INCIDENT INVESTIGATION REPORT

Type of occurrence **Motor vehicle incident (MVI)**		
Notice of incident number **2017178040008**	Incident outcome **Fatality (1)**	Date of incident **August 14, 2017**
Location of incident **Film set Vancouver Convention Centre 1055 Canada Place Vancouver, B.C.**	Primary investigator **Lance LABBY**	Investigation file number **FSI-REG-2017-0099**
Approved by manager, Fatal and Serious Injury Investigations **Jeff YOUNG**	Signature	Date Sept. 24, 2019

PARTIES INVOLVED IN INCIDENT

Employer	Name **TCF Vancouver Productions Ltd.**	Employer ID **816168**	Industry classification **763025 Motion Picture, Commercial, or Television Production**
Worker	**Sequana Joi COOKE HARRIS**	**Deceased**	Occupation **Stunt double**
Employer	Name **Fox US Productions 56, Inc.**	Employer ID **992234**	Industry classification **763025 Motion Picture, Commercial, or Television Production**
Employer	Name **Twentieth Century Fox Film Corporation**	Employer ID **Not Registered**	Industry classification **Not Registered**

Persons mentioned in report

Name	Known in the report as	Role in the incident/investigation
Sequana Joi COOKE HARRIS	Operator	Was hired as a stunt double to ride a motorcycle and was a new worker. Was fatally injured while riding the motorcycle.
[redacted]	Executive Producer	Responsible for overseeing the production of the film (line producer). In charge of budgets, schedules, crew, and general operations. [redacted] Was on the main unit and therefore was not on site at the time of the incident.
[redacted]	Production Manager	Assisted in the hiring of the Canadian crew and oversaw the Stunt Department. [redacted] Was not on site at the time of the incident.
[redacted]	Second Unit Director	Director of the second unit for the film. [redacted] Worked in conjunction with Stunt Coordinator 2 to execute the stunts. Was on site at the time of the incident but did not witness the incident.
[redacted]	First Assistant Director	[redacted] Was on site at the time of the incident but did not witness the incident.
[redacted]	Stunt Coordinator 1	Main unit stunt coordinator department head for the film. [redacted] Was not on site at the time of the incident.
[redacted]	Stunt Coordinator 2	Second unit stunt coordinator department head for the film. [redacted] as the direct supervisor of the Operator and assessed her ability to ride motorcycles. Witnessed the incident.
[redacted]	Vice-President, Environmental Health and Safety	Direct supervisor of the Health and Safety Consultant.

[redacted]	Health and Safety Consultant	Canadian health and safety risk management consultant for TCF Vancouver Productions Ltd. Was not on site at the time of the incident.
[redacted]	Picture Car Technician 1	Responsible for transporting and repairing motorcycles for the film. Transported the motorcycles to Mammoth Studios so the Operator could train on them. Witnessed the incident.
[redacted]	Picture Car Technician 2	Responsible for transporting and repairing motorcycles for the film. Gave the motorcycle to the Operator on the day of the incident. Witnessed the incident.
[redacted]	Picture Car Wrangler	Was tasked with maintenance, transportation, and preparation of the motorcycles. Was not on site at the time of the incident.
[redacted]	Stunt Person 1	Coached the Operator on the day before the incident. Was on site at the time of the incident but did not witness the incident.
[redacted]	Stunt Person 2	Assisted with training the Operator on the day before the incident. Was not on site at the time of the incident.
[redacted]	Stunt Person 3	Briefly worked as a stunt double and motorcycle operator prior to the Operator being hired. Worked with and observed the Operator on the day of the incident. Witnessed the incident.
[redacted]	Stunt Person 4	Observed the Operator during rehearsals on the day of the incident. Witnessed the incident.
[redacted]	Stunt Person 5	Was present for and observed the Operator's rehearsals on the day of the incident. Witnessed the incident.
[redacted]	Stunt Person 6	Stunt person who dropped the ice cream cone as the Operator rode past him in front of the Vancouver Convention Centre.
[redacted]	Makeup Artist 1	Worked with the Operator prior to the day of the incident. Was not on site at the time of the incident.
[redacted]	Makeup Artist 2	Worked with the Operator prior to and on the day of the incident. Witnessed the incident.
[redacted]	Ducati Dealership Technician	Employed by Ducati Richmond. Provided information about the motorcycle. Was not on site at the time of the incident.
[redacted]	Ducati Technical Director	Technical director of Ducati North America, Inc. Provided information about the motorcycle. Was not on site at the time of the incident.

Scope

This incident investigation report sets out WorkSafeBC's findings with respect to the cause of and contributing factors leading to the workplace incident that occurred on August 14, 2017, at the Vancouver Convention Centre, located at 1055 Canada Place in Vancouver, British Columbia. The purpose of this report is to help employers and workers understand the factors that contributed to the incident so that similar incidents can be prevented in the future.

This investigation report may include some of the enforcement action taken under the *Workers Compensation Act* and the Occupational Health and Safety Regulation in response to the incident and as a result of the investigation. Regulatory compliance activities may be summarized here but will be documented separately.

How the investigation was conducted

WorkSafeBC's Fatal and Serious Injury Investigations section, part of the Investigations Services Department, conducts health and safety investigations using a systematic approach based on the scientific method. This process involves collecting information from various sources to understand the facts and circumstances of the incident and analyzing that information to identify the causal and contributing factors that led to the incident.

The field investigation generally includes the following:

- Securing and examining the incident site, including any equipment involved
- Taking notes and photographs
- Interviewing people with relevant information, such as employer representatives, supervisors, workers, and witnesses
- Collecting documents such as equipment operating manuals, written procedures, and training records
- Conducting tests of materials or equipment, if necessary

The analysis of the information usually includes the following:

- Determining a sequence of events
- Examining significant events for unsafe acts and conditions
- Exploring the contributing factors that made the unsafe act or condition possible
- Identifying health and safety deficiencies

Contents

Incident synopsis

During the filming of the movie *Deadpool 2* in Vancouver, B.C., a stunt double (the Operator) was fatally injured when she was ejected from the motorcycle she was operating and crashed into the window of a building, striking the window frame.

1 Incident details

1.1 Employers

1.1.1 TCF Vancouver Productions (TCF)

TCF Vancouver Productions Ltd. (TCF) is a wholly owned subsidiary of Twentieth Century Fox Film Corporation (Fox) and is a Vancouver-based company that is utilized by Fox to produce feature films in B.C. *Deadpool 2* was one of many feature films produced by TCF in B.C. Filming for this project commenced in June 2017.

On January 4, 2017, a "Canadian Production Services Agreement" (referred to in this report as the *agreement*) was entered into between Fox and TCF. The agreement detailed the terms and conditions agreed upon by Fox and TCF for the production of the movie *Deadpool 2* in Canada. Under the agreement, TCF was responsible for hiring the Canadian personnel for this film. Pursuant to section 2.2(b) of the agreement, TCF was responsible for "overseeing the day to day Canadian production activities for the picture." As the company responsible for the day-to-day production activities, TCF was the employer responsible for the health and safety of the workers during the filming of *Deadpool 2* and, accordingly, was obliged to comply with the provisions of section 115 of the *Workers Compensation Act* (the Act).

At the time of the incident, the Operator was a worker of TCF. TCF was the employer of many of the workers on location at the Vancouver Convention Centre on the day of the incident.

The main film crew of TCF, referred to in this report as the main unit, operates out of Mammoth Studios in Burnaby, B.C., as well as on location. An additional film crew, the second unit, is used when filming takes place in a separate location. The incident occurred at the Vancouver Convention Centre, where TCF's second unit was filming for one day.

1.1.2 Twentieth Century Fox Film Corporation (Fox)

Fox is an American film studio that is based in Los Angeles, California, United States. TCF is a wholly owned subsidiary of Fox. Fox is the exclusive owner of the rights to the movie *Deadpool 2*. Fox entered into an agreement with TCF for TCF to provide production services in Canada for the filming of *Deadpool 2* in Vancouver, B.C.

1.1.3 Fox US Productions 56, Inc. (Fox 56)

Fox 56 is a wholly owned subsidiary of Fox. Fox 56 does not have a permanent location in Canada. Fox 56 was responsible for hiring the U.S. personnel who worked on the movie *Deadpool 2*. [redacted] the Operator signed a "Theatrical Motion Picture Stunt Performer Weekly Employment Agreement" (referred to in this report as the *employment agreement*) with Fox 56. The employment agreement covers collective bargaining, compensation, rights, ownership, confidentiality, and various other terms agreed upon between the Operator and Fox 56.

