

!'#\$%'(#&)\*#)\*,-.)"/0#1"22/),3,.0#4.'.,5.#36.,7#8&,7#96&7.#'::#  
;&'',).0#<)\*.7#36.#=>?@#1!1#A/,\*,.%,).0B?#

!"#\$%&'!"#()#\*+,-#\$.!/01)23/(4,!&/#2!05.52567,!!  
8/936!056%:,!;#<=>6!0?62@A<sup>B</sup>,!C'D(\*>!E6F@G<sup>H</sup>!

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0@H(@2I@\$.:,!+J+J!

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#

CD037&'3'!!&!2#K5\$!=51>L!5=!/@I#(@!#I5>(!\$#(35636%!%>3/@.36@L!=5\$!MNOPQRST!F#1136@L!3L!  
9)@)@\$#6/!)59!(5!H\$35\$3(3A@!#11@LL!=5\$!2365\$3(<!H5H>.#(356L!()#(!)#F@!I@@6!H#\$31>.#\$.<!  
#=@1(@/!I<!()@!H#6/@231,!#6/!I@@6!()@!L>IK@1(!5=! )3L(5\$31#.!#6/!L(\$>1(>\$#./!3L#/F#6(#%@,!  
H#\$31>.#\$.<!U.#1\*!#6/!P6/3%>65>L!36/3F3/>#.L!!V@!L32>.#(@!)@!+JSW!MQM!O#1136@!&..51#(356!  
%>3/@.36@L!>L36%!/#(#!=\$52!()@!&2@\$31#6!M522>63(<!0>\$F@<!>6/@\$!/3==@\$6(!#LL>2H(356L!56!  
(5(#.!F#1136@!L>HH.<!!U.#1\*!#6/!P6/3%>65>L!36/3F3/>#.L!152I36@/!\$@1@3F@!#!)3%)@L)#\$@!5=  
F#1136@L!152H#\$@/!(5!()@3\$!H5H>.#(356L!L)#\$@!=5\$!#..!#LL>2H(356L!56!(5(#.!F#1136@!L>HH.<!!  
-59@F@\$,!()@3\$!F#1136@!L)#\$@!>6/@\$!()@!+JSW!MQM!%>3/@.36@L!3L!156L3/@\$!I.<!59@\$!()#6!()@3\$!  
L)#\$@!5=!MNOPQRST!/@#()L!#6/!#%@R#/#>L(@/!/!/@#()L!!V@!()@6!L32>.#(@!56@2

6!P6/@X!Y&QPZ!#L!#!H\$5X<!-5\$!

/3L#/F#6(#%@,!9@!L)59!()#(!#7J [ !)3%)R&Q!\$@L\$F@!361\$@#L@L!()@!6>2I@\$!5=!F#1136@L!#..51#(@/!  
(5!U.#1\*!5!\$P6/3%>65>L!36/3F3/>#.L,!93!)#!L)#\$@!()#(!#HH\$5#1)@L!()@3\$!MNOPQRST!/@#()!L)#\$@!  
9)@6!()@\$@!#@\$@!#I5>(G!:!23..356!>63(L'!

@X1@..@6(!#LL3L(#61@'!!!  
^!CP; ,!M#2 I\$3/%@!C&!J+S4T,!D0&'!HH#()#\* ] 23('@/>!  
^!D63F@SL3(<!5=!'"@66L<.F#63#!")3.#/@.H)3#!,"&!ST\$J7,!D0&'!L1)23/() ]>H@66'@/>!  
^!CP; ,!M#2 I\$3/%@!C&!J+S4T,!D0&'!#/#2L5. ] 23('@/>!  
^!CP; ,!M#2 I\$3/%@!C&!J+S4T,!D0&'!L56%++ ] 23('@/>!  
^!U5L(56!M5..@%@,!M)@L(6>(!-3..!C&!J+7BG,!D0&'!(#<=>6'L562@A ] I1'@/>!  
^!U5L(56!M5..@%@,!M)@L(6>(!-3..!C&!J+7BG,!D0&'!>6F@ \$ ] I1'@/>!!!

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5IL@F#(356L!#LL3%6@/!(5!())@!%\$5>H!3L!#HH\$5X3 2#(<@!\>#.!(5!())@!6> 2 I@\$!5=H@5H.@!36!())@!%\$5>H!  
#L!156=3\$ 2 @/!5\$!@L(3 2#(@/!=5\$ 2 !#L@156/#\$<!L5>\$1@'!

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; )@!"DC0!/#(#!5@L!65(!156(#36!36=5\$ 2#(356!56!())@!)@#.(!)1)#\$#1(@\$3L(31L!5=L>\$F@<@/!  
36/3F3/>#L'!!V@!/@=36@!#6!36/3F3/>#.!#L!)3%)!\$3L\*!3=!(@<!)#F@!#!15 2 5\$I3/3(<!L>1)!#L!1#61@\$!,  
\*3/6@<!/3L@#L@,!)@#\$(!/3L@#L@,!/3#I@(@L,!5\$!)3%)!UCP!36!()@!Uak00!!V@!()@6!%\$5>H!()@!Uka00!  
/#!#I<!#%@!I36,!L@X,!\$#1@,!#6/!=5\$!@#1)!15 2 I36#(356,!9@!15 2 H>(@!)@!H\$5H5\$(356!5=!(@!)@!  
H5H>.#(356!())(3L!)3%)R\$3L\*!'; )@6!9@!\$@(>\$6!(5!())@!"DC0!/#(#!#6/!@#1)!36/3F3/>#.!3L!#LL3%6@/!(5!  
())@!\_)3%)!\$3L\*!1#(@%5\$<!9 3!())@!H\$5I#I3.3(<!\$@.F#6!(5!())@3\$!%\$5>H!36!()@!Uka00'!!!

