a confined gully or stream channel. Typically, in this channel, the debris flow combines with significant quantities of water which imparts liquid properties to the slide mass. Debris flows will frequently travel extensive distances because of these liquid properties. The runout zone of most debris flows is often a low gradient stream channel.
- **rock slide** (**RS**) - Rock slides consist of failure of a bedrock mass along structural discontinuities in the bedrock. Generally, rock slides initiate below the rooting zone of surface vegetation. It's been observed in other areas that many natural debris flows initiate as small rock slides on the sidewalls of gullies.

4.3.2 Landslide origin

The initiation zone of each mapped landslide was classified according to its associated land use as follows:

- **natural** (**N**) - natural landslides initiate on terrain unaffected by forest harvesting or other human activity.
- **road (R)** - road related landslides initiate immediately adjacent to a road. These landslides do not include landslides that start downslope of a road and which may be associated with runoff water from the road.
- **clearcut** (**C**) - clearcut failures are those that initiate on open slopes that have been logged at some time and are not immediately associated with a road.

4.3.3 Landslide terminus

The termination or end point of each landslide was characterized as follows:

- **<u>midslope</u>** (**MS**) - Landslides which terminate on steeper terrain or benches in the middle of the hillslope are characterized as having a midslope terminus. Typically debris slides and rock slides have midslope terminus points. Landslides terminating in a midslope position do not have an air photo observable stream channel connecting the failure to downslope stream systems.
- **<u>toe slope</u>** (**TS**) - Landslides which terminate on more gentle terrain at the base of steeper slopes are characterized as having a toe slope terminus. Toe slope terminus landslides do not have an air photo observable stream channel connecting the failure to downslope stream systems. Debris avalanches often terminate in toe slope environments.
- **<u>tributary stream</u>** (**TR**) - Landslides which terminate at small unmapped and first order stream channels are characterized as having a tributary stream terminus. Often these streams are ephemeral and do not flow during drier periods of the year. Generally the main landslide debris mass is not transported out of this tributary stream channel. Smaller debris flows and some debris avalanches have tributary stream terminus points.
- **<u>mainstem stream</u>** (**MA**) - Landslides which travel into larger second order and greater streams which flow throughout the year have a mainstem stream terminus point. Landslides which terminate in a mainstem stream channel transport the main mass of slide debris into the mainstem stream channel where it is often transported and redistributed by subsequent streamflow.

4.3.4 Landslide Width

Average landslide width was estimated in 5 m wide increments for each of the identified landslides. This width estimate was facilitated with a measurement tool included in the ArcMap GIS system. Some of the reactivated landslides show different landslide widths between the 1996 and 2011 studies.

4.3.5 Landslide Length

Landslide length is automatically calculated by ArcMap. Frequently there were minor discrepancies noted between landslide lengths in 1996 and 2011 which appear to be the result of the software. Larger discrepancies were common for those landslides that reactivated following the 1996 study.

4.3.6 Landslide Area

Landslide width and length were used to calculate an estimate of landslide area for the purpose of discussion.

4.3.6 Sediment generation potential (SGP)

The potential for a landslide to generate sediment from its surface is rated on the basis of the amount of unvegetated soil or unconsolidated surficial materail that appears on the air photographs to be exposed to rainfall and runoff water. Vegetative cover, large boulders and bedrock are considered to protect the surface of a landslide from generating sediment. The categories of landslide sediment generation potential are identified are as follows:

- **nil** (**N**) - A nil sediment generation potential is applied to landslides which have become stable. For the purpose of this study, stabilized landslides are restricted to those natural landslides that have remained inactive since the inception of forest harvesting in the watershed. These slides have not been mapped and, as such, no slides included in the inventory have a nil sediment generation potential.
- **low** (**L**) - A low sediment generation potential has been assigned to landslides that are already revegetated or show air photo evidence of a boulder and/or bedrock substrate. The majority of slides that have been identified as having a low sediment generation potential were estimated to be more than 20 years old at the time of photography although more rapid regeneration was observed in many instances.
- **medium** (**M**) - A medium sediment generation potential has been assigned to those slides which are partially revegetated. For these slides stabilization may consist of supplementing the existing vegetation.
- **high** (**H**) - Landslides which consist primarily of exposed, unvegetated soils and surficial materials have been assigned a high sediment generation potential. These landslides are of relatively recent origin and are generally considered to be less than 10 years old relative to the date of air photo coverage.