WorkSafeBC has determined that the Operator was lent by Fox 56 to TCF for the duration of her employment and, accordingly, that TCF was the employer of the Operator for the purposes of the Act and was responsible for all of the employer's duties and obligations with respect to the Operator, including the health and safety obligations of employers set out in Part 3 of the Act and in the Occupational Health and Safety Regulation (the Regulation).

1.2 Workers

1.2.1 Operator

The Operator, who resided [redacted], was hired under the employment agreement with Fox 56 and was lent to TCF for the duration of her employment. The Operator was hired as a stunt double and was new to the workplace; therefore, she is considered to have been a new worker. She was an experienced motorcycle racer who was licensed to race in the American Motorcycle Association. The Operator had competed in the Championship Cup Series and numerous other races since 2014. The Operator had no prior experience as a stunt double in the film industry. The Operator was assigned the task of riding a motorcycle out of the Vancouver Convention Centre as part of a stunt sequence being filmed.

1.2.2 Executive Producer

The Executive Producer had [redacted] years of experience in the film industry. On this production, the Executive Producer [redacted] was responsible for budget, crews, schedule, and general operations. According to the Fox "Occupational Health & Safety Program: British Columbia, Canada" (referred to in this report as *TCF's safety program*): [redacted]

At the time of the incident, the Executive Producer was not on site.

1.2.3 Production Manager

The Production Manager reported to the Executive Producer and had worked in this role in [redacted] years. He was hired as the production manager for this film and assisted with hiring the Canadian crew. The Production Manager oversaw the Stunt Department, which hired all of the workers, including the Operator. According to TCF's safety program:

The Production Manager observed the rehearsals on the morning of the incident but was not on site at the time of the incident.

1.2.4 Second Unit Director

The Second Unit Director reported to the Production Manager and collaborated with the Executive Producer and the main unit director to ensure the film sequence met the expectations of the main unit. The Second Unit Director had approximately years of experience in the film industry and was responsible for directing the film sequences for the second unit. This set was overseen by the Second Unit Director, who suggested changes or improvements to the scene during rehearsals to ensure they captured the desired appearance. His primary concern was the appearance of the events being filmed. As outlined in TCF's safety program, the role of the Second Unit Director was to

The Second Unit Director was on site at the time of the incident but did not witness the incident.

1.2.5 First Assistant Director

The First Assistant Director reported to the Production Manager and collaborated with the Executive Producer, the main unit director, and the Second Unit Director to ensure the film sequence met the expectations of the main unit. According to TCF's safety program:

The First Assistant Director was on site at the time of the incident but did not witness the incident.

1.2.6 Stunt Coordinator 1

Stunt Coordinator 1 was the main unit stunt coordinator department head and, as such, reported [redacted] as a department head, Stunt Coordinator 1 was responsible for the supervision of the main unit stunts. Stunt Coordinator 1 had been working in the film industry for [redacted] years [redacted]

Stunt Coordinator 1 was not on site at the time of the incident.

1.2.7 Stunt Coordinator 2

Stunt Coordinator 2 was the second unit stunt coordinator department head and, as such, reported [redacted] Stunt Coordinator 2 had been a stunt coordinator for approximately [redacted] and had been operating motorcycles [redacted]

For this film, Stunt Coordinator 2's job included positioning workers and equipment and orchestrating their activities [redacted]. According to TCF's safety program: [redacted]

Stunt Coordinator 2 witnessed the incident.

1.2.8 Vice-President, Environmental Health and Safety

The Vice-President, Environmental Health and Safety was the direct supervisor of the Health and Safety Consultant.

The Vice-President, Environmental Health and Safety was not on site at the time of the incident.

1.2.9 Health and Safety Consultant

The Health and Safety Consultant is a third-party contractor and worked as the Canadian health and safety risk management consultant for TCF, in coordination with the Production Manager. He had been a health and safety consultant for TCF for [redacted] The role of the Health and Safety Consultant was to make the TCF department heads aware of their responsibilities regarding workplace health and safety in B.C. The Health and Safety Consultant provided safety orientations to the various department heads. These orientations consisted of reviewing TCF's safety program and sections 115 through 117 of the Act.

The Health and Safety Consultant was not on site at the time of the incident.

1.2.10 Picture Car Technician 1

Picture Car Technician 1 transported the motorcycles to Mammoth Studios on the Saturday prior to the incident so the Operator could train on the motorcycles.

Picture Car Technician 1 was on site at the time of the incident and witnessed the incident.

1.2.11 Picture Car Technician 2

Picture Car Technician 2 had worked on this production for [redacted] and had previously been employed by [redacted] Picture Car Technician 2 was responsible for moving cars and motorcycles into position for filming and repairing vehicles on set if required.

Picture Car Technician 2 witnessed the incident.

1.2.12 Picture Car Wrangler

The Picture Car Wrangler was a [redacted] motorcycle mechanic and was hired for this production to transport and conduct surface preparations on the vehicles used for filming.

The Picture Car Wrangler did not witness the incident as she was not employed by TCF at the time.

1.2.13 Stunt Person 1

Stunt Person 1 had over [redacted] years of experience riding motorcycles and [redacted] years of experience in the film industry. Stunt Person 1 worked on this production for approximately [redacted] prior to the incident.

Stunt Person 1 was part of the film sequence at the time of the incident and had fallen off his bicycle as directed, and so did not witness the incident.

1.2.14 Stunt Person 2

Stunt Person 2 had approximately [redacted] years of experience in the film industry as a professional stunt person, including operating motorcycles. Stunt Person 2 was employed by TCF [redacted] Stunt Person 2 was identified by Stunt Coordinator 2 as the backup person to perform the work activity that consisted of riding the motorcycle up the escalator in the event that the Operator was unable to perform.

Stunt Person 2 was not on site at the time of the incident [redacted].

1.2.15 Stunt Person 3

Stunt Person 3 had been working in the film industry for [redacted] years. She started doing stunts at the age of [redacted] and had been employed for this production [redacted]. Stunt Person 3 [redacted] Stunt Person 3 worked with and observed the Operator on the day of the incident and conducted rehearsals prior to the incident.

Stunt Person 3 was on site and witnessed the incident.

1.2.16 Stunt Person 4

Stunt Person 4 had been working as a stunt performer for [redacted] years. Stunt Person 4 was involved in the stunt that was being filmed immediately prior to the incident.

Stunt Person 4 witnessed the incident.

1.2.17 Stunt Person 5

Stunt Person 5 was present on Sunday, August 13 and Monday, August 14, 2017. Stunt Person 5 witnessed the incident.

1.2.18 Stunt Person 6

Stunt Person 6 had been working as a stunt performer for over [redacted] years. Stunt Person 6 was part of the stunt being filmed; he was the stunt person who dropped the ice cream cone as the Operator rode past him in front of the Vancouver Convention Centre.

1.2.19 Makeup artists

Makeup Artist 1 and Makeup Artist 2 were tasked with ensuring the stunt people, including the Operator, had the same appearance as the actors in the film. Their tasks consisted of matching the skin tone and colour as well as hair. Makeup Artist 1 and Makeup Artist 2 worked with the Operator three days prior to the incident to assess her skin tone and plan the application of a wig. Makeup Artist 2 was on site and witnessed the incident.

1.2.20 Ducati Dealership Technician

The Ducati Dealership Technician was employed by Ducati Richmond and worked on the motorcycles used during this production. In addition, he reset the motorcycles after receiving a complaint about a throttle issue on one of the stunt motorcycles (not the motorcycle involved in the incident).

The Ducati Dealership Technician was not on site at the time of the incident.

1.2.21 Ducati Technical Director

The Ducati Technical Director was the technical director of Ducati North America, Inc. He was the subject matter expert on the Ducati motorcycle and provided information to WorkSafeBC about the motorcycles.

The Ducati Technical Director was not involved in the production of this film and was not on site at the time of the incident.

1.3 Workplace

The workplace where this incident occurred was a film set in a controlled area (no vehicle or pedestrian traffic) on the west side of the Vancouver Convention Centre. The set consisted of props, lighting equipment, stunt personnel, extras, transition ramps, and cameras arranged to capture suitable images required for the film scene.

This production involved the use of a motorcycle that was to be ridden out of the Vancouver Convention Centre doors and down a set of stairs. Initially, one wooden transition ramp was placed over the first set of stairs in order to facilitate a smooth transition for the motorcycle as it was ridden down the stairs at the conclusion of the shot.

During the rehearsals on the date of the incident, a second wooden transition ramp was added to the second set of stairs. The second transition ramp was intended to provide the Operator with more distance to safely stop the motorcycle at the conclusion of the shot.

