OFFICIAL PUBLICATION OF THE AMERICAN SOCIETY OF RECLAMATION SCIENCES

# Fall 2024

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#### PRESIDENT'S MESSAGE



## Change is inevitable. Growth is optional.

#### **BRENDA SCHLADWEILER**

For those of you who may not be aware, this is my second time as President of the American Society of Reclamation Sciences or ASRS. The last time I was elected was 2013, and I became President-Elect in 2014. The first annual meeting on the National Executive Committee or NEC under this role was in Oklahoma City. Remember the "earth moving" at that meeting?

Several changes have occurred since 2014. At that time:

- I followed Joe Friedlander as President Elect
- The Society was still called American Society of Mining and Reclamation or ASMR
- Bob Darmody was Executive Secretary
- Dick Barnhisel was JASMR Editor-in-Chief

- Jeff Skousen was Editor of *Reclamation Matters*
- Future meetings included Lexington (in conjunction with ARRI) in 2015 and Spokane in 2016 (NOTE: This latter was Dustin Wasley's volunteering the first time...the second and third were Boise in 2023 and Butte in 2025).

Many changes have occurred in the last 10 years or so in America, our professional and personal lives, I'm sure. Taking the helm as President in June 2024 was greatly helped by the previous two presidents, Michele Coleman and Julie LaBar. These two women covered the last two years of extreme change for the ASRS, in which the National Executive Committee took over many of the responsibilities of Bob Darmody, who retired.

As we look forward to the future, the

following items are happening or have happened:

- 1. FASS is our third-party account manager who has taken over many of the administrative tasks that Bob Darmody once did, including annual meeting management if directed by the NEC.
- 2. JASMR and Reclamation Matters are under new leadership. Thank you, Natalie Kruse Daniels and Mike Curran, for stepping up to the plate.
- The website and Facebook presence has been moved along tremendously under the guidance of Kelsea Green – thanks, Kelsea.
- 4. A Media Manager has recently been hired to promote Society events and information. Welcome to Alissa Meek.
- 5. Meeting guidelines last compiled





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in 2016 are being revised to assist planning committees.

6. Society finances are being overseen by the Financial Advisory Committee (FAC). This includes consolidated investments under Ruedli Investments and existing and proposed bank accounts. Michele Coleman heads up the FAC.

7. Introduction of webinars and/or virtual mixers Fall 2024 to further pass on knowledge to those who may not attend conferences and allow social interaction amongst members and non-members. Thank you, Kenton Sena, as Technical Divisions

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218-741-4290 www.netechnical.com will play a key role in deciding who is the webinar speaker and/or what is the topic during virtual mixers. The Marketing Committee will have a key role as well.

- Institution of strategy planning sessions (late summer and fall) to help guide the Society moving forward, based on membership input. Thank you, Julie LaBar, for spearheading that effort.
- 9. Development of the new Student Engagement Committee under the leadership of Bob Nairn to encourage student involvement in all aspects of the Society. Thank you, Bob.
- 10. Revised bylaws to be approved by the membership in Fall 2024.
- 11. Development of the International Initiative under the guidance of Brenda Schladweiler, Yoginder Chugh, and the IPC to provide input on mine closure and other pertinent projects to the international community of professionals. Thanks goes to IPC members Lee Daniels, Jeff Skousen, and Natalie Kruse Daniels.

I am sure I have left something out but hopefully this will give you an idea of what leadership in the Society is trying to do as we move forward. None of this happens in a vacuum, however. It takes all members to step up to make this Society a continuing influence in the field of reclamation and restoration. As John C. Maxwell said, "Change is inevitable. Growth is optional." I pray that you will join me as we continue to move ASRS forward for stakeholders who need us, including our historical knowledge and collective experience. Have a great Fall and Winter!. *@* 

#### EDITOR'S MESSAGE



#### MICHAEL CURRAN ABNOVA ECOLOGICAL SOLUTIONS

It was sure great to see everyone in Knoxville. As always, a great conference and an amazing amount of time and effort by some special ASRS members behind the scenes to pull it all together. It was fun to see members new and old and neat to have guests from multiple non-US countries in attendance.

Life's been a whirlwind for me since, having moved from New Jersey to Wyoming the week before the conference and being in the field working through some very hot Wyoming days all summer. I know the last article was about ASRS "not slowing down", but I'm sure looking forward to field work ending so I can take some time to slow myself down. I am very grateful for the many friends I have made through ASRS and others who have helped me find a work-life balance, and I encourage you all to find time to slow yourselves down.

As always, I'm grateful for all those who took the time to contribute articles, notes, photos, etc. to this issue. It's always exciting to get to learn more and more about the great reclamation happening across the country and across the globe. I'm glad this issue has a nice variety of topics across a wide geographic space, from the shores of New Jersey to the forests of Virginia, the gas fields of Colorado, and the kochia-invaded ecosystems of Idaho. Across the geographic range and variety of topics, I'm particularly glad to see articles from academia, consulting, government agencies, and industry in the same magazine, as I think something that really sets ASRS apart as a Society – the inclusion of individuals from all walks who work together to make reclamation better.

Congratulations to all the award winners in Knoxville! I encourage folks to nominate deserving individuals, companies, agencies, and projects as they see fit. I hope everyone had a great summer and I look forward to seeing everyone next year. As always, I look forward to interesting stories, practical articles, and great reclamation examples in Reclamation Matters. Feel free to contact me at reclamationmatters@ asrs.us if you have interesting stories to share. Feel free to reach out to Natalie Kruse Daniels at reclamationsciences@asrs.us for more rigorous and data-driven studies in ASRS' peer-reviewed publication, Reclamation Sciences. *#* 

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### **Looking ahead** BRANDON HOLZBAUER-SCHWEITZER STUDENT AND EARLY CAREER PROFESSIONALS REPRESENTATIVE

Thank you to everyone for their time, dedication, and participation in the 2024 Annual ASRS Conference! It was great to see new and familiar faces while beginning my term as the Early Career Professional. We have many activities planned for the year, some of which include Round Tables, Webinars, Mentor/Mentee sessions, and much more. We are excited to hear what the ASRS community thinks can improve future conferences, foster new relationships through



our Mentor/Mentee sessions, and have exciting discussions of new technologies and applications during our Webinars.

This summer has been incredibly busy with my relatively new role at Jacobs Engineering. Between the travel to sites and office work associated with various mines and reclamation sites throughout the southwest, time has flown by. Much of my work is focused on water treatment, characterization of surface and groundwaters, and targeted reclamation efforts. One of my favorite projects takes me back to my graduate school days, where I can work with the EPA on ongoing efforts within the Tar Creek Superfund Site. With such a complex site, many different challenges continually arise, and Jacobs along with the EPA and numerous other stakeholders are striving to reclaim the area.

As I begin my term as the ECP for the NEC, I look forward to meeting new people, reinforcing relationships with old friends, while looking forward to expanding on what ASRS can offer the students and ECPs as part of society. This cannot be done alone. So, please consider this a call out to all those interesting in becoming involved, learning more about the early years of your career and what opportunities are available as we grow together. Any questions, comments, or requests you may have are welcomed with open arms.

Finally, I'd like to take this opportunity to announce that my wife Heather and I are eagerly anticipating the arrival of our daughter this coming October. Much like all the ECPs apart of this society, we face many new and exciting challenges that I cannot wait to experience.

Thank you all for your continued support, engagement, and participation with ASRS. *(* 

# **2024 Wild Women of Reclamation**

#### BY MICHELE COLEMAN



The 10th meeting of the Wild Women of Reclamation (WWR) was held in conjunction with the 41st Annual American Society for Reclamation Sciences (ASRS) meeting in Knoxville, TN on June 4, 2024.

