Standard Operating Procedure

1. Title:

   Mississippi Lakes Association (MLA) Standard Operating Procedure (SoP) for Unmanned Aerial Vehicle (UAV)

2. Purpose:

   This SoP details recommended procedures and safe practices to follow when: preparing for UAV flights; conducting flights; and, completing post-flight requirements. The SoP includes several checklists as Appendices and emergency procedures are also detailed in the SoP. While it is difficult to make a 'one size fits all' document for the many different types of locations where the MLA may use the UAV, this SoP should be considered the 'go to' guideline. Further, not all of these instructions will apply to all situations, and in this regard, best judgment should be used and when in doubt, the safe course of action must always be taken.

3. Scope:

   This SoP applies to all volunteer personnel involved in any operation and all maintenance of the UAV for the purpose of conservation and environmental assessments on Mississippi Lake. Although these standards are to be adhered to by all commercial applications of drones, they are strongly recommended for use in recreational, research and conservation management drone operations being conducted in close proximity to wildlife and the human population.

4. Abbreviations:
   - ATC Air Traffic Control
   - FC Flight Crew
   - MLA Mississippi Lakes Association
   - PIC Pilot in Charge
   - RTH Return to Home
   - RPL Remote Pilot License
   - SoP Standard Operating Procedure
   - TC Transport Canada
   - UAV Unmanned Aerial Vehicle (aka 'aircraft')

5. Definitions:
   a) 'Code' refers to a code such as Transport Canada's Flight Regulations and Transport Canada's Privacy Guidelines.
   b) 'Competent' means the consistent application of knowledge and skill to the standard of performance required regarding the care and use of the UAV. It embodies the ability to transfer and apply knowledge and skills to new situations and environments.
   c) 'Pilot in Command (PIC)' is the individual with responsibility for all other personnel involved with the operation of the UAV
   d) 'Visual line of sight (VLOS)' is a term used in aviation with respect to a person's ability to see a UAV.

6. Reference Documentation Applicable to the UAV:
    a. CrystalSky DJI Operating Manual CS785/CS785U/CS550
    b. WB37 DJI Intelligent Battery Safety Guidelines
    c. Phantom 4 PRO V2.0 Quick Start Guide
    d. Phantom 4 Series Disclaimer and Safety Guidelines
    e. Phantom 4 Series Intelligent Battery Safety Guidelines

7. Training and Competency:
    a) All personnel need to be competent for the procedure(s) they perform, or be under the direct supervision of a person who is competent to perform the procedure(s).
    b) People who are not considered to be competent will be under the direction supervision of a person who is competent and a monitoring strategy will be in place.
    c) Training records for the PIC and other associated personnel will be maintained by the PIC, copies of which will reside with the presiding Secretary of the MLA. Such records will be available for inspection when and as required.
    d) The PIC will have, at a minimum, a current Basic Operations License as certified by Transport Canada (TC).
    e) The PIC will also be required to have an Advanced Remote Pilot License as certified by TC to operate in the airspace around the Beckwith aerodrome.
    f) The PIC will also have corrected 20/20 vision.

8. Material and Equipment:
    a) The equipment listed below represents the MLA UAV Kit:
        i. Phantom 4 Pro V2.0 (includes aircraft body, remote controller, propellers, flight battery, battery charger, power cable, gimbal clamp and micro SD card)
        ii. CrystalSky Monitor (includes monitor, battery, charging hub, mounting bracket)
        iii. Intelligent Battery WB37
        iv. Personal Carrying Case for Phantom IV Pro
    b) All UAV equipment will reside with the PIC and be the sole responsibility of the PIC.
    c) All equipment will be maintained according to the equipment's specific Operating Manuals as referenced in Section 6.

