

# AASHTO Innovation Initiative

[Proposed] Nomination of Innovation Ready for Implementation

## Sponsor

Nominations must be submitted by an AASHTO member DOT willing to help promote the innovation. If selected, the sponsoring DOT will be asked to promote the innovation to other states by participating on a Lead States Team supported by the AASHTO Innovation Initiative.

1. Sponsoring DOT (State): Arizona Department of Transportation
2. Name and Title: Mark Kilian - ADOT Highway Ops Tech Supervisor-Avondale Maintenance

Organization: Arizona Department of Transportation

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State: Arizona

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## Innovation Description (10 points)

The term “innovation” may include processes, products, techniques, procedures, and practices.

3. Name of the innovation:

Remote-controlled Skid Steer

4. Please describe the innovation.

ADOT purchased a piece of equipment shortly after a prototype was built that has the ability to do skid steer work in locations with limited access and confined spaces. The skid steer is outfitted with mechanisms and controls that allow operation to be remote-controlled. It can enter spaces as small as 4 feet high and 5 ½ feet wide. The machine can also operate multiple attachments that most skid steers operate.

5. What is the existing baseline practice that the innovation intends to replace/improve?

The cleaning of box culverts under freeways, highways and roads that are managed by Arizona Department of Transportation (ADOT) had been accomplished by contracted HydroVac teams or ADOT teams performing work made hazardous due to confined space.

6. What problems associated with the baseline practice does the innovation propose to solve?

- The high cost associated with HydroVac recruitment and use—the remote-controlled skid steer will reduce the need for third-party contractor recruitment.
- The time it took for the contractor to clean ADOT's box culverts—the remote-controlled skid steer will remove the labor and need for third-party contractors and thus save ADOT the costs of time-labor.
- The safety of employees and contractors when entering confined spaces and exposure to debris—the presence of construction detritus, barbed wire, broken materials, and potential wild animals are a serious health and safety concern.

Example of a quote for HydroVac operation by third-party:

Figure 1. Third-Party Contractor’s Scope of Work and Estimated Cost

**Scope of Work: 4 barrel box culvert (2) 75% full & (2) 25% full.  
Box culver size is considered to be 10'.5" x 4' x 210' each.**

*estimates that scope of work can be completed in (63) working days.*

DESCRIPTION	UNIT COST
Hourly Rate \$253.00 (882hrs)	\$223,146.00
Out of Scope Work ( debris greater than 6" in diameter or hard dig areas are considered to be out of scope and will be at additional hourly rate of \$253.00.)	\$253.00 per hour
Double time Rate	N/A
Travel Charges – MOB or DEMOB (21mi one-way at \$3.10 per mile.)	\$4,882.50
Water Per Load	Client will provide water
Material Off Loading Fees per Load (109 loads \$70.00 per load)	\$7,630.00
Coil Heater Charge for Heated Water	N/A
Additional Labor	N/A
Remote Hose per Foot (250' of 6" remote)	No Charge
Per Diem	N/A
Hourly Rate for Chase Truck	N/A
Third Party Services	N/A
Fluctuating Fuel Recovery Fee	N/A

***Estimated Total: \$235,658.50***

7. Briefly describe the history of its development.

ADOT was interested in pursuing a safer, more efficient alternative to what was available for clearing out box culverts. After researching remote-controlled mining equipment, ADOT staff identified a manufacturer in Canada that had a prototype remote-controlled skid steer operating in California, being used to clean storm channels and box culverts. ADOT contacted the California team using this equipment to get feedback on its capabilities and production, then receiving encouraging results. The information was discussed by ADOT staff, who then determined to try to find something similar and local, then a request for bid was put to the public. The units tested at that time underperformed drastically and were not considered any further. However, when an ADOT vendor became the sole distributor in Arizona for the newest version of the remote-controlled skid steer built in Canada, they were able to meet the request for bid. ADOT then tested the equipment in the field. It performed well

and provided outstanding results, so a purchase was made. ADOT continues to communicate with both the vendor and the manufacturer for improvements to the machine.


8. What resources—such as technical specifications, training materials, and user guides—have you developed to assist with the deployment effort? If appropriate, please attach or provide weblinks to reports, videos, photographs, diagrams, or other images illustrating the appearance or functionality of the innovation (if electronic, please provide a separate file). Please list your attachments or weblinks here.

Attach photographs, diagrams, or other images here. If images are of larger resolution size, please provide them as separate files.

