Understanding Modern Shale Gas Development:
Operations, rules, regulations, and Range’s commitment to responsible development.
Range Resources Corporation is a leading U.S. independent oil and natural gas producer with operations focused in Appalachia. The Company has approximately 1 million net acres across Pennsylvania, most of which has stacked pay potential for the Marcellus, Utica and Upper Devonian shale formations.

In 2004, Range pioneered the Marcellus Shale with the successful drilling of the Renz #1 well in Washington County, Pa.
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Advances in technology have unlocked new supplies of natural gas. For Range, shale development is long-term commitment that requires multiple stages of operations, and years of planning, engineering and science.

1. Planning
The first step of developing a well site is acquiring leases. While drilling usually takes places on a single property, one to two square miles are typically leased and combined to form a “unit”. Next the well site is designed by Range engineers and then permitted through government agencies.

2. Drilling
Utilizing horizontal drilling technologies, Range can drill multiple wells from a single location. During the drilling process, multiple strings of permanent steel casing are inserted into the wellbore and cemented fully to the surface. After reaching a pre-determined depth, which is typically more than 6,000 feet, horizontal drilling begins. Each well typically takes a few weeks to drill. Once completed, the drilling rig leaves the location.
3. Completions
To allow oil or natural gas to flow that would otherwise be trapped in geological formations; the wells must be hydraulically fractured. Fracturing fluid is pumped downhole to create a targeted network of paper-thin fractures within the shale. The fluid is typically 99.9% water and sand, with a mix of 3-4 highly-diluted additives, which many are biodegradable. This phase typically takes 2-3 days per well. Once completed, the equipment leaves.

4. Production
The locations are reclaimed to blend into the surroundings. The natural gas is transported through a system of pipelines from the location to a sales point. Each site is routinely inspected by one of our field employees. The permanent production equipment is monitored and remotely controlled 24/7 from a central office and is equipped with state-of-the-art air quality technology.
The Range Approach

The philosophy at Range is straightforward: to be good stewards for the environment and the communities where we live and work. It’s that simple. This core commitment starts with Range’s Board of Directors and extends to our 900 employees. Range’s approach and commitment is underscored with the basic belief that there does not have to be a choice between our shareholders, the environment and the communities in which Range works.

While many welcome responsible natural gas development, some people have questions about various aspects of the industry. We recognize that it’s normal for some to be skeptical of what the industry has to say in a vacuum. This document aims to address key aspects of our work – based on the science, facts and findings of top regulatory agencies and independent experts. Our goal is to help people make informed decisions and become more knowledgeable about Range and the industry.

Range’s culture of good stewardship ensures that we meet or exceed both expectations and regulatory guidelines. And we seek improvement to guidelines when we feel the standards are not high enough to match emerging new technologies and best practices.

A number of notable accomplishments in this regard include:

- **2009**, pioneered large-scale, shale-gas water recycling, first company to achieve 100-percent reuse.

- **2010**, first company to voluntarily disclose hydraulic fracturing on a per well basis, post information online. Now required regulation in leading oil and gas states and can be found at FracFocus.org.


- **2012**, initiated a Zero Vapor Protocol for wet gas and super rich areas in Marcellus shale gas development. Same year the Interstate Oil and Gas Compact Commission (IOGCC) recognized Range with Chairman’s Award for Environmental Partnership with the Rocky Mountain Elk Foundation.

- **2013** and in subsequent years, Oil and Gas Awards recognized Range with their Award for Excellent in Corporate Social Responsibility.

- **2014**, partnered with National Wild Turkey Federation on an award-winning conservation program at Cross Creek County Park in Washington County, Pennsylvania.

- **2015**, recognized as the Operator of the Year for industry leadership and stewardship by the Virginia Department of Mines, Minerals and Energy.
Are Regulators Doing a Good Job?

The United States Environmental Protection Agency (EPA), which is the largest environmental regulatory agency on the planet partnered with the Interstate Oil and Gas Compact Commission (IOGCC), which is a multi-state agency of state oil and gas regulatory agencies, to develop the State Review of Oil and Natural Gas Environmental Regulations or STRONGER as it’s more commonly known.