9. General Drone Maintenance:
    a) Visual Inspection Prior to Use (see also Pre-flight Checklist)
        i. Outer shell and other components inspected for damage prior to and after use.
        ii. Propellers checked before and after every flight.
        iii. Gimbal inspected for damage before and after every flight.
        iv. Camera lens checked for dust or debris before and after every flight.
    d) Battery
        i. Fully charged batteries are to be used for every flight.
        ii. Batteries should not be in contact with any liquids.

iii. Removal of a battery from the aircraft when it is turned on is prohibited.
iv. Recommended guidelines for battery use temperatures will be followed (typically 0^{o} to 40^{o}C).
v. Recommended guidelines for battery charging will be followed (typically 5^{o} to 40^{o}C).
vi. After charging is complete, batteries will be disconnected.
vii. Charger will be examined once every 3 months to maintain battery health.
viii. Batteries will be removed from the aircraft when stored for an extended period.

e) Transportation
   i. All UAV equipment shall be stored in the specified transportation suitcase prior to transit to avoid damage from external forces.
   ii. The gimbal clamp will be attached whenever drone is stored.
f) Storage
   i. The UAV will be stored in dry, cool, non-magnetic place to avoid damage.
   ii. If UAV and battery is to be stored for more than 3 months, it will be stored in an area with temperatures around 25^{o}C and not in direct sunlight.
   iii. The battery will be discharged to 40% to 65% prior to storage.

10. Safety:
   a) Operation of the UAV is prohibited by any individual who does not have PIC status.
   b) The PIC will adhere to TC aviation rules at all times. This may include restrictions on flying beyond VLOS, above a defined altitude, at night and near people or in the vicinity of important infrastructure and prohibited areas.
   c) In addition to the SoP it is recommended that a list of identified hazards and controls and the risk assessment before controls, the type of control implemented and the risk assessment after control is implemented.
   d) All FC members involved in UAV operations must adhere to any instructions given by the PIC to ensure the safe operation of the UAV at all times and the minimization of disturbance to resident wildlife species and the public.
   e) The UAV launch and recovery areas are to be located at a reasonable distance from the survey area to minimize any wildlife or public disturbance.
   f) The PIC will wear a safety vest during flight operations.
   g) MLA signage will be posted whenever flight operations are in effect. This signage will have cautionary symbol and text indicating that the public should remain a safe distance from flight operations. All signage will be posted in areas of high visibility.
   h) Emergency Procedures will be followed as per Section 14 of this SoP.
   i) Hazards:
      i. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to the public not directly involved with the flight mission. The PIC shall have final determination of risk to the public and authority over any launch of the UAV.
      ii. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to any property in the area involved with the flight mission. The PIC shall have final determination of risk to the property and authority over any launch of the UAV.

iii. The PIC shall make every effort to ensure that flight operations will not pose any undue risk to the personnel directly involved with the flight mission. The PIC shall have final determination of risk to personnel and authority over any launch of the UAV.

11. Weather:
    a) The PIC shall ensure that weather conditions are conducive to UAV operations and will have the final determination of risk due to weather and authority over any launch of the UAV.

12. Notice of Operations:
    a) The MLA will make every effort to notify the public of planned UAV operations via the MLA website and Facebook page; however, given the dependency on weather conditions for UAV operations, this may not always be possible.
    b) In the event that UAV operations will be conducted in immediate areas of lake users over an extended period of time (over a 1-2-week period, for example), a Notification of Drone Operations will be published.
    c) For all UAV Notifications of Operation, each will state the purpose of the mission and the date and area in which the mission will take place. A contact person will also be identified.

13. General Operating Procedures:
    a) Key operational procedures will be followed as per TC Guidelines.
    b) Pre-flight procedures are identified in the Pre-flight Checklist and must be followed for any launch of the UAV.
    c) Proximity to aerodrome airspace:
        i. The PIC shall ensure that permission is provided by the airfield operator for any flight operations within 5.6 kms of the Beckwith aerodrome. The PIC shall have final authority over launch after clearance has been granted by the controlling authority. The controlling authority maintains, at all times, the right to abort any flight operation regardless of the stage that operation is in.
    d) Landing Sites:
        i. The primary landing site is typically the same as the launch site. The PIC has final authority for any approaches to the primary site and may ‘wave off’ any approach deemed unsafe.
        ii. The PIC shall designate at least one alternate landing site. In the event that a ‘wave off’ is not possible and the primary landing site is deemed unsafe, procedures to use the secondary site will be invoked.
        iii. The PIC may occasionally invoke an ‘abort site’ whereby the UAV can be ‘dumped’ in an emergency situation. The abort site shall be chosen based on its ability to provide absolute minimal risk should the UAV be required to vacate airspace in an emergency. Should the PIC deem it necessary, the UAV can be flown to this site and inserted without regard to the safety of the UAV or flight equipment.

iv. The PIC will make every effort to select landing site that avoids or minimizes approaches over populated areas.