The goal of the gathering is comradery and to discuss common experiences - some unique as women, some not – in the pursuit of improving reclamation. This affiliation is another tool we can use to empower women to have confidence in our abilities to advance our careers in reclamation science, mentor the future generation of professionals, and improve the lives of everyone through our interactions. I was told by someone not participating in WWR that seeing how many women are attending ASRS Annual Meetings now, that maybe our breakfast gatherings have run their course. The worth of that comment was completely erased when a new participant in WWR started extolling the virtues of being included in this group as it helped her to make more connections throughout the conference and that

Sara Klopf's presentation gave her comfort in knowing that not everyone had a straight path to a fulfilling career. Great validation of our existence!

This year's speaker has been engaged with Wild Women since our creation. Sara Klopf talked of her very circuitous post-secondary path as she tried to find a program about which she was passionate. She discovered it in a fluke course she took in ecology. She had found her passion and said yes to every opportunity to get experience in the field, including working in research labs. She ended up studying reclamation work with sedges in northern Alberta, Canada while pursuing her master's degree at Southern Illinois University Carbondale. After moving to Virginia, she continued to say yes for every opportunity to obtain experience and this diligence paid off in having a hourly wage position become a fulltime research position. She said yes to projects ranging from working in mine spoils for the Forestry Reclamation Approach (FRA) project with OSMRE.

#### Our early morning crew for Sara's presentation!

Front row (L to R): Justine McCann, Sara Klopf, Brenda Schladweiler, Kelsea Green, Marie Shepherd, Kathryn Eckhoff, Michele Coleman, Hannah Angel, and Lindsey Moffitt. Back row (L to R): Gwen Geidel, Kaela Walton-Sather, Natalie Kruse Daniels, Jenise Bauman, Rayanna Benally, and Krista Noyes.



And a few that didn't quite make the main photo shoot! L to R Cassidy Mollick, Olivia Mitchell and Lerato Ratsoenyane.

She said yes to working with a forest geneticist working on saving the American Chestnut tree. She said yes to projects related to urban wetland restoration, poplar genetics, acid rock drainage, plant assemblages affected by ripping and tillage, pine tree silviculture, mycorrhizal growth on roots, and baseline vegetation studies for solar farm projects. Sara concluded that an open mind, a good work ethic and a positive attitude goes a long way to having a fulfilling career. In her interactions with people and the range of teams or groups she has worked with, Sara said you can learn

something from everyone, and nothing is done alone. In the age of specialists, her broad-based skills have been very valuable.

But then Henry came into her life. Henry was the adorable 3½ year old that most of us encountered at the conference when her husband Ryan brought him in. Sara then realized that saying yes was great when you can be flexible, but sometimes in life, you need be able to say no, because sometimes there are other projects that impact your availability. Projects like raising Henry. So, now that her reputation as a broad-based researcher has been established, she is exerting a different kind of flexibility, one that allows her to juggle a satisfying career and cherish the joys of raising a child. Proof that with flexibility, you can have it all, or have it both ways (if only some of the time). Thank you, Sara, for a truly warm hearted and inspiring presentation.

Wild Women of Reclamation was initiated by Dr. Brenda Schladweiler in 2013 as a tool to provide mentorship and professional support for women in reclamation. WWR is open to any woman in the field of reclamation, whether practitioner, academic, consultant, government employee or service provider in the natural resources industry or other. There are no forms and no formalities to join.

Our newsletters come out roughly twice a year. To keep them interesting, please send us short articles that we can share. One to two pages in length with a few photos makes them easy to put together and quick to read.

We are thrilled to announce that Sara Klopf has joined our group of WWR co-chairs so that some of us can start riding off into the sunset of retirement.

Looking forward to our next gathering in Butte, Montana in June 2025! *d* 

#### Contacts:

Michele Coleman | michele.m.coleman@gmail.com (Who will be riding off into the sunset, but she says that every year.)Gwen Geidel | geidel@sc.eduSara Klopf | ksara1@vt.edu



# Haulin' ASRS

# Haulin' ASRS is branching out!

Haulin' ASRS was started at the Pittsburgh, Pennsylvania Annual Meeting in 2010 as a way to provide professional interaction and a sense of ASRS community in a fun environment. This year, there was a running and a walking group which gathered at 6:30 in the morning and exercised and chatted together before participating in the ASRS Annual Meeting events. We were lucky as each morning rain event either finished by 6:30 a.m. or started after we finished running.

Bill Zeaman led the walking group through a quality walk through the historic Market Square in downtown Knoxville, one of the most diverse centers in America, with a stroll through the Federal Garden, and finished up with a walk by a church. The running group, led by Ryan Mahony and Michele Coleman, usually ran through World's Fair Park and along the Tennessee River and back up either through the University of Tennessee campus or past James White's Fort, the Women's Basketball Hall of Fame, and through some interesting historical architecture before returning to our hotels to prepare for the day. This year we had runners from three different countries and three different states all on the same day – what a great way to network!

This photo of the Wednesday morning running group is in front of the Sunsphere structure, which was constructed for the 1982 World's Fair. The Sunsphere was the huge gold disco ball situated next to the conference venue.



L to R: Lerato Ratsoenyane (Digby Wells), Ryan Mahony (BioMost), Michele Coleman (NB Power, retired), Curtis Yannis (Aster Canyon), and Marie Shepherd (Peabody Energy).

We hope to see anyone who is interested in a morning run (we are not very fast and only do three to five kilometres) or a pleasant walk to join us at the 2025 Annual Meeting in Butte! It's a great way to meet new people, network, and forge bonds in a smaller setting during the Annual Meeting. If you have any questions, please contact Ryan Mahony (ryan.m.mahony@gmail. com), Bill Zeaman (bill.zeaman@dnr. mo.gov) or Michele Coleman (michele. mcoleman@gmail.com).

See you in Butte in June 2025! 🧳

This photo of the Wednesday morning running group is in front of the Sunsphere structure, which was constructed for the 1982 World's Fair. The Sunsphere was the huge gold disco ball situated next to the conference venue.



#### William T. Plass Award

This award is the highest honor the Society has and recognizes those in research, teaching, outreach, and administration. The award is given to a person who has distinguished themselves in the field of disturbed ecosystem reclamation at the local, regional, national, and international levels.

#### Zhenqi Hu

#### Nominated by Brenda Schladweiler

Dr. Zhenqi Hu is a professor at China University of Mining and Technology and a life member of the American Society for Reclamation Sciences (ASRS). He has dedicated 36 years to mine land reclamation in China. He received his Ph.D., Master's, and bachelor's degrees from the China University of Mining and Technology in 1991, 1987 and 1984 respectively. Notably, he also participated in a joint Ph.D. program at Southern Illinois University at Carbondale from 1989 to 1991, focusing his doctorate research on land reclamation. Dr. Hu is well-known as the pioneer of mine land reclamation in China, and he made outstanding contributions to the innovation and internationalization of China's mine ecological restoration. Since 1991, he has led numerous wide-ranging research projects. His work has shed light on the mechanism and consequences of surface ecological damage caused by underground mining, and creatively proposed concurrent mining and reclamation technology, and yellow river sediment filling technology for restoring subsidence land to prime farmland in coal mining areas. Additionally, Dr. Hu developed methods for the ecological restoration of coal waste piles prone to spontaneous combustion. He established a soil reconstruction theory and technical system with "soil layer niche" and "soil key layer" as the core. These remarkable achievements have been widely implemented in



276 coal mines across 14 provinces in China. His work has significantly advanced the field of mine land reclamation theory and technology. It has also made substantial contributions to protecting farmland, maintaining ecological security, and promoting the development of green mines, leading to significant economic, social, and environmental benefits. He has published more than 500 papers and 21 academic books. He has won three national second-class prizes for technological progress, and nine first-class prizes at the provincial and ministerial level. He has also done great contributions to training students and technical transfer on land reclamation. Dr. Hu's mentorship has nurtured a new generation of talent in land reclamation. Under his guidance, an impressive nine post-doctoral fellows, 108 Ph.D. graduates, and 128 master's graduates have entered the field.