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a36#..<!9@!2>L(!3 2 H>(@!#6!&QP!L15\$@!=5\$!@#1)!36/3F3/>#.!V@!1#665(!#LL3%6!())@!#1(>#.!&QP!5=  
@#1)!H@\$L56!36!()@!"DC0!/#(#!I@1#>L@!&QP!3L!15 2 H>(@/!>L36%!1@6L>L!I.51\*!.@F@.!#F@\$#%@L!#6/  
()@!"DC0!%@\$#H)31!LH@13=313(<!3L!56.<!#!()@!">I.3!DL@!C31\$5/#(#!&\$@#Y"DC&Z!.@F@.'!036%)!  
Y+JJ4Z!\$@H5\$(L!)@!SG!15 2 H56@6(L!#6/!)@3\$115@=313@6(L!>L@/!(5!/@(\$ 2 36@!())@!1@6L>L!(\$#1(!.@F@.!  
&QP!36!STTJ'!V@!>L@!()@L@!15@=313@6(L!(5!=36/!&QP!#(!()@!)5>L@)5./!.@F@.'!8#1)!15@=313@6(!3L!  
#LL3%6@/!#!9@3%)(!=5\$!()@!)5>L@)5./!>L36%! "DC0!/#(#!#(!()@!)5>L@)5./!.@F@.'!; )@!9@3%)(@/!L>2!  
5=!15@=313@6(L!%3F@L!())@!\$#9!6> 2 @\$31#.!&QP!L15\$@!5=!(@!)5>L@)5./!'0361@!"DC0!.36\*L!  
)5>L@)5./L!(5!36/3F3/>#L,!9@!#LL3%6!()@L@!L15\$@L!(5!@#1)!36/3F3/>#.!5=!(@!)5>L@)5./!36!"DC0!  
V@!/3F3/@!()@!/3L(\$3I>(356!36!/@13.@L!#6/!#LL3%6!@#1)!/@13.@L!L15\$@L!S!(5!SJ'!!!

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V@!#\$@! 2 36/=>.!()#(!()@\$@!#\$@!L@F@\$#!.3 2 3#(356L!(5!5>\$!L3 2>.#(356!I@1#>L@!5=!/#!#156L(\$#36(L'!!  
;)@! 2 5L(!3 2 H5\$(#6(!.3 2 3#(356!L@ 2 !=5\$ 2 !1@\$#36!/#!#15 2 3LL356L!36!"DC0!/#(#!#6/!())@!#1!()#(!  
9@!15 2 H>(@!&QP!#(!()@!=# 2 3.<!.@F@.!\$#()@\$!()#6!()@!1@6L>L!I.51\*!.@F@.'!V@!5 2 3(!W! 2 3..356!H@5H.@!  
.3F36%136!%\$5>H!\>#(\$L!L>1)!#L!H\$3L56L,!6>\$L36!=#13.3(3@L,!#6/!15..@%@!#6/!>63F@\$L3(<!)5>L36!#L!  
2 5L!"DC0!F#\$3#I.@L!/5!65(!@X3L!=5\$!()@ 2 !#6/!()@<!#\$\$!#>(5 2#(31#..<!@X1.>/@/!=5\$ 2!()@!)3%)R  
&QP!%\$5>H'W!!05 2 @! 2 3LL36!F#\$3#I.@L!=5\$!H@5H.@!.3F36%136!)5>L@)5./!L@((36%#\$@!#LL> 2 @/!(5!I@!J'!!!

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V @\$H5\$(!)\$@@!I@61) 2 #\*\$L!=5\$!15 2 H#\$3L56!36!()@!a3%>\$@!()@!H5H>.#(356!=\$#1(356!5=!U.#1\*!#6/!  
P6/3%@65>L!%\$5>HL,!()@!=\$#1(356!5=!MNOPQRS\$@.#(@/!/ @#()L!# 2 56%!U.#1\*!#6/!P6/3%@65>L!  
H5H>.#(356L,!#6/!()@!#%@R#/K>L@

/3==@\$@61@!#1\$5LL!L(#(L!#L!F#1136@!L>HH.<!361\$@#L@L'!!; )3L!1#6!I@!L@6!I<!15 2 H#\$36%!()@!15.5\$L!  
#1\$5LL!()@!(9 5!L1@6#\$35L!36!()@!L@156/!H#6@.!5=!a3%>\$@!+'!!

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; )@!( )3\$/!H#6@.!5=!a3%>\$@!+!L)5 9L!()#(!\$@.#(3F@!(5!()@!L)#\$@!5=!/@#()L!36!()@!L(#(,!65\$()@#L(@\$6!  
L(#(L!\$@1@3F@L!.@LL!()#6!()@3\$L)#\$@!5=!/@#()L,!9)3.@!L5>()@#L(@\$6!L(#(L!\$@1@3F@! 2 5\$@!()#6!()@3\$!  
L)#\$@!5=!/@#()L'^@9!m@\$L@<!#6/!^@9!j 5\$\*!L(#6/!5>!>6/@\$!I5!()@!+J!#6/!: J! 2 3..356!L1@6#\$35