- STRONGER is a non-profit, multi-stakeholder organization whose purpose is to assist states in documenting the environmental regulations associated with the exploration, development and production of crude oil and natural gas.

- In addition to oversight from the United States Environmental Protection Agency and the United States Department of Energy, the IOGCC includes highly effective insight and engagement from states, industry, Congress, and the environmental community.


- In its most recent review “the review team has concluded that the Pennsylvania program is, over all, well-managed, professional and meeting its program objectives.”

- The report indicated that “in fact, we believe several aspects of the Department of Environmental Protection (DEP) and its operations merit special recognition.”

- In Pa, oil and gas regulations must follow a process that involves consideration by the Oil and Gas Technical Advisory Board, the Environmental Quality Board, the Citizen’s Advisory Council, the Independent Regulatory Review Commission, and the public.

**Pennsylvania’s oil and natural gas regulations “well-managed, professional and meeting its program objectives...merit special recognition.”**
How is Natural Gas Enhancing Air Quality?

As natural gas is increasingly used to generate electricity, heat our homes and power our transportation, air quality has improved dramatically. In fact, U.S. CO2 emissions are at a 20-year low thanks to expanded use of natural gas. Additionally, as shale gas production continues to grow, energy-related CO2 emissions have also plunged to a 10-year low. More importantly, air quality from power generation has dramatically improved with reductions in nitrogen oxides, sulfur dioxides, mercury and particulates. These reductions from increased natural gas use reduce smog and improve overall air quality, which has a direct correlation to enhanced overall public health.

The U.S. Energy Information Administration said that “growth in natural gas consumption contributed to the overall 2016 decline in total emissions.”

Energy-Related carbon dioxide emissions, 1990-2016


Natural gas development presents tremendous benefits that dramatically improve air quality through the increased use of the clean-burning fuel in power generation and transportation. Years of experience and study show that the air quality surrounding natural gas operations is well within safe and regulated levels and that the rules regulating this activity are sound.
Is Air Quality Regulated? Is it Being Protected?

The Pennsylvania DEP has stated:

“Pennsylvania requires the control of air emissions at all natural gas operations through standards that represent best available technology and through comprehensive leak detection and repair programs for both methane and volatile organic compounds.”

In Texas where there has been extensive shale gas development in dense areas, virtually identical to development in other parts of the country, including Pennsylvania, air quality has repeatedly found to be safe and well within regulated levels. In fact, the Texas Commission on Environmental Quality (TCEQ) in the Journal of Unconventional Oil and Gas Resources, researchers examined 4.7 million data points for volatile organic compounds (VOCs) across the Barnett Shale region. The air quality monitoring data reveled a key finding: “Long-term VOC levels were all below their health-based comparison values.”

“the rise in natural gas use over coal generates approximately $14 to $37 billion in annual public health benefits.” – Pennsylvania DEP

The Pennsylvania DEP has also conducted air quality tests near various industry locations, including compressor stations, water impoundments and drilling locations. The DEP sampled and studied Marcellus Shale locations and facilities in both the Southwestern and Northeastern parts of the state. The reports state:

“the screening results did not indicate a potential for major air-related health issues associated with the Marcellus shale drilling activities.” - PA DEP: Southwest Pa. Marcellus Shale Short-Term Air Sampling Report (November 1, 2010)

Fort Cherry school district in Washington County, Pennsylvania, commissioned a study with independent researchers from ChemRisk took air samples prior to development and then continued sampling through the entire completions process – fracking, flaring, etc. From the report:

“The results of the fracking and flaring sampling periods were similar to the results obtained from the baseline monitoring period and likewise, did not show anything remarkable with respect to chemicals detected in the ambient air. When volatile compounds were detected, they were consistent with background levels measured at the school and in other areas in Washington County. Furthermore, a basic yet conservative screening level evaluation shows that the detected volatile compounds were below health-protective levels.”
In recent years the West Virginia Department of Environmental Protection conducted an air quality test, which monitored ambient and indoor air at a school approximately one mile from a Marcellus shale well pad before and after hydraulic fracturing operations. According to the report:

“Extremely low concentrations of carbonyls, volatile organic compounds, and hydrogen sulfide were detected, and no indications of public health impacts related to hydraulic fracturing were found.”