#### Richard I. & Lela M. Barnhisel Reclamation Researcher of the Year Award

The Richard I. and Lela M. Barnhisel Reclamation Researcher of the Year award recognizes substantial contributions to the advancement of reclamation science and technology through scientific research.



#### Jenise Bauman Nominated by Richard Barnhisel

Dr. Jenise M. Bauman is a restoration ecologist with research career that has focused on the balance of energy demands and environmental initiatives. She has been involved with ASRS since 2010, currently on the Editorial Board for Reclamation Sciences, and is excited to begin her new role as a member of the National Executive Committee. Dr. Bauman earned her Ph.D. from Miami University of Ohio, M.S. from West Virginia University, and B.S. from Eastern Kentucky University. Her graduate work focused on the reforestation of landscapes impacted by mining for coal and natural gas. She completed a two-year post-graduate position as a Director of Conservation Science Research, which operated on 10,000 acres of reclaimed coal mines in southeastern Ohio. Dr. Bauman relocated to Washington State to join Western Washington University's College of the Environment in 2014. During her tenure she continued forest restoration projects on previously coal mined landscapes in Appalachia. She initiated new projects in the Pacific Northwest that included reforestation post-dam removal, as well as estuary, nearshore, and riparian projects that evaluate plant community, fish counts, soil development, and fate of soil metals in urban estuaries. Other projects include assisted migration as a climate adaptation strategy to restore riparian zones adjacent to estuary restoration projects. Most recently in 2024, Dr. Bauman joined Tacoma Power's Natural Resource Division of Tacoma Public Utilities as Research and Science Manager. She is now working with a team of scientists to initiate restoration and reclamation projects to improve anadromous fish passage and wildlife habitat in several rivers harboring hydroelectric dams in western Washington.

#### **Reclamationist of the Year Award**

The Reclamationist of the Year award recognizes individuals demonstrating outstanding accomplishments in the practical application or evaluation of reclamation technology. It also rewards individuals responsible for implementing innovative practices or designs for new reclamation strategies.

#### Michael French

Nominated by Kenton Sena

Michael French received a B.S. in Biology and M.S. in Forestry from the University of Kentucky where he focused his undergraduate and graduate studies on linking American chestnut restoration with coal surface mine reforestation efforts while working as an intern for The American Chestnut Foundation. Since 2015, Michael has served as the Director of Operations of Green Forests Work, a non-profit whose mission is restoring native forests on former coal surface mines. Michael has also served as a co-chair for the Appalachian

Regional Reforestation Initiative's Science Team since 2018, promoting research into reclamation and ecological restoration on formerly mined lands. Prior to joining Green Forests Work, Michael worked for The American Chestnut Foundation as a restoration ecologist and in the private sector for Williams Forestry and Associates, where he supervised the planting of millions of trees across the

![](_page_17_Picture_6.jpeg)

Appalachian region. During his leadership of Green Forests Work, the organization has planted millions more trees on active, legacy, and Abandoned Mine Lands throughout the Appalachia with a focus on restoring forest types that have undergone significant declines over the past several decades. Michael currently resides in Indiana with his wife and two boys, where he also promotes native ecosystem restoration.

#### **Pioneer of Reclamation Award**

This award is presented to an individual that has had significant impact and influence in the field of environmental science and reclamation relating to disturbed ecosystems over their entire career.

#### **Rick Williams**

#### Nominated by Chris Barton

Rick Williams, founder and president of Williams Forestry and Associates, LLC has been an advocate for diverse, high quality native tree plantings on surface mined lands for over 30 years. Since it's inception, Williams Forestry has planted over 500 million trees in the eastern U.S. of which at least 72 million have been planted on mined lands. Rick has always been a staunch advocate for diversity and productivity, having conducted his business in this area in a way that would result in the restoration of the native Appalachian Forest. Often this was done at cost to his business and occasionally at the risk of losing a customer as he pushed to have reclamation performed in a way that gave trees their best chance at thriving. Williams Forestry planted many of the experiments that led to the development of the Forestry Reclamation Approach and Rick instituted a study of his own to test survival and growth of numerous native shrub species to provide better results for his customers and to diversify his planting mixes. Over the years, Rick's clients have won

#### Early Career Award

This award is intended to recognize an early career member of ASRS that is involved in reclamation research, teaching, and/or on-the-ground reclamation practices within academics, regulatory oversite or in an industry position.

The nominee must have been employed in their field for a minimum of three years but not more than 10 years.

#### Michael Curran

#### Nominated by Michele Coleman

Dr. Michael Curran owns and operates Abnova Ecological Solutions, a small ecological consulting and research firm which specializes in ecological restoration, land reclamation, environmental monitoring, environmental data management, and a variety of other ecology related matters. Mike is originally from Manasquan, NJ and has a bachelor's degree in Biological Sciences, Geography, and Ancient Greek & Roman Studies from University of Delaware, where he worked as an undergraduate research assistant studying native vs. non-native plant impacts on terrestrial food webs. He has a Master of Science degree in Rangeland Ecology & Watershed Management as well as a PhD in Ecology and a Graduate Minor in Statistics from University of Wyoming. Curran received both the MS and PhD Student Awards from the American Society of Reclamation Sciences upon completion of each degree, both of which has a research component focused on land reclamation and ecosystem services associated with oil and gas development in Wyoming. In graduate school, Curran worked with 26 oil and

gas operators along with numerous State and Federal Government agencies. Between graduating from University of Wyoming and starting Abnova, Curran held a post-doctoral research position

![](_page_18_Picture_7.jpeg)

studying how to monitor wildlife with drones at Mississippi State University and has become a Certified Ecological Restoration Practitioner and Certified Wildlife Biologist. He also managed a native plant section at a large retail nursery in New Jersey. Through Abnova, Curran works with numerous oil, gas, renewable energy, and mining groups as well as with several government agencies to solve simple and complex ecological problems, mostly related to reclamation, threatened and endangered species, and decision management.

numerous reclamation awards and Rick has always been a great partner to his clients, going above and beyond to help them win these awards. This same qualityfirst mindset also pervades Rick's personal life. He brings the same work ethic and appreciation of natural beauty to his home farm where he spends his free time with his family and maintaining the farm's beauty and diversity.

![](_page_18_Picture_10.jpeg)

#### Distinction in Reclamation Award

This award recognizes a specific project in which a company has demonstrated excellence in reclamation design, implementation, and overall success, resulting in the conservation of natural resources and the ecosystem.

#### The Coteau Properties

#### Nominated by Rylan Sundsbak

The Freedom Mine of The Coteau Properties Company is in Mercer County in southwest North Dakota. The Coteau Properties Company is a surface mine that delivers approximately 13-14 million tons of lignite coal annually to three facilities owned by Basin Electric Power Cooperative. Coteau has approximately 49,300 acres in their mining permits authorized by the North Dakota Public Service Commission (PSC), and the mine has reclaimed nearly 35 percent of their permitted acres. Coteau has three common post mine land uses for the reclaimed tracts; cropland, native grassland, and hay land, and a smaller portion of reclaimed acres are preserved as wildlife enhancement areas. The Section 6 Wildlife Enhancement Area is 177 acres which contains many wetland features, some undisturbed and some reclaimed; 52 acres of undisturbed native grassland with the remainder seeded to perennially vegetated hay land. The enhancement area will act as an island of diversity within an otherwise large tract of uninterrupted reclaimed cropland and will provide food and cover for waterfowl, grassland birds, shorebirds, and pollinator insects. The Coteau Properties Company partnered with North Dakota 4-H

Pollinator Program to provide an educational opportunity for North Dakota youth to help develop and install pollinator plots on reclaimed surface coal mine land. North Dakota 4-H was selected as a candidate for the 4-H Pollinator Habitat program, and eight youth from around the state of North Dakota were selected to participate in the project. Coteau collaborated with the ND 4-H Pollinator Habitat group to provide reclaimed land in Section 6 to establish two pollinator plots. The Coteau Properties Company provided the group with post-mine land use maps, topographic maps, and post reclamation soils information as well as the native grassland seed mixture used in the surrounding reclaimed hay land. The youth group assisted in choosing the locations for the pollinator plots, helping create the seed mixture for the pollinator species, and aided in prepping and loading the seeding equipment. The Coteau Properties Company in conjunction with the 4-H group installed two large pollinator plots within the Section 6 Wildlife Enhancement Area. The pollinator plots are two acres in size and were seeded with pollinator species selected by the youth based on their research.

