Emergency Services

National Park Service
U.S. Department of the Interior

Search and Rescue Report - PAGE 1

Version 4.1
REV 2013

Use Tab to move between fields.

Park:	GRTE	Region:	IMR	Major SAR?:	Yes	Major SAR Number:	PX.EGRTES117.00.1
Incident Commander:	Philip Edmonds			Case Number:	NP-	16114877	
Park SAR Number:	24			Day of Week:	7- SATURDAY		
Date of Notification:	Jul 23, 2016			Time Notified (24 hour format)	10:30		
Date Subject Contacted:	Jul 23, 2016			Time Subject Contacted (24 hour format)	13:14		

Location:	Grand Teton, Owen-Spalding Rappel		
Coordinates:	43° 44.470'N, 110° 48.271'W		
Notification Method:	Cellular Phone		
Incident Type:	Rescue	Contributing Factor- 1st:	Equipment Failure
Mutual Aid?:	No	Contributing Factor- 2nd:	Judgement Error
Subject Organization:	Concession Employee	Contributing Factor- 3rd:	Fall
Subject Activity:	Climbing, Roped	Rescue Method - 1st:	Helicopter Rescue
Incident Environment:	Mountains 5,000'- 15,000'	Rescue Method - 2nd:	
SAR Disposition:	Subject Found/Rescued	Rescue Method - 3rd:	

Subject Info:	Age	Sex	Experience Level
Subject #1:	42	Male	5. Expert/Master/Instructor/Guide
Subject #2:			
Subject #3:			

Number Ill or Injured	Number Not Ill or Injured	Number of Fatalities	Number of Saves
0	0	1	0

The Following Items are Reported Only When Incidents Involve Searches For Lost Subjects

Search Type:	
Linear Distance In Miles from PLS: (blank if unknown)	
Vertical Direction from PLS:	
Search Duration:	

Emergency Services

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Search and Rescue Report - PAGE 2

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REV 2013

Use Tab to move between fields.

Incident Narrative:

(Type or Paste Text In Block)

On July 23, at about 1030 hours, TIDC transferred a cell phone call from (b) (6), (b) (7)(C)). (b) (6), (b) informed SAR coordinator Philip Edmonds that someone had fallen off the top of the Owen-Spaulding Rappel. (b) (6), (b) heard a body hit the ledge near (b) (6), (b and the body continued down into Valhalla Canyon near the Black Ice Couloir. (b) (6), (b) did not see who fell; (b only heard the sound of the fall. (b) also found blood on the ledge leading to Valhalla Canyon. Shortly thereafter Ranger Bellino received a call from the Exum office and was provided additional information. Ranger Bellino was informed that Exum Guide Gary Falk had fallen unroped from the top of the rappel into Valhalla Canyon. Ranger Jim Springer was at the top of Sargent's Chimney at the time of the fall. He descended to the Upper Saddle to look for Falk in the Black Ice Coulior. Ranger Springer was unable to locate Falk and advised that Falk had likely fallen the full length of the Coulior. Ranger Springer remained at the Upper Saddle and acted as a rock fall spotter for subsequent reconnaissance and recovery flights.

Helicopter 38HX conducted a reconnaissance flight of the area (Pilot Steve Wilson). Personnel on board (Rangers Case Martin, Marty Vidak, and Ron Johnson) were prepared to transition to a short haul rescue in the event that Falk was viable. At about 1155 hours, the reconnaissance flight located the body of Gary Falk approximately 2500 feet down from the top of the rappel in Valhalla Canyon. Due to the length of the fall and level of trauma visible, the personnel on board determined from the air that Falk was deceased.

Helicopter 38HX landed about a half mile away at an unimproved landing zone in Valhalla Canyon. Rangers Vidak and Martin were dropped off at the landing zone and they hiked to the scene. Vidak and Martin arrived at the scene at approximately 1315 hours. Martin confirmed that Falk was deceased. Helicopter 38HX delivered a cargo net of recovery supplies to Vidak and Martin via long-line and returned to Lupine Meadows. At 1500 hours, 38HX departed Lupine Meadows to extract Falk's body via long line. Shortly after, Vidak and Martin attached the cargo net with Falk's body to the long-line. Helicopter 38HX returned to Lupine Meadows and delivered the cargo net with the body to Rangers Jack McConnell and Scott Guenther. Falk's body was transferred to the Teton County Coroner at about 1513 hours.

Rangers Vidak and Martin hiked back to the landing zone in Valhalla Canyon where they were extracted by Helicopter 38.

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REV 2013

Use Tab to move between fields.

Time and Cost Summary	Hours	Cost
NPS Programmed Hours		
NPS Unprogrammed Hours		
Non-NPS Hours		
Totals:		

Other Services, Supplies, and Equipment	Cost
Supplies and Equipment	
Other Services and Expenses	
Totals:	

Aircraft / Vessel Summary						Hours	Cost
1.	Type:		Owner:		Hourly Rate:		
2.	Type:		Owner:		Hourly Rate:		
3.	Type:		Owner:		Hourly Rate:		
					Totals		

Prepared By: _____ Date _____

Signature: _____

Approved By: _____ Date _____

Signature: _____

For Incidents with NPS non-programmed costs in excess of $500, the following approval signatures are required

Superintendent Signature: _____ Date _____

Regional Director Signature: _____ Date _____

Print Form

Version 4	NATIONAL PARK SERVICE SEARCH & RESCUE REPORT – Page 1	FALK4877

SAR #:	16-24	Park: GTNP	SAR Account #:	PX.EGRTES117.00.1	Case #	NP16114877
Start Date:	07/23/16	Start Time: 1030	End Date: 07/23/16	End Time: 1900	Day of Week:	7-Saturday

	Subject Name	ADDRESS	Phone	DOB
1	Gary Falk	(b) (6), (b) (7)(C)	(b) (6), (b) (7)(C)	(b) (6), (b) (7)(C)
2		Insert address in this textbox		
3				
4				

Subject Info:	Age	Sex	Experience Level
Subject #1	42	M	5. Expert/Master/Instructor/Guide
Subject #2		Click	Click Here (5 choices)
Subject #3		Click	Click Here (5 choices)
Subject #4		Click	Click Here (5 choices)

Date Subject Contacted:	7/23/2016	Time Subject Contacted:	1314
Location:	Owen-Spalding Rappel		
Coordinates:	43° 44.470'N, 110° 48.271'W		
Notification Method:	2 - Cellular Phone		
Incident Type:	2 - Rescue	Contributing Factor - 1st:	5 - Equipment Failure
Mutual Aid:	No	Contributing Factor - 2nd:	11 - Judgement Error
Subject Organization:	8 - Concession Employee	Contributing Factor - 3rd:	6 - Fall
Subject Activity:	9 - Climbing, Roped	Rescue Method - 1st:	4 - Helicopter Rescue
Incident Environment:	10 - Mountains, 5,000 - 15,000 feet	Rescue Method - 2nd:	Click Here (14 choices)
SAR Disposition:	1 - Subject Found/Rescued	Rescue Method - 3rd:	Click Here (14 choices)

NUMBER ILL or INJURED:	0	NUMBER NOT ILL or NOT INJURED:	0	NUMBER of FATALITIES:	1	NUMBER of SAVES:	0	UNFOUNDED:	0

The Following Items Are Reported Only When Incidents Involve Searches For Lost Subjects

Search: TYPE	Click Here (5 choices)	
Search: Linear Distance in Miles from PLS (blank if unknown):		miles
Search: VERTICAL DIRECTION FROM PLS	Click Here (7 choices)	
Search: DURATION	Click Here (10 choices)	
Search: DISPOSITION	Click Here (5 choices)	
Search: HOW SUBJECT WAS FOUND	Click Here (10 choices)	

Brief Summary:

On 7/23/2016, Exum Mountain Guide Gary Falk fell to his death while guiding four clients down the Grand Teton. Falk was descending with four clients from the City Kids foundation. Falk fell at the Owen-Spalding Rappel. Falk's body was located by a reconnaisance flight approximately 2500 feet below the rappel in Valhalla Canyon. Rescuers hiked to Falk's body from an umimproved landing zone nearby. Falk's body was long lined from the scene and the rescuers were extracted by helicopter back to Lupine Meadows.

Version 4	NATIONAL PARK SERVICE SEARCH & RESCUE REPORT – Page 2	FALK4877

SAR #: 16-24	Park: GTNP	SAR Account #: PX.EGRTES117.00.1	Case # NP16114877

TIME/COST SUMMARY	Hours:	Costs:
NPS Programmed Hours: Actual, regular hours for permanent and seasonal NPS employees.	71.00	$1,509.41
NPS Unprogrammed Hours: Actual overtime, hazard pay, emergency hire (AD) and unscheduled part-time, and intermittent employee time & FICA-ER.	146.50	$5,868.50
Non-NPS Hours: Volunteer, military, and other non-NPS time.	64.00	$1,277.58
Totals:	281.50	$8,655.49

OTHER SERVICES AND MATERIALS	Costs:
Supplies and Equipment: Non-budgeted supplies and NPS equipment replacement.	$1,040.65
Other Services and Costs: Meals, travel,equipment rental, contracted hourly services, etc.	$59.70
Totals:	$1,100.35

AIRCRAFT AND VESSEL SUMMARY

Aircraft Organization:	Aircraft Costs:	Vessel Organization:	Vessel Costs:
NPS - Air Operations Cost	$1,225.00	NPS - Vessels Cost	$0.00
Other Air Operations Costs	$0.00	Other Vessel Costs	$0.00
Totals:	$1,225.00	**Totals:**	$0.00

Non-NPS Total:	$1,277.58	NPS Total:	$7,377.91	Grand Total:	$10,980.84	Total Charged to SAR Account:	$8,193.85

Prepared by:	Philip Edmonds	Approved by:	
Signature/Date:		Signature/Date:	

For incidents with NPS non-programmed costs in excess of $500, the following signatures are required:

Superintendent: David Vela	Regional Director:	Approved	
		Disapproved	
Signature/Date:	Signature/Date:		

Narrative:

Continue here if necessary

General Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 10:31 by GRTE4292

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:42
Entered time: 09/23/2016 09:42

Remarks:

Reconstruction of Events

Report:

Reconstruction of Events

On July 22, 2016, Exum Guides Gary Falk and (b) (6), (b) (7)(C) hiked to the Lower Saddle with City Kid (b) (6), (b) (7)(C) and four City Kid students. Their intent was to climb the Owen Spaulding Route (5.4, Grade II) on the Grand Teton (13,770 feet). During the hike it became apparent that one of the students would struggle with that objective due to his level of fitness. That night Falk and (b) (6), (b) (7)(C) discussed strategies for addressing this issue. They decided to start the ascent together and to see how the day progressed.

Each guide has their own cache of personally owned gear at the Lower Saddle (including rappel devices for their clients) that they use for guiding. The next morning Falk began with four ATC rappel devices in his pack and (b) (6), (b) (7)(C) began with three.

Shortly after first light the slower City Kid began lagging behind. (b) (6), (b) (7)(C) and (b) (6), (b) (7) remained behind with the slower City Kid. Falk came back down and met them a short ways above the Brigg's Slab. At that point they decided to formally separate from each other for the remainder of the ascent. (b) joined Falk and the other three City Kids on their ascent of the Grand Teton. (b) (6), (b) (7)(C) and the slower City Kid changed their objective to a non-technical ascent of the Enclosure. At that time, (b) (6), (b) (7)(C) gave Falk one of the ropes (b was carrying but did not give him a rappel device.

Falk and the City Kids stopped near the Upper Saddle for a break shortly after sunrise. A photo was taken at this location and is time stamped 0607 hours. The group then ascended the Owen Spaulding Route. A photo of Falk and the City Kids was taken on the summit of the Grand Teton. It was time stamped 0843 hours.

After leaving the summit, Falk and his clients descended to the Sargent's chimney. Near Sargent's chimney they met Exum Guide (b) (6), (b) (7)(C) and (b client. (b) (6), (b and (b client were moving faster than Falk's group. Falk suggested that (b) (6), (b and (b client pass them and proceed to the Owen Spaulding Rappel. Falk gave (b) (6), (b one of his ropes so that (b could rig the rappel station for Falk's group. Falk had left another rope near the base of the rappel. The plan was for (b) (6), (b to use the rope that Falk gave him along with one of (b ropes to rig the rappel station. (b) (6), (b would then leave the ropes fixed and descend. At the bottom of the rappel (b would pick up the rope that Falk had left there. This would leave both groups with the same number of ropes but would allow (b) (6), (b to rig the rappel and leave it in place for Falk's group.

(Exum uses a two-rope system for clients on the Owen Spaulding Rappel. The clients rappel on one rope and are belayed by the guide using a second rope.)

When (b) (6), (b got to the standard Owen Spaulding rappel station, (b fixed the rappel rope to the rappel rings on the anchor's master point using a bowline with a backup knot. (b fixed the end of the belay line to the climber's right side of the anchor above the knot shelf using a bowline with a backup knot. (b) client rappelled to the ground. Falk arrived at the anchor before (b) (6), (b rappelled. (b) (6), (b watched Falk clip into the anchor with a double length (48 inch) sling and a locking carabiner. (b) (6), (b then rappelled to the ground and continued working down to the Upper Saddle with (b client.

The first member of Falk's party to rappel was (b) (6), (b) (7) Falk was tethered to the anchor with a lanyard when (b) (6), (b) (7 was at the stance with him. Falk belayed (b) (6), (b) (7 while (b rappelled. The group was short one rappel device. When (b) (6), (b) (7 got to the bottom, (b connected the rappel device and locking carabiner that (b had used to the end of the belay line. Falk then

pulled up the belay line and the rappel device. As he was pulling the rope up, the rappel device and carabiner got stuck in a crack in the rock about 40 feet below the rappel station.

Exum Guide (b) (6), (b) (7)(C) and (b two clients (b) (6), (b) (7)(C)) arrived in the area during this time frame. So did private climber (b) (6), (b) (7)(C) and (b two climbing partners (an adult (b) (6), (b) and a juvenile). (b) (6), (b) (7)(C) all said that it was clear that Falk was tethered to the anchor because he was, at times, leaning out on his lanyard. The three City Kids students were sitting about twenty feet away from Falk to the climber's left in an area that is slightly recessed from the anchor. The City Kids were tied into a rope that was secured to the climber's left side of the rappel anchor above the knot shelf with a munter mule knot on a locking carabiner.

(b) (6), (b) (7)(C) discussed the situation with Falk. They suggested several alternatives for descending without a rappel device and for dealing with the stuck rappel device. Falk was focused on trying to free the rappel device. He was standing near the edge of the rappel stance trying to flip the belay rope outwards to free the stuck device. During this process, Falk fell from the rappel stance. None of the witnesses were focused closely enough on Falk's actions to see exactly what caused the fall. Some of the witnesses, including the three City Kids, initially speculated that Falk had unclipped his tether from the anchor and subsequently fallen. However, evidence and witness statements suggest that he was using a 98 inch section of 9/16 blue tubular webbing tied in a loop with a water knot to tether himself to the anchor and that the knot came untied during his attempts to free the stuck rappel device.

Falk fell approximately 125 feet onto the ledges at the bottom of the rappel. He bounced twice on those ledges and then fell off of the West Face of the Grand Teton and into the Black Ice Couloir. He continued falling down the Black Ice Couloir and came to rest near the bottom of the lowest snowfield beneath the couloir in the head of Valhalla Canyon, approximately 2500 feet below the top of the rappel.

Both (b) (6), (b) (7)(and (b) (6), (b noted that when Falk fell he was immediately projected outward (rather than downward) in an unexpected manner. Several witnesses said that Falk was facing roughly outwards prior to the fall and that he was facing downward juggling the belay line in his hands during the initial portion of the fall.

(b) (6), (b) (7)(C) yelled up to Climbing Ranger Jim Springer who was ascending the Sargent's Chimney. Ranger Springer began descending to the Owen Spaulding Rappel. (b) (6), (b) (7)(C) went over to the standard rappel anchor. (b found it still rigged in the manner described above. There was no damage to any of the components. There were three ATC rappel devices with locking carabiners pre-rigged on the rappel line. There were two wire gate non-locking carabiners and at least one, possibly two, locking carabiners clipped to the anchor between the knot shelf and the fixed end of the belay line on the climber's right side of the anchor.

When Ranger Springer arrived at the rappel, he advised (b) (6), (b) (7)(C) that (b should facilitate the safe descent of the three City Kids and (b clients. Ranger Springer than rappelled a rope that one of the bystanders had fixed to the non-standard (two bolt) rappel anchor nearby.

(b) (6), (b) (7)(C) had (b) (6), (b) (7)(C) descend the rappel line that was fixed to the standard anchor. During (b descent, (b) (6), (b) (7)(C) freed the stuck rappel device.

(b) called 911 immediately after witnessing the fall. The Teton Interagency Dispatch Center received this call at 1032 hours. (b) (6), (b) then returned to the base of the rappel where (b and (b) (6), (b) (7)(C) facilitated the safe descent of the remaining clients down the rappel. They contacted the Exum office and several other guides were sent to help the clients safely descend back to the trailhead.

Ranger Springer remained at the Upper Saddle where had acted as a spotter for the ensuing helicopter rescue/recovery operation.

Supplementary Incident Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 09:54

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:45
Entered time: 09/23/2016 09:45

Remarks:

Springer Supplemental

Report:

Climbing Ranger James Springer

My team was climbing the Owen-Spalding route on the Grand Teton on July 25, 2016. I had climbed out of the mid Sargent's Chimney pitch getting ready to belay up my teammates. I heard a shout and then a loud thump. I immediately suspected the worse and yelled down to the parties below asking what happened. "Gary Falk fell from the top of the Rappel!" was the response. I attempted to radio the information to Teton Dispatch with no success.

I belayed my two teammates up the pitch then rappelled down the Sargent's Chimney Rappel on another team's pre-rigged rope. I then scrambled down to the alcove at the top of the long Owen-Spalding Rappel and met Exum Guide, (b) (6), (b) (7)(C) explained that Falk had fallen from the top of the rappel while dealing with the ropes. Here I was able to pass on information to Teton Dispatch via the Rendezvous repeater. [redacted] asked for my help in getting the clients down, and I advised [redacted] to inspect the system and then to proceed with lowering the clients as usual. I noted that the rappel anchor was undisturbed with an ATC style friction device clipped to the anchor line. The ATC was threaded with one strand of climbing rope. I was primarily concerned with the clients who were all in a state of shock, having witnessed the event. [redacted] stated that [redacted] was turned and missed the start of Falk's fall. One of [redacted] clients stated that [redacted] was sure Falk was "not tethered" when he fell. Another client stated that [redacted] had seen Falk clip in with a red line earlier.

[redacted] proceeded to get the clients down, and I descended on a borrowed 70 meter rope from the alternate bolt rappel anchor, followed by my teammates. As I descended I could not see Falk's body and inquired of Exum Guide [redacted] t where he was. [redacted] indicated that Falk had fallen down into the Black Ice couloir, out of site. [redacted] had not seen the fall. I collected names and phone numbers of witnesses of the fall.

Once all the clients were off the rappel, I remained at the Upper Saddle then ascended to the top of the Enclosure to relay radio information and watch for rockfall threatening the recovery team in Valhalla Canyon.