Similar studies have generated similar results in shale fields across the United States. A report by the Colorado Department of Public Health concluded:

“The monitored concentrations of benzene, one of the major risk driving chemicals, are well within acceptable limits to protect public health, as determined by the U.S. Environmental Protection Agency. The concentrations of various compounds are comparatively low and are not likely to raise significant health issues of concern.”

A report examining data from the United States Environmental Protection Agency (EPA) shows:

“Based on the latest data from the U.S. Environmental Protection Agency’s (EPA) Greenhouse Gas Reporting Program, EID’s report shows methane emissions from the most productive shale basins in the country have fallen considerably in the past six years. These reductions have been achieved even as oil and natural gas production has increased.”
Air Quality Best Practices and Specific Actions

Range is committed to ensuring compliance and meeting its voluntary commitments to limit and manage emissions. Through engineering and implementation of best practices, Range manages and limits emissions while enhancing overall production. For example, Range conducts emission inventories and regular field inspections. Annually, Range reviews well site and compressor station designs to improve emissions controls by applying our core values of performance, integrity, innovation, and transparency.

Range also incorporates CNG (Compressed Natural Gas) Vehicles in the company’s fleet. help reduce emissions compared to traditional vehicles, as well as helps reduce operational costs.

Drilling
Implementing controls to limit the combustion of fuels is a top priority. In Pennsylvania, Range operates a natural gas-powered drilling rig. Flaring is limited to situations where it is necessary for repair, maintenance, emergency or safety. Range reduces natural gas flaring and the resulting greenhouse gas emissions by capturing and enclosed burning flaring, when possible. Selective Catalytic Reduction (SCR) technology is sometimes used for reducing NOx emissions from drilling, provided the rig is capable of accommodating the control.

Flowback
Range complies with the EPA’s green completions standards. A closed-loop system, constructed before permanent production facilities are installed, is utilized on new sites to capture emissions and virtually eliminate the need for flaring. Although Range has worked hard to greatly reduce flaring instances, it may be necessary for rare operational or safety purposes. Range’s newly developed internal flaring policy requires Range staff to log and detail any flaring instances. This data will be analyzed moving forward to identify any operational trends, improve safety and efficiencies, and to correct deficiencies.

Temporary Water Transfer
Range maintains a robust water-recycling program that utilizes permanent and temporary water transfer pipelines which significantly reduces truck traffic. Additionally, when trucks are used during water transfer, Range requires reduced idling times at its locations. Trucks are tracked by satellite to ensure the most efficient and safe operations possible.

Production
Range’s permanent shale production facilities are outfitted with emissions-reducing technologies. Range continuously evaluates its facilities through a leak detection and repair program used to find new and innovative methods for emissions management. For the Marcellus Shale Play, Leak Detection and Repair (LDAR) surveys are detailed in the Compliance Demonstration Reporting (CDR) submissions to the Pennsylvania Department of Environmental.

All of Range’s well sites that were completed after September 18, 2015 are required to have an LDAR survey under the Federal New Source Performance Standards. For sites with new wells, LDAR surveys are conducted
within 60 days of being turned on and semiannual follow-up surveys are performed thereafter. Range currently operates more than 100 sites with LDAR surveys.

In accordance with Federal New Source Performance Standards, an attempt is made to repair any leaks during the LDAR inspection. Leaks that are not able to be repaired during the inspection must be repaired within 30 days of the inspection, unless exempt. Additionally, in Pennsylvania, the Department of Environmental Protection’s standards require that leaks be repaired within 15 days of detection, unless ordering of parts or a facility shutdown is required to repair the leak.

Facility components are carefully selected and tested by Range’s engineering team to minimize potential leaks. Facilities are assembled using internally developed standard operating procedures based on nationally accredited industry standards. The facilities are then tested for leaks before commissioning. Once operation begins, facilities are tested with an optical gas imaging (OGI) camera within the first 60 days and then every 6 months through the life-cycle of the well. If a leak is found in Pennsylvania, where the majority of Range’s operations take place, state regulations require it to be fixed within 15 days, otherwise an extension permit must be filed while material is ordered.

