Rovver X Inspection System	**Exception**	
System Basics Complete Inspection shall have:	**Yes**	**No**
1. Three components:		
a. Automatic cable drum with cable		
b. Single hand held operator pendant with viewing, digital recording and system controls		
c. Crawler with zoom Camera for 6” diameter and larger pipe inspection		
2. Can Bus communications protocol		
3. Ability to connect to a network via network cable port or Wifi Connection for lifetime remote firmware upgrades and/or diagnostic services.		
4. Camera and crawler operator functions to be able to work simultaneously.		
5. Electrical requirement not more than 575W, or 5 A at 115 Vac (220 Vac available)		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
1. 10.1” (257 mm) (diagonally measured), hand held color touch-screen monitor with 1280 x 800px display resolution for viewing, recording video and accessing control and configuration functions.		
2. Detachable power cord		
3. Capable of connecting to an external monitor		
4. Capable of using External Keyboard and Mouse		
5. Pendant total weight to be less than 4 pounds.		
6. Total control pendant dimensions to be no larger than 12” x 10.75” x 2.5” (W X H X D).		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
7. Wide screen display format with daylight readable display.		
8. Power on/off button.		
9. Integrated emergency stop button.		
10. Pendant to have integrated, foldable stand and recessed handle.		
11. Standard ability to connect to a network via Ethernet or WiFi in order to access software update download for lifetime automatic performance and feature upgrades.		
12. Ability to connect to a network via Ethernet or WiFi in order to work with repair studio software for remote diagnosis.		
13. Embedded software with ability to wirelessly upload via Wi-Fi and share inspection data via WinCan Web.		
14. Embedded software directly integrates with WinCan software for PACP compliant reporting.		
15. 32 GB internal memory for data storage.		
16. Touch screen operation with or without gloves, even under wet conditions.		
17. Dual joysticks for Camera and crawler functions.		
18. Auto-upright display to allow joysticks to be positioned where they're most comfortable.		
19. Capable of switching joystick functions to suit user. Driving functions and Pan & Tilt functions can be swapped left to right.		
20. Ability to toggle between icon and text display commands.		
21. Must include the following interfaces: 2 x USB 2.0 (Typ A), 1 x Ethernet (RJ45), 1 x HDMI, 1 x analog Video OUT (BNC)		
22. Controls for manual and automatic focus of Camera.		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
23. Ability to display component pressure, temperature, sonde status, pitch (inclination) and roll.		
24. Pressure to be listed onscreen and saved within system history for predictive maintenance.		
25. Pressurization status of individual components (Camera, crawler, lift, auxiliary lighting, etc.) shall be listed separately.		
26. Controls for adjusting illumination intensity of Camera and auxiliary lighting.		
27. Ability to control cable reel functions: auto, manual, speed, direction, torque of the cable reel.		
28. Master single button interface to regain control from wireless controller.		
29. Minimum 20’ control cable that connects the automatic cable drum with the pendant via an emergency on/off switch box junction.		
30. Ability to record digital video.		
31. Video recording: mpeg4 or avi (selectable).		
32. Ability to capture digital stills.		
33. Still picture recording: jpg or png (selectable).		
34. On screen display (OSD); ability to generate text on video.		
35. OSD controls easily allow for turning various parameters and text on/off.		
36. OSD controls easily allow for manipulation of on-screen position of displayed parameters/text.		
37. OSD controls easily allow for manipulation of color of displayed parameters/text and background color.		
38. OSD controls allow addition of graphical images (agency or company logo, etc.).		
39. Ability to create multiple OSD profiles; customized OSD parameter/text configurations based on operator or application preferences.		
40. Graphical on-screen display of crawler roll status with respect to pipe sidewall.		
41. Ability to inform operator if one is getting close to flipping the crawler.		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
42. When critical roll angle is reached, system will alert operator with highlighted red indicator AND will show operator proper direction of counter-steer in order to re-stabilize crawler position.		
43. Optional ability to engage anti-roll feature, which will automatically stop crawler movement when critical angle is reached during use of cruise control.		
44. Ability to invert controls in the event of crawler roll, allowing for crawler and cable reel to continue synchronized movement.		
45. Graphical on-screen display of crawler inclination, including pitch degree or percentage (selectable).		
46. Ability to directly engage or disengage electronic clutch.		
47. Ability to capture, correlate and store still images with distance and observation information, all of which can be exported to various software reporting packages or viewed onscreen.		
48. Captured visual data can be saved directly from the pendant into an inspection report that has manhole to manhole schematic, observations, distances, asset information, operator details and PACP codes.		
49. Ability to generate a graphic inclination report to show pipe grade along inspection route.		
50. Ability to view a full schematic and observation inspection report, including pipe inclination report, on the pendant.		
51. Ability to operate crawler in cruise control mode where an operator does not need to touch the joystick for crawler speed.		
52. Ability to pause video when adding an observation as to not waste video file storage capacity.		
53. On/off control of digital zoom function.		
54. On/off control of auto shutter speed.		
55. On/Off control of auto iris		
56. Ability to toggle front-view Camera, integral rear view Camera, and accessory rear view Camera.		
57. On/off control for Camera lasers.		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
58. Ability to control laser intensity of increments of 25%.		
59. Control for remotely controlled motorized Camera lift.		
60. Button to activate automated software routine (Macro) for viewing laterals on the left and right.		
61. Button to activate automated software routine (Macro) for performing a circumferential scan of a pipe joint.		
62. Controls for auto-return of crawler that stops the crawler within specified distance of the insertion manhole and alerts the operator of its return for final extraction when returning via cruise control.		
63. The ability to operate larger (16” minimum diameter) and smaller crawlers (minimum 4” diameter) with no need for additional control unit or cable upgrades.		
64. CAN-bus control architecture allowing for precision control, diagnostic monitoring and future upgradeability.		
65. Ability to measure cracks and other observations without the need for external software		
66. Ability to measure wall defects, obstructions, bends, branch angles, flow level and inclination via touch screen controls.		
67. Ability to run a macro to measure actual pipe diameter using built in Camera lasers.		
68. Portable battery powered belt clip wireless remote controller with crawler, Camera and cable reel functions for easy direct single person deployment and retrieval of the crawler at the access point (manhole/basin).		
69. Wireless remote controller to be digitally encoded to the system with which it is delivered.		
70. Wireless remote control to have a range of at least 50’ without radio frequency interference being able to compromise the signal. RF systems will not be accepted.		