7/30/16

General Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 10:29 by GRTE4292

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:43
Entered time: 09/23/2016 09:43

Remarks:

Scene and Evidence

Report:

Scene Description

The accident occurred while the decedent and his clients were descending the Owen Spaulding Route on the Grand Teton (13,770 feet in elevation). The Owen Spaulding Route is rated Grade II, 5.4 in A Climber's Guide to the Teton Range by Ortenburger and Jackson. The decedent fell from a stance at the top of the standard Owen Spaulding Rappel (approximate elevation 13,200 feet; approximate coordinates 43° 44' 28.18"N, 110° 48' 16.23"W)

The rappel station is located on a ledge system that is not on the route of ascent. When descending, one approaches the ledge by travelling down and to the climber's right from the base of the Sargent's Chimney. If the appropriate route is chosen this terrain is third class. There is some significant exposure as one approaches the rappel station prompting some to belay this section.

There are two rappel stations in close proximity to each other on this ledge system. The non-standard station is comprised of two bolts. This rappel is in excess of 100 feet and is not commonly used. The standard station is comprised of several loops of rope which are wrapped around a large rock horn. The rope is fed through a firehose to protect it from abrasion.

To access the standard rappel, one must descend a loose low angle gulley and then ascend a short rock step. There is a large flat stance directly beneath the standard anchor.

When rappelling, one trends slightly right through overhanging terrain and arrives on the ground after about 100 feet of descent. The plumb line distance to the ground (without trending right) is closer to 120 feet. There is a rounded ledge a short ways below the initial edge transition along that plumb line path.

There are several hundred feet of 3rd class terrain between the base of the rappel and the next major cliff face. When descending, one must travel down and to the climber's right to avoid this cliff face and to access the Upper Saddle. This cliff face is part of the large West Face of the Grand Teton. The plumb line below the cliff face leads into the Black Ice Couloir which is a steep rock, snow, and ice couloir that extends from the head of Valhalla Canyon to the Upper Saddle.

The decedent was found at the base of the lowest summer snowfield beneath the Black Ice Couloir at the head of Valhalla Canyon (approximate elevation 10, 700 feet; approximate coordinates 43° 44' 42.37"N, 110° 48' 27.86"W.) His point of rest was approximately 2500 feet in elevation below the stance he fell from.

Conditions at the Rappel Anchor

The Exum Guides use a two rope system to facilitate their client's descent down this rappel. Both ropes are generally 35m in length. One is utilized as a rappel line. The clients use a rappel device to descend this line. The other is used as a belay line. The guides secure this line to their client's harness and then belay them to provide them a backup in the event they make a mistake rappelling.

The first person to the rappel anchor after the fall was Exum Guide Ned (b) (6), (b) (7)(C) (b) (6) was waiting to utilize the anchor a short distance away when the fall occurred. (b) (6), (b) (7)(C) described the conditions at the anchor as follows:

The rappel line was tied to the rappel rings with a bowline and a backup knot. There were three ATC rappel devices with locking carabiners pre-attached to the rappel line. The belay line was tied around the anchor cordage with a bowline and a backup knot. It was above the shelf created by the anchor's master point on the climber's right side of the anchor. There were at least two free wire gate non locking carabiners and one free locking carabiner connected to the anchor cordage between the shelf and the fixed end of the belay line. (b) (6), (b) (7)(C) believed that there was also at least one more free locking carabiner on the anchor. The City Kids were sitting about 20 feet away from the anchor to the climber's left. They were tied to a climbing rope. The climbing rope was connected to the anchor with a munter mule knot and a locking carabiner. This carabiner was attached to the anchor cordage above the shelf on the climber's left side of the anchor. The client end of the belay line had an ATC rappel device tied to it. The rappel device was stuck somewhere in the cliff face about 40 feet below the top of the rappel. (b) (6), (b) (7)(C) could not remember whether the belay line was stacked at the rappel stance or hanging down the cliff.

I descended the Owen Spaulding Route several weeks after the incident and made the following additional observations regarding the scene. The flat stance beneath the anchor is about 4 to 5 feet in width between the base of the rock horn that forms the anchor and the edge transition. There is a convex slab that projects outwards between the location where the decedent's clients were reportedly sitting and the standard rappel anchor.

Conditions at the Point of Rest

The decedent was located from the air by responders in the park rescue helicopter. It was immediately apparent that he was deceased due to the length of the fall and the amount of trauma. The helicopter landed in Valhalla Canyon and two responders hiked to the scene (Rangers Case Martin and Marty Vidak). The decedent's point of rest was in scree and talus at the base of the lowest summer snowfield beneath the Black Ice Coulior. Looking up towards the Owen Spaulding Rappel, it was apparent that the decedent fell down numerous steps of steep rock, snow, and ice.

The decedent had severe trauma. (b) (6), (b) (7)(C) .
The harness was missing all of its gear loops. (b) (6), (b) (7)(C) .
The harness was black in color and was soiled with body substances. Close inspection of the scene photos at later date, revealed that some of the "black" webbing that was initially thought to be part of the harness was actually, when dried and cleaned, blue 9/16 tubular webbing that was soiled and wet. The scene photos show that this webbing was entwined with the decedent's harness. One carabiner (a D shaped multi-directional auto locker) was also visible connected to the harness.

The responders packaged the decedent in a body bag and the decedent was flown by helicopter long line from the point of rest to the Lupine Meadows Rescue Cache where he was received by Rangers Scott Guenther and Jack McConnell as well as Teton County Deputy Coroner David Hodges.

Coroner's Examination

Ranger Guenther requested that Deputy Coroner Hodges photograph the decedent's harness during the Coroner's examination. Deputy Coroner Hodges provided me with those photos.

Deputy Coroner Hodges photographed the harness on the decedent's body. He then cut portions of the harness in order to remove it. During the removal process he found one carabiner (the previously mentioned D shaped multi-directional auto locker) attached to the harness. He also found the 9/16 inch tubular webbing that was entwined in the harness. There was an overhand knot in one end of the webbing. Again, this webbing looks black in color in the photos due to the wetness and body substances. Deputy Coroner Hodges took several photos of the harness after removing it. In the post removal photos, he clipped the carabiner into the harnesses waist loop and wrapped the webbing around the waist loop. Close inspection of the pre-removal photo shows that the carabiner was connected to both the harness's waist and leg loops. It also reveals that the 9/16 tubular webbing was entwined multiple times through the harness's waist and leg loops.

Investigator's Examination of Harness and Webbing

Ranger Guenther met with Deputy Coroner Hodges after the examination and took custody of the harness, carabiner, and webbing. On July 29, 2016 Ranger Guenther and I examined the equipment together.

The Mammut brand harness was a light weight alpine style harness without a belay loop. It was similar in construction to the popular Black Diamond Alpine BOD harness. We reconstructed the harness (i.e. repaired the cuts that the coroner had made) with paperclips. We then examined the harness.

The harness was missing all of its gear loops and had damage to some of the non-load bearing buckles but otherwise was intact. There was no damage to the harness that would have affected its integrity. The multi-directional carabiner was still clipped to the waist loop as the Deputy Coroner had left it. Though, as stated before, it was clearly clipped to both the leg loop and waist loop in the pre-removal photos. There was no structural damage to the carabiner and it functioned appropriately. The carabiner had blue post production paint on it.

The 9/16 tubular webbing was also inspected. At this time, the webbing appeared blue in color. It was approximately eight feet in length and had an overhand knot near one end. The ends of the webbing were cut at different angles and melted to prevent fraying. This indicates that the ends were cut prior to the incident. There was no substantive damage to any part of the webbing.

After the inspection, Ranger Guenther washed the webbing. I re-examined and photographed the webbing on August 20, 2016 with Ranger Martin. The webbing measured 98 inches in length. When tied in a loop it would have been about 48 inches (or four feet) in length. There was slight discoloration and stiffness present near the untied end of the webbing. This same type of discoloration and stiffness was also located on another portion of the webbing that had clearly been abraded likely during the fall (This does not indicate any kind of major structural damage. It is just mentioned for comparison.) The presence of color change and stiffness on the untied end, potentially indicates that this material experience some type of minor trauma, possibly heat from friction during a dynamic event.

Carabiners Provided by Exum Guide (b) (6), (b) (7)(C)

On August 30, 2016 Exum Guide (b) (6), (b) (7)(C) provided me with three carabiners that (b had found amongst (b equipment. (b) (6), (b) (7)(C) believed that (b) (6) had removed these carabiners from the Owen Spaulding Rappel Anchor after the decedent fell. (b) (6), (b) (7)(C) believed that there had been additional carabiners on the anchor at the time but was unsure where they had ended up.

I examined and photographed the three carabiners. There was one locking carabiner, a green I Beam style Petzl Attache 3D. It had blue post production paint on it. It was not damaged and functioned properly. There were two wire gate non-locking carabiners. Both were manufactured by Black Diamond. One was a hood wire carabiner. It had blue post production paint on it. The other, a standard wire gate, did not. Neither wire gate carabiner was damaged. Both functioned properly.

Photos Provided by Exum Client and City Kids (b) (6), (b) (7)(C)

City Kids (b) (6), (b) (7)(C) was one of the decedent's clients on the day of the accident. (b) (6), (b) (7 took photos during the group's climb. (b) (6), (b) (7 and the City Kids program provide two photos that showed the decedent and his equipment.

The first photo shows one of the City Kids sitting on a boulder in the vicinity of the Upper Saddle. It is time and date stamped 0607 hours on July 23, 2016. It is apparent that this photo was taken just after sunrise due to the Alpen glow on the peaks nearby. There is a pile of climbing gear in the foreground of the photo. (b) (6), (b) (7 stated that this equipment belonged to the decedent and that it was the gear he used to guide the group up the peak.

The blue 9/16 tubular webbing is clearly visible in this photo. It appears to be tied in a loop with a water knot (an overhand follow through). The knot is not tight. With adequate tails, this would not negatively impact the knot's integrity. But this suggests that the knot could be subject to shifting under pressure and that the knot might regularly be tied and untied by the decedent. One tail of webbing is visible protruding from the knot and is of adequate length. This tail is the "bottom" tail of the knot (the tail on the end of the original overhand that was tied before it was followed through). This is because it protrudes from the inside of the knot. Upon close comparison of the angles of the ends of the webbing, it appears the "bottom" tail in the photo is the same tail that retained an overhand in it post fall. The "top" tail is not within view. The webbing appears prepared to carry "cordelette style" is connected to a locking carabiner. This suggests that the decedent carried the webbing on his harness in a mass rather than over the shoulder or in an alpine runner configuration. The locking mechanism visible on this carabiner appears to match the free locking carabiner that was found on the anchor.

There are several cordelettes (maroon and orange) visible in the photo. There is also one green, presumably sewn, runner of an unknown length. Five Black Diamond Camalots are visible (sizes .4, .5, .75, 1, and 2). Five passive nuts of different sizes are visible. Several locking and wire gate non-locking carabiners are visible. One Black Diamond ATC rappel/belay device is visible. It is unknown if this is all the equipment that the decedent had with him that day but, based on

information provided by other Exum Guides, this likely was all of his equipment because no additional gear would be necessary to guide the route. Notably, the only other material in the photo that might normally be used for a lanyard is the green sewn webbing.

The second photo shows the three City Kids and the decedent on the summit of the Grand Teton. It is time and date stamped 0843 hours on July 23, 2016. In the photo the decedent is wearing his harness. The multi-directional carabiner is clipped into the harness's waist and leg loops in the same configuration that it was in when the coroner photographed it before removing the harness. No other equipment is visible except for two Black Diamond Camalots that can be seen hanging off the back of the harness. With the exception of several locking carabiners, no other equipment is visible on the City Kids.

General Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 09:58 by GRTE4292

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:44
Entered time: 09/23/2016 09:44

Remarks:

Witness Interviews

Report:

Witness Interviews and Contact Information

(b) (6), (b) (7)(C)
Exum Client
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) (7)(C) at the Lupine Meadows Trailhead with his climbing partner ((b) (6), (b) on July 23, 2016 and again by phone on July 30, 2016.

On the morning of July 23, 2016 (b) (6), (b) (7)(and (b) (6), (b ascended the Upper Exum Ridge on the Grand Teton with Exum Guide (b) (6), (b (b) (6), (b) (7)(C) This group was near the top of the rappel waiting for their turn at the time that Falk fell. (b) (6), (b) (7)(and (b) (6), (b stated that FALK had been tethered into the anchor prior to the fall and that Falk had been leaning out on that lanyard. They could not describe the lanyard. They said that Falk was struggling with a rope that he was trying to pull up the cliff because an ATC rappel device that was connected to the end of the rope was stuck somewhere below.

(b) (6), (b) (7)(and (b) (6), (b were looking in Falk's general direction but were not focusing closely on what Falk was doing. They said that they did not see what caused the fall but that they did see the fall itself. (b) (6), (b) (7)(said that, at the time of the fall, Falk was facing away from the anchor and standing near the edge of the stance. He was manipulating the rope that he was trying to pull up. Both (b) (6), (b) (7)(and (b) (6), (b noted that when he fell he was immediately projected outward (rather than downward) in an unexpected manner. During the initial portion of the fall, Falk was facing downward and juggling the rope that he was pulling up with two hands.

(b) (6), (b) (7)(said that he did not have any photos from that day that showed Falk or his equipment.

(b) (6), (b) (7)(C)
Exum Guide
Address: (b) (6), (b) (7)(C)
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) (7)(C) at the Lupine Meadows Trailhead on July 23, 2016, by phone on July 30, 2016, by phone on August 22, 2016, and outside of Park Headquarters in Moose on August 30, 2016.

On the morning of July 23, 2016 (b) (6), (b) (7)(C) guided (b) (6), (b) (7)(and (b) (6), (b on the Upper Exum Ridge to the summit of the Grand Teton. The (b) (6), (b) (7)(C) party was behind (b) (6), (b) (7)(C) group during the ascent. (b) (6), (b) (7)(C) party was near the top of the rappel waiting for their turn prior to Falk's fall. When the group arrived there Falk told (b) (6), (b) (7)(C) that he was having difficulty because he was short one rappel device. (b) (6), (b) (7)(C) offered some strategies for resolving the situation.

While Falk was pulling up the rappel device that his first client had used (b) (6), (b) (7)(C) it became stuck somewhere below. (b) (6), (b) (7)(C) also offered some suggestions regarding dealing with this issue. Falk continued to work on this problem while (b) (6), (b) (7)(C) turned away to face (b) (6) clients. Falk fell while (b) (6), (b) (7)(C) was facing away. (b) (6), (b) (7)(C) said that Falk was wearing his helmet and backpack at the time of the fall.

After the fall (b) (6), (b) (7)(C) went over to the rappel anchor and found it in the following condition:

The rappel line was tied to the rappel rings with a bowline and a backup knot. There were three ATC rappel devices with locking carabiners pre-attached to the rappel line. The belay line was tied around the anchor cordage with a bowline and a backup knot. It was above the shelf created by the anchor's master point on the climber's right side of the anchor. There were at least two free wire gate non locking carabiners and one free locking carabiner connected to the anchor cordage between the shelf and the fixed end of the belay line. (b) (6), (b) (7)(C) believed that there was also at least one more free locking carabiner on the anchor. The City Kids were sitting about 20 feet away from the anchor to the climber's left. They were tied to a climbing rope. The climbing rope was connected to the anchor with a munter mule knot and a locking carabiner. This carabiner was attached to the anchor cordage above the shelf on the climber's left side of the anchor. The stuck ATC rappel device was about 40 feet below the top of the rappel. (b) (6), (b) (7)(C) could not remember whether the belay line was stacked at the rappel stance or hanging down the cliff. There was no damage to any components of the anchor or the system.

(b) (6), (b) (7)(C) said that the guides typically belay clients in one of two ways at this station. The guide either belays off their body and redirects the rope through a carabiner on the anchor or the guide belays off the anchor using a munter hitch. (b) (6), (b) (7)(C) was unsure which method Falk had used to belay (b) (6), (b) (7)(C) (b) (6), (b) (7)(C) also said that (b) (6) typically uses a double length (48 inch) sewn runner as (b) (6) lanyard at this anchor and that (b) (6) can reach edge of the rappel stance with that length lanyard. This length lanyard allows (b) (6), (b) (7)(C) to see down the rappel line and watch (b) (6) clients transition through the overhang that is below.

(b) (6), (b) (7)(C) located three carabiners among (b) (6) equipment (one locking carabiner and two wire gate non-lockers) that (b) (6) believed came off the anchor. (b) (6), (b) (7)(C) turned those carabiners into me. The locking carabiner and one of the wire gates both have blue paint on them. Blue paint was also found on the carabiner that was recovered from Falk's harness after the fall. As stated above, (b) (6), (b) (7)(C) believed that there were more locking carabiners on the anchor but was unsure of their present location. The ATC rappel devices and their associated carabiners were returned to (b) (6), (b) (7)(C) sometime after the incident.

(b) (6), (b) (7)(C) said that (b) (6) did not have any photos of Falk or his equipment from that day.

(b) (6), (b) (7)(C)
Exum Client
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b at the Lupine Meadows Trailhead with his climbing partner ((b) (6), (b) (7)(C) on July 23, 2016 and again by phone on July 30, 2016.

On the morning of July 23, 2016 (b) (6), (b) (7)(and (b) (6), (b ascended the Upper Exum Ridge on the Grand Teton with Exum Guide (b) (6), (b) (7)(C) This group was near the top of the rappel waiting for their turn at the time that Falk fell. (b) (6), (b) (7)(and (b) (6), (b stated that Falk had been tethered into the anchor prior to the fall and that Falk had been leaning out on that lanyard. They could not describe the lanyard. They said that Falk was struggling with a rope that he was trying to pull up the cliff because an ATC rappel device that was connected to the end of the rope was stuck somewhere below.

(b) (6), (b) (7)(and (b) (6), (b were looking in Falk's general direction but were not focusing closely on what Falk was doing. They said that they did not see what caused the fall but that they did see the fall itself. Flug said that, at the time of the fall, Falk was facing to the climbers right leaning out. He said that Falk's right arm was towards the anchor and that he was pulling up rope with his left hand. Both (b) (6), (b) (7)(and (b) (6), (b noted that when he fell he was immediately projected outward (rather than downward) in an unexpected manner. During the initial portion of his fall he was facing downward and juggling the rope that he was pulling up with both hands.

(b) (6), (b said that he did not have any photos from that day that included Falk or his equipment.

(b) (6), (b) (7)(C)
Private Climber
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) (7 with (b) (6), two climbing partners ((b) (6), (b) (7)(C)) at the Lupine Meadows Rescue Cache on July 23, 2016. I interviewed (b) (6), (b) (7 again by phone on July 29, 2016.

(b) (6), (b) (7 and (b) (6), partners were doing a one day ascent of the Grand Teton via the Owen Spaulding route. They were at the base of the rappel when Falk fell. They witnessed the fall and observed the ATC rappel device stuck in the crack. (b) (6), (b) (7 said that the ATC was stuck about halfway up the cliff face.

(b) (6), (b) (7)(C)
Private Climber
Phone #: (b) (6), (b) (7)(C)

Summary of Statement:
I interviewed (b) (6), (b) (7)(C) with (b) (6) two climbing partners (b) (6), (b) (7)(C) at the Lupine Meadows Rescue Cache on July 23, 2016.

(b) (6), (b) (7)(C) and (b) (6) partners were doing a one day ascent of the Grand Teton via the Owen Spaulding route. They were at the base of the rappel when Falk fell. They witnessed the fall and observed the ATC rappel device stuck in the crack.

(b) (6), (b) (7)(C)
Exum Guide
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) at the Lupine Meadows Trailhead on July 23, 2016 and again by phone on August 6, 2016.