By maintaining thorough records of the OGI program, Range’s engineering team has been able to determine which components were most likely to leak. Analyzing that data and identifying trends has allowed Range to make strides in reducing leaks even further by selecting alternative components and altering processes based on quantitative information. The effectiveness of the operations, maintenance, and engineering teams have yielded a substantial reduction in identified leaks with this targeted approach.

In order to assure consistency, Range employees conduct all leak detection surveys for the company. All employees conducting leak detection surveys are required to receive Optical Gas Imaging training through the Infrared Training Center. If the training is not readily available, the employee may be trained in-house by a certified individual, but must receive the Infrared Training Center training when it becomes available.

Range annually reports the number of high bleed, intermittent, and low bleed controllers to the Environmental Protection Agency. In 2016, Range reported zero high-bleed controllers in both Pennsylvania and North Louisiana.

An optical gas imaging (OGI) camera is used to perform the LDAR surveys. View Range’s fact sheet here on best management practices for a typical Marcellus shale well. Range submits an annual Greenhouse Gas Report to the Environmental Protection Agency that includes details on its engines and fuel usage, as well as details on its production operations practices.

Additionally, methods of emission reduction are included in the annual emission report to the Pennsylvania Department of Environmental Protection (the PADEP) for the Marcellus Shale Play. For drilling operations, there is a control selection field in the Pennsylvania state oil and gas reporting electronic (OGRE) report. For each well pad that has been spud after August 10, 2013, a Compliance Demonstration Report (CDR) is submitted to the PADEP, detailing source emissions, emissions control, and methods of determining emissions rates within 180 days of the start of production.
Water Sourcing and Recycling

Like any construction process, natural gas development requires water, and protecting and managing both surface and groundwater resources are a top priority for our company.

The states in which Range operates have appropriate water management regulations. Each company division uses a specific set of best practices to address regional differences in regulation, geology, topography, site location and water sourcing accessibility.

These plans also include the use of both permanent and temporary water lines that allow for the transport of water to our shale gas development sites, often from centralized impoundments, dramatically reducing truck traffic. In other instances, Range may use temporary, mobile water storage solutions if centralized impoundments are not needed.

In the Marcellus Shale Play, Range maintains a robust water-recycling program that utilizes permanent and temporary water transfer pipelines which significantly reduces truck traffic. Additionally, when trucks are used during water transfer, Range requires reduced idling times at its locations. Trucks are tracked by satellite to promote efficient and safe operations possible. Reduced truck traffic notwithstanding, we’ve invested more than $50 million in roads and related transportation infrastructure over the last five years in Pennsylvania.

This is perhaps the most apparent in our leadership on voluntary disclosures, and with Range-pioneered water recycling and reuse technologies which efficiently and dramatically reduce both consumptive water needs and local truck traffic.

Water is closely monitored and regulated in the states where we operate. For example, all of our water management efforts in Pennsylvania are reviewed, permitted and regulated by the Department of Environmental Protection (DEP), as well as local regulatory bodies, such as the Susquehanna River Basin Commission. Our compliance with these regulations requires a complete analysis and reporting of all water usage, transportation, recycling and reuse, and disposal if warranted. This includes identification of water sources and withdrawal points and our activities are regularly audited by the state. It is truly a comprehensive, beginning-to-end process.

Of all major energy sources, natural gas produced from shale is among the least water consumptive energy resources per MMBTU. By utilizing best practices, going above and beyond regulations when appropriate and pioneering large-scale water recycling and reuse technologies, Range is continuing to focus on efforts that further enhance how we manage and use water.
Well Casing and Water Protection

The protection of water sources is important to Range. In the Marcellus Shale Play, Range surveys water sources such as springs, wells and ponds within a 3,000 foot radius from its proposed locations. This includes water intake reservoirs within 1,000 foot radius and notifies the surface owner of those water supplies. Those within a 2,500 foot radius are subject to water testing prior to activity conducted by an approved, third-party company and copies are sent to the owners, state regulatory agencies and is kept on file at Range.