	Exception	
2. Operator Pendant and Wireless Controller *The system control pendant shall have:*	**Yes**	**No**
71. Wireless remote controller must work with a single specific system in order to provide secure control when multiple systems are being operated in the same area. For operator safety and system protection, there can be no chance for operational interference.		
72.		
73.		

	Exception	
3. Pan/Tilt Color Zoom Camera *The system Camera shall have:*	**Yes**	**No**
1. 10X optical zoom with 12X digital zoom multiplier for a total zoom of 120X.		
2. Ability to produce a high-quality color video image with a readable resolution of no less than 530 HTV lines.		
3. Pan and tilt motors with no exposed gears or wires.		
4. Ability to pan a full 360 degrees and tilt ±135 degrees for full viewing of laterals and joints.		
5. Dual lasers to gauge the size of pipeline pipe features and defects.		
6. Solid-state circuitry designed to withstand shock and vibration while being pushed, pulled or propelled through the pipe.		
7. Front housing made of aluminum and stainless steel, with windshield made of impact-resistant, distortion-free material.		
8. Housing that is fully sealed and waterproof per IP68 to withstand external pressure up to 1 bar without damage or leaking.		
9. Ability to run off 12-volt DC solid-state power source for diagnostics and service.		
10. Encoders to measure pan and tilt position, allowing Camera to be controlled using macros stored in the operator pendant.		

	Exception	
3. Pan/Tilt Color Zoom Camera *The system Camera shall have:*	**Yes**	**No**
11. Ability to attach to the front of the crawler by a simple tool less locking mechanism atop the crawler that drives 3 stainless bearings into the rotate shaft of the Camera, all while maintaining a 1-bar waterproof seal.		
12. A valve for purge and pressurization of Camera-body. (Pressurization helps prevent ingress of water and helps prevent internal condensation and fogging.)		
13. A total weight of no more than 4 lb.		
14. A maximum size of 7” x 3” x 3” (lwh) in order to fit within a diameter of 3.5” (88mm).		
15. Integral clutches to protect pan and tilt motors.		

	Exception	
4. Steerable Motorized Crawler The system shall have:	**Yes**	**No**
1. 6-wheel drive (3 wheels per side) to generate traction necessary to crawl 1000’ in wet and slippery pipes.		
2. Tool-less quick connect and disconnect connections for pan/tilt Camera head and auxiliary lighting.		
3. In 8” configuration with the middle wheel remaining, the 4 larger wheels will overlap the middle ones to provide continuous traction to go over joints and debris and avoid high centering where 4 wheel crawlers can no longer move forward.		
4. The tractor shall have proportional left, right, forward and reverse capability via manual and automatic controls via a joystick and direct buttons amongst the operator pendant and wireless controller.		