4.3.7 Sediment delivery potential (SDP)

Sediment delivery potential assesses the potential for sediment that is generated from the surface of a landslide (**SGP**) to enter and be transported to downslope fish bearing stream channels. Sediment delivery potential is derived from the Forest Practices Code - Gully Assessment Procedures Guidebook (April 1995) classification of connectivity to fish streams or lakes or sensitive marine zones as follows:

- **not connected (N)** - Landslides having no airphoto observable stream connectivity to downslope streams are considered unconnected. It is expected that downslope streams are buffered from the debris and sediment generated by an unconnected landslide.
- **indirect** (**I**) - Landslides which discharge into non-fish bearing waters with a stream channel gradient less than 5% over a minimum of 100 m before reaching fish bearing habitat have an indirect sediment delivery potential. It is anticipated that this low gradient reach will capture much of the large organic debris and coarse sediment generated by the landslide thus buffering the downstream habitat from its impact. Finer suspended sediment is expected to pass through this buffering stream reach and into the downstream fish bearing habitat.
- **direct** (**D**) - Landslides which are connected directly to a stream channel which does not have a low gradient buffering reach between the slide terminus and fish-bearing waters are considered to have a direct sediment delivery potential. Most landslides which have a mainstem stream or tributary stream terminus are considered to have a direct sediment delivery potential.

4.3.8 Landslide Sedimentation Risk

The risk that a landslide will result in sediment being introduced into fish habitat is a combination of the potential for sediment to be generated from a landslide (**SGP**) and the potential for that sediment to be delivered to a stream channel (**SDP**). Figure 3 details a procedure for assigning a relative landslide sediment risk factor by combining these two attributes. This risk matrix was derived the Debris Flow Initiation Potential (DFIP) matrix outlined in the Forest Practices Code – Gully Assessment Procedures Guidebook (April 1995)

Figure 3: Landslide Sediment Risk Matrix

Landslide Sediment Risk Matrix

Sediment Generation Potential (SGP)	Sediment Delivery Potential (SDP): not connected	indirect	direct
low	L	L	L
medium	L	M	M
high	L	M	H

5.0 Landslide Database

Appendix I is a complete listing of the combined landslide database for both the 1996 and 2012 San Juan Watershed Landslide inventories. In addition to the landslide classification and attributes discussed in the previous section a column named STAT. or status was introduces as follows:

- U 1996 study landslide with updated landslide attributes
- R 1996 study landslide that subsequently become reactivated
- N “new” or post-1996 study landslide

Further to STAT., brief comments were included in the database for both the 1996 and 2011 studies. Those for the 1996 study include letter codes which relate to the apparent surface condition of each slide track as follows:

V	vegetated
PV	partially vegetated
R	rock
I	inaccessible

The code I (inaccessible) was applied to some canyon sidewall landslides that were in dark shadows and could not be observed during the ground truthing component of the study. In many instances multiple codes were included within the comments section for each landslide. Alternately many of the landslides had no comments code.

A similar comments section was included for the 2012 study. Rather than utilize codes, however, each of the unchanged landslides identified were described as "vegetated", "part veg" (partially vegetated) or "rock" (bedrock or large boulder landslide surface) characterizing the surface condition of the landslide. For any of the landslides not identified in the 1996 study and those landslides that have become reactivated subsequent to that study, a range of years within which the landslide occurred or became reactivated has been identified. For example post 1996 study landslide #59 in the Lower San Juan sub-basin has a 2012 comment section entry of 2007-2011 indicating that it occurred between 2007 and 2011.

6.0 Discussion

6.1 Landslide Numbers

Table 2 summarizes the number of landslides by origin and landslide sedimentation risk categories for the two studies. In 1996 there were a total of 903 landslides identified. Subsequent to that there have been an additional 55 "new" landslides and 16 of the 1996 study landslides have become "reactivated" since the time of that study. Of the 55 "new" landslides identified, 25 were classified as "road", 19 were classified as "clearcut" and 12 were classified as "natural". The majority of these "new" and "reactivated" landslides have occurred in drainages on the south side of the San Juan River and the Hemmingsen Creek drainage. Those on the south side of the San Juan River are largely associated with highly fractured and weathered metamorphic bedrock while those in the Hemming Creek drainage are largely associated with an area that was heavily burned and salvage logged prior to 1995. During the process of editing and analyzing the landslide database it became apparent that the majority of road and clearcut related "new" landslides were associated with road construction and harvesting that had occurred prior to 1995. In order to quantify this, each of the "new" landslides was assessed to determine whether the associated road or harvesting related activities had occurred before or after the

1996 study. Those “new” landslides associated with post-1995 road construction or harvesting activities were identified in the landslide database and summarized in Table 2:

Despite the increase in number of landslides and the reactivated landslides there was a significant reduction in the number of “high” sedimentation risk landslides with 204 being identified in 1996 and 24 being identified in 2011. This is the result of continued vegetative regrowth on the majority of these slides. Further to this, only 4 of the 55 “new” landslides were associated with activities occurring after 1995 suggesting that road construction and harvesting activities since 1995 have been significantly more effective with respect to maintaining hillslope stability.