The scene being filmed required the Operator to ride a motorcycle through the exit doors of the Vancouver Convention Centre and narrowly miss Stunt Person 6, causing him to drop an ice cream cone. The Operator was then to make a left-hand turn in front of a camera filming the scene, ride down the transition ramps, and stop. (See Figure 1.)

Figure 1: *Photograph facing north, showing the film set with the two transition ramps. The arrow indicates the Operator's intended path of travel.*

At the same time, Stunt Person 1 was directed to ride a bicycle in front of the Vancouver Convention Centre doors but behind the Operator as she rode past, ride over the previously dropped ice cream cone, crash the bicycle, and collide with a balloon stand.

1.4 Sequence of events

1.4.1 Pre-incident events

On Thursday, August 10, 2017, the Operator arrived in Vancouver.

On Friday, August 11, 2017, at 0900 hours, the Operator reported to work at Mammoth Studios and met Stunt Coordinator 2. During the day, the Operator and Stunt Coordinator 2 discussed the Operator's motorcycle experience, signed her employment records, toured the studio, and went into makeup in preparation for filming on Monday morning. In addition, the Operator was fitted with a padded costume that contained padding in the back, knees, and elbows. This workday ended between 1700 and 1800 hours. New worker orientation was not provided to the Operator as required by the Regulation and TCF's safety program.

On Saturday, August 12, 2017, at approximately 1000 hours, the Operator and Stunt Coordinator 2 met at Mammoth Studios to assess the Operator's motorcycle-riding abilities and to prepare for the work activity. Stunt Coordinator 2 arranged for the Operator to ride three motorcycles of the same make and model in the parking lot so the Operator could select a preferred motorcycle. Picture Car Technician 1 delivered the motorcycles to Mammoth Studios [redacted] Alternating between the motorcycles, the Operator rode around cones and did some high-speed riding while Stunt Coordinator 2 filmed and assessed her skills. In addition, Stunt Coordinator 2 assessed the Operator's skills with skidding, braking, use of the clutch, and throttle control. After riding all three motorcycles, the Operator selected the one she was most comfortable with. [redacted]
This workday ended between 1700 and 1800 hours.

On Sunday, August 13, 2017, preparation began on a film sequence that required the Operator to ride the motorcycle up an escalator at the Vancouver Convention Centre. In order to prepare for the work activity, Stunt Coordinator 2 arranged for the crew to assemble 1000 cardboard boxes and place them on the floor on each side of the escalator as a safe landing place in case someone fell from the escalator. The entire staircase of the escalator was covered with a wooden ramp to act as a smooth platform for the motorcycle as it ascended the staircase.

For several hours, Stunt Coordinator 2 and Stunt Person 1 worked with the Operator, observing her skills and preparing her for this work activity. The Operator practised riding up the escalator on a dirt bike and then progressed to the motorcycle she had chosen the previous day. Stunt Person 1 rode behind the Operator on a second motorcycle, coaching her and providing assistance. Stunt Person 2 was called in to observe the Operator, provide guidance, and prepare herself for the work activity in the event that the Operator was unable to perform. During this

time, Stunt Person 1 and Stunt Person 2 worked with the Operator to increase her comfort level with this work activity. Stunt Person 2 coached her about squeezing the motorcycle with her legs to increase her balance and control of the motorcycle. In addition, they identified a better line for the Operator to follow when she approached the ramp. After approximately 20 rehearsals,

The Operator's training on this day was primarily focused on practising on the escalator and inside the Vancouver Convention Centre. Stunt Person 1 and Stunt Coordinator 2 also had the Operator practise riding a dirt bike (not the motorcycle she had chosen to ride in the film sequence) down the stairs outside, where the sequence would be filmed the following day. A transition ramp was put in place on the first set of stairs to facilitate the safe transition of the motorcycle as it was ridden down the stairs during filming the following day.

Stunt Person 1 stated that after observing the Operator ride the motorcycle up the escalator and ride the dirt bike down the stairs outside, This workday ended at 1800 hours.

1.4.2 Day of incident

On Monday, August 14, 2017, the Operator arrived at the Vancouver Convention Centre between 0500 and 0515 hours for hair (which included a wig), makeup, and costume.

At approximately 0530 hours, Stunt Coordinator 2 arrived at the Vancouver Convention Centre to check the venue and ensure it was consistent with the requirements of the script and was safe for the workers. Stunt Coordinator 2 provided a briefing to all stunt performers that morning regarding their respective roles.

At approximately 0630 hours, a safety meeting was held by the First Assistant Director with the department heads, including Stunt Coordinator 2, and approximately 95% of the crew. During the meeting they discussed general location safety such as first aid attendants, muster locations, and the locations of fire extinguishers. In addition, they discussed the execution of the scene where Stunt Person 1 would crash his bicycle into the balloon stand.

In order to calibrate the cameras for filming and while the Operator was in makeup, Stunt Person 3 was directed by Stunt Coordinator 2 to ride the motorcycle in the same manner as required for the scene being filmed. During these rehearsals, Stunt Person 3 wore safety headgear and was operating the motorcycle at 15 km/h — not the full speed that would be required for the film sequence. Stunt Person 3 performed six rehearsals.

At approximately 0800 hours, rehearsals continued with the Operator replacing Stunt Person 3 on the motorcycle. Picture Car Technician 2 gave the motorcycle to the Operator. During these rehearsals, the Operator was not equipped with safety headgear. The Operator participated in approximately seven rehearsals, starting with partial cast and progressing up to the full cast required for the work activity. Stunt Coordinator 2 monitored the work activity from a position west of the Vancouver Convention Centre exit doors.

The first rehearsals began with the Operator moving at quarter speed. Then she progressed to half speed and then full speed for the shot (approximately 20 to 25 km/h) as directed [redacted]. In between the rehearsals and after the Operator stopped on the landing after the first transition ramp, another worker took the motorcycle to the starting point inside the Vancouver Convention Centre. This provided Stunt Coordinator 2 and the Second Unit Director with time to discuss the scene with the Operator.

Stunt Person 4, Stunt Person 5, and Picture Car Technician 2 later told WorkSafeBC investigators during interviews that they observed the Operator "grabbing" or "stabbing" the front brake of the motorcycle during the rehearsals as she was stopping on the first transition ramp. In one rehearsal, Stunt Person 4 saw the Operator stabbing the front brake, which caused the front wheel to lock up and skid down the transition ramp, making the motorcycle unstable. Stunt Person 5 stood on the ramp to help the Operator in case the motorcycle became unstable again. Picture Car Technician 2 later stated to WorkSafeBC investigators that he observed the Operator stop the motorcycle using only the front brake, [redacted] front wheel to skid on the ramp and leave a black mark. He stated that he could see that the Operator [redacted]

After a discussion between Stunt Person 4 and Stunt Coordinator 2, a second transition ramp was installed to provide the Operator with more distance to slow and avoid unsafe braking before stopping. No barriers were put in place.

1.4.3 Incident

The entire incident was captured on video with audio. The following is a summary of the events that were captured on video.

At approximately 0814 hours, the Operator was inside the Vancouver Convention Centre preparing for the work activity. The video shows that once "action" was called, stunt performers began to walk in the area of the Vancouver Convention Centre front doors and the Operator rode the motorcycle through the doors, narrowly missing Stunt Person 6 and causing him to drop an ice cream cone. The Operator turned left and approached the first transition ramp.

As the Operator exited the Vancouver Convention Centre doors, Stunt Person 1 rode a bicycle toward where the Operator had come through the doors, riding over the dropped ice cream cone and crashing the bicycle into the balloon stand (as planned). The video shows that as the motorcycle transitioned onto the first ramp, the front wheel became airborne. When the front wheel landed, the rear wheel became airborne. When the rear wheel landed, the motorcycle immediately accelerated, resulting in a loss of control on the part of the Operator.

As the rear wheel of the motorcycle landed after the first transition ramp, the motorcycle and the Operator can be seen and heard accelerating on the landing, rather than stopping as planned. The video shows that the motorcycle continued to accelerate as it proceeded over the second transition ramp, becoming airborne.

The Operator was hanging onto the handlebars as her body bounced off the motorcycle seat; her feet were completely off the foot pegs. The motorcycle continued, struck the median on the road, and ejected the Operator. The Operator struck the branches of the tree on the sidewalk and then crashed through a window of Shaw Tower, striking her head on the window frame. (See Figure 2.) After the Operator was ejected, the motorcycle continued on until it collided with the sidewalk curb, destroying the front wheel. The motorcycle then slid into the side of Shaw Tower and came to rest on the sidewalk.