	Exception	
4. Steerable Motorized Crawler The system shall have:	**Yes**	**No**
5. Maximum size of 12.2 x 4.3 x 3.5” (lwh), allowing proper clearance in 6” and lined pipes.		
6. An electronic clutch that can be engaged and disengaged without needing to move the crawler. Systems that demand movement of the crawler to engage or disengage a mechanical clutch will be deemed unacceptable.		
7. Can accept an option for a remotely operated lift that can raise the Camera a minimum of 7” from its lowest position.		
8. Full sensor package with inclination, roll, sonde, pressure, heat and motor readings.		
9. Integral rearview color Camera with high-lux tri-LED lighting to be positioned at the top rear of the crawler body and not to have any visible increase in the diameter of the crawler body or be integrated with the rear connector.		
10. Ability to remotely toggle between rear- and forward-viewing Cameras using the operator control pendant.		
11. Keyway on Camera rotation shaft to ensure damage-free mating of electrical pins between crawler and Camera.		
12. Rear receptacle that allows cable attachment with 2 turns of the stainless-steel cable connector’s outer barrel. Not tools required.		
13. A spring-loaded pin on the rear receptacle to lock the stainless-steel cable connector’s outer barrel, ensuring a secure connection and delivering pull strength beyond the 1000-lb-rated break strength of the cable.		
14. Minimum weight of 18.5 lbs. (with small wheels).		
15. Length of no more than 12.2” (18” with Camera and optional lift installed) for easy navigation through 90-degree inverts without rolling.		
16. Crawler body must be machined from a single continuous and complete piece of machined aluminum. Two piece bodies from top to bottom or front to rear crawlers will be deemed unacceptable.		
17. Single piece crawler body to have single top-plate access for control boards, single bottom-plate access for motors, and dual side-plate access for gears, ensuring maximum protection against leaks caused by bending stress. Tractor chassis of bronze, brass or other soft metals shall be deemed unacceptable.		

	Exception	
4. Steerable Motorized Crawler The system shall have:	**Yes**	**No**
18. Tapered wheels that conform to pipe sidewall.		
19. Quick Change wheel hub design to allow tool less wheel removal and replacement. No bolts or other hardware necessary.		
20. CAN-bus control architecture allowing for precision control, diagnostic monitoring and future upgradeability.		
21. Ability to fit in 8” pipe with top mount auxiliary lighting attached.		
22. A tilting rear cable connector that points vertically to protect cable during deployment into manhole, but which tilts to horizontal position during operation. Rear connectors that integrate a rear Camera will not be accepted.		
23. Strong stainless steel locking mechanism to augment the strain relief internal to the cable.		
24. 512 Hz integral sonde to facilitate locating crawler.		
25. Supplied Auxiliary lighting that has:		
26. Twin hi-lux tri-LED lamps for inspecting large pipes.		
a. Tool-less quick connect and disconnect.		
b. Ability to mount to crawler with instant-contact slide-connector positioned at top rear of crawler or optional Camera lift. Any exposed wiring or pigtails shall be deemed unacceptable.		
c. Waterproof design (when mounted) with ability to withstand 1 bar external pressure.		
d. Rear-viewing color Camera with single hi-lux tri-LED lamp (necessary when using lift and needing to see above water flow)		
e. Supplied Remotely operated motorized Camera lift that has:		
27. Ability to raise Camera 7” from complete down position.		
a. Tool-less quick connect and disconnect connections for pan/tilt Camera head and auxiliary lighting.		
b. Internal pressurization to protect against water ingress.		
c. Ability to fit in 10” diameter pipe when mounted on crawler with smallest wheels.		

	Exception	
4. Steerable Motorized Crawler The system shall have:	**Yes**	**No**
d. Be controlled from CAN BUS control architecture.		
e. Ability to mount auxiliary lighting and rearview Camera at top position for view near center of pipe and above flow.		
f. Can be remotely controlled using operator pendant.		
g. Pressurized struts and motors to ensure reliable, precise control in a compact form factor.		
h. Ability to make direct, waterproof connection to front Camera port for power, video and control. Systems with pigtails, exterior cable connections or loose wires will be deemed unacceptable.		
i. Ability to accept various cameras including pan/tilt color zoom or side scanning Camera without compromising any of the Camera's functionality.		
j. Ability to accept forward connecting auxiliary light which extends side scan and pan and tilt Camera completely beyond the front edge or the crawler so it does not interfere with captured video and side scan data when viewing the pipe bottom.		
k.		