Table 3 summarizes the estimated area of landslides by origin and landslide sedimentation risk. In 1996 there was an estimated 507.96 ha of surface area. This area increased to 530.66 ha for the 2012 study as a result of the occurrence of new landslides and increased area associated with some of the reactivated landslides. Of this total area in the 2012 study 204.31 ha was classified as “road”, 127.03 was classified as “clearcut” and 132.80 ha was classified as “natural”. As was the case with the landslide numbers there was a significant reduction on the estimated area of “high” sedimentation risk landslides with an estimated 159.82 ha of “high” sedimentation risk slides identified in 1996 and 11.71 ha being identified in 2012. Again, this is the result of continued vegetative regrowth on the majority of these slides.

Table 2:

San Juan River Drainage - Landslide Numbers

	Total # of slides		# of Road slides		# of Clearcut slides		# of Natural slides		# of new slides			# of reactivated slides		# High risk slides		# Medium risk slides		# Low risk slides	
	1995	2012	1995	2012	1995	2012	1995	2012	1995	2012	post-95 road/log	1995	2012	1995	2012	1995	2012	1995	2012
Lower San Juan	54	60	20	22	31	33	3	5	n/a	6	2	n/a	2	6	2	8	7	40	51
Murton	1	1	1	1	0	0	0	0	n/a	0	0	n/a	0	0	0	0	0	1	1
Falls	5	5	2	2	3	3	0	0	n/a	0	0	n/a	0	3	0	0	0	2	5
Mosquito	17	17	6	6	10	10	1	1	n/a	0	0	n/a	0	5	0	1	1	11	17
Bavis	20	20	3	3	13	13	4	4	n/a	0	0	n/a	0	5	0	9	2	6	18
Red	14	18	2	4	12	12	0	2	n/a	4	0	n/a	3	6	1	6	5	2	12
Sam	7	7	4	4	1	1	2	2	n/a	0	0	n/a	0	3	0	0	0	4	7
Three Arm	29	30	8	8	16	16	5	6	n/a	1	0	n/a	0	0	0	4	1	25	29
Blakeney	55	55	3	3	34	34	18	18	n/a	0	0	n/a	1	0	0	0	0	55	55
Dent	12	13	2	2	3	4	7	7	n/a	1	1	n/a	0	0	0	1	1	11	12
Renfrew	115	118	19	19	14	16	82	83	n/a	3	0	n/a	0	17	0	16	11	82	107
Lower Harris	8	8	2	2	6	6	0	0	n/a	0	0	n/a	0	0	0	0		8	8
Hemmingsen	163	179	77	83	25	33	61	63	n/a	16	1	n/a	5	34	0	48	22	81	157
Upper Harris	72	73	32	33	36	36	4	4	n/a	1	0	n/a	1	8	0	22	6	42	67
Lower Lens	78	82	48	52	20	20	10	10	n/a	4	0	n/a	0	30	3	25	6	23	73
Hillcrest	14	14	10	10	4	4	0	0	n/a	0	0	n/a	0	0	0	3	1	11	13
Upper Lens	2	2	1	1	1	1	0	0	n/a	0	0	n/a	0	0	0	1	0	1	2
Fleet	44	47	15	16	27	28	2	3	n/a	3	0	n/a	2	14	2	27	11	3	34
Upper San Juan	98	104	58	60	18	21	22	23	n/a	6	0	n/a	0	51	7	8	28	39	69
Williams	56	65	30	36	14	15	12	14	n/a	9	0	n/a	2	16	6	32	7	8	52
Floodwood	39	40	21	21	18	19	0	0	n/a	1	0	n/a	0	11	1	16	1	12	38
TOTAL	**903**	**958**	**364**	**388**	**306**	**325**	**233**	**245**	**n/a**	**55**	**4**	**n/a**	**16**	**209**	**22**	**227**	**110**	**467**	**827**