Pennsylvania, where the majority of Range’s shale development takes place, is one of only two states in the nation without private water well construction standards or regulations. Because of this, our third-party water tests often serve as an important public health function for neighboring residents who may be unaware of constituents in their wells before our operations begin. The tests set a baseline of naturally occurring gases and other constituents that may be present before drilling. The results are shared with the landowner. In other parts of the country, like Oklahoma, Range’s work typically takes place further away from population centers. Those states also have private drinking water well standards and regulations, which has resulted in less confusion about water quality with residents.

As a matter of best practice and in the pursuit of furthering the available data on the topic, Range assesses groundwater quality after completing certain operations. These situations may include, but are not limited to:

1. A request by surface owners, regulatory agencies, or other engaged stakeholders.
2. In fulfillment of the contractual terms of a lease agreement.

Based on the existing body of research and years of operational experience, Range has determined that it is unnecessary to systematically perform such analysis for each operation, rather it takes a balanced, science-based approach to ensure engagement with its stakeholders and to assure regulatory compliance.

Range’s policy is to immediately evaluate and respond to any concerns or complaints regarding landowner or water purveyor water supplies. Upon receiving a complaint, Range notifies and works with state regulatory agencies according to applicable regulations and retains an independent, state-certified laboratory to conduct testing of the water supply in question. Range also retains an outside environmental engineering consultant to fully investigate the root cause of any such concerns. Additionally, if needed, Range provides replacement water supplies during the testing and investigation.

In the Marcellus Shale Play, Range identifies and evaluates active, inactive, orphaned, abandoned, and P&A wells’ surface and bottom-hole locations within 1000’ of proposed new well locations with respect to the top-hole location and along the entire lateral length of the well bore. This is achieved by using a combination of regulatory agency data, Range’s own extensive database, landowner questionnaires, and physical field surveys.

Once any such wells are located and evaluated, Range develops and implements a well monitoring plan for those identified wells. Additionally subsurface geology is assessed within the same area of review by using historical data, data from previously drilled wells, and seismic survey data; the results of this assessment are
used to identify faults and mitigate any risks associated with those faults. Although it is not possible for fracturing fluids to communicate with the surface through a fault or fracture during well completions; for both safety and efficiency purposes Range relies on scientific analysis prior to and during active operations to closely monitor and prevent/mitigate communication between active wells and related potential subsurface issues, however rare those instances may be.

Within the Marcellus Shale Play, after drilling is completed, and before hydraulic fracturing begins, Range performs the following measures to evaluate well bore integrity:

• The wellbore is pressure tested to make sure that no fluid can escape through the protective casing and cement system;
• A pressure relief system is installed on the surface equipment, which is tested and monitored throughout fracking operations;
• In the rare event that abnormal pressures are encountered, the pressure relief valve enables the pressure to be dissipated on the surface;
• Cement bond logs are run, as warranted, to provide further confidence in the strength and integrity of the cement casing strings;
Fluid Management and Spill Prevention

Companies managing large numbers of vehicles and heavy machinery face the potential of surface spills from human or mechanical errors. In the rare instance of a release, Range has engineered safeguards to respond, minimize or eliminate potential impacts. During operations, Range’s shale gas locations are lined with multiple layers of geosynthetic and/or polyethylene liners, similar to the protection at state-of-the-art landfills, as well as engineered berms for added containment. During production, Range employs best practices for the unloading of produced waters and condensate which include spill prevention hose connections.

During each phase of operations, Range is required to develop and implement a Spill Prevention Control and Contingency (SPCC) as well as a Preparedness, Prevention, and Contingency plan (PPC) for each well site. These plans describe measures and actions in the event of a spill. Active well locations with an SPCC have a series of onsite preventative technologies, such as absorbent materials and readily available vacuum trucks to eliminate any spilled liquid beyond the double liner and secondary, bermed containment system. We are currently working with regulators and industry groups to more effectively consolidate and coordinate incident planning.

In 2016, Range managed and handled 74.7 million barrels of fluids in all parts of our operations. The majority of the fluids managed by Range are either produced water or re-use water. While we strive for zero incidents, the company experienced 53 reportable spills, totaling 1,188 barrels or 0.0016 percent total fluids handled. None of the spills had a lasting or significant environmental impact, and all spills were immediately reported, addressed and appropriately mitigated.
Hydraulic Fracturing Fluid Selection and Disclosure

Hydraulic fracturing is a safe, proven technology used by the oil and natural gas industry for more than 60 years and in more than a million wells across the United States. This process typically requires the pressurized injection of water to create a localized network of fissures into which we pump sand to allow trapped hydrocarbons to safely flow to the surface.