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\$#(35636%,!=5\$!)@!156(@X(!5=!L1)55.!L@#(!#LL3%62 @6('!!P6!)@!+JJG!"#\$@6(L!P6F5.F@/!36!M52 2>63(<!01)55.L!FL'!0@#((. @!1#L@,!!)@!D63(@/!0#(@L!0>H\$@2 @!M5>\$(!/@13L356!\$>.@/!#%#36L(!/3\$@1(<!>L36!\$#1@!#L!#!=#1(5\$!36!hRS+!#/ 2 3LL356L'!!0(#\$(36%!36!+JJT,!M)31#%5!">I.31!01)55.L!#/5H(@/!#!6@3%) I5\$)55/RI#L@/!#==3\$2 #3F@!#1(356!L<L(@2 ,!>L36%!56.<11@6L>L!(\$#1(!.F@.!2 @#L>\$@L!5=!/3L#/F#6(#%@!YQ>\$,!"#()#\*!#6/!0?62 @A!+J+Jn!8..3L56!#6/!"#()#\*!+J+JZ'!  
!  
&QP!)#L!#.L5!I@@6!>L@/!36!\$@1@6(!9 @3%)(@/!.5((@\$<RI#L@/!L1)@2 @L,!#LH@13#.!1#L@!5=!\$@L\$F@!  
L<L(@2L,!(!5!#..51#(@!#6(3RF3\$#!!/\$>%L!Y"#()#\*!@('!#!'+J+JIZ'! ; )@!M52 2569 @#.( )!5=!"@66L<.F#63#!  
)#L!>L@/!&QP!#L!H#\$(!5=!())@!L(#(gL!5==313#!H5.31<!5\$!#..51#(36%!L1#\$1@!MNOPQLH@13=31!  
2 @/31#(356L,!361.>/36%!k@2 /@L3F3\$!MNOPQ!H#(3@6(L!9)5!\$@L3/@!93(36!())@!25L(!/3L#/F#6(#%@/!  
6@3%) I5\$)55/L!36!"@66L<.F#63#!\$@1@3F@!)3%)@\$!H\$35\$3(<!9 @3%)(L!(5!\$@1@3F@!())@L@!L1#\$1@!

a3%>\$@!7!3..>L(\$#@L!)59!#!\$@L@\$F@!L<L(@2!95>./!95\$\*!=5\$!F#1136@L!93(!#!)3% )R&QP!\$@L@\$F@!  
1#(@%5\$<!36!# / /3(356!(5!( )@!5\$3%36#!.+JSW!MQM!1#(@%5\$<'!! ; )@!(5H!H#6@.!L)59L!( )@!H\$5H5\$(356!5=  
361\$@ 2 @6(#.!F#1136@!>63(L!#9#\$/@/!(5!( )@!)3% )!&QP!H5H>.#(356!



# 25>6(!;! ; )@!@==@1(!56!)@!5()@\$!(95! 2 @#L>\$@L!5!=#3\$L)#\$@L!/>@!(5!#!)3%)R&QP!\$@L@F@!3L!  
6@%.3%3I.@'!!!

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; )@!&HH@6/3X!\$@H5\$(L!56!L@F#\$#!5()@\$!/3 2 @6L356L!5=!F#1136@!#..51#(356!!a3%>\$@!&S!#/ /L!  
- 3LH#631!H5H>.#(356L!(5!a3%>\$@!;!#6/!L)5 9 L!()#(!#!)3%)R&QP!\$@L@F@!\$@L>.(L!36!#!)3%)@\$!L)#\$@!5=!  
U.#1\*,!P6/3%@65>L,!#6/! - 3LH#631!\$@13H3@6(L'!!&(!G:! 2 3..356!>63(L,!#7J [ !)3%)R&QP!\$@L@F@!\$@L>.(L!  
36! 2 5\$@!F#1136@L!(5!())3L!%\$5>H!()#6!I5()!()@3\$L)#\$@!5=!()@!H5H>.#(356!#6/!()@3\$L)#\$@!5=!MNO PQ!  
/ @#(L'!!a3%>\$@!&+!15 2 H#\$@L!#!)3%)R&QP!\$@L@F@!(5!#!/3\$@1(!\$#13#!.\$@L@F@!5\$!U.#1\*!#6/!  
P6/3%@65>L!36/3F3/>#L'!!a5\$!.@F@.L!5=!F#1136@L!>6/ @\$!SJJ! 2 3..356!H@L\$56!>63(L,!#7J [ !)3%)R&QP!  
\$@L@F@!)#L!#L3 2 3.#\$!@==@1(!#L!#!: [ !L@L@F@!5\$!U.#1\*!#6/!P6/3%@65>L!36/3F3/>#L'!!a3%>\$@!&4!  
L)5 9 L!()#(!()@!#F@\$#%@!#%@!5=!F#1136@!\$@13H3@6(L!3L!..5 9 @\$!()#6!()@!H5H>.#(356!#F@\$#%@!>6/ @\$!+JSW!  
MQM!%>3/ @.36@L!5\$! 2 5L(!.@F@.L!5=!F#1136@L!>HH.<'!a3%>\$@!&7/L)5 9 L!()#(!()@!L)#\$@!5=!F#1136@L!  
#..51#(@/!(5!=@ 2 #.@L!3L!)3%)@\$!()#6!()@!H5H>.#(356!-\$#1(356!-5\$!F#1136@L!>HH.<.@L!()#6!SJJ!  
2 3..356!H@L\$56!>63(L,!I>(13L!1.5L@!(5!()@!H5H>.#(356!=@ 2 #.@!-\$#1(356!9 )@6!L>HH.<!3L!%\$#@#(5!()#6!  
SJJ! 2 3..356!H@L\$56!>63(L'!

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; )@!1>\$@6(!/ @I#(@!56!)5 9 !(5!H\$35\$3(3A@!F#1136@!#..51#(356!=5\$!)#\$/ @L(R)3(!15 2 2 >63(3@L!)#L!65(!  
9\$@L(.@/!93(!LH@13=31!/@(#3.L!5=!9 )@()@\$!@X3L(36%!L<L(@ 2 L!#\$@!@ \>3(#I.@!I#L@/!56!@ 2 H3\$31#!./#(#!  
5\$!)5 9 !(5!#1(>#..<13 2 H.@ 2 @6!)@3%)@6@/!H\$35\$3(<!=5\$!H#\$31>.#\$!%\$5>HL'!!0361@! 2 #K5\$!%\$5>HL!)#F@!  
65(!<@(!=36#3A@/!%>3/ @.36@L!56!#..51#(356!/ @LH3(@!9 5\$\* ,!9 @!\$@H5\$(!56!)5 9 !()@!+JSW!MQM!  
"#6/ @ 2 31!P6=-.>@6A#!O#1136@!%>3/ @.36@L!9 5>./!#..51#(@!F#1136@L!(5!U.#1\*!#6/!P6/3%@65>L!  
36/3F3/>#L!#6/!#1\$5LL!L(#@L'!!!!