	Exception	
5. Motorized Automatic Cable Drum *The system cable reel shall have:*	**Yes**	**No**
1. Capacity for the systems 1000' cable.		
2. A hub equipped with a continuous-contact slip-ring assembly to allow the cable to be dispensed and retrieved while the Camera and tractors are operational.		
3. A motorized system with sensors that monitor cable tension in order to coordinate cable feed/retrieval with direction and exact speed of the crawler.		
4. Ability to perform all forward, backward and different speed functions without the operator having to control any cable reel functions directly.		

	Exception	
5. Motorized Automatic Cable Drum *The system cable reel shall have:*	**Yes**	**No**
5. An emergency stop switch.		
6. Ability to operate in both automatic and manual modes.		
7. External cable reel chassis to be made of strong and lightweight aircraft grade aluminum.		
8. Work with pendant based speed and torque controls to adjust for different pipe conditions and user preferences.		
9. Weight of no more than 145 lbs. (including 1000' of cable).		
10. CAN-bus control architecture allowing for precision control, diagnostic monitoring and future upgradeability.		
11. Work with a remote wireless pendant granting control of crawler and reel while away from the primary control pendant.		
12. Ability to operate manually, with direct control of speed, direction and torque.		
13. Teflon coated integral drip tray at bottom beneath stored cable. Allows for liquids to drain and be collected in a specific area for health and safety reasons. Can be slid out the front without tools for emptying and cleaning.		
14. BNC video output for local video connection.		
15. BNC video input for external video feed		
16. Size of no larger than 21 x 14.5 x 24.5" (hwd) with standard cable roll bar that extends 15" from the front of the reel.		
17. Two handles to be at the top left and right of the cable reel for moving and transport.		
18. Extended roll bar to be able to be placed back against the reel for storage and shipment without the need for additional fasteners or tools.		
19. All moving hazardous components to be completely covered/enclosed to prevent injury – hand or clothing can't reach dangerous moving parts. Open access design of the front, top and sides where an operator can touch level-wind mechanism, gears, chains and belts will be deemed unacceptable.		
20. Cable protection accessories, including:		

	Exception	
5. Motorized Automatic Cable Drum *The system cable reel shall have:*	**Yes**	**No**
a. Upper cable guide that uses Delrin (or similar) roller mounted to lightweight aluminum frame to protect cable from abrasion during operation, and to limit operator strain during setup.		
b. Lower roller assembly that uses Delrin (or similar) roller mounted to lightweight aluminum frame to protect cable from abrasion during operation, and to limit operator strain during setup. Designs requiring use of interlocking poles shall be deemed unacceptable.		

	Exception	
6. Lightweight Heavy Duty Transmission Cable *The system cable reel shall have:*	**Yes**	**No**
1. 1000’ of cable with maximum 6-wire continuous-length multi-conductor wires for lightweight and easy maintenance performance.		
2. Kevlar reinforcement to provide a minimum break strength of 1000 lbs.		
3. Diameter of no more than 0.255” (6.5mm).		
4. Strain relief to be internal to the cable and cable connector. No external wires, pig tails or other visible external strain mechanisms will be accepted.		
5. Waterproof rating of at least 1 bar or 1 atmosphere.		
6. Tough outer jacket to resist tears and scrapes.		
7. Smooth outer jacket to reduce friction.		
8. Solid stainless steel ring on connector at crawler end that locks with two turns, and which engages a locking spring-loaded pin on the rear of the crawler to secure the cable and provide strain relief. Connections that require **ANY** tools or screws will be deemed unacceptable.		
9. Crawler electrical connection with keyway to prevent damage to electrical pins when mating with Camera or crawler.		

	Exception	
6. Lightweight Heavy Duty Transmission Cable *The system cable reel shall have:*	**Yes**	**No**
10. Ability to be re-terminated by soldering no more than 6 wires, then sealed and strain-relieved using a quick-dry epoxy. Procedure shall take no more than one hour to complete. More than 6-wire solder repair and Scotch-cast style solutions that require longer cure times will be deemed unacceptable.		
11. Cable to be only single connection regardless of use of optional items such as additional lighting, side scanning Camera, rear Camera, laser circle, remotely operated lift or large pipe carriage.		
12. Ability to connect directly to the following without any modification or exterior wires, ability to be operated by system controls in this specification:		
a. 4” minimum pipe ID crawler		
b. 6” minimum pipe ID crawler		
c. 16 minimum pipe ID crawler		