We feel that transparency and open dialogue are important to the continued progress of energy development. These principles led Range to become the first company to voluntarily disclose the fracturing fluid for each completed shale gas well on our website. Range complies with state regulations by providing a well-by-well disclosure of completed wells fracturing fluid through Frac Focus, a national disclosure registry for oil and gas exploration founded by the Ground Water Protection Council and the Interstate Oil & Gas Compact Commission. Range has also supported frac fluid disclosure of Act 13 and voluntary industry trade group efforts.

*In Pennsylvania, Act 13 “enacted one of the most aggressive and transparent hydraulic fracturing disclosure laws in the country…..Colorado’s requirements, upon which much of this Act’s disclosure requirements were based, were hailed by progressive industry representatives, environmental organizations and many other groups as a model for other states.”* — Pennsylvania Department of Environmental Protection

Range works with service companies to design and select the most environmentally friendly additives possible for hydraulic fracturing, based on technical needs and feasibility. For a typical shale well, more than 99% of the fracturing fluid is water and sand, the rest is a blend of common additives that are a part of our everyday lives, some of which are biodegradable. For instance, as a best engineering practice, Range has replaced an antimicrobial with a naturally-occurring nitrate-reducing bacteria, which is biodegradable and nonhazardous, in our Pennsylvania operations.

**For the vast majority of Range’s activities a well completion may consist of:**

- Water 95.75%
- Sand 3.97%
- Chemical Additives 0.38%
- Nitrile Reducing Bacteria
- Scale Inhibitor
- Anti-friction Reducer
- Nitric Acid
- Bacterial Nutritional Supplement

*Range does not use diesel fuel or BTEX in any fracturing fluids.* For a more complete analysis of fracturing fluid composition disclosures, please visit fracfocus.org.
Operating a Safe Workplace

Health and safety – for our employees, contractors and the communities where we work – is of primary importance at Range; it is woven into our business. With nearly 8,000 employees and contractors, the success of our health and safety efforts is evidenced not only by our industry-leading safety record, but also by our commitment to compliance, contractor management, employee training and technology deployment. Best practices for safety procedures are used by Range to help maintain an efficient, safe working environment. Dedicated health, safety and environmental employees support our efforts in each divisional office, conducting frequent site inspections and engaging employees in safety and preparedness programs. Our policy is that every shift at each Range location must begin with a safety meeting.

Personnel
Range personnel manage company locations to ensure that programs and processes are implemented—paying particular attention to maintenance.

In addition to the operations workforce, Range maintains a group of dedicated site inspectors who proactively inspect various sites looking for hazards or factors that may cause unsafe conditions or lead to a future violation of regulatory requirements. Through regular visits, the company is able to monitor potential environmental or safety impacts and is often able to identify areas of concern and hazards prior to any issues arising.

Site personnel are provided details about Range’s expectations for safety. A Stop Work protocol allows any individual at a site to stop ongoing work if imminent danger exists to personnel, property or the environment. The company believes and communicates that any shortcuts that create hazards are unacceptable. Focusing on a safe work environment helps our personnel and contractors eliminate potential environmental, health and safety impacts. With dedicated, trained personnel and supervision dedicated to safe operations, Range is able to meet production goals in a safe manner.

Programs
To help ensure a safety conscious workforce, Range utilizes a combination of computer based training and live safety meetings to continually educate personnel and contractors. We have also worked with first responders to develop customized well site training to best prepare them in case of an emergency. Range implements Safety Alerts to address industry incidents and so called near misses. These alerts describe an incident and its impact, to help educate personnel and prevent future occurrences.

Range’s contractor management program is another way that Range promotes safety. The program verifies that contractors maintain a viable safety program and conducts compliance audits to ensure that contractors are operating safely on Range locations.