!

N>\$!#6#.<L3L!3..>L(\$#@L!()@!3 2 H5\$(#61@!5=!#H\$@13L@!/@=363(356!5=!@ \>3(#I.@!#..51#(356!36!L@((36%!  
F#1136@!#..51#(356!H5.31<'!V @!@L(3 2 #(@!()#(!U.#1\*!#6/!P6/3%@65>L!H5H>.#(356L!15 2 I36@/!\$@1@3F@!  
2 5\$@!F#1136@L!15 2 H#\$@/!(5!()@3\$(5(#.!H5H>.#(356!L)#\$@!5\$!#..!@F@.L!5=!F#1136@L!>HH.<'! - 5 9 @F@\$,!

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@L(3 2 #(@L!5=!MNO PQ!1#L@L!#6/!/ @#()L'!!&L!3 2 H\$5F@/!/ #(!I@15 2 @!#F#3.#I.@,!3(!9 5>./!I@!  
9 5\$( ) 9 )3.@!(5!\$@F3L3(!()@L@!@L(3 2 #(@L'!! ; )@!L@156/!3LL>@!36F5.F@L!(#\*@R>H'!!0@F@\$#!.L(>/3@L!  
L>%%@L(!()#!U.#1\*!

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4.:.7.)'.0#

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M@6(@\$L!=5\$!Q3L@#L@!M56(\$5.'!+JSW'!!\_&..51#(36%#!#6/!;!#%@(36%!"#6/@231!P6=->@6A#!O#1136@!  
Q>\$36%#!#6!P6=->@6A#"#6/@231`!!DO!Q@H#\$(2@6(!5=!-@#.)!#6/!->2#6!0@\$F31@L'!!

!

M5)@6,lm56'+J+J'!\_ ; )@!e36@!3L!a5\$236%!=5\$#!MNOPQRST!O#1136@'!V)5!0)5>./!U@!#!(!)@!  
a\$56(i`!!"#%\$"%\$,!m>6@!+T'!/53ISJ'SS+BsL13@61@'#!I/:GGJ!!

!

M5F3/(\$#1\*36%'152'!!+J+J'!\_ ; )@!MNOPQ!k#13#!Q#(!; \$#1\*@\$`!!&F#3.#I.@!#!(!  
15F3/(\$#1\*36%'152s\$#1@'!e#L(!#11@LL@/!&>%>L(!+W,!+J+J'!

!

Q55.36%,!h#( ).@6'+J+J'!!\_MNOPQRST!O#1136@!"\$35\$3(3A#(356!V5\$\*!b\$5>H!M56L3/@\$#(356L``!!  
&MP"!MNOPQRST!O#1136@L!V5\$\*!b\$5>H'!!&F#3.#I.@!#!(!  
)((HLlss999'1/1'%5FsF#1136@Ls#13Hs2@@(36%Ls/596.5#/LsL.3/@LR

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"#()#\*,"#\$%&'!;#<=>6!0?62@A,!C'D(\*>!E6F@\$,!#6/!C'!U>236!j @62@A'+J+J'!!\_ ;\$3#%@!  
"\$5(515.!Q@L3%6!=5\$!O@6(3.#(5\$!k#(35636%!36!#!"#6/@2311!P6(@%\$#(36%!C>.(3H.@!8()31#.!O#.>@L!  
)\$5>%)!k@L@F@L`!!^U8k!V5\$\*36%!"#H@\$!+BT:S'!

!  
"#()#\*,"#\$%&'!;#<=>6!0?62@A,!C'D(\*>!E6F@\$,!#6/!C'!U>236!j @62@A'+J+J'!!\_a#3\$!  
&..51#(356!5=!O#1136@L,!O@6(3.#(5\$L!#6/!&6(3F3\$#!!;\$@#(2@6(L!e@#F36%!^5!8()31#.!O#.>@!U@)36/!  
36!-@#.!M#\$@!k#(35636%`!!&>%>L(!&F#3.#I.@!#(!!)(HL!ss#\$X3F'5\$s#ILs+JJW'JJ4G7'!

!  
r>366,!0#6/\$#!M\$5>L@,!&2@.3#!m#23L56,!O31\*3!0'!a\$@32>(),!m3!&6,!b\$@%5\$<!k'!-#6151\*!,Q56#./!  
C>L#!+JSG'!\_8XH.5\$36%\$#13#!.36=->@61@L!56!=->!F#1136@!#((3(>/@L!#6/!I@)#F35\$!k@L>.(L!5=!#!  
6#(356#.!L>\$F@<!5=!V)3(!#6/!&=\$31#6!&2@31#6!#/>.(L`!A\*""#%\$,!4:YWZ,!SSBGRSSG7'!

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!"#\$%&'(())"\*+,-./:0123456789@A\$B7%3\$82(1-36C)  
!"#\$%&'(())"\*+,-./:0123456789@A\$B7%3\$82(1-36C)