e) Pre-flight, Takeoff, Inflight and Post-flight Checks
   i. Pre-flight activities will be completed and verified by the PIC as per the Pre-flight Checklist. Such activities refer to knowledge gathering, area assessment and actions performed on the UAV before taxi or takeoff. This includes inspection of the aircraft, assessment of the operating location and coordination with other crew members.
   ii. In-flight activities will be completed by all FC and are to be verified by the PIC. Such activities will include: climbing to a safe altitude away from potential hazards and checking control systems (PIC); resetting trims if required (PIC); keeping the UAV at a safe operating distance from people and buildings (PIC); and, continually scanning the flight and ground areas for potential hazards (FC and PIC).
   iii. Post-flight activities are to be completed and verified by the PIC as per the Landing and Post Flight Checklist.

f) Launching From a Non-Stationary Platform (for example, on a boat)
   i. To launch:
      I. FC member will hold the aircraft over their head. It is recommended that the FC use eye protection during launch and landing procedures.
      II. Power will be applied to launch the aircraft. This will reduce the chance of the aircraft hitting any part of the platform (or crew) before altitude is reached.
      III. FC member will release the aircraft upon direction from the PIC.
   ii. To land:
      I. The PIC will hover the aircraft over the head of the FC member responsible for receiving the UAV and ensure that the UAV is within their reaching distance.
      II. Once the UAV is in the hands of the FC member, the motors will be disabled.
   iii. Other Considerations:
      I. When landing, it is best to pilot the aircraft towards the boat backwards. This may help with the challenge of having to apply reverse horizontal controls to the aircraft when flying forward and toward the PIC.
      II. The PIC may wish to have the UAV approach the boat from a downwind position.
      III. It is recommended that when launching or landing from a boat, the boat be in an anchored position.

g) Repairs
   i. After UAV recovery, if an inspection should reveal any damage, the PIC may authorize the field repair(s) which can be considered critical or non-critical repairs. Non-critical repairs are those not critical to flight control or function of the aircraft in its assigned mission (patches to covering, replacing fairings, cowlings, etc.). Critical repairs are those that must be made that directly affect the ability of the aircraft to perform its function and to continue the mission. Typically repairs of this nature would include replacing a motor or replacing a flight control servo.

h) Clearing the Scene
   i. All FC are responsible for leaving as small an environmental footprint as possible. The immediate area around all landing sites and flight operations shall be checked for

equipment, personal items or trash at the end of a UAV flight. Any material that was removed to make way for flight operations shall be returned and re-established as it was found.

14. Emergency Procedures:
    a) Loss of Aircraft Control
        i. Change UAV Flight Mode to Attitude mode and try to regain control (PIC).
        ii. If control is not restored, activate Return to Home (RTH). Check whether mode is functional and/or if control of UAV has been regained (PIC).
        iii. Turn off and on the controller and try to recover control of the aircraft (PIC).
        iv. If safe to do so, attempt to power off the motors (PIC).
        v. If aircraft flyaway continues, note battery life, height, speed and heading (PIC).
        vi. Inform the police and/or ATC (PIC).
        vii. Maintain VLOS with aircraft as long as possible (PIC and FC).
        viii. Clear flight area of all personnel (FC).
        ix. Await instruction from PIC (FC).
    b) PIC Incapacitation
        i. If possible, warn crew of your status (PIC).
        ii. Check the area is clear and activate RTH (PIC).
        iii. Follow instructions of PIC (FC).
        iv. If PIC is unable to, ensure the landing area is clear and activate the RTH (FC).
        v. Monitor aircraft until it has landed and shut down before attending to PIC (FC).
        vi. If required, notify emergency authorities (FC).
    c) Public Enter Flying Area
        i. It is the responsibility of the PIC and FC to monitor the public, have safety signs erected and inform any member of the public that they're in the flight area and request that they remove themselves from the area and/or remain in position to enable the PIC to safely land the aircraft.

15. Records Management
    a) The PIC will be responsible for completing the Pre-flight Checklist and keeping copies of those records.
    b) Details of the date, location, area surveyed and purpose of flight shall be recorded for each flight mission.
    c) Any data generated by the UAV (footage from the digital camera, GPS co-ordinates, etc.) shall serve as records of the observational study.

16. Privacy and Consent:
    a. All UAV operations, mission information and generated data will respect and adhere to TC Privacy and Consent Guidelines.