(b) (6), (b) was guiding a one day ascent of the Grand Teton via the Owen Spaulding route with a single juvenile client on July 23, 2016. (b) (6), (b) was on the summit of the Grand Teton at the same time that Falk and his clients were there. (b) (6), (b) again met Falk and his clients while descending the Sargent's Chimney. Falk suggested that (b) (6), (b) continue on ahead to the rappel because of the size of Falk's group. Falk provided (b) (6), (b) with one of his ropes and (b) (6), (b) later used it to rig the rappel. (b) (6), (b) then used one of (b) (6) ropes to rig the belay. Falk arrived at the anchor while (b) (6), (b) was belaying (b) (6) client down the rappel. (b) (6), (b) remembers seeing Falk clip into the anchor with a double length (48 inch) red or purple sling and a locking carabiner. (b) (6), (b) left the rappel and belay lines fixed to the anchor and rappelled. (b) (6), (b) then continued descending down to the top of the Black Ice Couloir where (b) (6) heard a yell and then witnessed a portion of Falk's fall.

(b) (6), (b) said that (b) (6) did not have any photos of Falk or his equipment from that day. (b) (6), (b) provided a comprehensive written statement which is attached to this report.

(b) (6), (b) (7)(C)
City Kids (b) (6), (b) (7)(C) and Exum Client
Address #1: (b) (6), (b) (7)(C)
Address #2: (b) (6), (b) (7)(C)
Phone #1: (b) (6), (b) (7)(C)
Phone #2: (b) (6), (b) (7)(C)
Email: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) (7 on July 23, 2016 in the Lupine Meadows Parking Lot and again on August 11, 2016 by phone.

(b) (6), (b) (7)(C) the City Kids Program and an Exum Client. (b) (6) accompanied the group of four City Kids to the Lower Saddle on the afternoon of July 22, 2016. The following morning (b) (6) climbed the Grand Teton via the Owen Spaulding route with Falk and three of the City Kids. (b) (6), (b) (7 was the first member of Falk's group to do the Owen Spaulding Rappel. When (b) (6) got to the bottom of the rappel, (b) (6) connected the rappel device and locking carabiner that (b) (6) used to the bottom of the belay line. Falk then pulled the belay line and device up the cliff face. The device got stuck in a crack and Falk fell while trying to free it. (b) (6), (b) (7) watched the fall from the bottom of the rappel.

(b) (6), (b) (7 said that Falk was tethered to the anchor when (b) (6 began rappelling. (b) (6) remembered the tether as being purple or pink in color. (b) (6), (b) (7) said that the City Kids had very limited exposure to climbing prior to this ascent. (b) (6) believed that they would have difficulty understanding the actions that Falk was taking at the anchor.

(b) (6), (b) (7) searched the photos that (b) (6) took that day and provided two photos of value to the investigation. One photo includes a pile of Falk's gear. This photo was taken in the vicinity of the Upper Saddle prior to beginning the technical portion of the climb. The other photo is of Falk with the City Kids on the summit of the Grand Teton prior to the descent.

(b) (6), (b) (7)(C)
Private Climber
Address: (b) (6), (b) (7)(C)
Phone #: (b) (6), (b) (7)(C)

Summary of Statements:
Ranger Scott Guenther and I interviewed (b) (6), (b) (7)(C) at the Lupine Meadows Rescue Cache on July 23, 2016. I interviewed (b) (6), (b) (7)(C) again by phone on July 30, 2016.

(b) (6), (b) (7)(C) and (b) (6) two climbing partners (one adult and one juvenile) were waiting in line near the top of the rappel when Falk fell. (b) (6), (b) (7)(C) witnessed the fall but did not see the cause. (b) (6), (b) (7)(C) said that Falk was tethered to the anchor with a "daisy chain" that was possibly red in color. (b) (6), (b) (7)(C) said that it was clear that he was tethered because he was, at times, leaning back on this lanyard. Falk was trying to free a rope that was stuck below by flipping it to try to get it loose. An ATC rappel device that was tied to the end of the rope was stuck in the rock. Falk's clients were sitting about 20 feet away and were secured with a rope. (b) (6), (b) (7)(C) saw three ATC rappel devices pre-attached to the rappel line at the rappel station. (b) (6), (b) (7)(C) was the first person to rappel that line after Falk had fallen. (b) (6) freed the stuck rappel device on his way down.

(b) (6), (b) (7)(C) completed a written statement which is attached to this report.

(b) (6), (b) (7)(C)
Private Climber
Address: (b) (6), (b) (7)(C)
Phone #: (b) (6), (b) (7)(C)
Email: (b) (6), (b) (7)(C)

Summary of Statements:
I interviewed (b) (6), (b) (7) with (b) (6), two climbing partners (b) (6), (b) (7)(C) at the Lupine Meadows Rescue Cache on July 23, 2016. I interviewed (b) (6), (b) (7) again by phone on July 29, 2016.

(b) (6), (b) (7) and (b) (6), partners were doing a one day ascent of the Grand Teton via the Owen Spaulding route. They were at the base of the rappel when Falk fell. They witnessed the fall and observed the ATC rappel device stuck in the crack. (b) (6), (b) (7) took photos of the accident scene. (b) (6), provided these photos to me. (b) (6), (b) (7) also provided a written statement which is attached to this report.

(b) (6), (b) (7)(C)
City Kids Student and Exum Client
Phone #: (b) (6), (b) (7)(C)

Summary of Statement:
I interviewed the three City Kids who witnessed Falk's fall (b) (6), (b) (7)(C)) at the Lupine Meadows Trailhead on July 23, 2016 in the presence of a City Kids chaperone.

The three City Kids and (b) (6), (b) (7) had been guided by Falk to the summit of the Grand Teton via the Owen Spaulding Route on the morning of July 23, 2016. The three City Kids were the closest people to Falk when he fell from the top of the rappel. Other witnesses on scene reported that the City Kids were sitting about 20 feet away from Falk when he fell. When I interviewed the City Kids, I asked them what caused the fall. (b) (6), (b) (7)(said that Falk had unclipped from the anchor and (b) (6), (b) (7)(C) and (b) (6), (b) (7)(agreed with (b) (6), statement. They did not provide any additional information.

I made numerous attempts to re-contact the three City Kids to re-interview them both directly by phone and via the City Kids Program. I was unable to re-contact any of them.

(b) (6), (b) (7)(C)
Exum Guide
Phone #: (b) (6), (b) (7)(C)

Summary of Statement:
I interviewed (b) (6), (b) (7)(C) by phone on August 6, 2016.

(b) (6), (b) (7)(C) and Falk were the guides for (b) (6), (b) (7) and four City Kids. It became apparent during the hike up to the Lower Saddle on July 22, 2016 that one of the City Kids was unlikely to complete the climb due to (b) (6) level of fitness. That night, (b) (6), (b) (7)(C) and Falk discussed strategies for addressing the issue. (b) (6), (b) (7)(C) suggested that (b) (6) and the slower City Kid break off from the rest of the group and attempt to climb the Enclosure. (b) (6), (b) (7)(C) also suggested that, in preparation for that plan, Falk should take one of (b) (6), (b) (7)(C) client rappel devices with him. Falk said that they should plan on starting the ascent together and then see how the day progressed. Falk said that (b) (6), (b) (7)(C) should keep the rappel device for the time being.

(b) (6), (b) (7)(C) explained that each guide has their own cache of personally owned climbing gear that they use for guiding (including rappel devices for their clients) at the Lower Saddle.

The next morning Falk began with four ATC rappel devices in his pack and (b) (6), (b) (7)(C) began with three. The group became separated at first light with the slower City Kid lagging behind. (b) (6), (b) (7)(C) and (b) (6), (b) (7) remained behind with the slower City Kid. Falk came back down and met them a short ways above the Brigg's Slab. At that point they decided to formally separate from each other for the remainder of the ascent. (b) (6), (b) (7) joined Falk and the other three City Kids on their ascent of the Grand Teton. (b) (6), (b) (7)(C) and the slower City Kid changed their objective to a non-technical ascent of the Enclosure. At that time, (b) (6), (b) (7)(C) gave Falk one of the ropes (b) (6) was carrying but did not give him a rappel device.

(b) (6), (b) (7)(C)
City Kids Student and Exum Client
Phone #1: (b) (6), (b) (7)(C)
Phone #2: (b) (6), (b) (7)(C)
Email: (b) (6), (b) (7)(C)

Summary of Statement:
I interviewed the three City Kids who witnessed Falk's fall ((b) (6), (b) (7)(C)) at the Lupine Meadows Trailhead on July 23, 2016 in the presence of a City Kids chaperone.

The three City Kids and (b) (6), (b) (7) had been guided by Falk to the summit of the Grand Teton via the Owen Spaulding Route on the morning of July 23, 2016. The three City Kids were the closest people to Falk when he fell from the top of the rappel. Other witnesses on scene reported that the City Kids were sitting about 20 feet away from Falk when he fell. When I interviewed the City Kids, I asked them what caused the fall. (b) (6), (b) (7)(said that Falk had unclipped from the anchor and (b) (6), (b) (7)(C) and (b) (6), (b) (7)(agreed with (b) (6) statement. They did not provide any additional information.

I made numerous attempts to re-contact the three City Kids to re-interview them both directly by phone and via the City Kids Program. I was unable to re-contact any of them. I did receive an email from (b) (6), (b) (7)(containing a copy of the photo of the three City Kids and Falk on the summit of the Grand Teton.

(b) (6), (b) (7)(C)
City Kids Student and Exum Client
Phone #: (b) (6), (b) (7)(C)

Summary of Statement:
I interviewed the three City Kids who witnessed Falk's fall (b) (6), (b) (7)(C) at the Lupine Meadows Trailhead on July 23, 2016 in the presence of a City Kids chaperone.

The three City Kids and [redacted] had been guided by Falk to the summit of the Grand Teton via the Owen Spaulding Route on the morning of July 23, 2016. The three City Kids were the closest people to Falk when he fell from the top of the rappel. Other witnesses on scene reported that the City Kids were sitting about 20 feet away from Falk when he fell. When I interviewed the City Kids, I asked them what caused the fall. [redacted] said that Falk had unclipped from the anchor and [redacted] and [redacted] agreed with [redacted] statement. They did not provide any additional information.

I made numerous attempts to re-contact the three City Kids to re-interview them both directly by phone and via the City Kids Program. I was unable to re-contact any of them.

General Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 10:32 by GRTE4292

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:41
Entered time: 09/23/2016 09:41

Remarks:

(b) (6), (b) Written Statement

Report:

(b) (6), (b) (7)(C)
July 24, 2016

On Saturday, July 23 I left the office for a One- day Grand Teton climb just after 2:00 AM with one client (b) (6), (b) (7)(C) We left the hut at the Lower Saddle at around 6:00 AM towards the summit via the Owen Route. We passed Springer (Jenny Lake Ranger) who was on patrol below the Black Dike, and ran into (b) (6), (b) (7)(C) at the Briggs Slab. (b) (6), (b) (7)(had started the day with Gary, and was descending with one of the "City Kids" who needed to go down. Our climb went smooth, and I arrived at the summit at about 9:00 AM. Gary and his 4 remaining clients were at the summit when we arrived, and (b) (6), (b arrived with 2 clients shortly after. A private party arrived at the summit as well with a (b) (6), (b) (7)(C), and a 3rd.

Gary with his 4 started the descent first, and I caught up to him with (b) (6), at the Sergeant Chimneys. Gary suggested that we play through as I only had one with me, so I grabbed a rope from Gary's pack to fix at the rappel, so it could be left for his crew. I fixed the rappel rope, and used one of my ropes to belay (b) (6), down the rappel. Gary arrived as (b) (6), was descending, and clipped into the rappel anchor with a red/purple double sling and a locker. I remember this distinctly as it prompted me to double check whether or not I was properly clipped in (which I was). Gary mentioned that he was short a belay device, presumably because (b) (6), (b) (7)(had one of the client's devices, initially expecting to be there with Gary. I offered Gary mine, and I would descend with a carabiner brake, but Gary said he would send (b) (6), (b) (7)((adult leader with the City Kids) first and have him tie his device on the rappel rope for Gary to pull up. Gary said that he had another rope near the start of the Owen route (I'm not sure why it was there) so I left the belay rope for Gary to use, and agreed to pick up Gary's rope when I descended. I pulled up the belay rope stacking it on the ledge and tied one end around the anchor slings with a bowline so that Gary could keep track of the end.

I rappelled, grabbed the rope and (b) (6), (and descended the boulder problem skiers left of the rappel above the Exum gully. I traversed back right with (b) (6), and was near the top out of the Black Ice Couloir when I heard a yell. (b) (6), and I turned to see a body falling. We lost sight of the body just before hearing the impact because of the short steep section between the Upper Saddle and the start of the the Owen route/ rappel landing zone. The falling body was so far away from the wall, and so far to the west, that I was certain at the time that it was a member of the public who fell while approaching towards the rappel area from the Sergeants.

I told (b) (6), to sit down and not move until I gave him further instructions, and I started running uphill. I called 911 at 10:31 as I was moving back towards the rappel landing zone. There was a brief delay as 911 was transferring me to park dispatch, which allowed me to climb the short boulder problem (the western option above the Black Ice). When I arrived I was simultaneously trying to talk to dispatch and figure out what had happened. There were several private climbers there who were waiting to start the Owen route.

I quickly found the impact location which was obvious because of the blood, and was confirmed by a private climber who saw the fall. It was very near the top of the small couloir / chute in between the top out of the Black Ice and the start of the crawl. I looked down the couloir and could see blood in the snow and ice leading towards the floor of the Valhalla. I moved around for a few minutes while on the phone with dispatch to see if I could find a safe view of the body. It was obvious

based on the blood trail location that the body would have ended up far below where I could access. I also had trouble finding a location where I felt safe to look over the edge as it was quite loose. Dispatch said they would deploy a helicopter ASAP to search the area.

Dispatch then asked if there was anyone in the area who was with the victim's party there. Since there was a number of people around by then I shouted out the question. A member of the public responded "yes up here" from where the rappel rope touched down. I ran up there, and realized that the person was [redacted] and that whoever fell was likely with an Exum Party. [redacted] was having a hard time communicating as he saw the fall, impact, and bounce into the Valhalla. He told me that all he knew was that it was either [redacted] or Gary because he noticed the distinct marmot pants from last year's uniform kit. I tried shouting up to the top of the rappel, but was not getting a response. Eventually one of the public said they heard a "yes" response to my shout "was it Gary that fell". I relayed that to dispatch and asked if I could hang up to call the Exum office. They took down my contact info, and gave me a number to call to get back in touch with them, then gave me permission to hang up.

I called the Exum field line at 10:42 and told [redacted] that I was pretty sure that Gary fell off the rappel and ended up at the bottom of the Valhalla. [redacted] encouraged me to do what I thought best for the clients, and that [redacted] would get ahold of [redacted] ASAP.

[redacted] who identified [redacted] as affiliated with JHMG but off duty, and seemed composed, asked if there was anything [redacted] could do. I asked [redacted] to descend to [redacted] and stay with [redacted] but not to descend with [redacted] [redacted] agreed and went to [redacted]

There was what seemed like a significant amount of time from then until I saw activity at the rappel. I took the opportunity to call [redacted] to inform [redacted] of what [redacted] saw, and that [redacted] was safe, as I was not sure if [redacted] tried to contact him, and what message [redacted] was getting. I talked to [redacted] a few more times throughout the day to keep [redacted] updated, and [redacted] seemed very supportive of how we were handling things.

Some time after that I talked to [redacted] on the phone and told [redacted] what I knew, and asked [redacted] to send any guides that were at the hut up to us so that I could hand [redacted] off to them.

One of the first people to rappel down (a separate rap was set up on the bolted anchor) was [redacted]. [redacted] told me that [redacted] thought maybe somebody bumped into Gary. This turned out to be totally inaccurate speculation. I relayed this to [redacted] because if true, I felt like I would need a different kind of additional professional help with a student thinking they were the cause of the accident. This was the source of any "rumors" that may have floated around. Much later after talking with all who were at the top of the rappel, it was clear that there was no one near Gary when he fell.

Sometime during that span, Springer rappelled down and started providing firemen belays to the public climbers on the bolted rappel. One of the public rappellers swung over and freed the belay device that was stuck in a crack just above the overhang. (it was on the rappel rope that Gary had tried to pull up to re-use the device).

Eventually [redacted] and I were able to communicate clearly, and [redacted] started sending the city kids down to me. Once the three city kids were down with [redacted] in the safe zone below the rappel, I noticed that [redacted] was shivering significantly (combination of shock and cold). I told [redacted] that I was going to move them down to [redacted] and [redacted] because it was sunny there. I belayed them one at a time down the boulder problem above the black ice, as I felt it would be easier to keep a rope above them than it would be in the loose zone of the standard way above the Exum gully. I down climbed and started walking them towards [redacted] and [redacted] when [redacted] arrived. [redacted] agreed to take the 5 (Gary's 4 clients and [redacted] and start moving towards the hut. I relayed the plan to [redacted] and then passed the phone to Springer so they could talk about the recovery effort. I moved up to assist [redacted] with [redacted] last two clients.

When [redacted] clients arrived at the base of the rappel, it was obvious they were quite shaken, so after checking with Springer if it was ok to leave, we agreed to each short rope one of the clients all the way to the black dike. We caught up to [redacted] at the black rock chimneys. At the base of the chimneys we rearranged the rope teams so that I had 3, [redacted] had 2, and [redacted] had 2. We negotiated the Briggs slab with the standard batman line, and continued to short rope towards the Black Dike. [redacted] and [redacted] met us in between the Briggs slab and the Black Dike. They were at Lupine with a WV group when word got out, and they ran up to meet us. I handed off my rope team to [redacted] so I could walk out in front with the kids following me, and be free to think about how to debrief at the hut.

Below the Black Dike I agreed with [redacted] that [redacted] should run ahead and clear out with [redacted] and their clients to eliminate that distraction since we had the additional help we needed with [redacted].

After everyone had a chance to get food, water etc. I gathered the 9 people in the Exum parties who saw the fall into the hut for a debrief. (My 1 client, [redacted]'s 2 Clients, Gary's 4 clients, [redacted] and Myself). My goals were to 1) Acknowledge that we all witnessed something horrible. 2) assure the clients that there was nothing they could have done to prevent the accident, or to help Gary after the accident 3) Congratulate them on a safe composed descent 4) Acknowledge that there were going to be tough times ahead for us dealing with what we saw, and the questions that would greet us when we got down to the trailhead 4) Assure them that we were all in it together and that I (and Exum) would remain in contact and be there for them if they needed anything 5) let anyone speak who wished to, or ask questions. The adult clients were quite emotional and talked about Gary, and a fund for his family. The kids were very reserved, said little, and showed little outward emotion.

After meeting we agreed that [redacted] (who had arrived at the saddle sometime around then) would handle the technical parts of the remaining descent. And [redacted] and I would walk with them to maintain continuity for the clients. Given that they were very scared and affected by the ordeal we put the harnesses back on the clients and did belayed rappels down the fixed line area. [redacted] and I walked down with the clients as [redacted] returned harnesses and packed up the hut.