As a part of Range’s due diligence, we conduct an audit of potential partner companies prior to doing business with them. A compliance audit confirms that proper procedures are maintained and that the contracted company complies with regulatory guidelines for proper waste handling and disposal.
Lagging and Leading Indicators
To gauge the company’s safety and environmental performance, Range uses both lagging and leading indicators. The lagging indicators are a reflection of incidents that are in the past and reflect what has already occurred. This statistical data identifies how Range is performing using OSHA’s criteria for determining rates for injuries and incidents that result in lost time or restricted duty. The statistics are compared to the industry. Range also compares performance to other industrial groups and consistently works to improve performance.

Leading indicators are those used to show progress in minimizing injuries or impacts. We know that providing knowledge to employees creates better hazard awareness, and that helps decrease the probability of an incident. For example, a leading indicator may be how many employees have been trained for a particular process, reflecting the progress made toward prevention.

### Range Resource Health and Safety by the Numbers – 2016 Calendar Year

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<td>Total Recordable Injury Rate (TRIR)</td>
<td>0.81</td>
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<tr>
<td>Days Away, Restricted, Transferred</td>
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Range is open and proactive in our efforts to mitigate incidents and impacts. Notices of Violation (NOV) are received when an impact or release has been identified as a violation of regulatory codes. Nearly all of Range’s NOVs have originated from self-reporting. When Range personnel identify that a reportable incident has occurred, timely notifications are required within allocated time frames established by the various state regulatory agencies.

If an NOV is issued, Range utilizes a Management System approach to identify the root cause(s) that could have contributed to the incident or caused a violation. Once these have been identified, corrective actions are developed and assigned. Major impacts are communicated to other divisions in the company to help prevent future events and to increase personnel awareness. Range’s goal is, of course, to operate with no violations, but when an incident occurs, Range takes immediate steps to address the issue and prevent re-occurrences.

**Contractor Management**

Range utilizes a third party to collect, verify, and maintain data regarding safety, insurance, quality and regulatory information on contractors and suppliers. Additionally, Range’s contractor management program verifies that contractors maintain viable safety programs. Range also conducts periodic contractor audits.

As a part of Range’s due diligence, the company conducts an audit of potential partner companies prior to doing business with them. A compliance audit confirms that proper procedures are maintained and that the contracted company complies with regulatory guidelines for proper waste handling and disposal.
Community Engagement

For many years, the majority of Range’s activity has taken place in Pennsylvania, specifically southwestern Pennsylvania. Range’s core philosophy is straightforward: to be good stewards for our shareholders, while doing the same thing for the environment and the communities where we live and work. This includes working as hard as possible to ensure that our operations are conducted in a manner with the least possible inconveniences in the communities where we live and work.

Range maintains a Response Center in the Company’s core operating area and publishes contact information for communities across Range’s full operational footprint. All reported concerns are reported to Range’s Response Center where the information is logged and tracked by a team of employees solely dedicated to resolving these issues. This data is tied internally to Range’s GIS programs, which better help to inform the Company on how to manage community concerns over long-term periods and such data is routinely shared with senior management.

Range maintains a robust outreach team working with a variety of stakeholders including citizens, nongovernmental organizations, local and state units of government and area school districts, area first responders, and others. Range maintains five Community Advisory Panels made up of 35 local individuals from a variety of backgrounds in the company’s core operating region. This group formally meets bi-annually with Range representatives specifically on two-way communications. Range hosts annual meetings, workshops, open houses, small and large group presentations, field tours, and a variety of other grassroots community outreach events to proactively engage with the communities where the Company operates. Annually, in the Company’s core operating region, Range directly engages more than 150,000 people at more than 200 of these events.

Range has company representatives who live in active communities and meet face to face with households near our operations. The Company also meets on a case-by-case basis with households beyond the 3,000 foot radius at key intersections or other areas that may be impacted by the Company’s work. Annually, in the Company’s core operating region, Range directly makes more than 15,000 notifications specifically related to the Company’s work schedule.
Traffic Management

Range works with local governments and safety officials to develop traffic coordination plans. These plans look at site specific conditions that help minimize traffic impacts during operations. Range coordinates with area schools to manage operations with their school bus schedules and routes. Additionally, Range posts signage on local roadways to ensure employees and contractors follow the approved traffic routes and any other site specific traffic conditions. Range enters into Excess Maintenance Agreements with local communities that defines maintenance requirements, permit types and expectations and can be unique to each municipality.