Tier 1

Tier 2

Tier 3

Tier 4

Tier 5



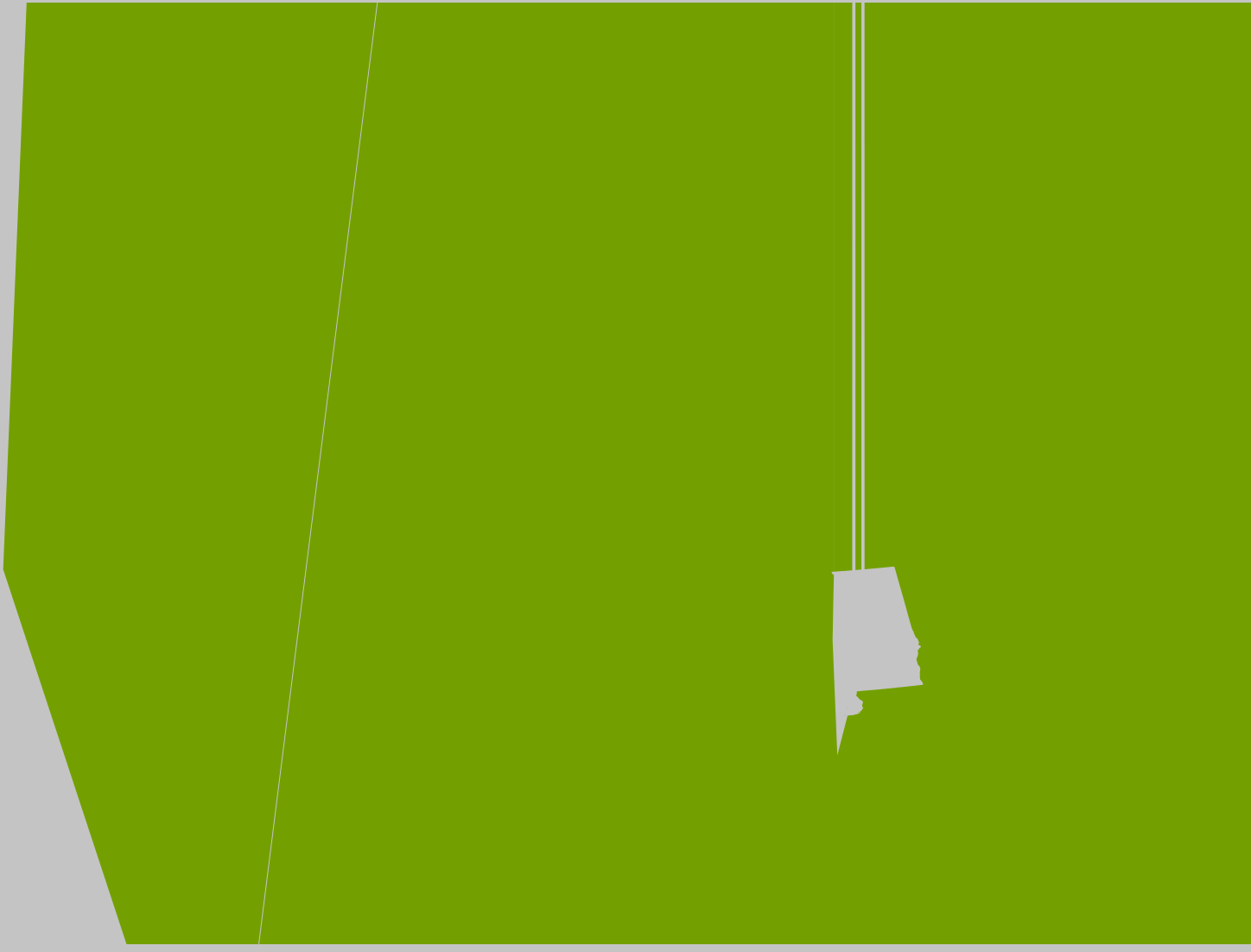






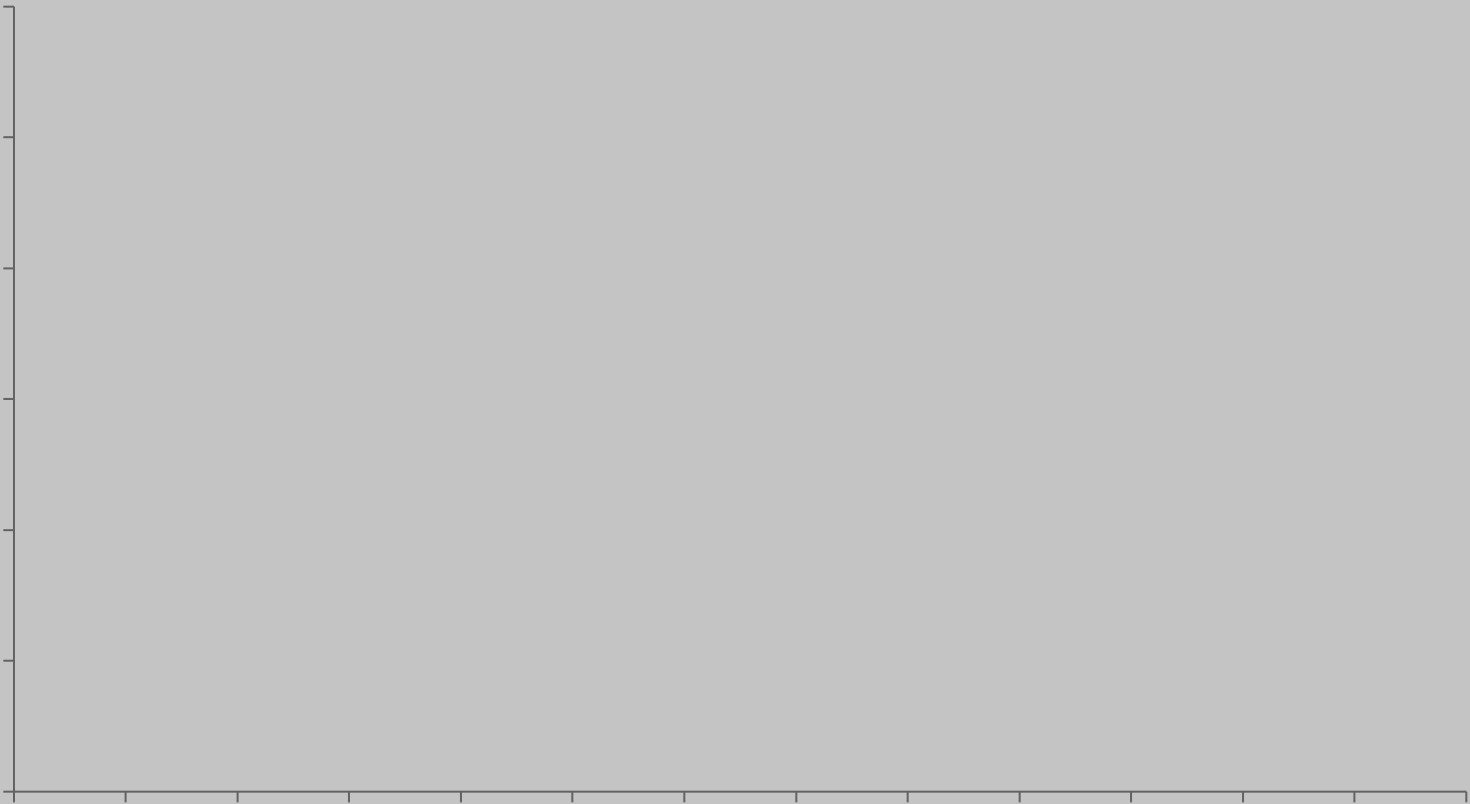
Figure 4

Marginal share of high-DI population obtaining a vaccine