![](_page_19_Picture_6.jpeg)

#### Peabody Energy/Kayenta Mine

#### Nominated by Jen Schlotthauer

The Kayenta Mine Complex (KMC), which includes mines separately designated as the Kayenta Mine and Black Mesa Mine, is located on Black Mesa in Navajo County, Arizona on lands leased from the Navajo Nation and Hopi Tribe. The Black Mesa is a massive highland in Northeastern Arizona covering approximately 2.1 million acres. Along its northern boundary, the Mesa rises abruptly in a 1,200- to 2,000-foot-high uneven wall then descends gently southward in a plane of rolling

#### Jonah Energy LLC

#### Nominated by Mike Curran

Located in Sublete County, Wyoming, Jonah Energy operates nearly 2,400 natural gas wells within the sagebrushsteppe ecosystem, home to abundant antelope, Greater Sage Grouse, and many other wildlife species. At over 7,000 feet above sea level, with less than 39 frost free days

![](_page_20_Picture_3.jpeg)

per year and inconsistent precipitation the soils are poorly developed with low organic mater. In one of the harshest environments in the lower 48 states, Jonah Energy has been able to achieve remarkable reclamation results. They've done this by being dedicated stewards of the land on which they operate, through strategic partnerships with universities, consultants, and government researchers, and by adapting their operations to lessons learned through science and on the ground practices. Jonah Energy has shown, despite the harsh climatic and soil conditions, that they can truly leave the land in better shape following reclamation than prior to disturbance. With over 7,300 acres of disturbance, of which

hills to the Litle Colorado River. Near the northern rim and in some of the canyons there are dense stands of pinyon and juniper trees, forming a dark vegetative cover from which the Mesa derives its name. Most of the Mesa, however, is rolling country covered primarily by a sagebrush shrubland. The Peabody lease covers 64,858 acres on the northern part of the Mesa just south of Kayenta, Arizona. Within the Kayenta Mine, there are several pit areas, one of which is J19. The J19 pit was mined from 2003 to 2016 and final reclamation was completed in 2022. The spoil ridge created on the edge of the pit during mining had to be placed back into the final pit, which required Peabody to move the backfill several times. This could be achieved most cost effectively with a dragline, and the site committed to reclaiming the pit with the dragline prior to shutting the machine down. A support fleet 80 percent has been reclaimed, herbaceous production on average has increased 40 percent, species richness has increased 77 percent and wildlife utilization of reclaimed lands from insects to ungulates has increased. In their quest to improve upon existing reclamation, Jonah Energy continues to fund scientific research and has co-authored three peer-reviewed, published articles. In addition to pushing the envelope for reclamation associated with oil & gas development in the western US, Jonah Energy has implemented cutting edge air and water quality programs, showing a full commitment to environmental responsibility.

including dozers, trucks, loaders, scrapers, and excavators also aided with completion of the reclamation from backfilling to drainage construction. The permitted post-mining land uses for KMC are rangeland grazing, wildlife habitat, and cultural plant habitat. To demonstrate that these land uses are being achieved, Peabody manages a sustainable community-based grazing program, conducts annual monitoring to document wildlife use across the mine permit area, and conducts annual vegetation monitoring. In 2019, this reclamation area of the mine received the: "Excellence in Surface Coal Mining and Reclamation Director's Award" from the "Office of Surface Mining and Reclamation Enforcement". This award recognized the importance of the Cultural Plant Habitat and domestic grazing opportunities that the mine had returned to the local indigenous people's life and culture. *Imagenetical* 

![](_page_21_Picture_0.jpeg)

![](_page_21_Picture_1.jpeg)

PhD level scholarship winner: Anna Vietmeier

Anna is a fifth-year PhD candidate at Duquesne University in the laboratory of Dr. Nancy Trun and earned both her BS and MS from Youngstown State University in biological sciences. Anna's PhD work is on the impact of microbial metal cycling in abandoned coal-mine drainage (AMD) to improve bioremediation and limit biocontamination within passive remediation systems. Through being awarded the Department of Energy (DOE) National Energy Technology Laboratory (NETL) Oak Ridge Institute for Science Education (ORISE) fellowship, Anna has collaborated with the laboratory of Dr. Djuna Gulliver to investigate the ability of harnessing microbes for the biomining of AMD waste. After earning her doctorate, Anna plans to continue her research as a postdoc on the interaction of microbes and chemical cycling. She enjoys painting, is learning to play the piano, and loves her houseplants.

![](_page_21_Picture_4.jpeg)

Masters level scholarship winner: Aliching Marma

Aliching Marma is a second-year master's student in Environmental Studies program at Ohio University's Voinovich School of Leadership and Public Service. She holds a bachelor's degree in civil and environmental engineering from Military Institute of Science and Technology in Bangladesh. She previously worked as a process engineer in Bangladesh, designing wastewater treatment plants for industrial and sewerage systems. Her current research focused on treating mine water using hydrochar in compost bioreactors. Her goal is to get more expertise and develop novel solutions to wastewater and acid mine drainage treatment.

![](_page_21_Picture_7.jpeg)

Bachelors level scholarship winner: Scotland Souders

Scotland Souders is a fourth-year Environmental Science student at Oklahoma State University. She has been doing research with Dr. Julie LaBar on the behavior of manganese in passive treatment systems. During her time at OSU, she has also enjoyed being president of the Environmental Science Club and the Juggling Club. After graduating with a bachelor's degree in May 2024, she plans to pursue graduate-level education in Environmental Science while also working as an environmental specialist in Midland, TX. *#* 

![](_page_22_Picture_0.jpeg)

Abnova Ecological Solutions Albemarle Brierley Associates Costmine Intelligence Earthres Full Circie Mushroom Compost Morgan Contracting OSMRE Purewest Energy University of Tennessee School of Natural Resources Stewards Truax, Company Inc. Williams Forestry & Associates

![](_page_22_Picture_4.jpeg)

![](_page_23_Picture_0.jpeg)

![](_page_23_Picture_1.jpeg)

![](_page_23_Picture_2.jpeg)

![](_page_23_Picture_3.jpeg)

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![](_page_24_Picture_0.jpeg)

### Drone application in surface reclamation of oil & gas operations

#### BY BRENDAN CUSICK CPESC, CISEC- RECLAMATION & SUSTAINABILITY PROGRAM SPECIALIST RED WILLOW PRODUCTION CO.

Reclamation, the process of restoring land to its original or improved state after mining, construction, or other forms of development, plays a crucial role in sustainable resource management. In recent years, the integration of cutting-edge technologies has revolutionized the field of reclamation. One such technological advancement making significant strides is the use of drones. Unmanned Aerial Vehicles (UAVs), commonly known as drones, have emerged as powerful tools in monitoring, assessing, and expediting reclamation projects. The use of UAVs has gained considerable application in a diversity of applications within the oil & gas industry over the last decade. UAVs have been begun to provide promising application in aerial surveys for methane detection, surface topography, vegetation surveys, erosion monitoring and pipeline rights of way surveys, among others.