Figure 2. Remote-controlled Skid Steer and Clearing Effectiveness




ADOT Remote-controlled skid steer



[ADOT Vimeo-External-Remote Skid Steer Innovation](#)

Skid steer's remote controller



Operation of Skid Steer with State-of-the-Art Technology

## State of Development (40 points)

Innovations must be successfully deployed in at least one State DOT. The All selection process will favor innovations that have advanced beyond the research stage, at least to the pilot deployment stage, and preferably into routine use.

9. How ready is this innovation for implementation in an operational environment? Please select from the following options. Please describe.

- Prototype is fully functional and yet to be piloted
- Prototype has been piloted successfully in an operational environment
- Technology has been deployed multiple times in an operational environment
- Technology is ready for full-scale implementation



ADOT has been utilizing the remote-controlled skid steer for clearing box culverts for nearly three years. In this time, a single ADOT work unit from Avondale, Arizona has completed the clearing and maintenance of 100 culvert locations in addition to unexpected but required emergency maintenance work for nearly the same cost as what a third-party contractor quoted to clear a *single* culvert location. This remote-controlled skid steer can clear a box culvert in one or two days, whereas it would take ADOT maintenance team one or two weeks to clear by hand or even using HydroVac equipment. Therefore, ADOT has been deploying the remote-controlled skid steer throughout the state and experiencing operational savings in the reduced time needed to clear box culverts. The capability to operate the machine with the remote-controlled condition greatly increases the safety of ADOT workers by removing the need for hand work and other physical labor inside the culvert in a very confined space.

10. What additional development is necessary to enable implementation of the innovation for routine use?

None. The Remote-controlled Skid Steer is already in full use, and the only ongoing training is for new operators.

11. Are other organizations using, currently developing, or have they shown interest in this innovation or of similar technology??  Yes  No

If so, please list organization names and contacts. Please identify the source of this information.

ADOT is unaware of other organizations using this equipment; however, the ADOT contacts below have utilized this equipment and are available to provide supportive information on ADOT’s use of this innovation.

Organization	Name	Phone	Email
ADOT Southeast District	George Collaco Superintendent	928-402-5619	gcollaco@azdot.gov
ADOT Northwest District	Gabriel Alvarado Superintendent	928-777-5868	galvarado@azdot.gov
ADOT South Central District	Thomas Eckler Jr Superintendent	928-779-7531	tecklerjr@azdot.gov

## Potential Payoff (30 points)

Payoff is defined as the combination of broad applicability and significant benefit or advantage over baseline practice.

12. How does the innovation meet customer or stakeholder needs in your State DOT or other organizations that have used it?

**As one of the ADOT operators commented:**

“This remote skid steer can clear a box culvert in a day or two whereas it would take us one or two weeks to clear by hand or using a hydrovac. The use of this equipment has virtually eliminated confined space exposure for our crews.”

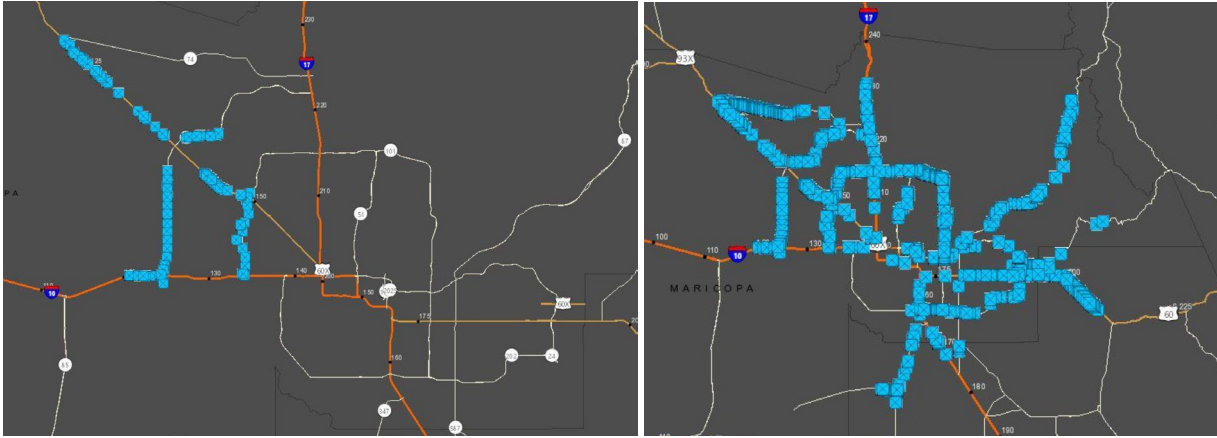
The remote-controlled skid steer has been exceptionally well received among ADOT maintenance teams.