[redacted] took his two clients and my client [redacted] ahead (They were moving faster) and I stayed back with Gary's 4 clients. [redacted] caught up to me just past the caves, and I sent him to keep a close eye on [redacted] who was quite distraught and tending to walk ahead faster than the kids could go. Just past the meadows boulders, 2 City kids staff members arrived with Gatorades and snacks and lifted the spirits of the kids. [redacted] and [redacted] caught up at the switchbacks and walked with us. [redacted] and [redacted] walked up the trail and followed our group down from about the 1.7 mile junction down, and we arrived to debrief with [redacted] and the rangers at about 8:00 PM.

National Park Service/Grand Teton National Park
Voluntary Statement

Case #

Return this Form to Ranger _____

Last Name of Witness	First	M.I.	Telephone	Drivers Lic#	SSN	Date of Birth
(b) (6), (b) (7)(C)						

Street Address	Mailing Address	City	State	Zip Code
(b) (6), (b) (7)(C)		(b) (6), (b) (7)(C)		

How long will you be in the area?	Where can you be located?
Indefinitely	The address above.

I (b) (6), (b) (7)(C) do hereby make the following statement of my own free will.

I have not been threatened, mistreated or promised reward or lenience in return for giving my statement. "You are notified that statements you are about to make may be presented to a magistrate or a judge in lieu of your sworn testimony at a preliminary examination. Any false statement you make and that you do not believe to be true may subject you to criminal punishment as a class A misdemeanor."

Incident _____

Location _____

on the _____ **day of** _____ **20**___ **at** _____**AM/PM.**

Statement: I, (b) (6), (b) (7)(C) WITNESSED GARY FALL ON JULY 23rd. I WITNESSED HIM HIT & FLY DOWN INTO THE COULOIR AS WELL AS HEARD IT. I ALSO WITNESSED THE RAPPEL ROPE WITH AN ATC STUCK IN A CRACK. I HAVE PHOTOS FROM THE SCENE.

I have read the above and foregoing statement consisting of 1 page(s), and it is true and correct to the best of my memory and knowledge

Signature of person (b) (6), (b) (7)(C)	Time: 5:30 PM	Date: 7/23/16
Officer: C. Bolton	Badge Number: 1568	Date: 7/23/16
Witness:		Date:

National Park Service/Grand Teton National Park
Voluntary Statement

Case #

Return this Form to Ranger _____

Last Name of Witness	First	M.I.	Telephone	Drivers Lic#	SSN	Date of Birth
(b) (6), (b) (7)(C)						

Street Address	Mailing Address	City	State	Zip Code
(b) (6), (b) (7)(C)				

How long will you be in the area?	Where can you be located?

I _____ **do hereby make the following statement of my own free will.**
(Signature of person giving statement)

I have not been threatened, mistreated or promised reward or lenience in return for giving my statement. "You are notified that statements you are about to make may be presented to a magistrate or a judge in lieu of your sworn testimony at a preliminary examination. Any false statement you make and that you do not believe to be true may subject you to criminal punishment as a class A misdemeanor."

Incident _____

Location _____

on the _____ **day of** _____ **20**___ **at** _____**AM/PM.**

Statement:

- I WITNESSED THE FALL FROM THE TOP OF THE RAPPEL BUT I DID NOT SEE EXACTLY WHY HE FELL.
- HIS CLIENTS WERE STILL AGAINST THE WALL SITTING DOWN. HE WAS THE ONLY PERSON AT THE 60m RAP.
- ONE OF THE ROPES WAS STUCK AND HE WAS TRYING TO FLIP IT LOOSE WHILE ATTACHED TO HIS DAISY CHAIN.
- (OVER)

I have read the above and foregoing statement consisting of ___ page(s), and it is true and correct to the best of my memory and knowledge

Signature of person giving statement	Time:	Date:
Officer: C. Billing	Badge Number: 1564	Date: 7/23/16
Witness:		Date:

Voluntary Statement

CONTINUED STATEMENT OF:

* I SAW THAT THERE WERE THREE ATC'S ~~ATTACHED~~ ATTACHED TO THE ~~STUCK~~ ROPE.
* I WAS THE FIRST TO RAP ON~~E~~ THE FIXED ROPE AND FREE THE OTHER ROPE THAT HAD AN ATC TIED ONTO THE END. THE ATC WAS WEDGED IN A CRACK.

I have read the above and foregoing statement consisting of ___ page(s), and it is true and correct to the best of my memory and knowledge

Signe[redacted]	Time:	Date: 7/23/16
Offic[redacted] C Lt. Bellino	Badge Number: 1560	Date: 7/23/16
Witness:		Date:

General Report

U.S. Department of the Interior , National Park Service

Printed: 10/05/2016 10:32 by GRTE4292

Incident: **NP16114877 SAR (Search and Rescue) @07/23/2016 10:32 CDT**

Author: #1568 BELLINO, C.
Entered by: #1568 BELLINO, C.
Report time: 09/23/2016 09:37
Entered time: 09/23/2016 09:37

Remarks:

Conclusions

Report:

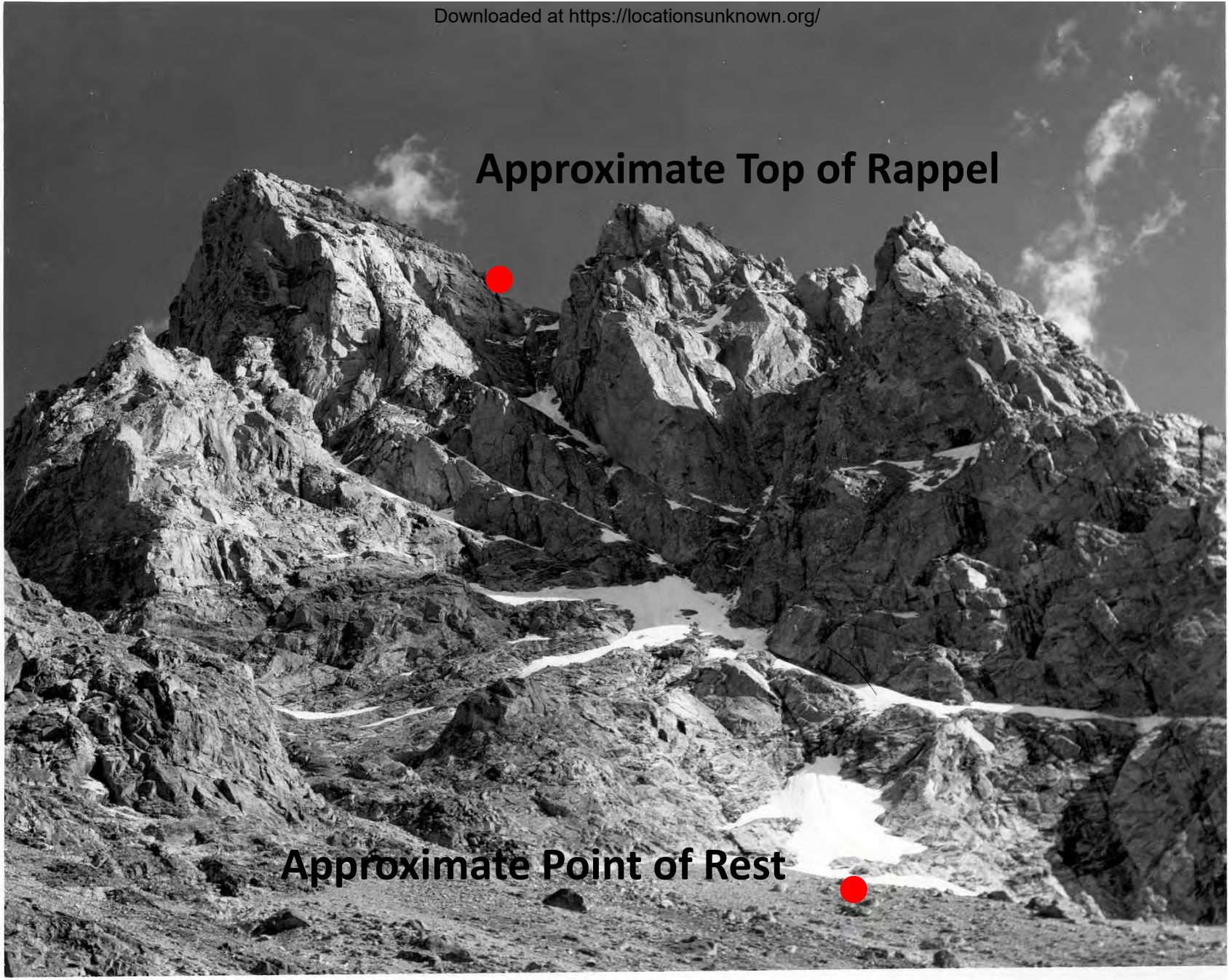
Conclusions

Gary Falk died as the result of an accidental fall that occurred while he was working as a Climbing Guide for Exum Mountain Guides at about 1032 hours on July 23, 2016. There is no evidence suggesting that he was under the influence of alcohol or any controlled substances at the time of the incident. Falk had guided three members of the City Kids program and their chaperone to the summit of the Grand Teton (13,770 feet) via the Owen Spaulding Route (5.4, Grade II). During the descent, Falk fell from the stance at the top of the standard Owen Spaulding Rappel. When he fell, Falk was trying to free a rappel device that was attached to the end of a belay rope and was stuck in a crack about 40 feet below him. Although several witnesses initially said that he had unclipped his lanyard from the anchor; the fall was likely due to the failure of a knot on his lanyard. This conclusion is supported by the following evidence and observations:

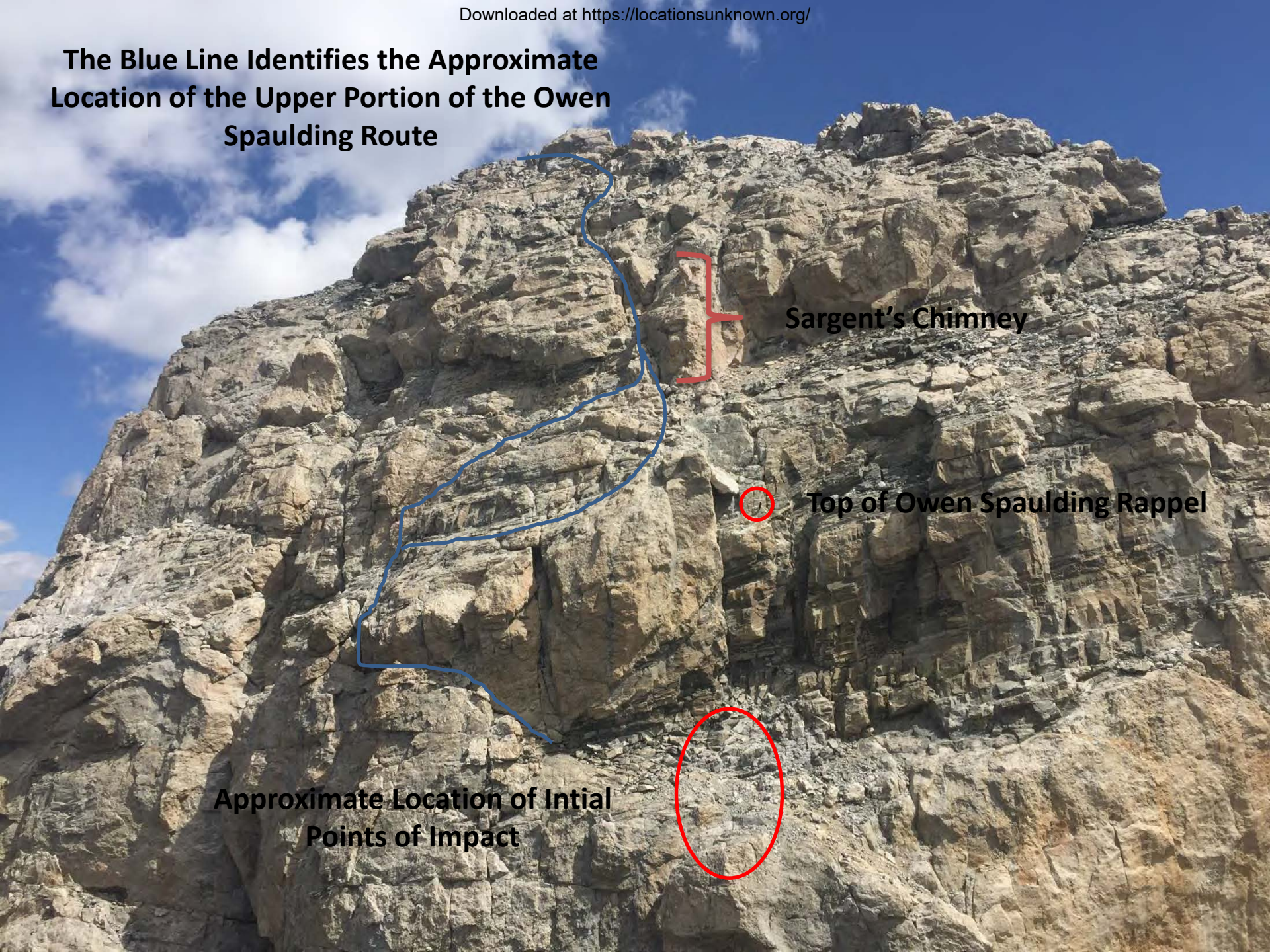
1. Numerous witnesses stated that Falk was secured to the anchor prior to the fall. Several of the witnesses noted that Falk was, at times, weighting the lanyard.
2. After the fall, a 98 inch section of blue 9/16 tubular webbing was found entwined multiple times in the waist and leg loops of Falk's harness in a manner consistent with a partially untied girth hitch (which is a common knot used for securing a lanyard to a harness).
3. After the fall, an overhand knot was found in one end of the webbing.
4. There was slight discoloration and stiffness in the un-tied end of the webbing. These property changes are possibly the result of heat from friction during a knot slippage event.
5. When tied in a loop, the 98 inch section of webbing would make an approximate four foot lanyard which would have allowed Falk to stand at the far outer edge of the rappel stance.
6. A photo taken prior to beginning the technical portion of the climb shows that this webbing was tied in a loop with a water knot. One tail is visible and is of adequate length but the knot is not tightened.
7. In the photo the webbing appears prepared to carry "cordelette style" with a locking carabiner connected to it. This suggests that the decedent carried the webbing on his harness in a mass rather than over the shoulder or in an alpine runner configuration.
8. The Owen Spaulding Route climbs several chimney features. It would be normal for equipment hanging on one's harness to come in contact with the rock face while ascending through this type of terrain. This could result in shifting of a loose knot.
9. There were several free carabiners, including at least one locking carabiner, on the anchor after the fall which is consistent with the knot failing and the fabric pulling through leaving a free carabiner.
10. The locking mechanism on the free locking carabiner that was found on the anchor appears to be the same locking mechanism that is visible on the carabiner connected the webbing in the photo taken prior to ascending the technical portion of the climb.
11. Several witnesses reported that Falk was immediately projected outward (rather than downward) in an unexpected manner. This would be consistent with leaning out on a lanyard that fails.
12. According to other Exum Guides familiar with the techniques used on the route, Falk may not have used the 9/16 webbing until he arrived at the Owen Spaulding Rappel meaning he would not have weighted the knot until that point in the day.
13. Falk likely would have repeatedly weighted and un-weighted the lanyard during the process of belaying his first client down the rappel, pulling up the belay rope, and then trying to free the stuck rappel device.

14. Several studies have focused on the tendency of water knots to slip and fail when the tails are of inadequate length and when the knots are cyclically loaded and unloaded. (Water Knot Testing by Tom Moyer and Failure of Water Knots in Spectra and Nylon Webbing from Cyclic Loading by Richard Wright, Eric Steffler and Tom Walters).
15. One of these studies highlights the tendency for a significant amount of tail slippage to occur during initial loading which would have been the case had Falk not weighted the lanyard up until that point in the day. (Failure of Water Knots in Spectra and Nylon Webbing from Cyclic Loading by Richard Wright, Eric Steffler and Tom Walters)
16. This study also states that the "top" tail on the water knot is the tail that slips. The "top" tail is the tail that is followed through after the initial overhand is tied. When the "top" tail slips through, it leaves an overhand knot in the "bottom" tail end. (Failure of Water Knots in Spectra and Nylon Webbing from Cyclic Loading by Richard Wright, Eric Steffler and Tom Walters)
17. The two ends of the blue 9/16 webbing are cut at slightly different angles allowing for comparison of the ends.
18. The "bottom" tail is the tail visible in the photo taken prior to the technical climbing that day. Upon comparison, it appears that this is the same tail that still had an overhand tied in it post fall which would be consistent with the findings in the fore-mentioned study.
19. Other than the untied knot, there was no structural damage to any of the weight bearing components of the system at the anchor or on Falk's person post fall.
20. It is approximately six vertical feet down from the edge of the rappel stance to the next possible stance.
21. Falk could have reached the far outer edge of the rappel stance had he been using the blue 9/16 tubular webbing as a lanyard. Falk had several quick and easy alternatives to unclipping if he wanted to reach the next stance. These included clipping into one of the three rappel devices that were pre-rigged on the rappel line or tying into one of the fixed ropes using the locking carabiner that was already connected to the waist and leg loops on his harness.
22. Numerous co-workers said that it was out of character for Falk to shortcut and that he was among the most safety conscious staff members.
23. I interviewed all of the witnesses and only the three City Kids told me that Falk had unclipped his lanyard prior to the fall. The three City Kids were initially interviewed together and did not respond to my attempts to re-interview them.
24. At the time of the fall, the three City Kids were sitting in a position where it would be difficult to clearly see what was happening at the anchor without effort.
25. Falk would have been clipping and unclipping items at the anchor in order to belay [redacted] and then pull the belay rope up.
26. The City Kids' chaperone/founder and several Exum Guides involved in the City Kids program all agreed that the three City Kids did not have enough technical climbing experience to understand what was occurring at the anchor.
27. The three City Kids made no mention of Falk unclipping to anyone who was on scene or who hiked out with them.