The above SoP and procedures shall be adhered to at all MLA events and operations involving the UAV. Failure to adhere to these guidelines, shall be, on a case by base basis, grounds for removal from future UAV operations. Furthermore, any member knowingly operating the UAV in a manner that is dangerous will not be welcomed at any future MLA UAV event.

Pre-flight Checklist					
CREW					
1.	Pilot				
2.	Visual Observer				
3.	Other Crew Members				
WEATHER INFORMATION					
4.	Cloud cover %				
5.	Temperature				
6.	Wind direction				
7.	Wind speed				
SITE INFORMATION					
8.	Within 5.6 kms of aerodrome		Yes	No	NA
9.	Obtained required airspace authorization (if applicable)		Yes	No	NA
10.	Safe distance from crowds, animals, property		Yes	No	NA
11.	Clear of overhead obstructions		Yes	No	NA
12.	Clear take off, landing, secondary and abort site identified		Yes	No	NA
13.	Safety signs erected		Yes	No	NA
DRONE FLIGHT EQUIPMENT VISUAL INSPECTION					
14.	Gimbal lock and lens cap removed		Yes	No	NA
15.	Lens inspected for dust and dirt		Yes	No	NA
16.	Router and transmitter on		Yes	No	NA
17.	Inspection of frame for cracks, loose parts		Safe	At Risk	NA
18.	Motors able to spin freely		Safe	At Risk	NA
19.	Props and hubs free from cracks or damage		Safe	At Risk	NA
20.	Wings in good structural condition, properly secured and aligned		Safe	At Risk	NA
21.	No loose wires and ensure wires are secured to airframe		Safe	At Risk	NA
22.	Batteries for drone fully charged		Yes	No	NA
23.	Battery for screen/monitor fully charged		Yes	No	NA
24.	Battery for controller fully charged		Yes	No	NA
FIRMWARE AND MEMORY					
25.	Transmitter firmware updated		Yes	No	NA
26.	Drone firmware updated		Yes	No	NA
27.	SD Card in camera with sufficient memory		Yes	No	NA
28.	Apps updated, if applicable		Yes	No	NA
29.	Signal and satellite strength checked		Yes	No	NA
30.	Compass calibrated		Yes	No	NA
31.	GPS calibrated		Yes	No	NA
DOCUMENTATION					
32.	Pilot License with PIC		Yes	No	-------
33.	Flight approvals obtained		Yes	No	NA
34.	Flight plan documented		Yes	No	-------
35.	Operating manuals for all equipment are on hand		Yes	No	-------
36.	Risk Assessment conducted, if applicable		Yes	No	NA
37.	Date: PIC Signature: Purpose of Flight Mission:				

Flight Control/Ground Station & Pre-Takeoff Checklist		
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FLIGHT CONTROL/GROUND STATION		
1.	Ensure all body parts, clothing and other obstructions and bystanders are well away from any prop or rotor and its arc before turning power on to any systems	
2.	Make sure craft is secure and will not move if the motor was suddenly powered up	
3.	Announce “CLEAR PROP” out loud	
4.	Turn on transmitter. If it displays information such as aircraft memory and battery voltage, ensure that these numbers are correct	
5.	Make sure throttle stick on transmitter is in the power off position	
6.	Connect battery and or turn on the power switch on the UAV	
7.	Check that all servos are steady and not chattering or making any other abnormal noise when in operation or idle	
8.	Check motor for proper operation. Firmly secure the UAV and gradually increase the throttle to full power and back down to idle – checking for lack of thrust, vibration or other possible anomalies. Check that motor stops completely when throttle stick is at the off position.	
PRE-TAKE OFF		
1.	Confirm transmitter antenna is fully extended	
2.	Confirm transmitter trims settings in proper position	
3.	Check that take off area is clear of obstructions and people	
4.	Double check weather conditions and review emergency landing areas	
5.	Announce ‘Preparing to Take Off’ out loud	

Landing and Post Flight Checklist		
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LANDING		
1.	Scan landing area for potential obstruction hazards	
2.	Announce “Preparing to Land”	
3.	Carefully land the aircraft away from obstructions and people	
POST FLIGHT		
1.	Turn power off and/or disconnect batteries	
2.	Turn off transmitter	
3.	Visually check for signs of damage and/or excessive wear	
4.	Secure the aircraft	
5.	Ensure landing site is returned to original condition	