13. Identify the top three benefit types your DOT has realized from using this innovation. Describe the type and scale of benefits of using this innovation over baseline practice. Provide additional information, if available, using quantitative metrics, to describe the benefits.

Benefit Types	Please describe:
Improved Safety	Employees no longer have to enter confined spaces
Cost Savings	Current innovation cost less than 10% of contractor cost
Time Savings	Current work hours a fraction of baseline work hours by contractor

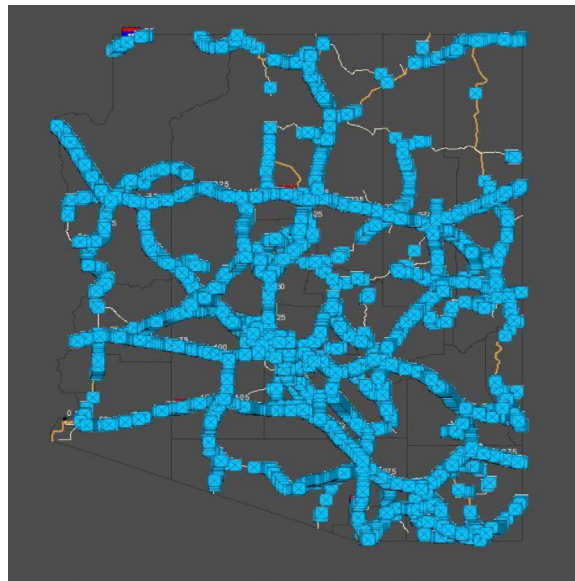
In the images below, there are over 100 box culvert locations on the map of the Avondale Work Unit; the map of the Central District (Phoenix area) shows 650 box culverts, and the statewide map shows 7,000 box culverts.

Figure 3. Box Culverts in the Avondale Work Unit (a), Central District (Phoenix area) (b), and Statewide (c) That Have Been Cleared by Remote-controlled Skid Steer



(a)

(b)



(c)



**Quantitative Measures:**

- One location estimated at \$235,658 by third-party contractor; ADOT completed location with Remote-controlled Skid Steer for \$4,700
- 100 locations within one unit completed along with emergency work for a total cost to the State of \$236,449 (cost of machine, all labor and support equipment, and all maintenance costs)
- Projected long-term savings to the State (compared to hiring contractor) based on a conservative estimate of the average box culvert being only 25% full of debris will save **millions of dollars** and **thousands of work hours**

Provide any additional description, if necessary:

14. How broadly might this innovation be deployed for other applications? in the transportation industry (including other disciplines of a DOT, other transportation modes, and private industry)?

This piece of equipment can not only provide box culvert maintenance, but it can also operate any standard-flow skid steer attachment. This allows for broad use throughout right-of-way maintenance.

## Market Readiness (20 points)

The All selection process will favor innovations that can be adopted with a reasonable amount of effort and cost, commensurate with the payoff potential.

15. What specific actions would another organization need to take along each of the following dimensions to adopt this innovation?

Check boxes that apply	Dimensions	Please describe:
<input checked="" type="checkbox"/>	Gaining executive leadership support	Executive leadership can assist with funding constraints
<input checked="" type="checkbox"/>	Communicating benefits	Providing data and cost savings
<input checked="" type="checkbox"/>	Overcoming funding constraints	Providing data and cost savings
<input type="checkbox"/>	Acquiring in-house capabilities	
<input type="checkbox"/>	Addressing legal issues (if applicable) (e.g., liability and intellectual property)	
	Resolving conflicts with existing national/state regulations and standards	
<input checked="" type="checkbox"/>	Other challenges	Proper training of operators

16. Please provide details of cost, effort, and length of time expended to deploy the innovation in your organization.

**Cost:** \$125,000

**Level of Effort:** Difficult, due to there being only one prototype in the U.S.

**Time:** 2 ½ years of research and white paper, then acquiring funding by the agency to purchase equipment.

17. To what extent might implementation of this innovation require the involvement of third parties, including vendors, contractors, and consultants? If so, please describe. List the type of expertise required for implementation.

Due to the growing cost savings realized and the high demand for this innovation across the state, numerous rental vendors and contractors have purchased the same equipment to supply the demand.

The current equipment distributor in Arizona has trained mechanics to assist in the maintenance of this specialized piece of equipment.