All Range drivers participate in regular driving training courses. Expectations are clearly articulated to third-party contractors. Actions are taken for contractors who do not comply with Range’s traffic management plans. Where it makes the most sense in Range’s core operating area in southwestern Pennsylvania, the Company employs a dedicated team of traffic management personal who monitor traffic around the clock.

In Range’s core operating area in southwestern Pennsylvania, the company employs a host of traffic management personnel and practices, including, but not limited to, roving traffic monitors, restricted speed limits and GPS technology to ensure the traffic coordination plan is followed. Specific outcomes include not using or only using certain roads during designated hours based on community input when feasible.
Lights, Sound & Dust

Range recognizes that there may be some inconveniences associated with shale gas development. The Company makes every effort possible to best eliminate, mitigate and reduce these possible inconveniences by working with local communities, townships and residents. Many local communities may place rules, regulations or conditions on these aspects of our shale gas development as part of the permitting process. Range is committed to working with local governments and the communities to work in the most responsible and sensitive manner possible. Depending on site conditions, Range may utilize the following to address such concerns:

- equipment to shield light and procedures to focus it on to the location and not on surrounding areas
- dust control measures for roads
- sound engineering modeling and analysis prior to work
- In Range’s core operating region of southwestern Pennsylvania, Range performs advance light and sound studies for every location.

Range works to eliminate or limit as much dust as possible from our locations. In the Company’s core operating area, Range paves the first 50 feet of access roads to allow for as much dust and aggregate to remain on access road. Range utilizes street sweepers, fresh water or DEP-approved suppressant to eliminate or reduce dust and closely monitors roads for dust.

Range actively controls odors if they happen to occur as a result of our operations.
Property Values

The Pittsburgh Tribune Review reported that average home prices in Washington County increased 5.9-percent between 2012 and 2014, ahead of the 5.2-percent increase seen across the region, according to statistics the paper compiled with the help of South-Side based real estate information firm RealStats. And in the first quarter of 2015, the average sales price for a home in Washington County topped out at $204,334; a 20-percent increase from one year ago, and larger than increases seen in any other county in southwestern Pennsylvania.

Washington County was also the most expensive area in the Pittsburgh region in which to buy a newly built home last year, while at the same time boasting more wells than almost anywhere else in the state. The average price for a new home in 2014 was $378,960, up 18 percent in two years, according to RealStats. That compares with a 10.3 percent increase for the entire five-county region. The Trib quotes local real estate agent Monica Mahla as saying, “Many businesses that are moving their businesses to Southpointe are creating a higher demand...We’re seeing growth of the major corporations there.”

These statistics are noteworthy not just because they illustrate just how rapidly property values are rising in Washington County – but also because they appear to contradict claims that hydraulic fracturing and natural gas drilling activity diminish property values. Exactly the opposite is unfolding across southwestern Pennsylvania.

Overall, according to the U.S. Census Bureau, Washington County has seen a steady increase in Median Home Values since 2005.
Shale Drilling: Best Management Practices

- **Liner and berm system** under all equipment to prevent and eliminate spills
- **High-tech drilling technology**
- **Permanent erosion and sedimentation control**

- **Walking rig technology**, shortens drill time, reduces surface footprint. Certain rigs are powered by natural gas for further emission reductions
- **Methane burner** safely eliminates and reduces certain greenhouse gas emissions
- **Closed-loop drilling system** recycles fluid and eliminates drilling pits
Shale Completions: Best Management Practices

- Permanent facilities installed, “green completion” and eliminates need to flare the wells
- High-tech command center
- Recycled water storage tanks
- Temporary water transfer lines, reduces amount of trucking
- Location liners and berms under all equipment for spill prevention
- Sand storage towers, reduces and eliminates dust
Shale Production: Best Management Practices

- Vapor and emission collection and recovery units, ventilation capture for truck loading
- High-tech, remote monitoring and computer based controls
- Backup vapor emission destructor unit, eliminates emissions not captured in recovery

- Vapor recovery units capture and send any vapor or emissions to pipeline for sales
- Methane detectors are located on multiple locations on well site
- Regular visits and inspections by technicians