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What can you do with a county road that you can't afford to maintain?

Unpaving to create affordable, safe, smooth gravel roads

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Problem and Solution

Many rural county road networks were created at a time when funding was greater and rural populations were often larger than they are today. Eventually, surface treatments such as chip seals or thin asphalt were applied to many of these gravel roads to provide them with an all-weather surface. These treated surfaces were also desirable because conventional gravel roads are dusty, often develop washboarding quickly, and have high rates of gravel loss—which result in unsafe and uncomfortable conditions and greater damage to vehicles and crops.

Today funding to maintain these low-volume roads has dried up, and this has led to the frequent development of deep potholes that create dangerous vehicle- and freight-damaging conditions. And while some road networks can be abandoned, most of these roads are still needed to support the economic needs of tax-paying residents, by serving agriculture, forestry, and recreation area access.

A solution to this problem, called *unpaving using engineered gravel roads*, has been

developed in South Africa and has been implemented by UCPRC/CCPIC researchers¹ in several counties in California. *Unpaving* involves pulverizing the existing surface of a gravel road and any granular base layers below it, and importing additional granular material as needed. The grindings and any additional granular material are checked in the laboratory with simple and inexpensive tests to determine the amount of additional fines or clay material that needs to be added—typically less than five percent by total weight of aggregate—to ensure that the now unsealed wearing course will be tightly bound and not susceptible to washboarding or excessive dust. The supplementary gravel and fines are spread on top of the existing road, mixed in place with a recycler (note that recycling depth can often be adjusted to incorporate a small amount of the subgrade material if it is suitable as an alternative to trucking in fines), then shaped with a grader and compacted to finish up with a four to five percent cross-slope. A chemical treatment (stabilizer or dust palliative/fines preserver) can be applied during mixing or after the

¹ The research was originally done in by the Council for Scientific and Industrial Research (CSIR) in South Africa by Phil Paige-Green and David Jones. Dr. Jones is now Associate Director of UCPRC and CCPIC.

The City and County Pavement Improvement Center, hosted by University of California Pavement Research Center, a partner of the University of California Institute of Transportation Studies, is dedicated to increasing the pavement knowledge and technical capability among local government staff, planners and managers by providing timely, relevant, and practical technical support, training, research, publications, and outreach.

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road has been compacted to seal the surface, which will increase the time between grader maintenance work and lower the rate of gravel and fines loss. The resulting compacted surface layer creates the *engineered gravel road* that will be much smoother than the old distressed

surface treatment/asphalt road, and if the correct grading and clay content is achieved and the road is correctly shaped, the surface will effectively shed water to prevent ponding and the formation of potholes.



From Skorseth, South Dakota LTAP

Cost and Sustainability Benefits

Experience in many areas in the United States has shown that road users generally welcome the unpaving and engineered gravel approach once they realize that no funding for reconstructing distressed asphalt surfaces on very low volume roads is available. Local residents have even been

heard to say that their road has been upgraded to an unpaved surface! That said, it is very important to discuss plans to unpave roads with local residents to address safety and level-of-service concerns because common first reactions are that the functionality of the road is going to diminish and that progress is being reversed.

Engineered gravel surfaces are maintained by simple blading with a grader, often not more than once a year, and potential recompaction where needed. This is a very low-cost maintenance procedure.

In addition to having a much longer-lasting, smoother ride quality, engineered gravel roads also produce a lot less dust under traffic than conventional gravel surfaces. Their maintenance and construction also produce lower greenhouse gas emissions than chip seals or asphalt concrete. Spraying chemical treatments onto the road surface once or twice a year has been shown to cost-effectively reduce dust and further bind the road surface, which extends the time between maintenance activities and slows the rate of gravel and fines loss.

What You Need to Do

Take the following steps to implement an unpaving and engineered gravel road strategy:

- *Identify currently unmaintainable asphalt and chip-sealed roads with traffic of less than 100 vehicles per day.* Roads with higher traffic volumes (up to 250) can also be unpaved, but will typically require more regular grader maintenance and more frequent chemical treatment applications.
- *Identify and fix drainage issues.*²
- *Determine if there are at least four inches combined thickness of chip seal, asphalt concrete, aggregate base, or other granular materials.*

² There is a separate document coming soon from CCPIC about identification and correction of poor drainage. No road, of any type, will function well for very long if drainage is poor.

Plan to import additional material if the current thickness is insufficient or if the road surface needs to be raised to facilitate drainage. Any kind of material that meets Caltrans aggregate base or subbase specifications will meet the requirements. Recycled asphalt pavement is also often appropriate if available.

- *Perform the test and analysis procedure available from CCPIC on your combined materials to determine the amount of clay, if any, that needs to be added.* Before adding the clay (often from the subgrade or ditch material), have it tested to determine its plasticity and from that result find the correct amount to use. This testing and analysis is simple and easy, and can be done yourself or by a laboratory.
- *Spread the imported materials, mix with a recycler, strike off to four or five percent cross-slope and compact.*³ Keep in mind that a flatter cross-slope will cause ponding and a steeper cross-slope will cause erosion and make it difficult for trucks to drive safely.
- *Maintain with a grader as needed.*
- *Select and apply an appropriate chemical treatment.*

³ Details of the testing, construction, and maintenance procedures as well as a web-based chemical treatment selection tool will be available soon on the CCPIC website.

But What About...?

Won't the public prefer a chip seal or asphalt-surfaced road? *Experience has shown that the public is happier with a smooth gravel surface than a potholed, treated surface.*

Don't gravel roads washboard quickly and cause a lot of dust? *Traditional gravel road surfaces in California typically use materials ranging from pea gravel to Caltrans Class 2 aggregate base. None of these materials have sufficient plastic fines to glue the stones together, help waterproof the surface, or keep dust down. A small amount of clay provides a low-cost binder for the gravel. As long as water doesn't penetrate the clay—which is prevented by good drainage and maintenance of the cross-slope—it will continue to bind.*

I work in a non-attainment area, so won't the increased dust levels affect my status? *Unpaved roads constructed properly with the right amounts of gravel, fines, and plasticity emit very little dust. The use of an appropriate chemical treatment will all but eliminate dust from passing vehicles and from wind.*

How Others Have Done This

A list of several counties in California and other states who have already worked with CCPIC to implement this strategy will soon be available on the CCPIC website.

Where to Get More Information

NCHRP Synthesis 485 (2016) Converting Paved Roads to Unpaved. Download at: <http://www.trb.org/Publications/Blurbs/173716.aspx>

Webinar at: <http://onlinepubs.trb.org/onlinepubs/webinars/160630.pdf>

There will soon be a CCPIC unpaved roads manual that includes a chapter on unpaving.