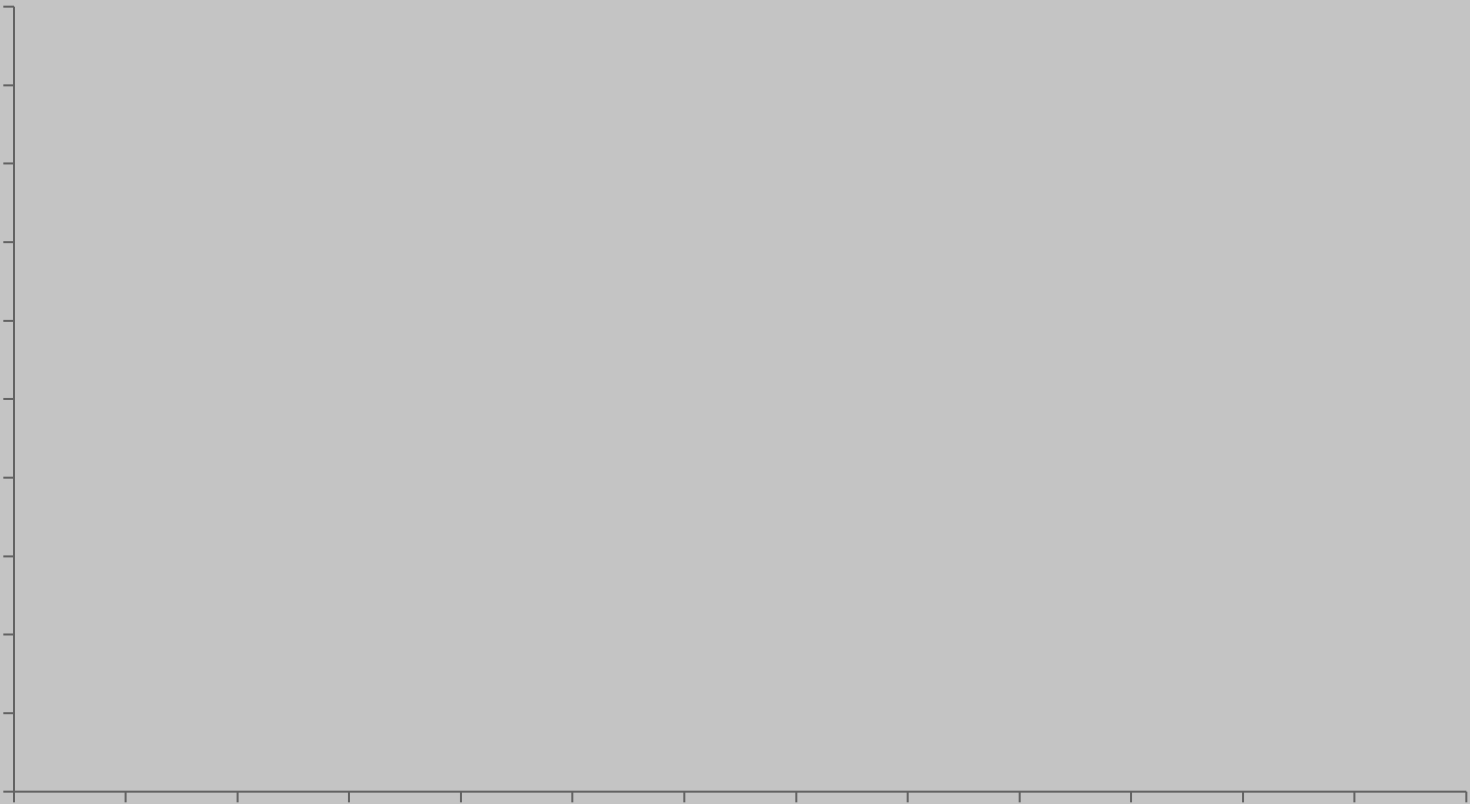
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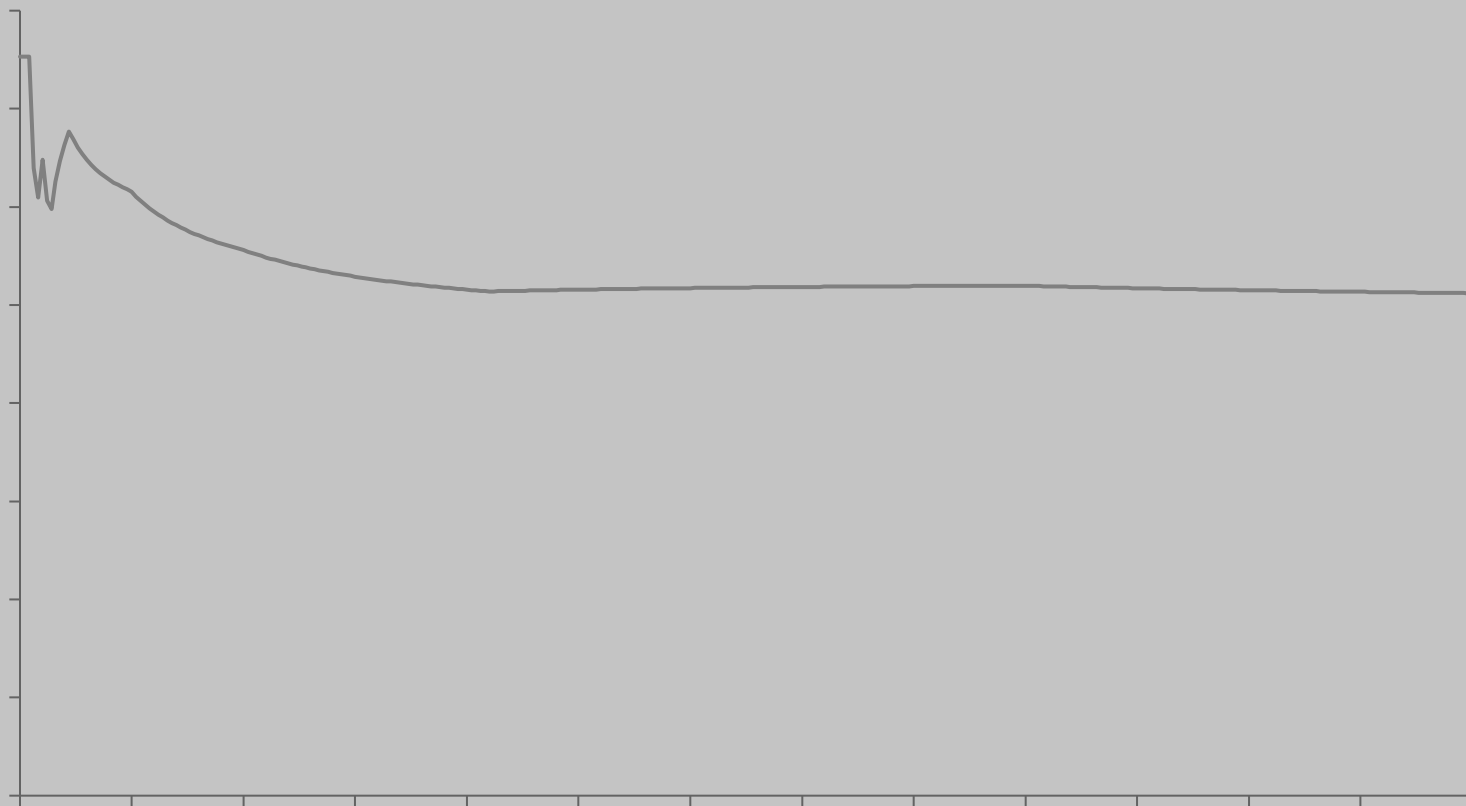