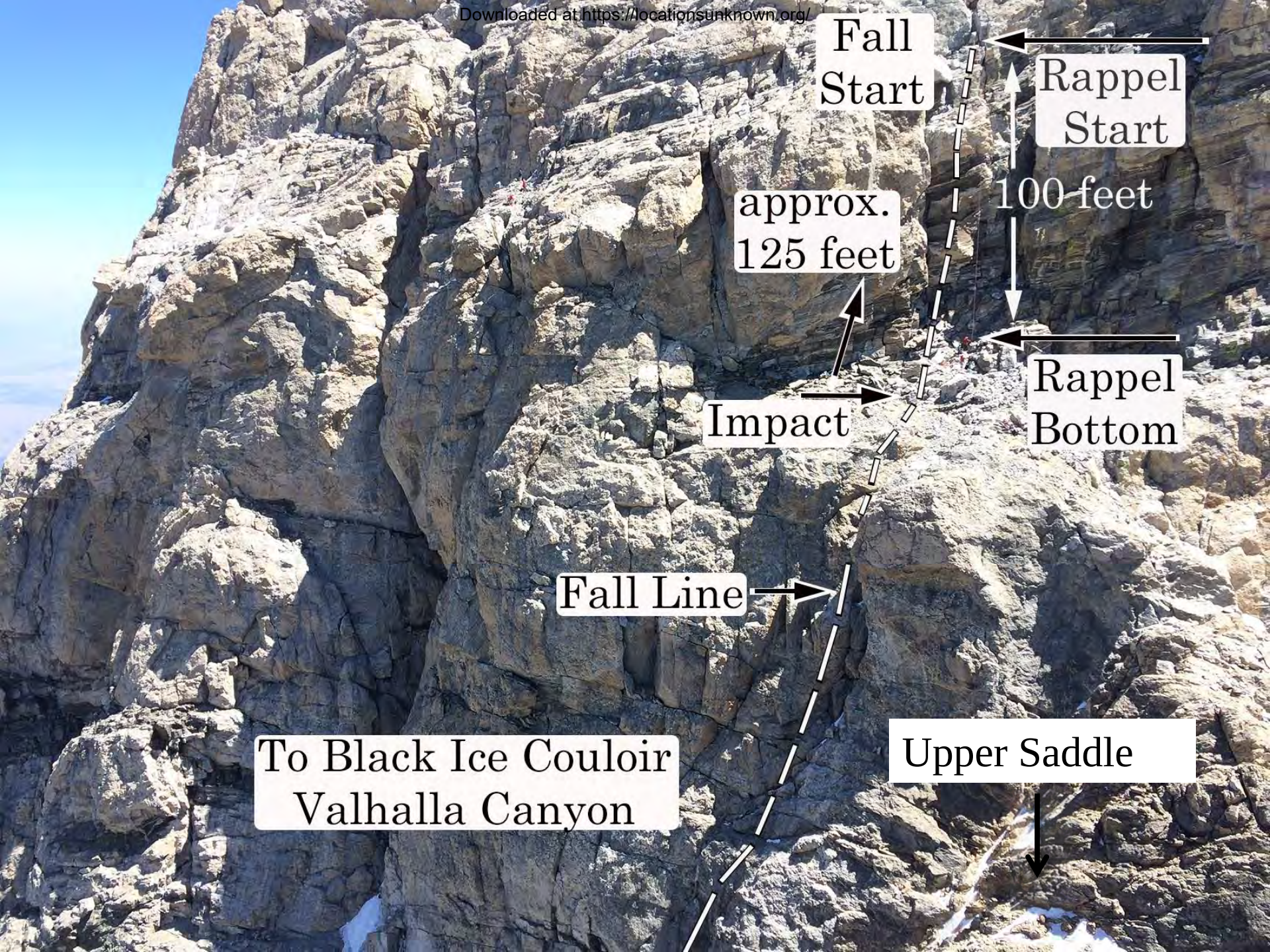
In conclusion, the evidence suggests that Falk was tethered to the anchor with a 98 inch section of blue 9/16 tubular webbing that was tied in a loop with a water knot, that one of the tails on the water knot was of inadequate length, that the tail slipped through the knot causing it to fail while Falk was weighting the lanyard, and that this caused Falk to fall from the rappel stance resulting in his death.



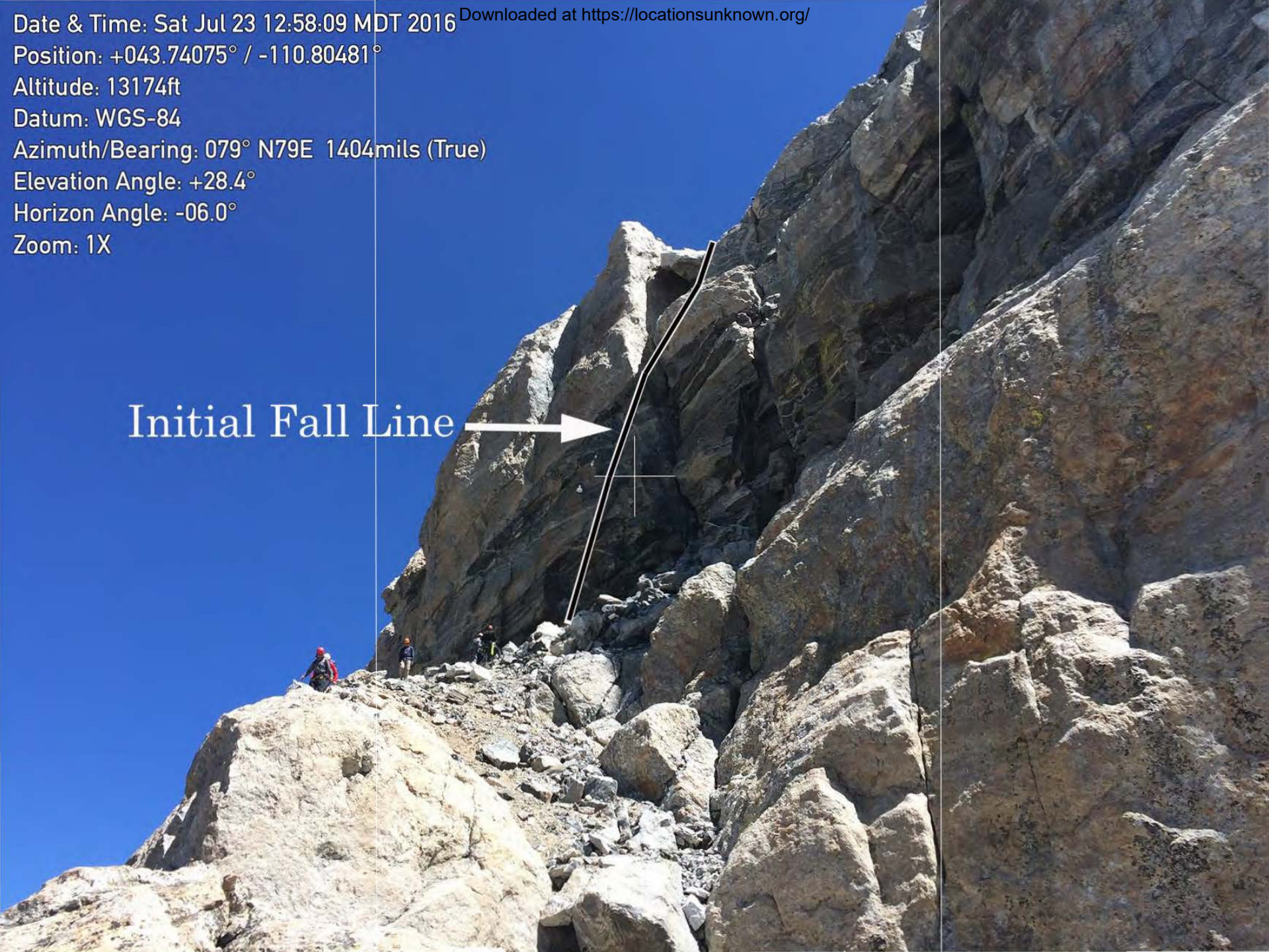
GRAND TETON, NW Aspect: showing N Ridge, NW Chimney, W Face, Black Ice Coul., Enclosure N face routes and NW Ridge. Photo by Ortenburger



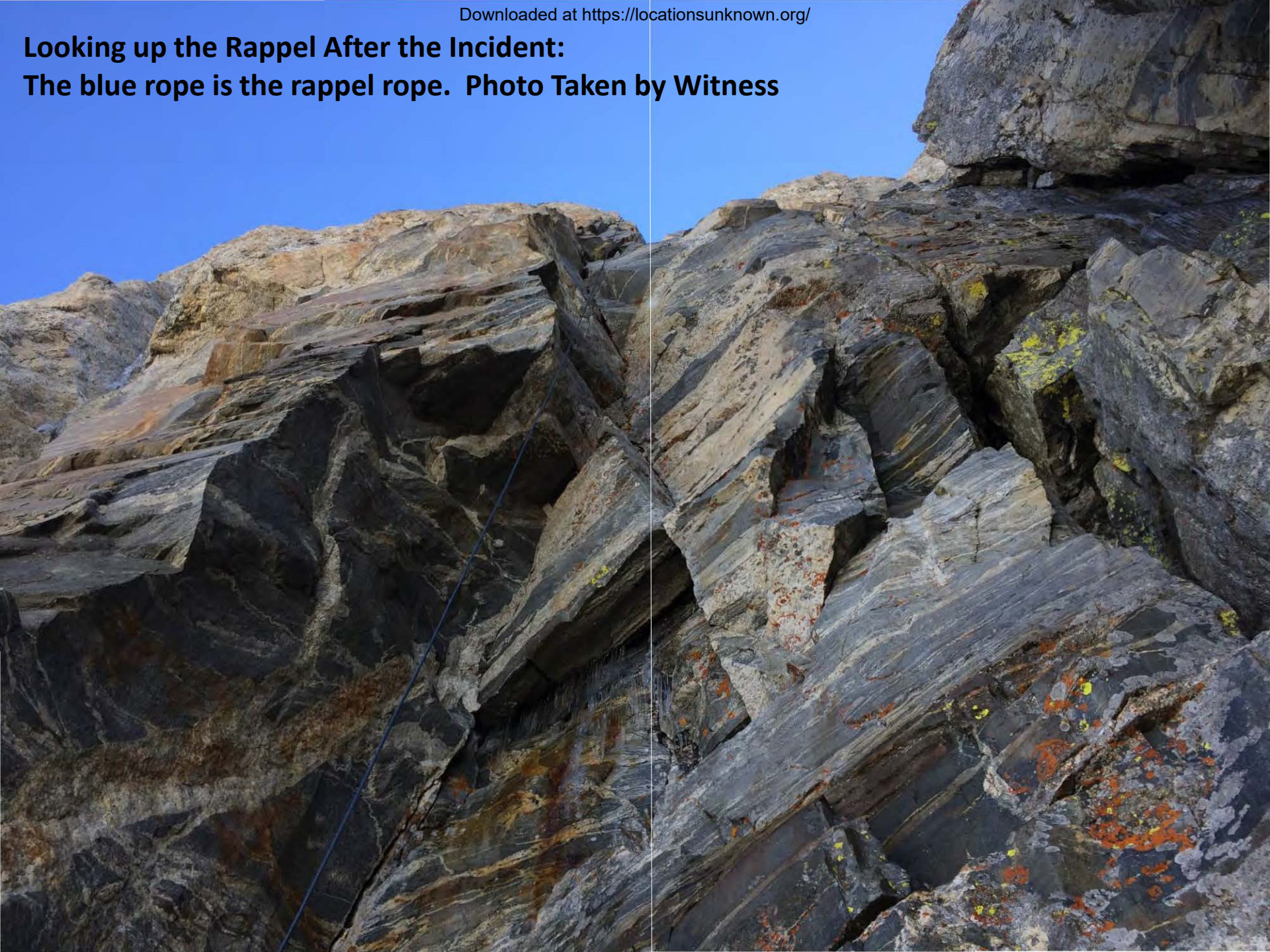
Rappel Anchor-Photo Taken Several Weeks After the Incident



Date & Time: Sat Jul 23 12:58:09 MDT 2016
Position: +043.74075° / -110.80481°
Altitude: 13174ft
Datum: WGS-84
Azimuth/Bearing: 079° N79E 1404mils (True)
Elevation Angle: +28.4°
Horizon Angle: -06.0°
Zoom: 1X



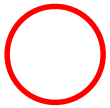
Looking up the Rappel After the Incident:
The blue rope is the rappel rope. Photo Taken by Witness



Graphic Photo Redacted

(b) (6), (b) (7)(C)

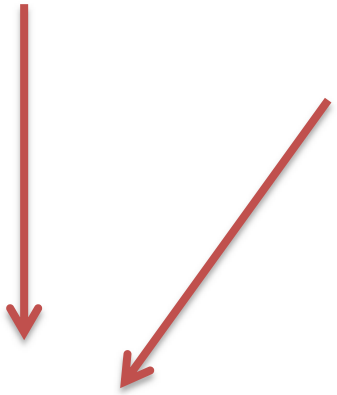
Point of Rest



Looking Up the West Face and the Black Ice Couloir from the Point of Rest

(b) (6), (b) (7)(C)

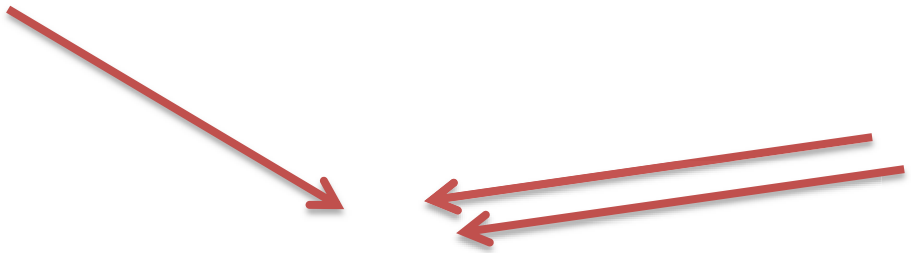
Arrows Indicate the Location of the 9/16 Tubular Webbing



Graphic Photo Redacted

(b) (6), (b) (7)(C)

Arrows Indicate the Location of the 9/16 Tubular Webbing



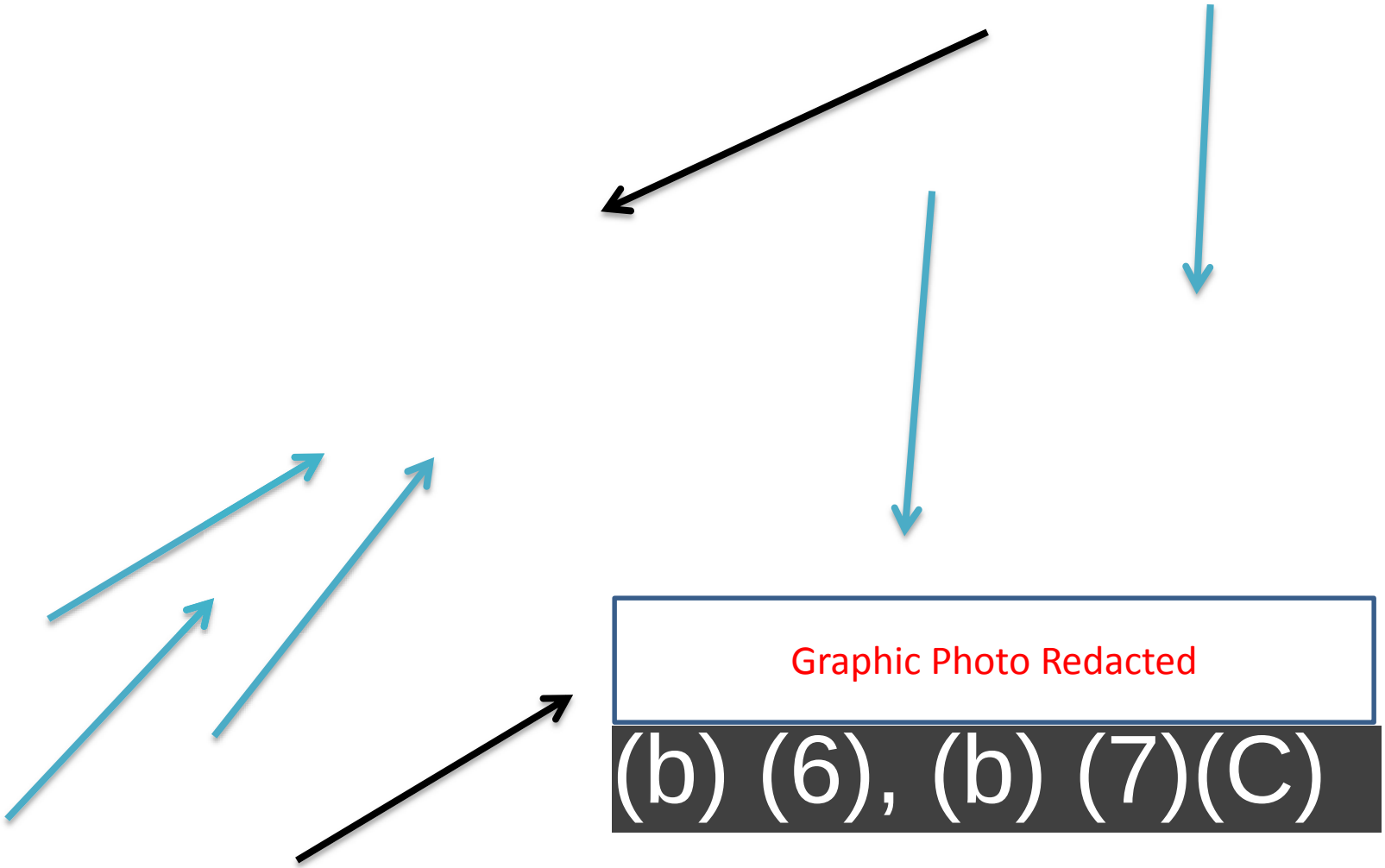
Graphic Photo Redacted

(b) (6), (b) (7)(C)

Photo Taken by Coroner

Blue Arrows Indicate the 9/16 Tubular Webbing

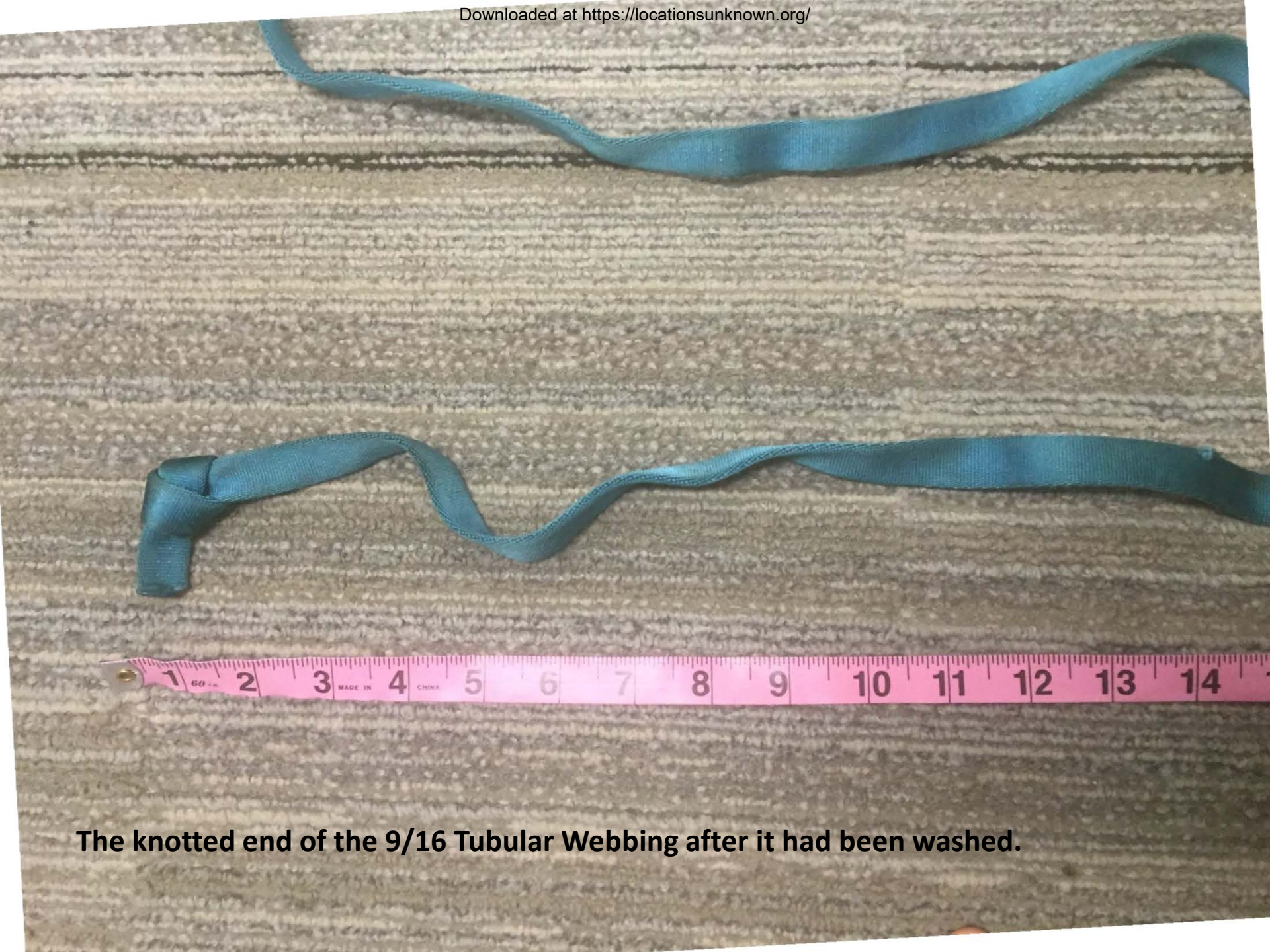
Black Arrows Indicate the Harness Waist and Leg Loops