Members of the Vancouver Police Department (VPD) who were on site called 911, and BC Ambulance Service arrived at approximately 0823 hours. This incident was investigated by the VPD, the BC Coroners Service, and WorkSafeBC.

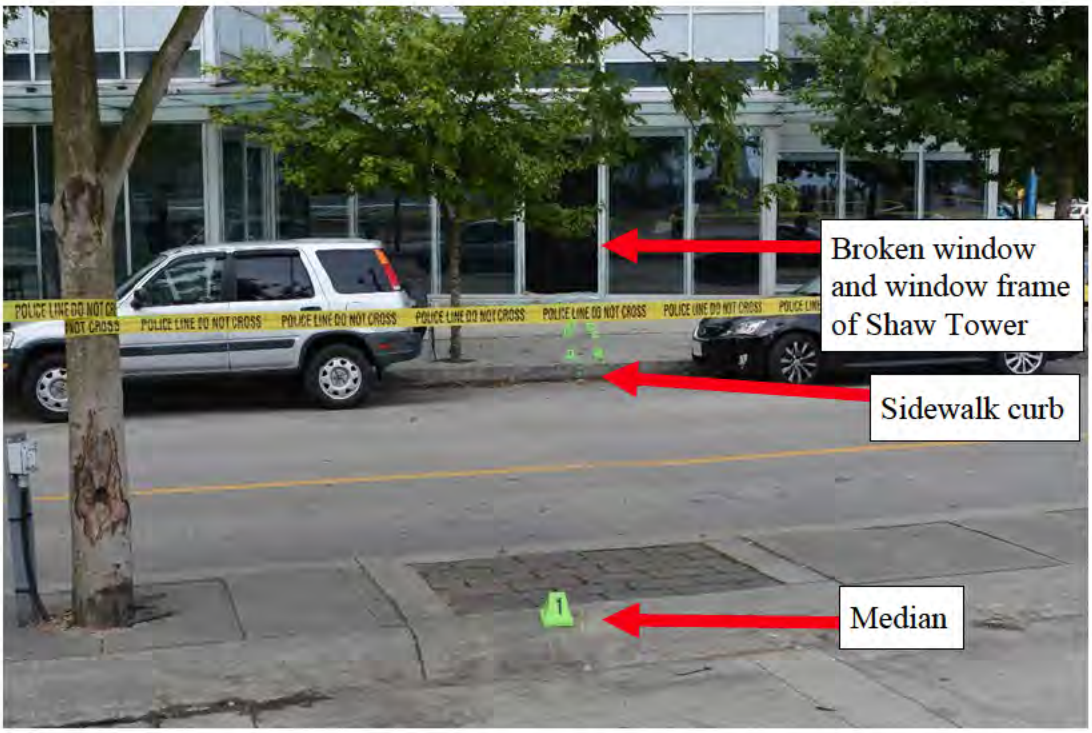

Figure 2: *Photograph facing south, showing the median (with VPD marker 1); the curb of the sidewalk that the motorcycle struck; and Shaw Tower, which the Operator and the motorcycle struck. The distance from the median (marker 1) to the broken window on Shaw Tower is approximately 18 metres.*

1.5 TCF's safety program

At the time of the incident, TCF had a formal safety program titled "Occupational Health & Safety Program: British Columbia, Canada." This program was prepared by Fox Production Safety, located in Los Angeles; tailored to reference and comply with B.C. law and regulation; and provided to TCF, which adopted the program as its own. The program begins with the following policy statement:

> The health and safety of our employees are of primary importance. Therefore, we have an obligation to each employee to maintain the highest possible safety standards.
>
> Production Management has taken an aggressive approach to fulfill this responsibility by insisting upon the total support and commitment of management in our safety program(s). This approach enables us to minimize the potential for workplace accidents, to meet or exceed provincial and federal compliance requirements, and to establish our reputation as leaders by integrating safety standards into all aspects of our operations.

On May 15, 2017, and July 13, 2017, the Health and Safety Consultant provided safety orientations to the various department heads associated with this production. These orientations consisted of reviewing TCF's safety program and sections 115 through 117 of the Act. It was the responsibility of the various department heads to convey the information from the orientations to their respective workers.

TCF's safety program contains 18 sections, including TCF's health and safety policy and information regarding the responsibilities and duties of TCF and its workers.

TCF's safety program contains a list of forms and checklists for various activities and locations that are to be completed to ensure a safe work environment. Section 18.0 of the TCF safety program states: "Keep in mind that no checklist covers all possible situations, so unique circumstances might require different or additional documentation. *Risk Assessment Worksheets* … should be completed in addition to the following checklists that help identify / verify necessary preparations for, potentially hazardous activities."

Although the entire program was thoroughly examined, only the following relevant sections and checklists of this program will be discussed in this report:

- Risk assessment — According to the "Risk Assessments" section of TCF's safety program: "A written risk assessment is to be completed by personnel who are familiar with the particular work to be conducted at a prospective location. The purpose of the risk assessment is to identify potential site safety hazards prior to production activities being undertaken. … See the *Risk Assessment Worksheet*."

  TCF was unable to provide documentation to show that a written risk assessment was completed.

- Stunt safety inspection checklist — According to the "OH&S Program Responsibilities" section of TCF's safety program: [redacted] must ensure the safety of cast and crew before, during, and after stunt sequences. Refer to the *Stunt Safety Inspection Checklist* … which provides basic safety guidelines."

  The stunt safety inspection checklist has a list of nine "basic procedures" [redacted] to review and follow:

  1. Complete a stunt diagram on enclosed form.
  2. Notify all personnel involved of your intention to perform a stunt.

3. Conduct a detailed briefing of the stunt: What will happen, who it will happen to, the hazards involved, emergency procedures and the location of emergency medical facilities.
4. Answer any questions or respond to concerns completely.
5. Allow adequate rehearsal time.
6. Have one last briefing and dry run to ensure everyone's understanding.
7. If there are any changes, review from the beginning.
8. Clear the set of unnecessary personnel.
9. Make sure that communications are absolutely clear between everyone involved.

After a space where [redacted] is to "describe in detail the stunt to be performed," the next section of the stunt safety inspection checklist consists of checkboxes where "Yes," "No," or "N/A" can be selected in response to a series of inspection items. One of the inspection items says:

Have you planned procedures for:
- Human error
- Mechanical error
- Natural acts (i.e. weather changes)
- Outside interference
- Anything unexpected

TCF was unable to provide documentation to show that the stunt safety inspection checklist was completed for this work activity.

- Production activity notification checklist — According to the "OH&S Program Responsibilities" section of TCF's safety program, [redacted] must ensure that the production activity notification checklist is completed whenever stunts, special effects, or unusual activities or locations are scheduled. As part of this checklist, motorcycles are listed under specialized vehicles/equipment. This document is to be sent to the Production Safety Department at least 48 hours prior to the activity to allow sufficient time for that department to contact the production. The production activity notification checklist states: "This form is designed to encourage ongoing communication between the Fox Production Safety Department and your production."

  TCF was unable to provide documentation to show that the production activity notification checklist was completed for this work activity.

- Location hazard assessment checklist — According to the "Location Hazards Assessments" section of TCF's safety program: "The purpose of the location hazard assessment is to identify potential site safety hazards prior to production activities being undertaken. This way, the hazards can be eliminated or effectively controlled before production personnel arrive on site." The location hazard assessment checklist assesses the following items: access and egress, hazardous materials, security, water/washroom facilities, fire systems, electrical hazards, fall protection, traffic control, safety notices, and first aid.

  TCF completed a location hazard assessment checklist for this location.

- Personal protective equipment — According to the "Personal Protective Equipment (PPE)" section of TCF's safety program:

  > Personal Protection Equipment (PPE) must be worn when hazards cannot be controlled practically by elimination, substitution and/or engineering controls. Depending on the work to be performed, crew members may be required to wear various types of PPE, such as hard hats, safety glasses, face protection, steel toe and shank boots, high visibility vests, life jackets, hearing protection, respiratory protection and others.

  A subsection titled "Safety Headgear" states the following in its entirety: "Hard hats must be worn by all crew members in any work area where there is a danger of head injury from falling, flying or thrown objects. Safety headgear must meet the requirements for industrial applications and class 'B' requirements for construction applications."

  Another subsection, titled "Other Special Protective Clothing," states the following in its entirety: "There may be other special protective equipment and/or clothing required, depending on the work to be conducted (e.g., life jackets if performing work on water)."

- Young and new worker orientation checklist — According to the "Young & New Worker Orientation" section of TCF's safety program: "All productions must ensure that a young or new worker is given a health and safety orientation and training specific to his/her workplace before beginning work."