For the past four years Red Willow Production Company, a wholly owned subsidiary of the Southern Ute Indian Tribe, has been implementing the use of UAVs in the surface reclamation of oil and gas production facilities. Red Willow operates within the Northern San Juan Basin (Southwestern Colorado), producing natural gas

Abnova Ecological Solutions combines ecological expertise with spatial and quantitative knowledge to provide customized solutions to a variety of ecological and environmental challenges. While our passion lies in restoring ecosystem services and functionality to degraded lands, we are set up to provide a vast array of services related to soil, vegetation, habitat assessment, regulatory compliance, wildlife monitoring, and more.

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TABLE 2: Vegetation Transect Locations

![](_page_25_Picture_1.jpeg)

![](_page_25_Picture_2.jpeg)

Drones equipped with high-resolution cameras and sensors provide an unparalleled advantage in obtaining data for reclamation sites. They can capture detailed images and generate accurate topographical maps, allowing personnel the ability to assess the extent of degradation and plan reclamation strategies accordingly. This capability aids in identifying areas with specific issues, such as erosion drainages, and vegetative cover.

from a variety of hydrocarbon bearing formations. As these wells reach their lifespan of production and economic viability (on average 20 to 30 years in this basin), the wells are plugged, equipment is removed, soils are remediated, and the surface is then reclaimed to pre-development topography and seeded for revegetation. The goal is to return these locations to a natural, pre-disturbance state.

The number of wells that have been determined to have reached their production capacity and economic viability is growing, due to the finite nature of the natural gas resource. The number of long-term shut-in wells that must be plugged and abandoned increases incrementally on an annual basis. Historically, wells were identified for this plugging and abandonment process and a contractor proceeded with the operation on a case-by-case basis, with little forethought in regrade

![](_page_25_Picture_8.jpeg)

Thermal imaging sensors on drones can detect variations in temperature, helping to identify areas with poor vegetation cover or soil quality. This level of detailed analysis enables more precise decision-making in terms of vegetation dispersal, erosion, and bare ground presence in order to implement reclamation interventions.

design or meeting specific design standards for reclamation success. With the increasing number of plugging candidates, regulatory scrutiny for improved surface reclamation, and overall drive to ensure reclamation success, technologies such as UAVs have been employed to improve efficiency and better define reasonable approaches for surface reclamation.

UAVs play a small but important role in the overall planning, design, and implementation of proper surface reclamation of historic oil and gas production sites. This is particularly true in Western Colorado where oil and gas locations are commonly located within mountainous and topographically challenging terrain. Utilizing UAV technology includes a flyover of a selected location, usually between one- and three-acres including access road and production areas. The flyover uses light detection and ranging (LiDAR) remote sensing to image the surface topography of a location and surrounding undisturbed drainage characteristics.

The data generated from these flights is placed into software (AutoCad or Carlson) for development of a regrade (topographic) design of the location to match surrounding undisturbed topography. The contours of the location and hill shade models are generated to determine the available cut and fill volumes of a well pad and access road for regrade. This analysis provides material volumes for contractor guidance and a more precise cost estimate during the scoping and budgeting phase of a project. Additionally, high-resolution imagery is incorporated to further refine the topographic model. This workflow is

translated into a site-specific regrade design that provides clear project direction, including anticipated postconstruction design to better facilitate contractor expectations, as well as regulatory review and approval. The use of the UAV data in design and surface recontouring refines the overall process for expedited work and economic efficiency in the regrade of these historic locations. Where historically pedestrian surveys of the topography were completed over a period of several hours, a one acre well site can be flown, and extensive data obtained in less than five minutes. This time savings alone has made the use of UAV resources invaluable in well site regrade design. Including the additional time of landbased target surveying and satellite

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![](_page_26_Picture_6.jpeg)

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![](_page_26_Picture_9.jpeg)

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communication accuracy verification, the average time taken to fully survey a 1.5 acre well pad and 1/3-mile road is 45 minutes.

Reclaimed oil & gas locations are also required to meet long-term monitoring requirements to achieve the 70 percent desirable perennial vegetative establishment to be released from regulatory requirements. Due to the location of these wells in Southwestern Colorado, they are subject to periodic drought conditions, which can delay meeting this metric. To support onthe-ground monitoring surveys, a select representation of locations is flown each year using a multispectral camera with a calibrated reflectance panel to ensure consistency for multiple surveys of the same site over multiple years. The camera records imagery of

vegetation based on signatures from chlorophyll, which help determine the vegetative health of the reclamation project. This data is then evaluated for percent vegetative cover, in addition to a pedestrian survey of vegetation type, to eventually meet the regulatory standards for release of the location from responsibility of the operator.

UAV use in surface reclamation has proven to be a valuable resource for time savings, dependable and accurate surface contouring, and a viewshed of adjacent topography for regrade design. The implementation of UAV technology reduces on-the-ground unforeseen drainage characteristics and other topographic challenges that are made visible through this technology. Over the past four years, since the implementation of this technology, Red Willow has successfully reclaimed over 75 acres of well pad and production locations, with no long-term erosion or other regulatory concerns on the outcome of the regrade designs.

Drones have emerged as invaluable tools in reclamation efforts, offering a cost-effective and efficient means of monitoring, assessing, and implementing restoration strategies. As technology continues to advance, the integration of drones in reclamation projects is expected to become even more sophisticated, contributing to the sustainable management of natural resources and the restoration of ecosystems around the world. The sky is not the limit; it is the new frontier for reclamation endeavors. *Ø* 

![](_page_27_Picture_6.jpeg)

## Building the ASRS community through American Chestnut research collaboration

#### BY SARA KLOPF, VIRGINIA TECH, BLACKSBURG, VA

The American Society of Reclamation Sciences provides endless opportunities for building professional networks. At the 2023 ASRS meeting in Boise, ID, one event was a highlight for me: a fascinating and inspiring talk by Dr. Jenise Bauman for the Wild Women of Reclamation where she described her professional path and evolution of her research interests (Figure 1). Her overarching theme was the symbiosis between plants and fungi that was mirrored in the relationships she has built with colleagues. During her talk, she talked about the mycorrhizal symbionts of American chestnut, which was a relatively new topic of interest for me.

But first, some background on the American chestnut. Prior to the introduction and spread of a fungal blight pathogen (Cryphonectria parasitica), the American chestnut (Castanea dentata) was a large canopy tree that dominated the deciduous forests of the Appalachian Mountains (Tallamy 2007). The abundant annual mast and rot-resistant, highquality timber made it an important species for humans and wildlife (Figure 2). The blight pathogen results in crown death, such that new sprouts grow from the roots, only to succumb to the blight infection after a few years of growth. Despite efforts to stem the spread, the disease spread rapidly and rendered the American chestnut functionally extinct by the mid-1900s (Orwig 2002, Money 2007, Dagleish 2015).

Since 1983, the American Chestnut Foundation (ACF) has conducted a backcross breeding program to develop blight resistant chestnut hybrids by cross-pollinating American chestnuts with blight resistant Chinese chestnuts (Clapper 1954, Hebard et al. 1994). The resulting hybrids differ in the proportions of their genomes that come from American chestnuts as well as their resistance to the blight. Current efforts include growing different hybrid chestnuts in real world settings as part of forest communities to assess how well they would perform in a forest restoration.

Not long after the extirpation of the American chestnut, coal surface mining began in Appalachia, and the associated degradation of the regional ecosystems has created extensive need for reforestation within the heart of the historic range of the American chestnut. Therein lies an opportunity to test the performance of hybrid chestnuts within their historic range, on land already in need of reforestation (French et al. 2007, TACF.org). Methods of coal surface mine reforestation have improved with the development of the Forestry

![](_page_28_Picture_7.jpeg)

*Figure 1. Jenise Bauman delivering a talk for the Wild Women of Reclamation in Boise, ID, 2023.* 

![](_page_28_Picture_9.jpeg)

Figure 2. American chestnut forest, Great Smoky Mountains, ca 1909 (Forest History Society, Durham, NC).