The 9/16 Tubular Webbing is Wrapped through the Waist and Leg Loops

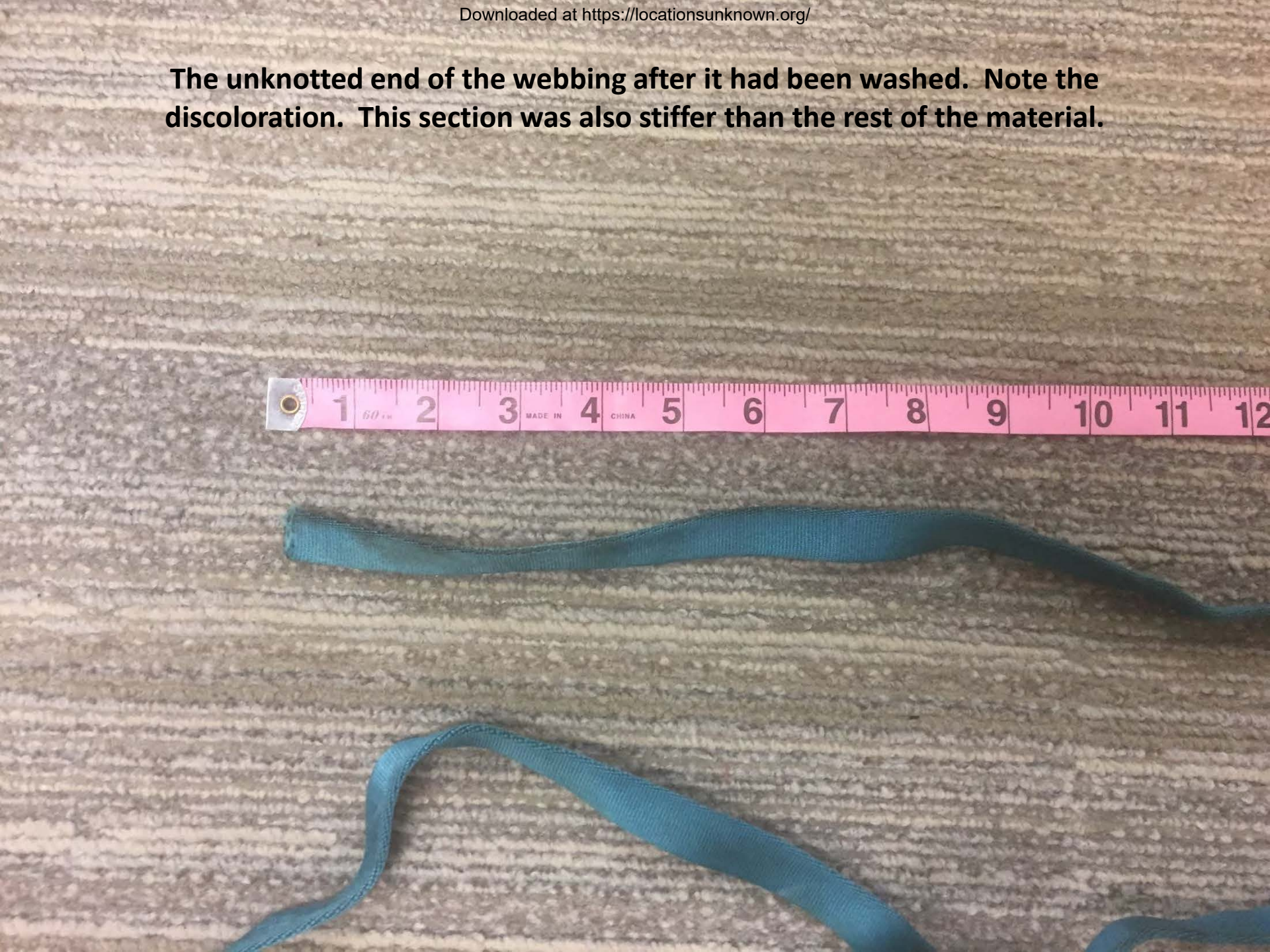
Harness Reconstructed with Paper Clips After it was Cut Off the Body

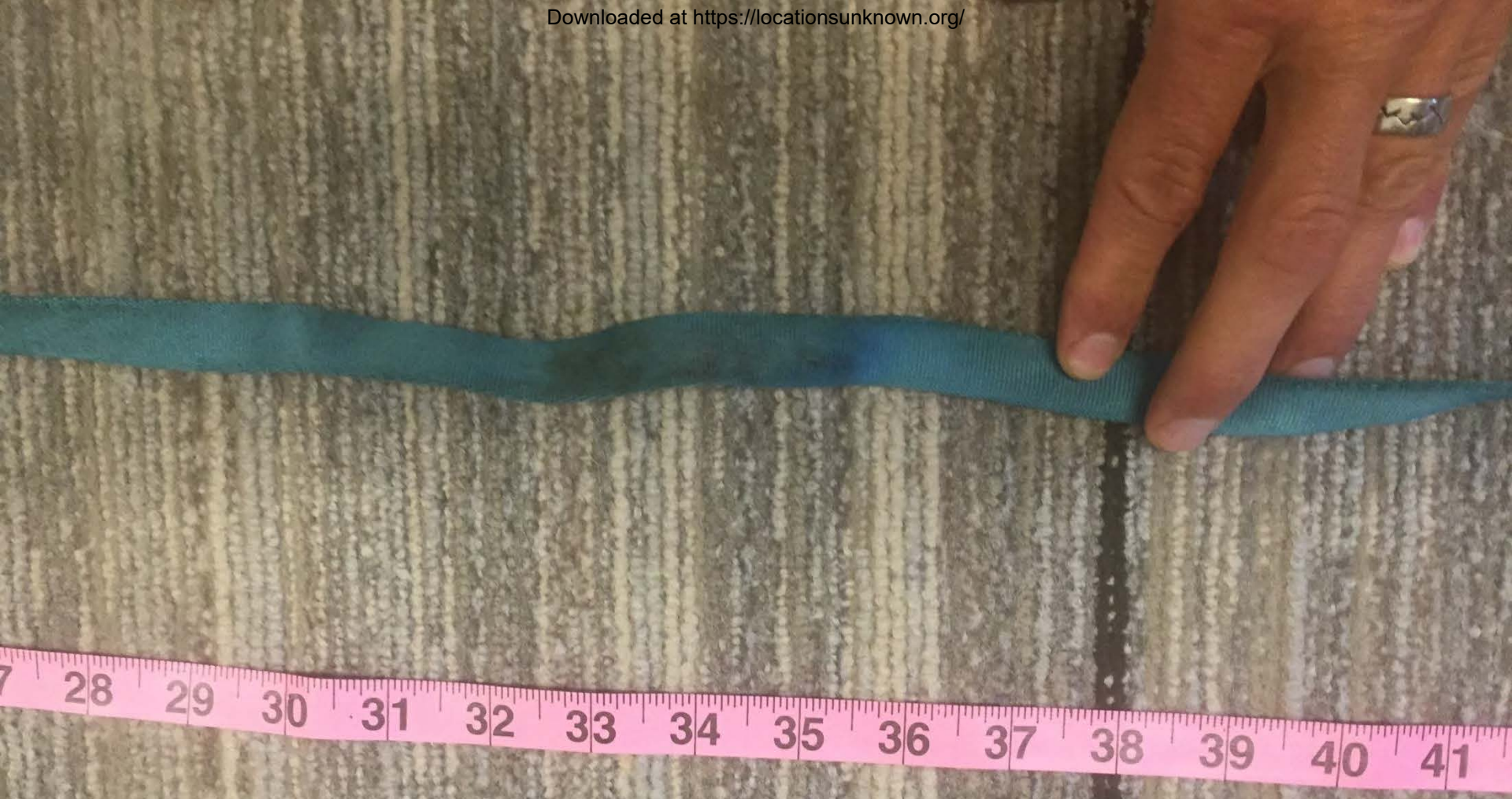
The 9/16 Webbing after it was washed.
The webbing measured at 98 inches (8 feet 2 inches) in length



The knotted end of the 9/16 Tubular Webbing after it had been washed.

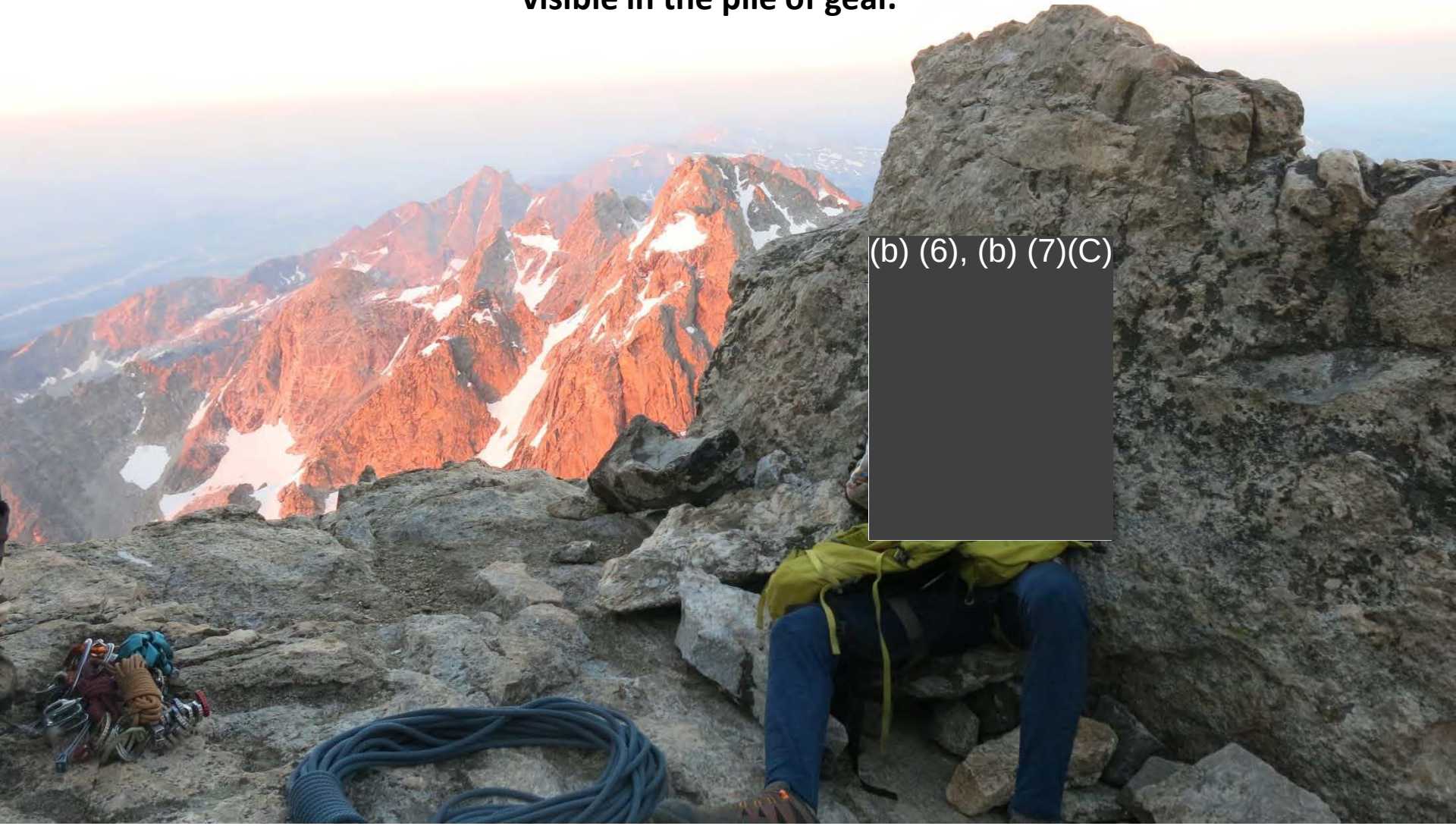
The unknotted end of the webbing after it had been washed. Note the discoloration. This section was also stiffer than the rest of the material.





An abraded section of the 9/16 tubular webbing after it had been washed. Note that the discoloration that is similar to the discoloration found on the unknotted end. This section was also stiffer than the rest of the material.

Photo Taken by Lusky Near the Upper Saddle Prior to Climbing. Falk's climbing equipment is in the lower left corner of the photo. The 9/16 tubular webbing is visible in the pile of gear.



Previous Photo Zoomed In: The Water Knot in the blue 9/16 Tubular Webbing is not tight. The knot's "bottom" tail is visible. The webbing is configured to carry cordellette style. The locking mechanism on the carabiner that is attached to the webbing appears to match the free locking carabiner that was found on the anchor post fall.

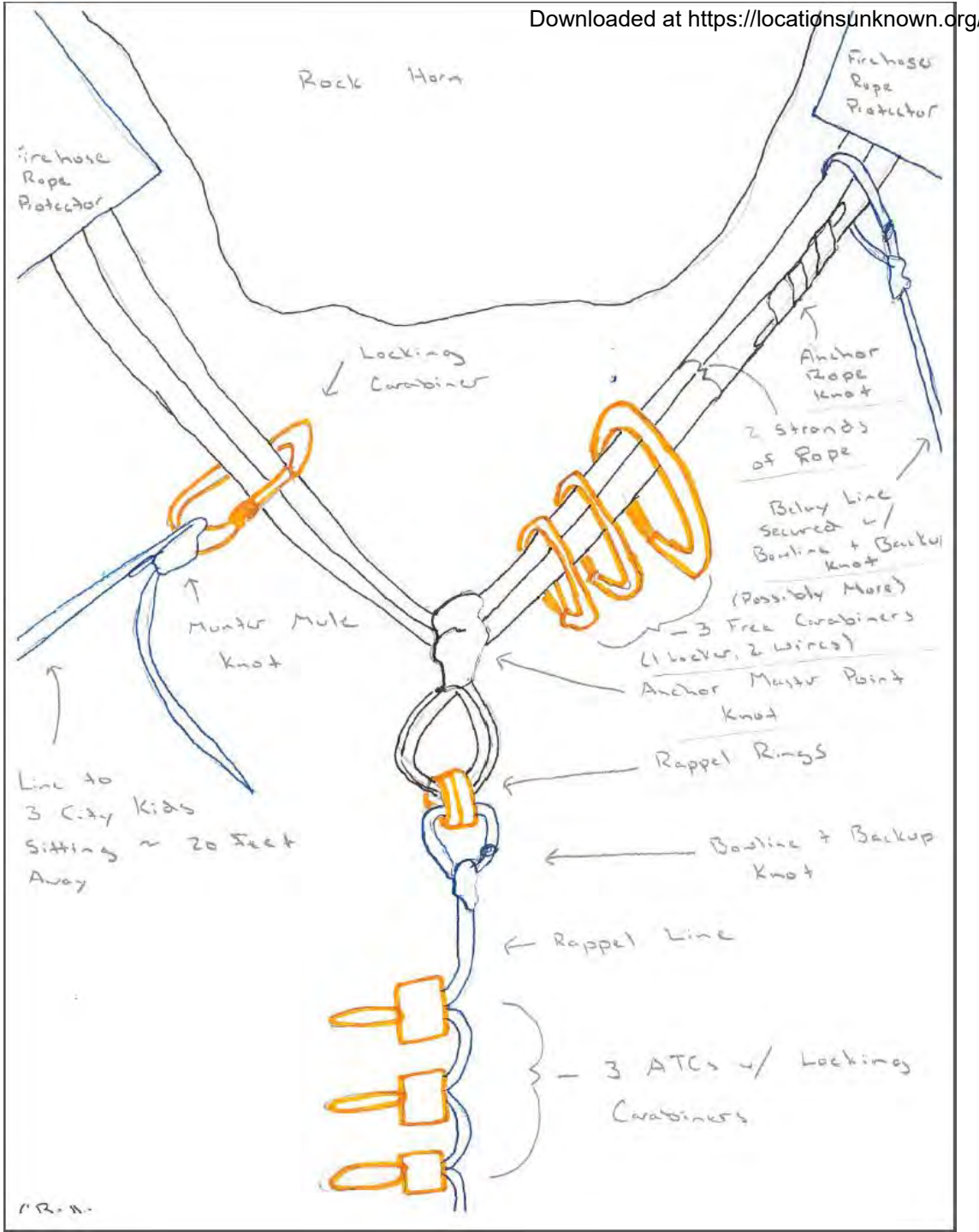
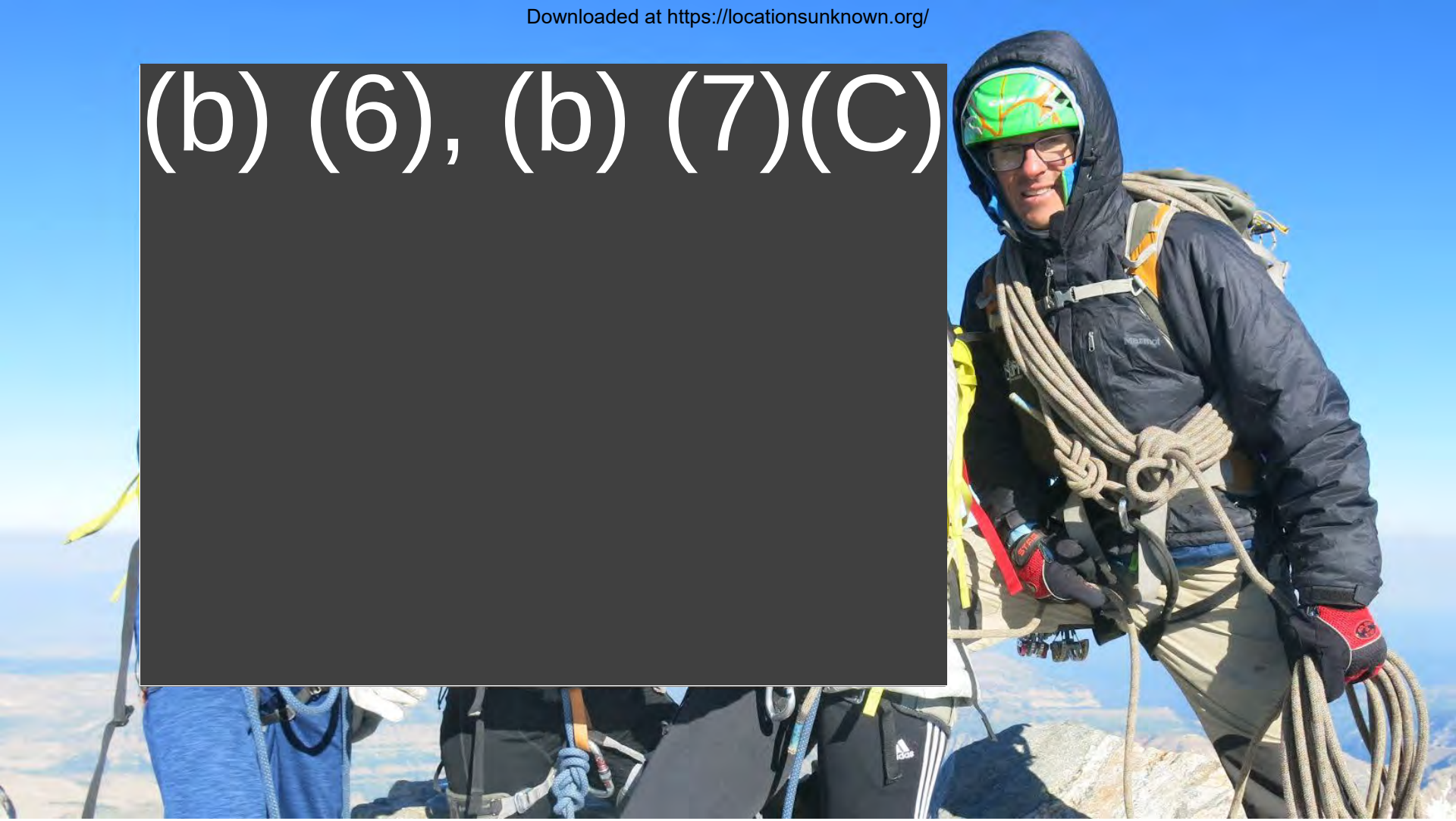


Diagram of Post Fall Anchor Configuration as Described by Exum Guide Ned Corkoran

Free Carabiners Removed from the Anchor Post Fall by Exum Guide Ned Corkoran. There was also blue paint on the carabiner found on FALK's harness. The locking mechanism on this carabiner appears to match the one attached to the webbing in the photo taken of Falk's gear from earlier in the day. Corkoran said that there was at least one additional locking carabiner on the anchor after the fall.