  TCF was unable to provide documentation to show that the Operator was provided with the orientation or completed the young and new worker orientation checklist.

- Employee OH&S [occupational health and safety] orientation sign-off form — According to the "New Employee Orientation" section of TCF's safety program, the employee OH&S orientation sign-off form must be signed by the employee upon completion of the new worker orientation.

  TCF was unable to provide documentation to show that the Operator completed the employee OH&S orientation sign-off form.

1.6 TCF's process for hiring the Operator

TCF did not have a written process for hiring and assessing stunt people. According to Stunt Coordinator 2 and the Union of British Columbia Performers (UBCP), a common practice used by TCF for hiring a stunt person is for the stunt coordinator to seek out local talent in consultation with the UBCP. Considerations for the stunt person being hired were height, weight, and ethnicity to match the actor and skill set to match the work activity.

TCF was unable to locate a worker who resided within Canada to fulfill its needs; therefore, TCF broadened its search to include the U.S. Stunt Coordinator 1 explained to WorkSafeBC investigators that TCF was seeking [redacted] female motorcycle operator. The Operator was ultimately chosen for this work activity.

The Operator was not considered local talent by the UBCP/ACTRA (Alliance of Canadian Cinema, Television, and Radio Artists) as she resided in [redacted] In order for the Operator to work as a stunt performer in B.C., TCF required authorization from the UBCP/ACTRA because of the collective bargaining agreement that was in place.

[redacted] the Operator signed the employment agreement with Fox 56 to work as a stunt performer acting as a "stunt double."

On August 9, 2017, TCF submitted a UBCP/ACTRA work permit request, seeking consent to hire the Operator because she possessed [redacted] In addition, TCF stated in the work permit request: [redacted] the role requires 'trick' riding [redacted] This work permit was approved on August 10, 2017, authorizing the Operator to work as a stunt performer in B.C. [redacted]

The Operator was lent by Fox 56 to TCF for the duration of her employment to work in B.C. as a stunt performer. Accordingly, TCF was the Operator's employer for the purposes of the Act and was charged with all of an employer's duties and obligations with respect to the Operator.

1.7 Operator's motorcycle experience

The Operator began riding motorcycles in 2009. According to the Operator's website, prior to 2014, she had one and a half years of road-racing experience. In 2014, the Operator participated in multiple classes of motorcycle racing in the Championship Cup Series and continued to race motorcycles in American Motorcycle Association–sanctioned events. The Operator participated in approximately 10 races per year until 2017.

The Operator had experience racing different motorcycles, including a 2014 Kawasaki Ninja 300 and a 2013 Suzuki GSXR 750. In addition, she had experience riding a Suzuki 1000cc and a Suzuki 1300cc motorcycle and owned a dirt bike for riding off road.

1.8 Personal protective equipment

Pursuant to Part 8 of the Regulation, the Operator was required to use safety headgear during the work activity.

The motorcycle owner's manual states: "Attention: Failure to be wearing a helmet in case of accident increases the chance of serious injury and even death." When discussing apparel, including helmet, the owner's manual states: "Important: For your safety this type of clothing must be used in both summer and winter."

This manual was not made available on the set. The manual was not reviewed [redacted] prior to using the motorcycle.

Actsafe Bulletin #20, titled "Motorcycles" and dated May 2003, includes eight points to be followed while using motorcycles on set. Point number 3 in the Actsafe bulletin states:

> Approved protective clothing and other approved equipment such as a helmet, gloves, etc. should be worn at all times, the only exception being scene requirements while actually being photographed. In such situations, protective clothing should be worn under the costume if possible.

Actsafe is a health and safety association that provides safety training and resources to employers and workers in B.C.'s motion picture and performing arts sectors.

1.9 Motorcycle selected for filming

The motorcycle selected for use was a 2016 Ducati Hyperstrada 939 that was loaned to TCF for this film by Ducati North America in July 2017.

TCF received six brand new 2016 Ducati Hyperstrada 939 motorcycles to use during this film. Three were dedicated for use by the actors and would not be used for stunts; these were known as *hero* motorcycles. Three other motorcycles were dedicated for use by the stunt people and were known as *stunt* motorcycles. The hero and stunt motorcycles were each numbered from 1 to 3. The motorcycle involved in the incident was stunt motorcycle 2 and was the motorcycle selected for use by the Operator during the days prior to filming.

As part of the agreement between Ducati North America and TCF, the motorcycles were prepared cosmetically to be black instead of the original red. The suspensions were lowered so the operators would be able to touch the ground. The Ducati Technical Director (from Ducati North America) stated that the rider "would still get the full benefit of the standard suspension." The suspension on the Ducati motorcycles is designed for riding on flat surfaces and going over potholes and roadside curbs.

1.9.1 Onboard computer (riding modes)

Each motorcycle was equipped with a computer system that would allow the motorcycle operators to select one of three riding modes: Sport, Urban, and Touring. According to the Ducati Dealership Technician, Sport mode is the motorcycle's default setting. Sport mode is described by the Ducati Technical Director as "aggressive" because it provides more torque, "full power, and a faster throttle delivery" than Urban and Touring modes.

According to the Ducati Technical Director: "The Ducati is more powerful lower in the rev range. The rotation distance of a Ducati throttle would typically take less movement for more power, enhancing the chance of whiskey throttle." *Whiskey throttle* is a term used by motorcycle riders and those in the motorcycle industry to describe an inadvertent act on the part of the rider that results in twisting of the throttle, sudden acceleration, and resultant loss of control of the motorcycle.

Picture Car Technician 1 stated in an interview that when he delivered the motorcycles to Mammoth Studios on the Saturday before the incident, the motorcycles were in Sport mode. Picture Car Technician 2 stated that when he gave the motorcycle to the Operator on the day of the incident, it was in Sport mode.

The post-incident analysis of the motorcycle determined that at the time of the incident, the motorcycle ridden by the Operator was in Sport mode.

1.9.2 Ducati traction control (DTC)

In addition to different riding modes, this motorcycle was also equipped with DTC. According to the owner's manual, the DTC can be set to a sensitivity of 1 to 8 or off. The DTC for this motorcycle controls the traction between the rear tire and the ground. Level 1 traction control reduces friction between the tire and the ground and allows the operator to perform a burnout (tire slippage and loss of traction with the road surface). Level 8 increases traction between the tire and the ground and prevents burnouts from occurring. Level 8 is most desirable in slippery road conditions.

The post-incident analysis of the motorcycle determined that at the time of analysis, the instrument panel reported that the DTC was set at level 1, while the black box status and both faults reported level 8. Due to these conflicting results, the exact DTC setting at the time of the incident is unknown.

1.9.3 Anti-lock braking system (ABS)

The ABS on the motorcycle had three settings: off, level 1, and level 2. The motorcycle owner's manual states that the ABS default setting for Sport and Touring modes is level 1, and for Urban mode the default setting is level 2. Both levels affect the performance of both wheels. The manual states that level 1 ABS is to be used "in good grip conditions" as "this calibration focuses on braking power and yet keeps good stability under braking and lift-up control." The manual states that level 2 is "for use in any grip conditions. … This calibration focuses on maximum vehicle stability and lift-up prevention, yet ensuring performance in terms of top maximum deceleration."

The post-incident analysis determined that the motorcycle was in Sport mode. Since level 1 is the default setting while the motorcycle is in Sport mode, it is logical to conclude that the ABS was set to level 1 at the time of the incident.

1.9.4 Kill switch with lanyard

Each motorcycle was equipped with a standard kill switch (button) on the right handlebar. A secondary kill switch was added by TCF on the right side of the motorcycle, with a lanyard attached. (See Figure 3.) The lanyard is attached to the wrist, waist, or thigh of the stunt person; the location of the lanyard is left to the stunt person's discretion. When the motorcycle is being driven and is purposefully or inadvertently spilled by the stunt person, the lanyard is pulled from

the secondary kill switch and the engine immediately stops running. This prevents the motorcycle from continuing on under its own power, out of control.

Picture Car Technician 1 explained during an interview that when he delivered the motorcycles to Mammoth Studios, he oriented Stunt Coordinator 2 and the Operator to the use of the kill switch. Stunt Coordinator 2 stated during an interview that he told the Operator to wear the kill switch lanyard. At the time of the incident, the Operator was not wearing the kill switch lanyard.

Figure 3: *The motorcycle, showing the location of the secondary kill switch.*

1.10 Motorcycle mechanical inspection

WorkSafeBC contracted SAMAC Engineering Ltd. to conduct a mechanical inspection of the motorcycle to determine whether there were any indications that the motorcycle accelerated without throttle input by the Operator. SAMAC Engineering's inspection and the motorcycle specifications at the time of the incident will be discussed in section 2.7 of this report.