Table 3:

San Juan River Drainage - Landslide Areas

	Total area (ha) of slides		Area (ha) Road slides		Area (ha) Clearcut slides		Area (ha) Natural slides		Area (ha) new slides		Area (ha) reactivated slides		Area (ha) High risk slides		Area (ha) Medium risk slides		Area (ha) Low risk slides	
	1995	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**	**1995**	**2011**
Lower San Juan	43.11	44.74	7.29	7.69	17.66	18.19	18.16	18.86	n/a	1.56	n/a	1.70	5.35	0.35	2.26	3.34	35.51	41.05
Murton	0.66	0.66	0.66	0.66	0	0	0	0	n/a	0	n/a	0	0	0	0	0	0.66	0.66
Falls	1.13	1.13	0.44	0.44	0.70	0.70	0	0	n/a	0	n/a	0	0.57	0	0	0	0.56	1.13
Mosquito	9.83	9.83	3.15	3.15	2.24	2.24	4.44	4.44	n/a	0	n/a	0	3.01	0	0.14	0	6.68	9.83
Bavis	14.08	14.08	1.36	1.36	5.48	5.48	7.24	7.24	n/a	0	n/a	0	3.87	0	3.32	1.11	6.89	12.97
Red	14.21	17.11	9.62	11.49	4.60	4.95	0.00	0.67	n/a	2.94	n/a	3.75	10.99	2.04	2.97	3.20	0.26	11.86
Sam	3.53	3.53	1.43	1.43	0.06	0.06	2.04	2.04	n/a	0	n/a	0	1.06	0	0	0	2.47	3.53
Three Arm	9.54	10.28	1.78	1.78	5.70	5.70	2.06	2.80	n/a	0.74	n/a	0	0	0	1.57	0.74	7.98	9.54
Blakeney	31.90	32.43	0.27	0.27	11.32	11.32	20.31	20.83	n/a	0	n/a	1.07	0	0	0	0	31.90	32.43
Dent	10.31	10.71	1.78	1.78	1.35	1.76	7.17	7.17	n/a	0.41	n/a	0	0	0	0.18	0.18	10.13	10.54
Renfrew	69.72	70.80	14.63	14.63	5.67	6.44	49.42	49.73	n/a	1.09	n/a	1.05	20.08	0	3.87	7.89	45.76	62.91
Lower Harris	3.86	3.86	2.14	2.14	1.72	1.72	0	0	n/a	0	n/a	0	0	0	0	0	3.86	3.86
Hemmingsen	72.03	77.54	23.52	26.30	10.58	12.28	37.94	38.96	n/a	4.45	n/a	5.08	13.53	0	16.45	11.51	42.05	66.03
Upper Harris	29.43	29.70	15.91	15.91	9.34	9.61	4.18	4.18	n/a	0.28	n/a	1.33	2.25	0	6.20	2.71	20.98	26.99
Lower Lens	52.86	53.64	35.79	36.57	9.14	9.14	7.93	7.93	n/a	0.80	n/a	0	28.54	0.25	11.03	7.63	13.28	45.76
Hillcrest	4.70	4.76	3.25	3.31	1.45	1.45	0	0	n/a	0	n/a	0	0	0	0.81	0.32	3.89	4.44
Upper Lens	2.49	2.49	0.29	0.29	2.19	2.19	0	0	n/a	0	n/a	0	0	0	0.29	0.29	2.19	2.19
Fleet	23.76	25.82	16.35	16.55	6.25	6.74	1.15	2.53	n/a	2.09	n/a	1.24	11.29	1.88	12.18	11.36	0.29	12.58
Upper San Juan	59.22	60.78	37.30	37.52	7.36	8.16	14.55	15.10	n/a	1.60	n/a	0	35.56	2.58	1.75	21.42	21.91	36.79
Williams	27.18	32.43	11.47	15.65	5.29	5.70	10.42	11.07	n/a	8.95	n/a	3.23	9.14	4.55	9.73	6.37	8.31	21.50
Floodwood	24.41	24.35	5.48	5.40	18.93	18.95	0	0	n/a	0.06	n/a	0	14.59	0.06	4.57	0.22	5.25	24.07
TOTAL	**507.96**	**530.66**	**193.91**	**204.31**	**127.03**	**132.80**	**187.01**	**193.54**	**0.00**	**24.94**	**0.00**	**18.44**	**159.82**	**11.71**	**77.31**	**78.29**	**270.83**	**440.67**

5. References

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