Last Known Photo of Falk Taken on the Summit of the Grand Teton.

1999 International Technical Rescue Symposium

Water Knot Testing

3/22/99

(© Tom Moyer)

Summary

Anecdotal evidence exists to suggest that water knots - commonly used to join webbing into a sling - sometimes fail by slipping. I have found through testing on a load frame that this knot gradually slips when cycled repeatedly with loads as low as body weight. When the tails have slipped all the way into the knot, the knot fails. This resolves the concern I have had about "mysterious" failures of this knot. I believe it is completely safe to use as long as it is checked and found to have sufficient tails before loading.

Background

I have been told many anecdotal stories of accidents caused by the failure of water knots (also called ring bends or overhand follow-through bends) by slipping. Understanding these failures is of some concern to mountain rescuers who use this as a standard knot for tying two ends of a webbing sling together. Many climbing and rescue texts recommend leaving plenty of tail with this knot and pretensioning it carefully to avoid possible slipping, but none of them provides any detail on failures. Past pull-testing I have done on water knots (with sufficient tails) showed ***no*** slipping failures - no matter how poorly the knot was dressed or how poorly it was pretensioned. This caused me some consternation. If a knot occasionally has mysterious failures that I can't duplicate, should we be using that knot for rescue work? Suggestions by other climbers (and the temporary availability of a programmable load frame) prompted me to look at the possibility that these knots were slipping over time under repeated loading and unloading cycles, rather than by slipping when loaded for the first time.

Test Methods

I used a small MTS load frame to pull on a loop of 9/16" tubular webbing tied with a water knot. The load was cycled from 0 to 250 lbs at a fairly slow loading and unloading rate (about two seconds per cycle). Loads and extensions were measured directly by the load frame. The test was halted automatically upon failure of the knot.

Results

The test showed consistent slipping of one of the tails into the knot at an average rate of 0.0035 inches per cycle. A knot that started with tails almost three inches long had one tail gone after 806 cycles. It was interesting to note that only one of the tails slipped into the knot - the one on the "top" side of the knot.

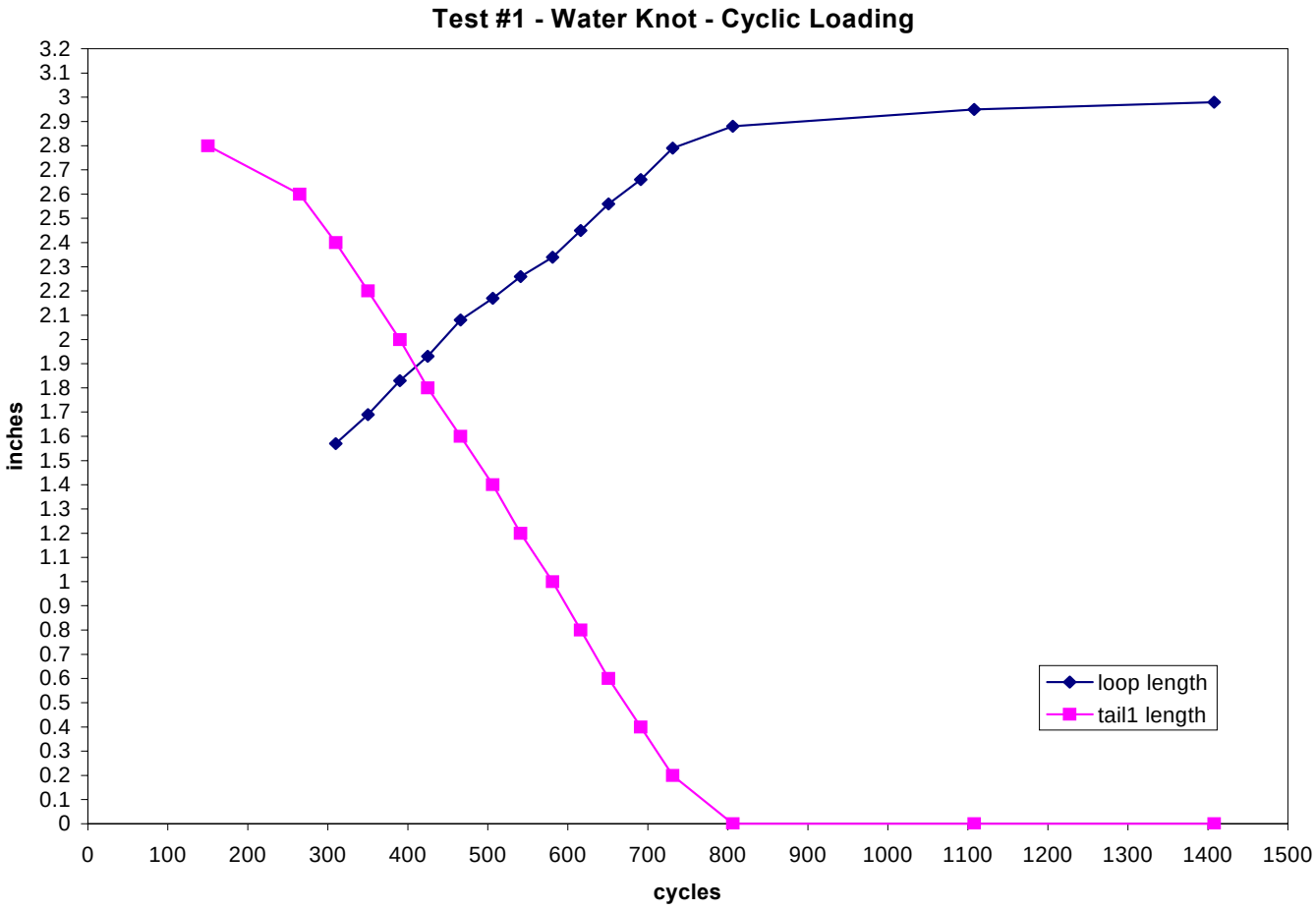
A test with overhand safeties on the water knot gradually slipped through 1.75 inches of tail, and then cinched and did not slip any further. Interestingly, the slip rate was not linear as in the first test, but decreased as the safeties gradually tightened.

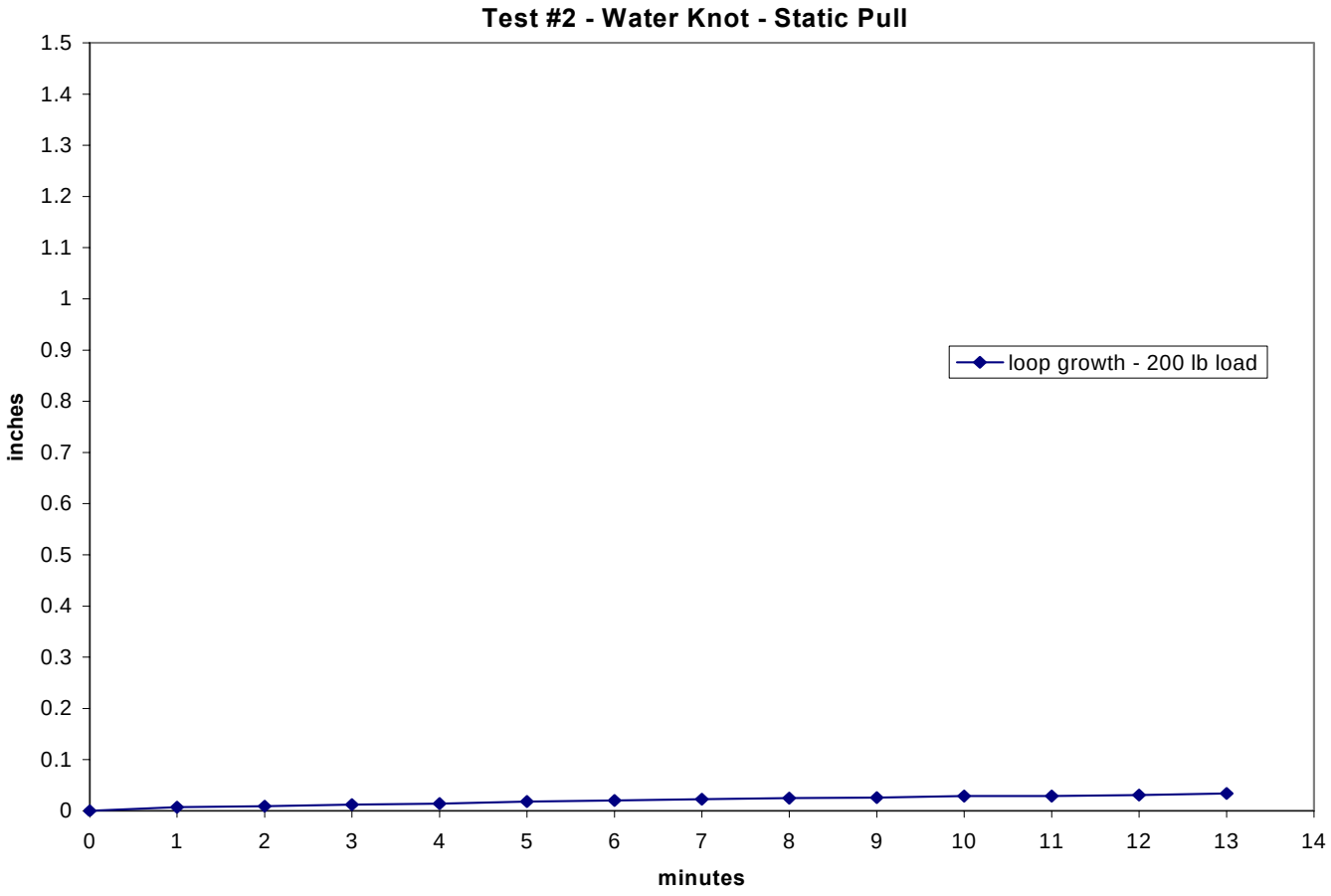
A loop tied with a water knot was loaded with a static pull of 200 lbs to check whether the knot was slipping by creeping. The test was run for thirteen minutes. After an initial period of setting the knot, no further slipping occurred. The water knot seems to be affected by loading and unloading, not by a static pull.

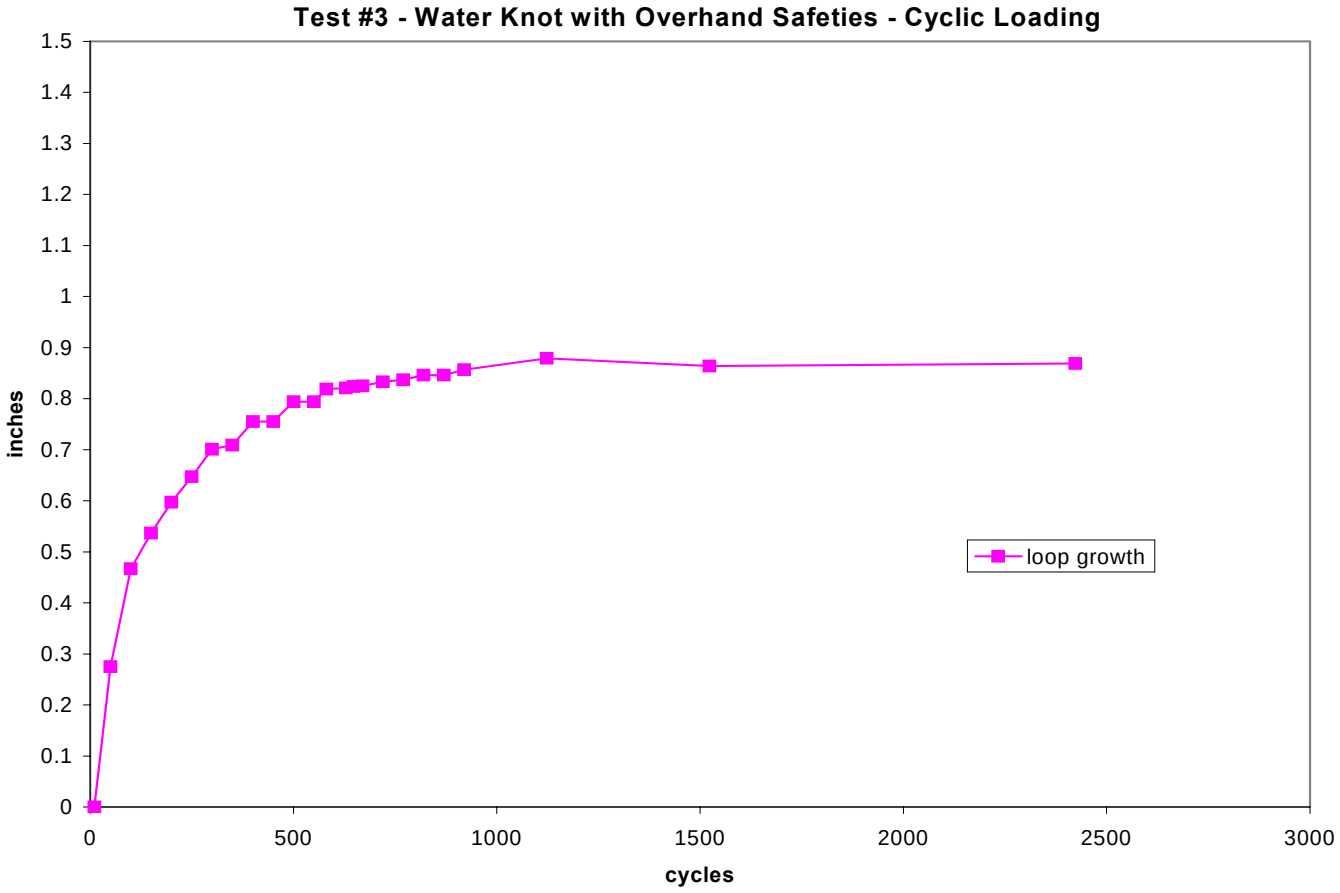
Another cycle test was done on a loop tied with a single fisherman's knot. Over the first 1000 cycles, the loop elongated by 1/4 inch as the knot set. After that, no further elongation occurred. The test was discontinued at 1630 cycles.

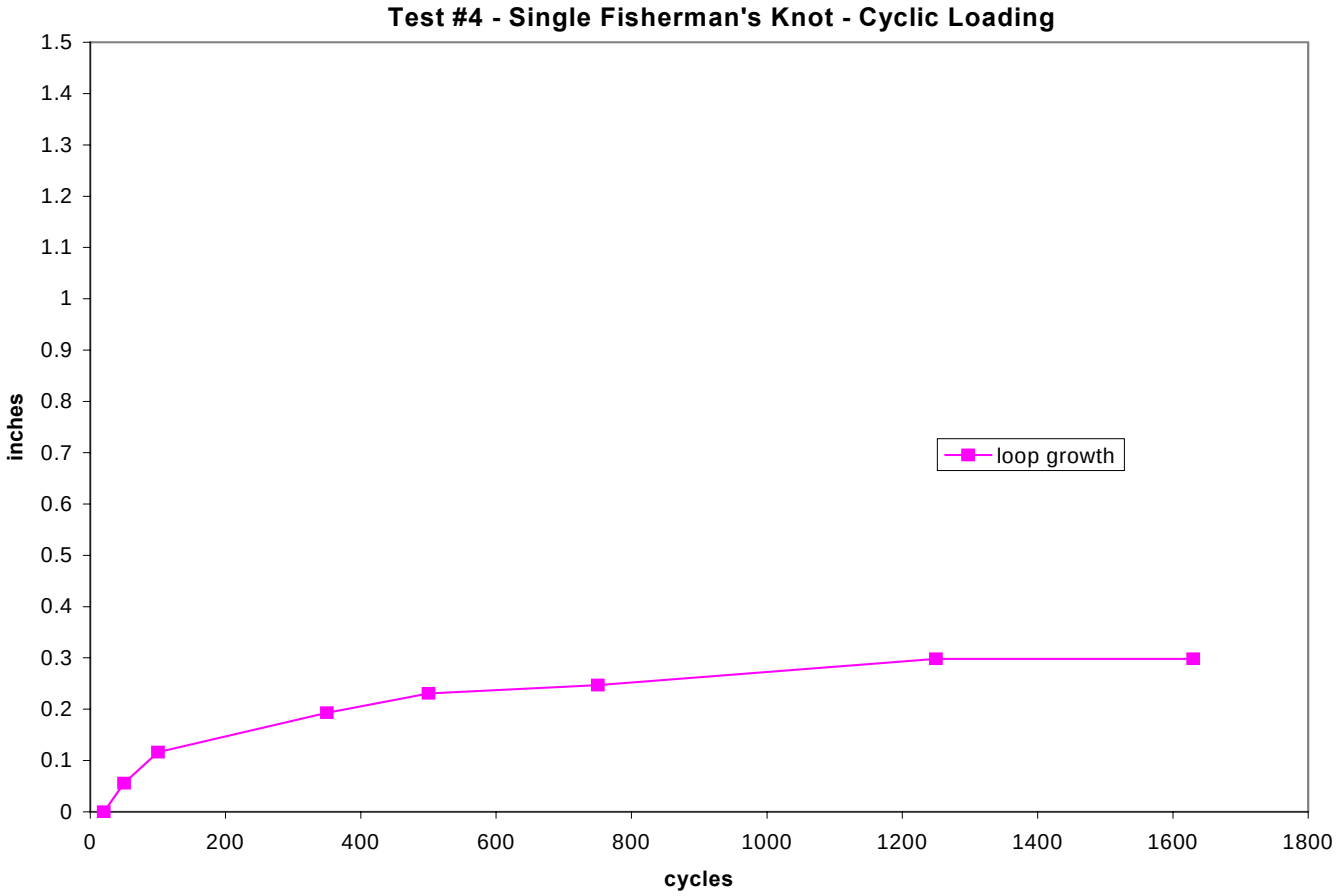
Conclusions

Water knots definitely fail by slipping under cyclic loading. Low loads, such as body weight, are sufficient to cause failure. Other knots (such as a single fisherman's) tied in the same material do not exhibit this kind of failure. Overhand safeties tied on top of a water knot may prevent the failure, but do not guarantee it. This is not all bad news for water knots. I now understand the mechanism of failure and know how to prevent it. This is a lot more comforting than using a knot about which I have suspicions. I will always check the length of the tails on every water knot - and particularly every fixed rappel anchor tied with a water knot - before trusting my life to it. We will continue to use water knots in Salt Lake County, and continue to require long tails on this knot as we always have.