1.11 Incident scene video footage

Video footage of the incident was obtained during the course of the investigation. Two separate experts were tasked with conducting an analysis of the video footage of the incident.

One expert, a WorkSafeBC engineer, was tasked with determining what caused the motorcycle to accelerate rather than stop at the first transition ramp landing. This analysis consisted of examining the motorcycle throttle and video footage for evidence of mechanical failure or rider error. The engineer's analysis will be discussed in section 2.9.1 of this report.

The second expert, Blackstone Forensics Ltd., was tasked with determining the speed of the motorcycle as it reached the top of the first transition ramp and the top of the second transition ramp. This analysis consisted of an examination of video footage and measurements obtained

from the incident scene. The Blackstone Forensics analysis will be discussed in section 2.9.2 of this report.

2 Findings

2.1 Vancouver Police Department investigation

On August 14, 2017, the VPD was on site during filming and immediately notified emergency personnel at the time of the incident. The VPD was able to preserve the scene for examination.

The VPD conducted an investigation that consisted of photographing, measuring, and recording the scene; conducting witness interviews; and reviewing video footage of the incident. The VPD did not conduct a mechanical inspection of the motorcycle. The VPD determined that a criminal investigation was not warranted.

2.2 BC Coroners Service investigation

According to the BC Coroners Service, the Operator sustained multiple injuries, the most significant [redacted]

2.3 TCF's safety program

2.3.1 Daily morning safety meetings

According to the Health and Safety Consultant, safety meetings were held every morning on set by the First Assistant Director and the meetings were documented. The cast, crew, and department heads attended these meetings. The department heads are expected to share the information discussed with members of their teams who did not attend the safety meeting. During these meetings, they discussed hazards on the set, evacuation routes, first aid, and any known hazards.

2.3.2 Risk assessment

As stated in section 1.5 of this report, TCF's safety program requires a written risk assessment by personnel who are familiar with this particular work activity. According to the Executive Producer, completion of the risk assessment reports is the responsibility of the [redacted]

This investigation determined that neither [redacted] nor any personnel who are familiar with this particular work completed or directed anyone to complete a risk assessment with respect to:

- Whether a motorcycle could be safely used during this stunt.
- Whether the motorcycle used in the stunt was an appropriate (in other words, safe) choice of motorcycle for use during the stunt.

- Whether the motorcycle should have been modified to ensure a safe maximum speed during the filming of the stunt.
- Determining the safest riding mode (Sport, Urban, or Touring) for the motorcycle during this stunt. Ducati representatives were on the set and available for consultation during the filming.
- Whether the Operator should have worn a safety helmet during the filming of this stunt.
- Whether safety barriers, nets, or pads should have been put in place to ensure the safety of the Operator, other workers, and the general public in the event of human error or mechanical failure during the filming of the stunt. No consideration was given to the fact that as a result of the installation of the second transition ramp, the Operator was no longer required to stop the motorcycle so quickly after the first ramp. This change in the set design allowed the Operator to approach the first transition ramp with greater speed than on previous practice runs. The potential consequence of this change was that the Operator could approach the first transition ramp with greater speed, causing the motorcycle to become airborne, resulting in a loss of control.
- Whether a flat deceleration area could have been provided just north of the Vancouver Convention Centre doors where the Operator exited to ensure safer deceleration, given the type of suspension that the motorcycle was equipped with.

By failing to complete a risk assessment, TCF did not comply with the requirements of its own safety program.

2.3.3 Stunt safety inspection checklist

[redacted] stated during an interview: "We probably had 10 to 15, 10 to 12 stunt performers in that scene." The planned stunt included Stunt Person 1 crashing his bicycle into a balloon stand and knocking over a helium tank. During filming, the scene unfolded as follows:

- The Operator rode the motorcycle out the front doors of the Vancouver Convention Centre, narrowly missing Stunt Person 6, causing him to drop an ice cream cone.
- Stunt Person 1 rode a bicycle toward where the Operator had come through the doors of the Vancouver Convention Centre.
- As planned, Stunt Person 1 rode over the ice cream cone that had been dropped and crashed his bicycle into a balloon stand.
- The Operator continued on after the planned near miss but lost control of the motorcycle she was riding, was ejected from the motorcycle when it struck the median, and collided with Shaw Tower across the street, sustaining fatal injuries.

[redacted] failed to describe this activity as a stunt even though it included 10 to 12 stunt performers working in close proximity to a motorcycle. Stunt Person 1 was involved in this scene and stated during an interview that it was his actions (crashing his bicycle into the balloon stand) that formed the basis of the stunt.

[redacted] e weren't doing anything dangerous other than, the dangerous thing was

the kid on the bicycle. Crashing. So that was the danger of this scene. He was falling off his bike, on concrete, into a balloon stand. That's it. [The Operator] was not doing anything [redacted] failed to recognize this work activity as a stunt and therefore did not complete a stunt safety inspection checklist.

According to the employment agreement, the Operator was hired as a "stunt double." Other workers involved in this work activity were referred to as *stunt performers* or *stunt people*. The events on the set leading up to the incident included workers who were hired as stunt performers and directed to perform a stunt (crashing a bicycle into a balloon stand).

[redacted] stated that stunt coordinators review the stunt activities and assess controls for the safety of the stunt person doing the stunt as well as stunt people nearby. [redacted] stated that because stunts are "fluid," [redacted] stunt safety documents like the stunt safety inspection checklist. This is contrary to TCF's safety program.

[redacted] Whiskey throttle was, therefore, a risk known [redacted] By not completing the stunt safety inspection checklist, [redacted] not identify whiskey throttle or human error as a risk; therefore, no controls were put in place to eliminate or mitigate this risk. Had the stunt safety inspection checklist been completed as required, the risks associated with human error (whiskey throttle) and changes to the set (adding a second ramp) could have been assessed, and mitigating factors could have been implemented to reduce risk to the Operator, the rest of the film crew, and the general public.

According to TCF's safety program: [redacted] are responsible for ensuring that their crew conducts work in compliance with health and safety policies and procedures." TCF's safety program states: [redacted] must ensure the safety of cast and crew before, during, and after stunt sequences. Refer to the *Stunt Safety Inspection Checklist* … which provides basic safety guidelines."

[redacted]

For the following reasons, this investigation has concluded that the work activity involving the Operator was a stunt:

1. The work activity was supervised by Stunt Coordinator 2.
2. The Operator was hired as a "stunt double."
3. TCF had arranged for approximately 10 to 15 stunt performers to perform in this work activity.
4. The work activity consisted of:

a. The use of a motorcycle ridden by a stunt double.
b. Stunt Person 6 having a near miss with the motorcycle and dropping an ice cream cone.
c. Stunt Person 1 riding a bicycle over the ice cream cone and crashing the bicycle into a balloon stand, knocking over a helium tank.
d. The Operator riding a motorcycle at slow speed through other stunt performers and riding down a transition ramp.

[redacted] had a responsibility to ensure the cast and crew were following safe work procedures. [redacted] had a responsibility to ensure the safety of the cast and crew. [redacted] had the responsibility to ensure that the stunt safety inspection checklist was completed. [redacted] had the responsibility to ensure that the production activity notification checklist was completed and the Production Safety Department received a copy of the checklist advising that a specialized vehicle, a motorcycle, was being used.

2.3.4 Production activity notification checklist

As stated in section 1.5 of this report, the production activity notification checklist is intended to identify potentially hazardous activities and advise the Production Safety Department so it can provide assistance with regulatory requirements and recommend precautions for cast and crew.

This investigation determined that [redacted] did not ensure that this checklist was completed. According to TCF's safety program, it was the responsibility of [redacted] to ensure that this checklist was completed when activities involving specialized vehicles, including motorcycles, takes place.

2.3.5 Location hazard assessment checklist

As stated in section 1.5 of this report, the location hazard assessment checklist is intended to identify potential site safety hazards prior to production activities being undertaken so they can be resolved prior to filming. The location hazard assessment checklist completed by TCF did not consider the work activity the Operator was being directed to perform; therefore, site safety hazards associated with this specific work activity were not identified.

2.3.6 New worker orientation

Section 3.23(1) of the Regulation requires an employer to ensure that before a new worker begins work in a workplace, the new worker is given health and safety orientation and training specific to that workplace. Specific topics must be included in the new worker orientation, such as the worker's right and responsibility to report unsafe conditions, the right to refuse to perform unsafe work, workplace health and safety rules, hazards the new worker may be exposed to, the employer's safety program (if one is required under section 3.1 of the Regulation), and personal protective equipment. Section 3.25 requires the employer to document and keep records of all orientation and training provided under sections 3.23 and 3.24 of the Regulation.