Reclamation Approach (Burger et al. 2005). However, the growth and performance of American chestnuts on reclaimed coal mines is variable, suggesting that there is more about American chestnut success that we need to learn (Fields-Johnson 2001, Clark et al. 2012, Gilland & McCarthy 2014, Skousen 2016).

I have presented several talks to ASRS on the American chestnut, and I typically end by posing more questions and suggesting new directions for research. Particularly after hearing Dr. Bauman's Wild Women talk, I have been curious if the variable performance of chestnuts on mine sites is related to whether chestnuts build associations with mycorrhizae as well as which fungal associates these chestnuts acquire. At the poster session later in the meeting, Dr. Bauman and I got talking about this very question and decided to write a grant application to investigate mycorrhizal associates of different chestnut hybrids. Later that summer, I followed up and we made good on our plans. We selected a well-cited study site that was initially set up by Chris Fields-Johnson in 2007 as part of his Master's thesis, and with funding provided by the Powell River Project (powellriverproject.org), the wheels were officially in motion. Dr. Bauman traveled to Virginia Tech in March 2024 and, after giving a spectacular invited seminar to the School of Plant and Environmental Sciences, we were on our way to southwestern Virginia to begin collecting soil and root samples (Figure 3).

We were amazed to see the striking differences in the survival and growth of American chestnut (and other tree species) in the two reclaimed soil types – the unweathered sandstone and siltstone site was still quite open with heavy grass and invasive cover, while the weathered sandstone site was largely comprised of planted trees, larger chestnuts, and had relatively few invasive species (Figure 4). We took our samples back to our respective labs for analysis, and perhaps more importantly, we also built community and left as friends (Figure 5). Our analysis is ongoing, but perhaps you'll see it presented in Butte, MT next year!

I truly appreciate all the opportunities for new connections,

![](_page_29_Picture_5.jpeg)

Figure 3. Left: collecting soil and root/mycorrhizae samples on a reclaimed mine site in Wise County, VA in March 2024. Right: Mycorrhizae growing on American chestnut roots from reclaimed mine site in Wise County, VA.

![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_1.jpeg)

Figure 4. Forest communities around chestnuts in (left) weathered sandstone plots and (right) unweathered sandstone and siltstone plots, May 2024 (Photo courtesy of Chris Fields-Johnson).

collaborations, learning experiences, and friendships that I have gained from ASRS. Whether you were able to attend the fantastic conference in Knoxville, TN or not, I encourage everyone to reach out to the connections you have made at the annual meetings and use the rest of the year to stay engaged in the society and continue to build these relationships. You never know when an engaging talk or intriguing poster might lead to new research collaborations, but ASRS consistently offers a unique medium for such novel professional connections to emerge.

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![](_page_30_Picture_11.jpeg)

Figure 5. Finishing up with soil and mycorrhizae field sampling in Wise County, VA in March 2024.

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# A river runs through it: Restoration of highly contaminated sites in New Jersey

#### Three case studies of Superfund sites

#### BY WILLIAM E. YOUNG, PWS, CERP

Years ago, erosion controls and a grass cover were adequate for closure of a remediated site. Today, higher standards convert contaminated sites to wildlife habitat, commercial reuse, and public amenity. Here are three case studies proving it can be done.

#### Horseshoe Road Superfund, Sayreville, NJ

Horseshoe Road Superfund is a 12-acre site on the Raritan River. It's among the 114 hazardous waste sites in New Jersey on the Environmental Protection Agency's National Priorities List, which includes about 1,200 sites nationwide that the agency has determined present a "significant risk to human health or the environment."

Post remediation, an array of wetland habitats was established at Horseshoe Road. Contaminated sediments and soils were dug up and removed, leaving

![](_page_31_Picture_7.jpeg)

Salt marsh (background, along river, and brackish marsh (foreground) were restored in former upland/woodland areas. Brackish marsh species used were Hibiscus moscheutos, Schoenoplectus pungens, Juncus gerardii, Spartina patens, and Scirpus robustus (Salt marsh bulrush).

grades slightly lower than previous. This created an opportunity for extensive marshes where woodlands and scrub shrub habitats were previously.

Over two acres of salt marsh were restored right on the Raritan, with a rare brackish marsh just upland. Fringing young woodlands and a large upland meadow provide a range of successional seres to the adjacent remnant mature forests. Osprey and Bald eagles have nested there for the last two years.

![](_page_31_Picture_11.jpeg)

After the remediation is completed, there is ample opportunity to recreate native ecosystems on site. Here an early successional planting yields to a late succession forest to the rear. Between the marshes, the meadows, and the young and old woodlands, there is a range of successional seres, making for valuable wildlife habitat.

When the site is opened to the public, they will have access to the Raritan River, known for fishing, crabbing, and recreational activities. Perhaps there is some measure of environmental justice to have the site restored to full health and habitat after decades of toxicity and no access.

![](_page_31_Picture_14.jpeg)

Photo 5. There are even a few acres of meadow that provide critical early succession habitat.

#### Cornell-Dubilier Electronics, South Plainfield, NJ

The Cornell-Dubilier Electronics, Inc. (CDE) site is in South Plainfield, New Jersey and is composed of a 26-acre property formerly owned by CDE, several adjacent residential, commercial and municipal properties, and the adjoining Bound Brook corridor. The former facility at Hamilton Industrial Park manufactured electronic components between 1936 and 1962. Poor waste handling practices resulted in releases of polychlorinated biphenyls (PCBs) and chlorinated volatile organic compounds (VOCs), primarily trichloroethylene (TCE), which contaminated soil, sediment, and groundwater at the site.

About \$27 million has been recovered from the potentially responsible parties for restoration to compensate for natural resource injuries due to contamination at the Cornell-Dubilier facility.

![](_page_32_Picture_2.jpeg)

The entire site was excavated to remove and dispose of contaminated sediments. Groundwater treatment proceeded during construction and continues via a permanent groundwater treatment facility.

![](_page_32_Picture_4.jpeg)

After soil and sediments were removed, and groundwater treated on site, the restoration begins with new topsoil and then seeding, mulching, fencing, and planting.

A series of habitats were recreated from scratch in a floodplain/riverine complex. Palustrine forests, scrub shrub habitats, emergent marsh, and upland meadows were planted and seeded in a two-year period.

A list of planting items and reclamation protection measures can be found in Table 1. Wildlife returned overnight to the restored site. American beaver (Castor canadensis) found the new site and chewed down 23 trees in 2021 but never built a dam on the Bound Brook. A growing number of bird species frequent the site. Plant species diversity has more than doubled in the three years after completion.

*Table 1.* Planting items include container grown trees and shrubs as well as two-inch plugs of herbaceous emergent plants.

Other reclamation items needed at the site included stakes (Fresh cuttings of willows and other species), fencing, gates and fencing specific to deer and Canada geese. Straw and wood chips provide mulch for erosion control, weed deterrent, and moisture retention.

Item Description	Unit	Jnit Quantity		Remarks	
Total trees	Each	1302	1823	w/guarantee	
Total shrubs	Each	815	1019	w/guarantee	
Total live stakes	Each	550	580	w/guarantee	
Two inch plugs	Each	17900			
Total seeding acres	Acre	5.99	6.85	w/guarantee	
8 foot high steel wire deer fence	Lf	3489			
Gates for deer fence	Each	3			
Herbivory fence	Sf	69729			
Wood chip mulch	Cf	1058.5			

![](_page_32_Figure_12.jpeg)

#### Monitoring and Reporting

Ten major transects and seventeen minor transects were monitored over a three-year period. The results showed excellent survival and improvement in native hydrophytic cover over time:

The following table summarizes the. species by frequency and total cover (red indicates invasive species), which were treated each year in an Adaptive Management Plan

![](_page_33_Picture_0.jpeg)

Willow live stakes (Salix nigra) were established along the banks. Palustrine forests with wetland trees and shrubs were planted throughout the site.