!

! '\$''%& ' ( (''' )\$\*+&, \$ - .#/0\$1''&2314%) .3%&/'')&5 /0/&, 1.34%6&

!

"#!\$%#!&'()\*!(+ ,!-+ , ./0+#12!3# 4 4 1+ ."02!50)0.60!"70.8!9(.8!: 7(80!#;!!  
<()).+02! =+ , 08!"70!>?@A!3% 3!B1. , 0'.+02CD



' 89k ! : %3: \$% ; &

!

' 8989k 5 / 0 / & , 1.34%6&

!

` 0!U(20!#18!W8.#8."E!".082

0eW'.)."!2"("040+"!\\$+#"!.)'1,0,!.+!7./708!W8.#8."E!/8#1W2D^I!"70!3%3d2!.4W'.)."!2"("040+"!  
\\$#"708!/8#1W2D^I!#8!)#44#+!20+20!\L#!/8#1W2!"7("!"70!F=P:!,#02+d"!,.,;080+."("0!U1!"127#1',!!  
+#!")1('E!#608'(W^H!R18!1+,082'(+,./!#;!"7#20!802"8.).#+2!7(2!U00+!())#1+"0,!,#8!.+!#18!  
'(UO''.+!/!)8."08.(H!  
!  
%10!"#!,("(!'.4."(.#+2I!L0!80'E!#+!8(+,#4.0("#+!;#8!"70!(22./+40+"!#;!W0#W'0!"#!)08"(./+3%3!  
/8#1W2H!  
!  
M70!G3: !F=P:!,#02!+#!"+)'1,0!,("(!#+!"70!W8020+)0!#;!7./7Z8.2\*!)#+,."#+2I!L7.)7!.4W()!"2!  
#+0d2!".08!W8.#8."E! `0!21WW'040+"!L."7!>?@A!,("(!;8#4!"70!&07(6.#8('!5.2\*!9())#8!:1860.'(+0!  
:E2"04!&59: :^!\3%3!>?@AU^H!G2!"70!#U2086("#+2!+!"70!&59: :!(80!1+80'("0,!"#!"7#20!+!"70!  
F=P: !L0!80'E!#+!8(+,#4.0("#+!"#!' +\*!"70!"L#!,("20"2!UE!)#4W1".+/"70!W8#W#8".#+!L."7!(!  
7./7Z8.2\*!)#+,."#+!;#8!0()7!)7(8()08.2".)! ,04#/8(W7.)!/8#1W!.+!"70!&59: :!(+ ,!(22./+.+/!0()7!  
#U2086("#+!.+!F=P: !W082#+,("(!2!7./7Z8.2\*!12.+/"L0./7"0,!)#.#+!;'W2H!P#80!,0'(.2!(80!.+!"70!  
\$M.08!+)'12.#+!)8."08.(D!20)".#+!#;!"7.2!,#)140+"H!  
!  
`0!)7#20!"#!81+!"70!".08!(22./+40+"!W8#)022!#+'E!#+)0!,10!"#!"70!'(8/0!2.00!#;!"70!,("20!"(+,!"70!  
'(8/0!2.002!#;!/8#1W2!(+ ,!,04#/8(W7.)!)("0/#8.02!80'("60!"#F`BMFH!M7.2!.2!+#!("P#+!0!3(8#!  
2.41'("#+H!  
!  
`0!120!U#!"7!"70!W082#+(+ ,!"70!7#12.+/"1+."!F=P: !,("(!;#8!(22./+.+/!G80(!%0W8.6("#+!+ ,0e!!  
G%-^!>H?! \=+.6082."E!#;! `2.)#+2.+!:)7##!#;!P0,.)+0!(+ ,!F1U'.!)J0("7!>?@[^!"#!.+ ,.6.,1('2I!  
(2!"70!)#4W#+0+"2!#;!"70!G%-!.+6#'60!U#!"7!.+ ,.6.,1('Z'060!'("8.U1"02!;#1+ ,!#+'E!.+!"70!W082#+!  
,("(!(+ ,!7#1207#',Z'060!'("8.U1"02!;#1+ ,!#+'E!.+!"70!7#12.+/"1+."!,("H! `0!L080!(U'0!"#!' +\*!"70!  
"L#!,("20"2I!(2!L0"!2!. ,0+";E!802.,0+"2!#;!"70!2(40!7#12.+/"1+."!L."7.+!"70!W082#+,("I!12.+/"!  
"70!6(8.(U'0!:K5-GTXRI!(+!-%!+14U08!1+.b10!"#!"70!7#12.+/"1+."!"7("!.2!W8020+"!.+!U#!"7!"70!  
W082#+(+ ,!"70!7#1207#',!,("H!  
!  
`0!)(++#!(22./+"70!)1('!G%-!#;!0()7!W082#+.+!"70!F=P: !,("(!U0)(120!G%-!2!)#4W1"0,!  
12.+/"!0+212!U'#)\*!'060!(608(/02!(+ ,!"70!F=P: !/0#/8(W7.)!2W0).;)."E!#+'E!/ #02!,#L+!"#!"70!  
F1U'.!)=20!P.)8#,("(!G80(!\F=P G^!'060'H! `0!.+2"0(,!(WW8#e.4("0!"70!G%-!#;!0()7!;(4.'E!  
12.+/"!(608(/02!"(\*0+!(!"70!;(4.'E!