TCF did not provide any documentation, such as the young and new worker orientation checklist and/or the employee OH&S orientation sign-off form, to show that the Operator was given any new worker orientation.

[redacted] stated that a new worker orientation was not given to the Operator. According to TCF's safety program: [redacted] is ultimately responsible for ensuring that young and new worker orientations are provided to every employee at every facility and location. Every employee is considered to be a 'new worker' at every new location."

[redacted] the Operator received training on the motorcycle in the days leading up to the incident; however, TCF did not provide any documentation to WorkSafeBC to support that this training took place, nor did TCF provide documentation to show that a new worker orientation took place.

This investigation determined that [redacted] nor any of the individual department heads completed or directed anyone to complete a new worker orientation with the Operator, which is contrary to the Regulation and TCF's safety program.

2.3.7 Examination of due diligence on the part of TCF

The investigation determined that TCF did not ensure that:

- A written risk assessment was completed [redacted] or any personnel who are familiar with this particular work.
- The stunt safety inspection checklist was completed for this work activity by [redacted] or anybody under TCF's direction.
- The production activity notification checklist was completed for this work activity by the [redacted] anybody under TCF's direction.
- [redacted] anyone under TCF's direction provided the Operator with a new worker orientation and ensured that the Operator completed the young and new worker orientation checklist.

TCF has the responsibility to ensure the health and safety of workers. This investigation determined that there was insufficient evidence to demonstrate that TCF was duly diligent in ensuring the Operator's health and safety.

2.4 Operator's motorcycle experience

Based on documentation, interviews, and the Operator's website, the Operator was experienced in the following:

- Racing certain types of motorcycles on an open race track
- Travelling at a high rate of speed on a motorcycle
- Performing high-speed braking on a motorcycle

- Operating specific motorcycles (as noted above in section 1.7)

[redacted]

2.5 Personal protective equipment

According to TCF's employer incident investigation report, [redacted] stated that the Operator did not need to wear safety headgear. [redacted] stated that the character the Operator was portraying in the script did not wear a helmet and, therefore, the Operator was not to wear one.

[redacted] However, no one was overseeing [redacted] work to ensure compliance with the Regulation.

The Operator was provided with a helmet and wore the helmet on the two days prior to the incident, during her assessment at Mammoth Studios and during rehearsals on the escalator at the Vancouver Convention Centre. The Operator did not wear a motorcycle helmet during the rehearsals on the morning of the incident or during the filming at the time of the incident.

Makeup Artist 1 and Makeup Artist 2 told WorkSafeBC investigators that the wig the Operator was required to wear would have hidden safety headgear.

[redacted] had a responsibility to ensure proper safety headgear was worn by the Operator, as required by Part 8 of the Regulation, [redacted]

2.6 TCF's mechanical inspections

The Picture Car Wrangler stated that she conducted pre-trip inspections of the motorcycles on a daily basis. TCF was unable to produce documentation to show that these mechanical inspections were completed. The Picture Car Wrangler reported that the inspections consisted of bringing the motorcycles up to operating temperature, checking fluids, testing the lights, and test riding the motorcycles.

Prior to the incident, in August 2017, Stunt Person 3 reported that one of the stunt motorcycles had a mechanical issue with the throttle. (This was not the motorcycle that was later involved in the incident.) As a result, the Ducati Dealership Technician was dispatched to inspect the motorcycles. The Ducati Dealership Technician conducted an injection update and reset all six motorcycles. No other mechanical issues were reported in relation to any of the motorcycles for the remainder of this production.

2.7 Motorcycle specifications at time of incident

WorkSafeBC conducted a post-incident analysis on the motorcycle with the assistance of a third-party forensic engineering company, SAMAC Engineering. WorkSafeBC invited representatives of Ducati Richmond, Ducati North America, and TCF, who were present for the analysis. Computer data stored on the motorcycle's system was downloaded and analyzed. Data downloaded includes but is not limited to wheel speed, rpm (revolutions per minute), error codes, throttle, and accelerator. The motorcycle was analyzed with the engine off and on, including operator controls such as the throttle, clutch, and brakes.

Other than damage sustained during the collision, the examination determined the motorcycle to have been free of any defects and functioning according to the manufacturer's specifications.

2.7.1 Onboard computer (riding modes)

Each motorcycle was equipped with a computer system that enables the motorcycle operator to select one of three riding modes: Sport, Urban, and Touring. Sport mode is designed for racing or aggressive driving and accelerates quickly. Urban and Touring modes delay acceleration. The post-incident analysis of the motorcycle conducted by SAMAC Engineering determined that at the time of the incident, the motorcycle ridden by the Operator was in Sport mode. TCF did not complete a risk assessment to determine the safest mode for the motorcycle for this work activity.

The motorcycle's onboard computer revealed that the last reading regarding speed, rpm, and gear selection shows that the motorcycle was travelling at 47 km/h, the rpm was 4728, and the motorcycle was in first gear. Based on a review of the video of the incident, these readings likely indicate the speed, rpm, and gear selection of the motorcycle as it collided with the sidewalk curb (see Figure 2). It is at this time that the motorcycle sustained significant front-end damage and the front wheel stopped rotating.

2.7.2 Throttle

After the incident, the motorcycle could be started and a throttle test was conducted. The test revealed that the throttle was operating as per the manufacturer's specifications.

The post-incident analysis indicated that the motorcycle responded to throttle control inputs by the Operator at the time of the incident.

2.7.3 Ducati traction control (DTC)

The DTC can be set to a sensitivity of 1 to 8 or off. At the time of the post-incident analysis of the motorcycle, the instrument panel reported that the DTC was set at level 1, while the black box status and both faults reported level 8. Due to these conflicting results, the exact DTC setting at the time of the incident is unknown. A risk assessment was not performed by TCF to identify the most appropriate traction control setting for the motorcycle for this work activity.

2.7.4 Anti-lock braking system (ABS)

The ABS was not intervening at the time of the incident because the Operator did not engage the brakes. TCF did not conduct a risk assessment to determine the most appropriate ABS setting for the motorcycle for this work activity.

As SAMAC Engineering's analysis showed, the motorcycle was in Sport mode. It is logical to conclude that the ABS was in level 1, since it is the manufacturer's default setting.

2.7.5 Kill switch with lanyard

Each motorcycle was equipped with a standard kill switch on the right handlebar and a secondary kill switch on the right side of the motorcycle, with a lanyard attached. The Operator was not wearing the lanyard at the time of the incident.

Actsafe Bulletin #20, titled "Motorcycles" and dated May 2003, states:

> All picture motorcycles must be equipped with a grounded cut-off switch (deadman switch). When a stunt is to be performed, this switch must be attached to the handlebars and the wrist of the operator in such a manner that the engine shuts off when the rider's hand separates from the motorcycle.

A post-incident examination of both kill switches found them to be in working condition and operating as intended.

2.8 Operation of motorcycle at time of incident

Prior to the work activity, the Operator was instructed to drive the motorcycle at approximately 20 to 25 km/h during filming.

The forensic analysis of the video footage of the incident determined that the motorcycle was travelling at approximately 28 km/h when it reached the top of the first ramp. The last known reading from the onboard computer system indicates that the motorcycle was travelling at 47 km/h, likely at the point of impact with the sidewalk curb.

The forensic video analysis shows that the speed at which the Operator was travelling when she exited the Vancouver Convention Centre doors was approximately 17 km/h, which was consistent with the directions provided to her prior to the work activity. However, when the Operator approached the first transition ramp, the motorcycle was travelling at approximately 28 km/h, which caused the motorcycle to leave the surface of the first transition ramp and land hard on the first staircase landing. TCF did not conduct a risk assessment to determine if the motorcycle would or could become airborne as it travelled over the first transition ramp at a speed of 20 to 25 km/h.

Witnesses reported that the Operator was travelling faster during the incident than previously rehearsed. [redacted] at the time of the incident, he noted that the speed of the motorcycle appeared faster than on the four previous practice runs. In the video, it can be seen that the impact of the motorcycle landing on the first transition ramp compressed the motorcycle's suspension, causing it to bottom out. Because the Operator was seated as the motorcycle landed, the force of the landing caused her body to move down along with the motorcycle. This downward movement caused the Operator's wrists to drop down while holding onto the handlebars of the motorcycle. As her right wrist moved down, the throttle on the right handlebar rotated down as well, causing the motorcycle to suddenly accelerate. Due to the force of the acceleration, the Operator's body was forced backward, pulling her away from the handlebars. Her grip on the handlebars caused the motorcycle to continue to accelerate.