![](_page_33_Picture_2.jpeg)

Emergent marshes absorb all the floodwater. Two years after completion, we found 27 species of native wetland plants. Here is Hibiscus moscheutos (Marsh mallow) in bloom. Pollinators have flocked to the site.

![](_page_33_Picture_4.jpeg)

T ... 1

Planted oak tree chewed down by beaver.

Table 3. Dominant species and Frequency, ranked, on the Major Transects

						Total
Transect	Code	Specific Epithet	Common Name	Indicator	Frequency	Cover
T-2	ES	Eupatorium serotinum	Lateflowering thoroughwort	FAC	9	133%
T-4	PV	Panicum virgatum	Switchgrass	FAC	7	125%
T-2	HS	Helenium autumnale	Common sneezeweed	FACW	8	75%
T-4	CF	Chamaecrista fasciculata	Partridge pea	FACU	5	68%
T-1	BF	Bidens frondosa	Devils beggartick	FACW	9	60%
T-9	SS	Symphyotrichum subulatum	Annual salt marsh aster	OBL	4	52%
T-1	EV	Elymus virginicus	Virginia wildrye	FACW	9	39%
T-2	JE	Juncus effusus	Soft rush	OBL	8	37%
T-1	AV	Artemisia vulgaris	Mugwort	UPL	6	33%
T-4	RH	Rudbeckia hirta	Black eyed susan	FACU	4	33%
T-1	HM	Hibiscus moscheutos	Marsh mallow	OBL	5	29%
T-6	MS	Mikania scandens	Climbing hempvine	OBL	2	23%
T-2	XS	Xanthium strumarium	Common cocklebur	FAC	3	21%
T-4	EH	Erechites hieracifolia	American Burnweed	NI	2	19%
T-5	LC	Lespedeza cuneata	Chinese bushclover	UPL	4	19%
T-10	MF	Monarda fistulosa	Wild bergamot	FACU	1	18%
T-6	PP	Polygonum punctatum	Dotted smartweed	OBL	1	15%
T-3	VH	Verbena hastata	Swamp verbena	FACW	5	15%
T-6	PC	Polygonum cespitosum	Oriental lady's thumb	FACU	1	14%
T-4	CC	Conyza canadensis	Canada horseweed	FACU	3	13%
T-4	AA	Ambrosia artemisifolia	Annual ragweed	FACU	3	12%
T-5	SNA	Symphyotrichum novae-angliae	New England aster	FACW	2	12%
T-6	CS	Calystegia sepium	Hedge bindweed	FAC	2	11%
T-3	BC	Bidens cernua	Nodding beggar ticks	OBL	3	10%
T-3	CV	Carex vulpinoidea	Fox sedge	OBL	2	8%
T-8	SJ	Solidago juncea	Early goldenrod	NI	3	8%
T-4	SL	Symphyotrichum laeve	Smooth blue aster	FACU	3	8%
T-2	CL	Carex lurida	Nodding sedge	OBL	2	7%
T-9	EN	Chamaesyce nutans	Eyebane	FACU	1	7%
T-7	MP	Monarda punctata	Spotted Bee balm	UPL	1	6%
Of the tor	twelve s	necies nine are hydronhytes and only	v one is invasive			

#### Harrison Ave Landfill (now Cramer Hill Waterfront Park)

The 62-acre project has four main components: shoreline protection, landfill closure, natural resource restoration, and park construction.

#### **1. Shoreline Protection:**

- Stabilizing over 3,000 feet of shoreline along the Delaware River.
- Addressing soil contamination (including pesticides and PCBs) on steep slopes.

#### 2. Landfill Closure:

- Excavating and redistributing 375,000 cubic yards of solid waste and soil.
- Installing a passive gas venting system.
- Constructing a two-foot-thick semi-permeable cap using clean fill material and vegetation.

#### 3. Natural Resource Restoration:

- Expanding freshwater wetlands (seven acres) on the Cooper and Delaware Rivers.
- Creating living shorelines along the Delaware and Cooper Rivers.
- Preserving existing trees as bald eagle forage habitat.
- Replanting hundreds of trees in the Bald eagle foraging zone.
- Total tree/shrub/herbaceous plug/ live stake is 445,000 plants.

#### 4. Public amenity and Recreation:

- Playgrounds and amphitheater
- Sensual and touch gardens for blind and handicapped.
- Public fishing pond and kayak channel.
- Two miles of trails and Observation overlooks with views to Delaware River, Petty's Island and Camden and Philadelphia.

Total tree/shrub/herbaceous plug/ live stake planting totals over 440,000 plants.

![](_page_34_Picture_21.jpeg)

Harrison Avenue being capped graded, October 2019. Photo courtesy NJ Department of Environmental Protection.

Green Site Remediation (GSR) are practices to reduce the environmental impact of a project, take cost and economics into account, and consider the social consequences of the project (Economy/Ecology/Culture). A SURF study using GSR made significant improvements in all three metrics.

GSR practices implemented during the pre-design investigation stage included the use of EPA's Triad approach, the use of biofuels (and biohydraulic fluids) for heavy equipment, and the use of a local marina to store heavy equipment. A carbon footprint analysis was conducted to determine the reduction in environmental impacts from implementing GSR practices during the characterization stage, compared to a traditional approach, and the environmental impacts were: 45 percent reduction in CO<sub>2</sub> equivalents; 50 percent reduction in analytical costs and schedule; 40 percent reduction in field effort, reduced generation of IDW

"This park represents equity and justice in the city. Today, this green space rivals any park in the state, and represents the kind of investment and change that Camden deserves" said Commissioner Jeff Nash. "Moving

![](_page_34_Picture_26.jpeg)

Over 3,000 feet of living shoreline was constructed along the Delaware and Cooper Rivers. This was designed to withstand heavy erosion and scour forces. The Delaware River is to the left.

![](_page_34_Picture_28.jpeg)

A large public fishing pond is under construction in 2019.

![](_page_34_Picture_30.jpeg)

Fishing pond near completion. A footbridge provides access for residents to the park. Past the footbridge is a kayak channel that leads directly to the Cooper River. The skyline in the distance is the city of Philadelphia.

forward, I hope the city and county can develop programs that gets as many kids as possible onto this property to stoke their imagination and curiosity"

These are just three examples that prove even the most contaminated sites can be restored, especially in urban areas that lack open space and natural areas. The EPA and the Army Corps of Engineers should be commended for their commitment to public safety and restoration of native habitats.

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# Diversifying Intermountain Fuel breaks with Curlycup Gumweed

#### BY DEREK TILLEY, NATURAL RESOURCES CONSERVATION SERVICE

#### What's the burning issue?

Wildfires are an increasing problem in the western U.S., damaging rangelands, reducing habitat value, destroying property, and costing millions of dollars in firefighting and post-fire reclamation activities. Fires in the region are becoming larger and are occurring more frequently largely due to the spread of the invasive annual, cheatgrass (*Bromus tectorum*), which creates large continuous swaths of fine fuels in late summer. One strategy that has been widely employed to compartmentalize the landscape, reduce fuel loads, and slow fire progress is the use of vegetative green strips, or fuel breaks, to allow crews to employ fire stopping treatments (Figure 1).

![](_page_35_Picture_4.jpeg)

Figure 1. Forage kochia monocultures, like the one shown in this fuel break near Mountain Home, Idaho, offer little wildlife or pollinator value. Photo by Landon Goolsby, NRCS.