Failure of Water Knots in Spectra and Nylon Webbing from Cyclic Loading

Richard Wright, Eric Steffler and Tom Walters

The results and conclusions in this paper are the personal opinion of the authors and are not intended as an endorsement of any specific product or climbing methods.

INTRODUCTION

Every climber has runners, quick draws, or etriers made from flat webbing in their collection of gear. When many of todays middle aged climbers were learning their craft the standard for runners and etriers was knotted 1" tubular nylon webbing. The majority of webbing in use today is purchased with sewn joints. Sewn joints are less bulky than knots and can be easier to tuck into a crack to direct the load on a piece of protection. Sewn construction also has greater strength compared to knots since there are no sharp bends in the webbing. As a result of greater strength from sewn construction, and new materials, the norm for runners is now for widths less than 1".

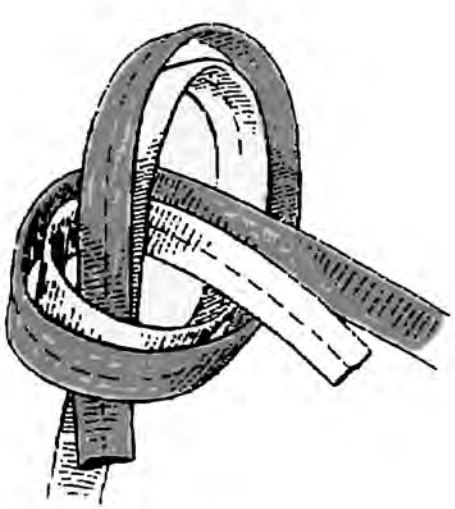
Despite the ubiquity of sewn runners and quick draws, most climbers continue to carry a few knotted slings since they are convient for threading bolts or chockstones, or tying around a tree for rappel anchors. The knot of choice for slings is the water knot, sometimes known as the ring bend. While other knots might be used, the grapevine for example, the water knot is commonly used because it is relatively strong, uses the minimum amount of webbing length in the knot, and is easier to untie after it has been loaded.

There has long been some concern about water knots working loose in service, although the concern seems to have centered on knots that saw much repetitive motion under low loads, like the knot on the now extinct swami belt. As early as 1970 the British Mountaineering Council recommended using sewn runners after investigating the death of a climber as a result of a water knot on an anchor coming untied. At least one US manufacturer only sells sewn products from Spectra webbing and warns against cutting the sling and reattaching it with a knot since the knot can slip at low loads.

Tom Moyer published a note in the July 2000 American Alpine News on an alarming tendency of water knots to fail in an unexpected manner under a fairly large

cyclical load. He reports a kind of incremental slippage where one tail of the knot is pulled through the body of the knot a fraction of an inch on each load/unload cycle. Given enough cycles the knot fails entirely. We have repeated Moyer's experiments and confirm his basic conclusions. Under cyclic loading conditions that are near the limits of those plausible for a rappel anchor for example, a one inch long tail of the water knot can be pulled through in less than 100 load/unload cycles. We have extended the range of conditions examined and have determined that type of webbing material and details of the loading cycle are very important in determining the probability that a water knot will fail in this way.

Note that it is not necessary to have access to a mechanical test frame to observe this effect. If a water knot is tied in new 9/16" wide tubular spectra webbing the ratchet can easily be observed taking the sling in your hands and repeatedly pulling in the direction away from the knot and releasing the load completely on each cycle. In agreement with Moyer, note that only the tail that comes out of the "top" of the knot



exhibits the ratchet movement. An exploded view of the water knot is shown in Figure 1, where the tail on the "top" and the portion of the webbing leading to it are shaded to make it more apparent to the eye.

Figure 1. Schematic representation of a water knot. The tail of the knot and the adjacent portion of the sling that are active during cyclic loading, referred to in the text as the "tail on the top", are shaded to aid in visualizing the process. This figure is adapted from Tom Moyer's American Alpine News article.

RESULTS AND DISCUSSION

In our experiments loops of webbing about 4' long tied with a water knot were tested by cycling the load from zero to various maximum loads at a loading rate of a few seconds. After reaching the peak value the load was completely relaxed at the same rate. We developed a standard protocol for these tests that gave consistent results. A new knot was tied for each test, the loop of sling allowed to reach maximum load, and reference marks were made on the tails of the knot after it first reached maximum load. Cyclic testing was started immediately after the reference marks were established. The distance from the reference mark to the knot was measured every 25 load cycles until a total of 100 cycles was accumulated for each test condition. The rates of ratchet on the tail of the sling that we report here are the average over the 100 total cycles. Three different webbing materials were tested, 9/16" wide tubular Spectra, ¾" wide flat nylon obtained by cutting out the stitching of a sewn runner, and 1" tubular nylon.

The length of tail pulled into the knot for each cycle for the three materials is shown in Figure 2. In every case the entire ratchet was observed for the tail of the knot that came out of the top of the knot, the other tail showed no change in length after 100 cycles. The trends that we observe are consistent with those reported by Moyer, however, the rates that we observed for the webbing less than 1" wide are considerably greater than his. Note that he used 9/16" width webbing, however, he did not report the material.

Why are the rates that we measure so much higher? One reason may be that the details of testing made considerable difference in measured ratchet. When the knot is loaded for the first time there is large extension of the sling as the knot sets and the applied load drifts lower. If the test is set up such that maximum load is maintained by the test frame until all slippage is halted then the knot is set very tight. We carried out several tests using this procedure as well as our standard protocol. In cases where the knot was allowed to completely set, the rates of ratchet on subsequent cyclic loading were considerably reduced. Thus, the results shown in Figure 2 are probably the maximum rates that can be observed.

Also note from Figure 2 that the nylon materials showed quite different behavior on cyclic loading compared to the spectra webbing. The ¾" nylon generally showed less

ratchet on cyclic loading than the spectra and the maximum in the ratchet rate was shifted to lower maximum loads. We were unable to find any test conditions where the 1" wide nylon sling exhibited any ratchet.

Normally in mechanical testing the results are reported in terms of stress (defined as load/cross sectional area) rather than load. This might be an important consideration when comparing results for material with different size, as we do here. Intuition tells us for example that it will take greater load to break rope of 11mm diameter compared to 9mm rope of identical construction, however, the stress to failure should be the same. We report many of our results here in terms of load (rather than stress) since those numbers are more related to a climber's judgment of loads applied in service. Considering stress rather than applied load does not alter the basic results that we observe.

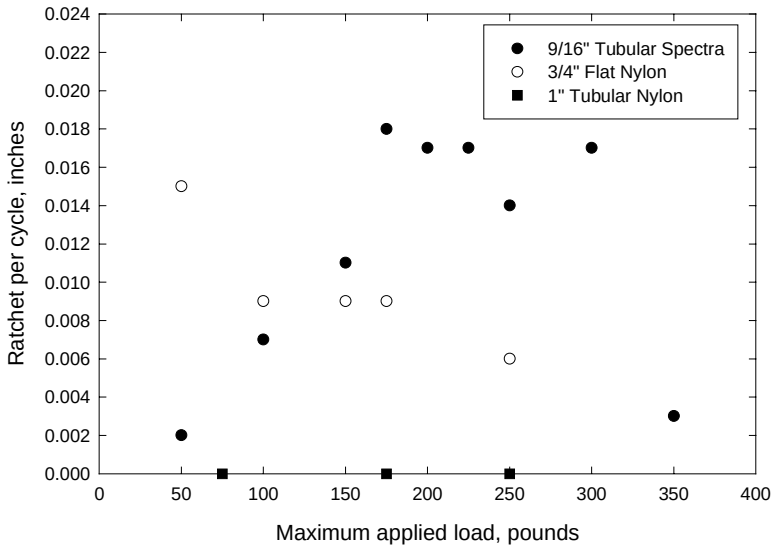


Figure 2. The amount of ratchet of the tail of a water knot per cycle for loading from zero to the peak load indicated on the graph. The values are averaged over 100 load cycles.

In a real climbing situation the type of cyclic loading examined here with complete unloading on each cycle is may not occur. For a rappel anchor for example the typical load cycle is more likely to be from a large fraction of body weight on the low end to series of irregular peak loads as the climber bounces or the rope alternately slips and binds in a mechanical rappel device. Our tests probably more closely approximate the

loading cycle on slings attached to ascenders. To investigate the situation that we envision for a rappel anchor, we did tests on 9/16" spectra loops where the load was cycled from 25 or 50 pounds to a peak load of 175 pounds. These results can be compared to the results for a load cycle from zero to 175 pounds shown in Figure 2. We found that maintaining a minimum load of 25 pounds reduced the rate of ratchet by a factor of four, while a minimum load of 50 pounds suppressed the effect completely.

The ratchet occurs in two steps. During the loading cycle the outside of the knot extends in the direction of the applied load while the tail of the knot is pinched by the loop passing over it and does not move. On the unloading cycle the knot relaxes and the tail moves into the knot an equal amount to catch up. In order for the knot to ratchet, both extension and slip of the tail must occur. If some minimum load is maintained on the sling, 50 pounds for the case discussed above, then the knot does not relax sufficiently on unloading for the tail of the knot to slip and the ratchet is halted. Since we never observed the tail of the knot that comes off the "bottom" of the knot to ratchet during cyclic loading it must remain pinched even during relaxation to zero load, therefore it does not participate in the ratchet.

The ability of the knot to relax during the unloading cycle, which can be thought of as springback, is directly related to the stiffness of the material. We can measure the stiffness of a material by recording the amount of extension of the material (not the knot) for a series of applied loads. Experimental data for the three materials that we examined are shown in Figure 3. In the type of plot shown in Figure 3 a stiffer material will have a steeper curve. The 1" tubular nylon sling has low stiffness compared to the other two materials, the ¾" solid nylon has an intermediate behavior, and the Spectra has the highest stiffness.

Spectra webbing has the reputation of requiring a high load to set knots tightly, which is often attributed to the Spectra being more "slippery". Our results indicate that at least in part, this is actually a result of the material having higher stiffness and greater tendency to springback. For the low stiffness 1" nylon sling the loading cycle causes a good deal of extension (strain) during the loading cycle. However, the load sets the knot tight enough that the elastic springback upon unloading cannot relax the knot so that the second part of the ratchet, slipping of the tail, cannot occur for any load cycle. The ¾"

nylon is somewhat stiffer so that at low loads there is significant elongation during loading and sufficient springback during unloading so that both parts of the ratchet mechanism can operate. The very stiff Spectra material requires higher loads to achieve significant elongation during loading, but the knot can relax after those loads. The ratchet mechanism thus occurs in the Spectra webbing, but at higher loads compared to the ¾" nylon.

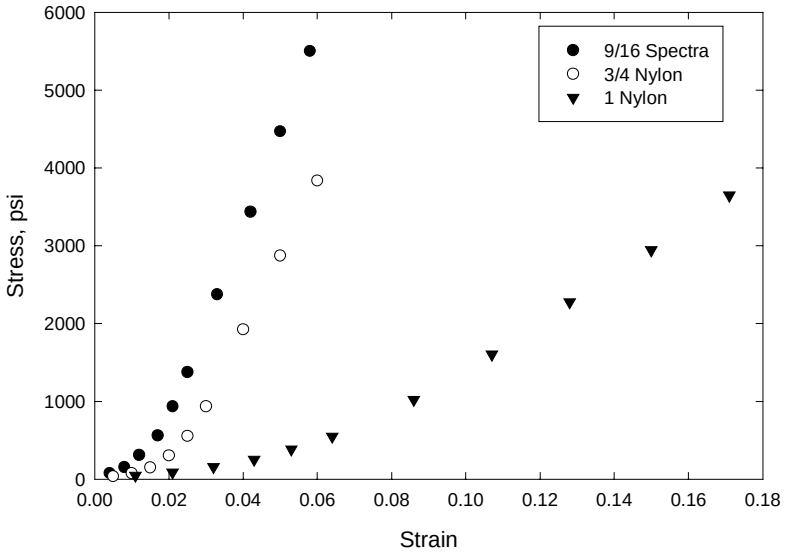


Figure 4. The stress-strain behavior of the three materials tested. Stiffness of the material is the measure of how much strain (elongation) occurs for a given stress. The spectra webbing has higher stiffness than either of the nylon materials tested.

Another relevant trait of the spectra webbing that became clear during testing was that the ratchet rate declined after the material underwent a few hundred cycles. The ratchet rate as a function of total accumulated zero-to-175 pound load cycles is shown in Figure 5. The ratchet rate falls by 50% between the first and second set of one hundred cycles and reaches a more or less constant value after three hundred cycles. The test was interrupted after each set of one hundred cycles and the knot retied before completing the next set of one hundred cycles, so we are confident that the behavior shown in the plot is not merely a reflection of an increasingly tight knot.

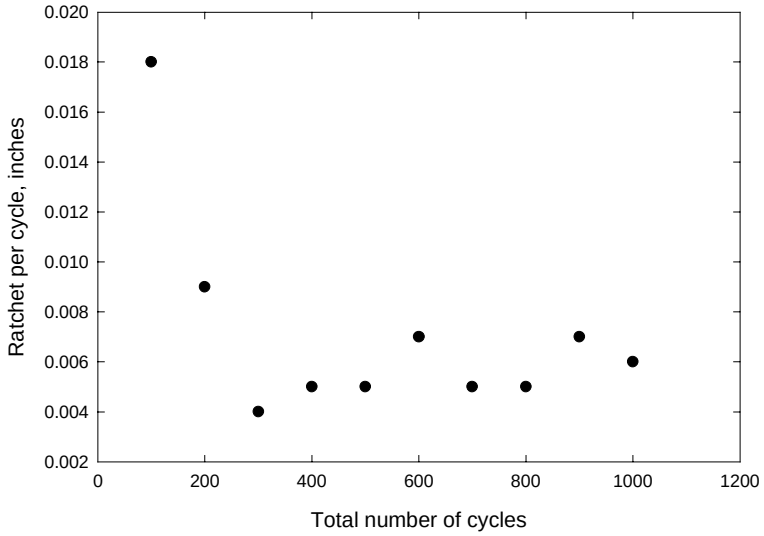


Figure 5. The influence of total load cycles on the ratchet rate for spectra webbing cycled from zero to 175 pounds.

To try and explain the decreasing rate of ratchet after a number of load cycles, we tested the stiffness of the spectra webbing in a series of rather severe load cycles up to 700 pounds load on a loop tied with a water knot. The resulting stress-strain plots are shown in Figure 6. It is clear from the plot that the spectra changes properties dramatically between the first and second load cycles and continues to change at a declining rate thereafter. As the spectra is cycled it requires a greater stress to achieve the same strain (elongation), in other words it becomes stiffer after load cycling. For most polymeric materials this change in behavior is thought to result from rearrangement of the polymer chains on the microscopic level as a result of deformation.

The practical effect of this increased stiffness with cycling is that the amount of elongation on the load portion of the ratchet cycle decreases as more cycles are accumulated and the total ratchet rate is reduced. The stiffness of the spectra increases rapidly over the first cycles and more slowly as more cycles accumulate and finally the effect saturates. This is reflected in the data shown in Figure 5 as a rapid decrease in ratchet rate after the first 200 cycles and eventually constant rate is reached. We noted above that our testing protocol was designed to give rise to maximum ratchet rates. Note that the very high ratchet rates shown in Figure 2 were for pristine material and for this reason too they are thought to represent the maximum rates that can be observed.

Repeating the tests after a section of webbing had accumulated many load cycles caused a sharp decline in the observed ratchet rate to values that were more consistent with those reported by Moyer.

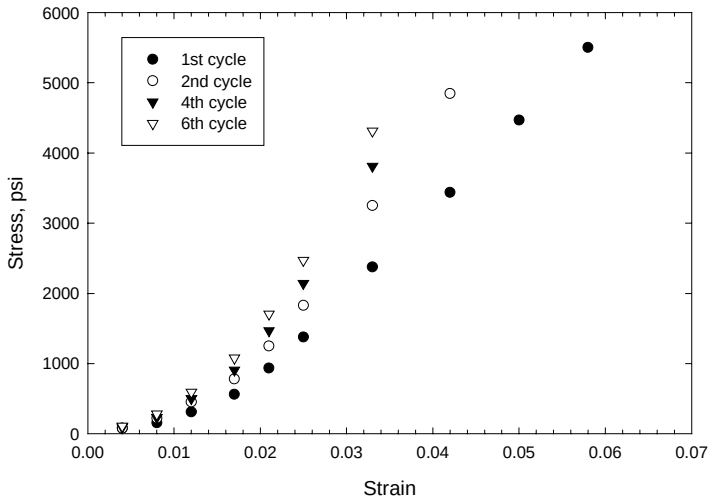


Figure 6. Stress-strain curves for spectra webbing loaded to 700 pounds. As the number of load cycles increased, the spectra becomes stiffer.

SUMMARY

We have confirmed the basic conclusion of Moyer that the water knot can fail under cyclic loading conditions by a ratchet mechanism. There are circumstances for which we found much higher rates of ratchet than Moyer reported. With pristine Spectra webbing tested in a load cycle that allows the knot to relax completely upon unloading a 1” long tail could ratchet through the knot in just over one hundred load cycles. The ratchet mechanism consists of two distinct parts, extension of the outside loop of the knot on loading, followed by release and motion of the tail into the knot upon unloading. Any factor that prevents either part of the mechanism from occurring suppresses ratcheting. Maintaining a minimum load of as little as 50 pounds suppresses the ratchet almost completely for a maximum load near body weight.

Knots in nylon slings are not as prone to ratchet as are those in Spectra webbing. While knots in ¾” wide nylon sling did exhibit ratchet at lower loads compared to the Spectra, no load cycle could be found that would cause standard 1” tubular nylon webbing to ratchet any appreciable amount. The product literature of one manufacturer warns against cutting sewn Spectra slings and reconnecting them with a knot. Our results

for the ¾" nylon webbing suggest that caution should be exercised with knotting narrow nylon slings as well.

We do not yet know if differences in friction coefficients between different materials play a role in determining the rates of ratchet. The shape of the webbing is also likely to play a role that we have not examined in detail. For the tests we present here comparison of the ¾ and 1" nylon webbing is not exact because the narrow webbing is solid while the 1" material is tubular. We do not expect that this makes a big difference, but it may play a role in determining the elastic properties that we measured. It is also easy to observe that the wider webbing cupped on both sides of the knot while the narrower nylon and the Spectra remain flat even under load. This shape change within the knot may also play a role in suppressing ratchet in the 1" nylon sling.