These actions caused the motorcycle and the Operator to accelerate off the second transition ramp and become airborne, resulting in a total loss of control. The motorcycle continued until it hit the median and ejected the Operator. After being ejected from the motorcycle, the Operator collided with the branches of a tree and then the window and window frame of Shaw Tower. The motorcycle collided with the sidewalk curb and then the side of Shaw Tower, where it came to rest on the sidewalk.

2.9 Forensic video analysis

In the audio portion of the video during this sequence, the rpm of the motorcycle can be heard increasing in a manner consistent with the speed of the motorcycle, indicating that the motorcycle's throttle was being activated. When the motorcycle landed, it continued to accelerate until coming into contact with a median on the street. Upon impact with the median, the Operator was ejected from the motorcycle and launched into the air. The video shows the Operator striking tree branches prior to crashing into a window and window frame of Shaw Tower. When the motorcycle landed, it struck the sidewalk curb and collided with the side of Shaw Tower before coming to rest on the sidewalk.

2.9.1 WorkSafeBC engineer

A WorkSafeBC engineer was tasked with examining the motorcycle and the video footage of the incident to determine if the motorcycle accelerated as a result of a mechanical failure or inputs from the Operator.

The engineer concluded that the physical examination of the motorcycle and the video analysis failed to show any indications that the motorcycle experienced a mechanical malfunction during this incident.

2.9.2 Motorcycle speed

WorkSafeBC contracted Blackstone Forensics to conduct a forensic video analysis to determine the speed of the motorcycle at various points during the work activity, based on a review of the video footage and measurements made at the scene.

This series of calculations indicates that the motorcycle was accelerating from the point it left the Vancouver Convention Centre doors (approximately 17 to 18 km/h) until it reached the top of the second transition ramp. The following is a summary of the calculations:

1. Vancouver Convention Centre doors to 4.65 m away: Approximately 17 to 18 km/h
2. Top of first transition ramp: Approximately 28 km/h
3. Top of second transition ramp: Approximately 33 km/h

When the motorcycle reached the top of the first transition ramp, it was travelling approximately 28 km/h — only slightly above the speed directed to the Operator [redacted] but fast enough to cause the motorcycle to become airborne, resulting in the Operator losing control of the motorcycle.

3 Conclusions

3.1 Cause

3.1.1 Operator lost control of motorcycle

The Operator suffered a fatal injury after losing control of a motorcycle while filming a stunt scene. While riding a motorcycle down a transition ramp, the Operator lost control of the motorcycle, causing it to accelerate. The motorcycle collided with a median on the street and ejected the Operator. The Operator subsequently collided with the branches of a tree and then the window and window frame of Shaw Tower across the street from the filming location.

3.2 Contributing factors

3.2.1 Failure to conduct risk assessment

TCF failed to conduct a risk assessment addressing the following:

- Safety controls — An assessment should have identified the hazards and risks of performing the stunt, including the possibilities of human error and mechanical failure. The implementation of effective safety controls in the event of a mishap would have reduced the risk to the Operator, the cast, the crew, and the general public. By failing to complete a risk assessment and failing to implement effective safety controls with respect to the execution of a dangerous work activity, TCF failed to ensure the safety of the Operator.
- Speed of motorcycle — [redacted] directed the Operator to ride the motorcycle at 20 to 25 km/h. No risk assessment was conducted to determine at what speed the motorcycle would become airborne as it travelled off the first transition ramp. Nor was a risk assessment conducted to determine if the addition of a second transition ramp would cause the Operator to travel over the first transition ramp at a speed great enough to cause the motorcycle to become airborne, resulting in a loss of control.
- Equipment limitations — The motorcycle selected for use in this work activity is designed to navigate on smooth surfaces. The suspension of this motorcycle and the adjustments made to it (lowering the suspension so the operators would be able to touch the ground) make it a poor choice for use in situations where it may become airborne. Additionally, a risk assessment was not conducted to determine the most appropriate riding mode (Sport, Urban, or Touring) for the motorcycle during this work activity.
- Stunt safety inspection checklist — TCF's safety program requires a stunt safety inspection checklist to be completed prior to the stunt taking place as a safety measure to assess risk. [redacted] did not complete a stunt safety inspection checklist in relation to this work activity, nor [redacted] convey the contents of the stunt safety inspection checklist to the Operator. The location hazard assessment checklist completed by TCF did not adequately consider the work activity that the Operator was taking part in. By failing to complete a stunt safety inspection checklist and failing to implement effective safety controls with respect to the execution of a dangerous work activity, TCF failed to ensure the safety of the Operator.
- Production activity notification checklist — TCF's safety program requires that a production activity notification checklist be completed whenever stunts, special effects, or unusual activities or locations are scheduled. By failing to complete a production activity notification checklist, TCF did not notify the Fox Production Safety Department.

3.2.2 Failure to provide new worker orientation

TCF failed to ensure that the Operator was provided with a new worker orientation and failed to ensure that the Operator completed the young and new worker orientation checklist.

As the Operator had no prior experience as a motorcycle stunt double and was new to the film industry and the filming location, TCF was required to provide a new worker orientation for the

Operator. Among other things, a new worker orientation should have advised the Operator of the personal protective equipment required for her job duties, such as proper safety headgear.

3.2.3 Inadequate workplace set-up and planning

TCF failed to ensure that the workplace was designed with safety controls in place so that the Operator or the motorcycle could not proceed beyond the perimeter of the film set. Barriers were absent that should have prevented the Operator and motorcycle from leaving the set perimeter. During this incident, the Operator and the motorcycle she was riding left the perimeter of the set and narrowly missed members of the public prior to crashing into Shaw Tower across the street from the filming location.

The second transition ramp was not part of the initial planned design; it was installed during the rehearsals after the Operator was observed stopping in an unsafe manner on the first transition ramp. The second transition ramp was intended to increase the Operator's stopping distance, which would in turn eliminate the need to stop the motorcycle in an unsafe manner to avoid the second set of stairs. However, this did not take into account the fact that the addition of the second transition ramp might allow the Operator to approach the first transition ramp at a speed great enough to cause the motorcycle to become airborne. A flat deceleration area would have removed the need to transition to another level and would have prevented the loss of control that resulted in this incident.

3.2.4 Lack of safety headgear

TCF failed to ensure that the Operator was wearing safety headgear as required by the Regulation and the motorcycle manufacturer.

3.2.5 Failure to ensure the health and safety of workers

TCF failed to ensure the health and safety of the Operator by failing to provide adequate supervision with respect to this work activity.

[redacted] did not ensure that TCF's safety program was fully implemented and that personnel were performing their assigned duties under this program.

[redacted] did not verify that production carried out the policies and procedures as outlined in the TCF safety program.

[redacted] did not make the health and safety of the cast and crew a priority when planning and filming scenes.

[redacted] did not ensure that the production activity notification checklist was completed for the work activity involving the Operator.

did not ensure the safety of the cast and crew before, during, and after stunt sequences by completing the stunt safety inspection checklist, which provides basic safety guidelines.

4 Health and safety actions

4.1 WorkSafeBC

WorkSafeBC generated notice of incident 2017178040008, detailing the facts collected immediately after the incident.

During the investigation, WorkSafeBC identified the following violations of the *Workers Compensation Act* and the Occupational Health and Safety Regulation by TCF. These violations are described in detail in inspection report 201917317005A:

- Section 115(1)(a)(i) of the Act — Failure to ensure the health and safety of all workers by failing to identify the hazards and assess and control the risks of the work activity and failing to provide adequate supervision
- Section 115(2)(b)(ii) of the Act — Failure to ensure that the Operator complied with the Regulation by wearing safety headgear while operating the motorcycle
- Section 115(2)(e) of the Act — Failure to ensure the health and safety of the Operator by failing to provide adequate supervision with respect to this work activity
- Section 3.23(1) of the Regulation — Failure to provide the Operator with a new worker orientation
- Section 8.12(1) of the Regulation — Instructing the Operator not to wear safety headgear while operating the motorcycle

WorkSafeBC also referred TCF to the following sections of the Regulation:

- Section 3.23(2) — Topics that must be included in the new worker orientation
- Section 3.25 — Requirement to keep records of all orientation and training provided under sections 3.23 and 3.24
- Section 4.1 — Requirement to plan, construct, use, and maintain a workplace to protect from danger any person working at the workplace

4.2 TCF Vancouver Productions Ltd.

For the remainder of this production, TCF did not use Ducati motorcycles, and operators in all motorcycle-related sequences wore helmets.