Two species are commonly used in fuel breaks in the region. Forage kochia (*Bassia prostrata*) is a low-growing subshrub in the goosefoot family (*Chenopodiaceae*), while Russian wildrye (*Psathrostachys juncea*) is a perennial grass, both introduced from Eurasia. Both are highly competitive against cheatgrass and stay green with high leaf moisture content even under arid conditions. They decrease fire intensity by reducing flammable dry matter and creating more open space or bare ground. However, both species have limited wildlife habitat or pollinator value. Most fuel breaks containing these species are purposefully created as monocultures. Therefore, there is interest in increasing fuel break species diversity without sacrificing efficacy.

![](_page_35_Picture_8.jpeg)

Figure 2. Numerous beneficial insects have been documented visiting curlycup gumweed for pollen and nectar. Photos by Jim Cane, USDA-ARS.

Curlycup gumweed (*Grindelia squarrosa*) is a native, shortlived perennial forb of the sunflower family (*Asteraceae*) that may have potential for use in fuel breaks in the arid west as it stays green throughout the fire season and is difficult to ignite. This species is adapted to disturbed areas in the Intermountain West and is included in seed mixes for its value as an early seral colonizer. Further, curlycup gumweed is visited by numerous genera of native bees and butterflies (Figure 2) and is recommended for use in pollinator friendly habitat plantings, flowering from August through October when few other pollinator-supporting plants are available. Finally, greater sage-grouse, a conservation species of high importance in the region, will eat curlycup gumweed leaves. The plants are also home to numerous insects and other arthropods that are eaten by sage-grouse chicks.

It's not known if gumweed can be established concurrently with forage kochia and Russian wildrye or if it will persist among these highly competitive species. It's also not known if reducing forage kochia and Russian wildrye components in seed mixes to add diversity will significantly reduce the overall efficacy of the fuel break. In 2020, we established a study in southeastern Idaho to examine various proportions of forage kochia, Russian wildrye, and curlycup gumweed in an arid cheatgrass site to explore these ideas.

Our trial included six treatments (seed mixes) and a nonseeded control. Treatments included three single-species treatments with: 1) 100 percent forage kochia (100B); 2) 100 percent gumweed (100G); and 3) 100 percent Russian wildrye (100P). We also had three multi-species mixes including 4) 75 percent forage kochia and 25 percent gumweed (75B25G), 5) 75 percent Russian wildrye and 25 percent gumweed (75P25G), and 6) 50 percent forage kochia, 25 percent Russian wildrye, and 25 percent gumweed (50B25P25G). In 2024, four years after planting, we collected target species and weed species storied canopy cover data and cheatgrass biomass data.

#### What did we find?

The greatest target species cover was produced by seed mixes with high percentages of forage kochia (Table 1). The 100 percent forage kochia (100B) and the forage kochia/ gumweed mix (75B25G) both resulted in 61 percent target species cover. We saw mature plants and new seedlings from recruitment. The three-way (50B25P25G) mix had lower cover (53 percent) but did not differ significantly from the high-percentage kochia mixes. Solid stands of Russian wildrye (100P) and gumweed (100G) produced the lowest target species cover with 31 and 7 percent cover, respectively. **Table 1.** Target species cover, cheatgrass cover, and cheatgrass biomass resulting from six seeding treatments and a non-seeded control, four years after planting. Different letters indicate significant differences at P<0.05.

	Target Species Cover %	Cheatgrass Cover %	Cheatgrass Biomass g/m²
100B	61 a	24 c	17 c
75B25G	61 a	25 с	35 bc
75P25G	21 bc	63 b	89 bc
50B25P2	5G 53 a	47 bc	66 bc
100G	7 c	72 ab	99 b
100P	31 b	40 bc	39 bc
Control	NA	100 a	297 a

100B = 100% forage kochia; 75B25G = 75% forage kochia/25% gumweed; 75P25G = 75% Russian wildrye/25% gumweed; 50B25P25G = 50% forage kochia/25% Russian wildrye/25% gumweed; 100G = 100% gumweed; 100P = 100% Russian wildrye

Cheatgrass cover was significantly reduced by all seeding treatments except the full stand rate of gumweed (100G), with the greatest reductions occurring in the forage kochia and Russian wildrye dominated mixes. The 100B and the 75B25G treatments reduced cheatgrass cover from 100 to 25 percent. However, the three-way 50B25P25G mix resulted in two times more cheatgrass cover (47 percent) than the full stand of forage kochia. The 75P25G treatment also had increased cheatgrass cover compared to the full stand of forage kochia but reduced cheatgrass cover compared to the non-seeded control.

Cheatgrass biomass was significantly reduced by all seeding treatments compared to the non-treated area. Cheatgrass biomass was lowest in the 100B treatment with 17 g/m<sup>2</sup>, a 94 percent decrease. Other treatments produced greater amounts of cheatgrass biomass but did not differ statistically from the 100B treatment, except for the 100G treatment which produced 99 g/m<sup>2</sup> of cheatgrass. We observed two

#### Benefits of Curlycup Gumweed:

- Native forb that colonizes disturbed areas. Easy to establish in arid and semi-arid rangelands.
- Leaves are eaten by adult sage-grouse. Arthropods living in the plant are eaten by sage-grouse chicks.
- Excellent pollinator species that attracts bees and butterflies with pollen and nectar.
- Difficult to combust due to high leaf moisture content similar to forage kochia.

times more cheatgrass biomass from the 75B25G mix compared to the full rate of forage kochia and nearly four times more cheatgrass with three-way 50B25P25G compared to forage kochia alone.

Curlycup gumweed established in low numbers and produced minimal cover; however, low forb establishment is common in Intermountain rangeland seedings. The full stand seeding of gumweed (100G) averaged seven percent cover, as did the gumweed portion of the 75P25G treatment (Figure 3). Replacing 25 percent of forage kochia seed with gumweed (75B25G) yielded one percent gumweed cover. However, it did not significantly reduce the amount of forage kochia cover, nor did it increase the amount of cheatgrass cover compared to the forage kochia monoculture. Russian wildrye cover was reduced from 28 to 14 percent with the substitution of 25 percent gumweed. The three-way mix had 20 percent less forage kochia cover than the 100B mix, but total target cover did not differ significantly. Finally, cheatgrass cover was two times greater in the three-way mix plots than in the plots of the standard forage kochia monoculture.

*Figure 3. Cumulative cover of seed mix components, cheatgrass, and bare ground.* BAPR=forage kochia, GRSQ=curlycup gumweed, PSJU=Russian wildrye, BRTE=cheatgrass.

![](_page_37_Figure_3.jpeg)

#### What's it all mean?

All seed mixes reduced cheatgrass biomass, and all mixes except for the 100 percent gumweed mix reduced cheatgrass cover. We successfully established curlycup gumweed in forage kochia and Russian wildrye stands (Figure 4), and curlycup gumweed was still present at the site four years after planting despite being a biennial. While producing only small amounts of cover, the addition of curlycup gumweed provided pollinator and wildlife benefit that is otherwise absent at the site.

#### What's next?

*Figure 4.* Forage kochia, curlycup gumweed, and Russian wildrye can be seen growing together in the 3-way mix plot in 2024. Photo by Derek Tilley.

![](_page_37_Picture_8.jpeg)

Higher seeding rates of curlycup gumweed may improve establishment outcomes. We saw low total target species cover in the three-species mix plots, resulting in higher cheatgrass cover. Research has shown that higher seed rates can increase establishment, richness and cover in low precipitation environments. It's possible that adding gumweed to a full stand seeding rate of forage kochia or Russian wildrye (resulting in a higher overall seeding rate), as opposed to replacing part of the full seeding rate with gumweed, could result in higher target species cover with a greater forb component without sacrificing primary species cover. *#* 

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