=\$%3k AB\$@CDE%3Fk B\$@Ck ,%:%3\$0FGk	6. ?0\$%303/'Hk ; \$0C\$''00\$%3k A113k0\$%3k8Gk	J31. (k	5 %IS''\$0\$1''k	7 5 7K6k L60\$ - /0%)k M. - ?%3k\$''k J31. (k
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@!

@!	S!;#8!;8#+".+0! K P : I [!;#8! ;8#+".+0!'(L! 0+;#8)040+! (+ ,!;80! 2086.)02!!a!;#8! 802"!	K 4 08/0+)E!2086.)02!(+,!W1U'.)! 2(;0"E!20)"#8!W082#++0'!\0H/!! 04 081.99065-2(1.99021T f 0.1294
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S!

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&(+\*.+!/! j !;,+(+0I!)704 .)(!'  
;##,! j !(/8.)1""180!  
W7(84 ()01".)(!W#2"(! j !  
27.WW.+/I! j !"8(+2W#8"(.#+!20)"#8!





' <9<909& B\$@CP3\$6H&41'')\$0\$1''6&/')&0C%&QRS, ,&

!

M70!F= P :!, #02!+#"!7(60!, ("(!#!"70!70("7!)#+, ".# +2!#;"70!21860E0,!.+, .6., 1('2#! ` 0!"7080;#80!  
.4 W1"0!3 R<-%Z@Y!8.2\*!;#8!0()7!#U2086(" .#!+.!"70!F= P :!12.+/"70!&59 : :!, ("(#!

!

` 0!'(U0'!0()7!#U2086(" .#!+.!"70!&59 : :!(2!7./7Z8.2\*!;#8!3 R<-%Z@Y!.;!(!"!0(2!"# +0!#;"70!  
;#' '#L.+/"!2!"810g!

M70!.+, .6., 1('!7(2!U00+!\$K608!"#', ^!E#1!7(, !2\*.+) (+)08D!!

M70!.+, .6., 1('!7(2!U00+!\$K608!"#', ^!E#1!7(, !(+E!#"708!"EW02!#;!) (+)08D!!

M70!.+, .6., 1('!7(2!U00+!\$K608!"#', ^!E#1!7(60!\*., +0E!, .20(20D!+#!.+) '1, .+/"\*., +0E!  
2"# +02I!U' (, , 08!.;0)".#!#8!.)#+" .+0+)0!!

M70!.+, .6., 1('!7(2!U00+!\$K608!"#', ^!E#1!7(60!)78#+.)!#U2"81)".60!W1' 4#+(8E!, .20(20I!  
3#R#F#%#H!04 W7E20 4 (!#8!)78#+.)!U8#+)7".2D!!

M70!.+, .6., 1('!.2!#U020I!, 0;.+0, !(2!7(6.+/"(!& P -!1m!S?!

M70!.+, .6., 1('!7(2!U00+!\$K608!"#', ^!E#1!7(, !(+/.+(!#8!)#8#+(8E!70(8"!, .20(20D!

7./7Z8.2\*H! ` 0!#4."!(+E!#U2086("&#x22;L7080!#+0!#8!4 #80!#;! "7020!,04 #/8(W7.)!6(8.(U'02!(80!  
1+\*+#L+!#8!4 .22.+/H!  
!





- o ` 0!( ""04 W"0, !"#!120!"70!21W0820!"#;!"7#20!L."7!(!XG-3 :!)# , 0!#; !Y>A@@?Fi !# P -TZ =# : #!G840 , !9#8)02I!&8(+ )7!X#"! : W0). ; , 0 , !#8!Y>A@@?Fa!# P -TZ P .!". (8E!50208602!R8!X(" .#+(!B1(8 , !L7#!7(60!+#"!(!'80( , E!U00+!(22./+0, !"#! .08!@!21U".08!>#! J#L0608I!"7.2!20!"#+'E!80W8020+"2!a>\*!W0#W'0!.+!"70! = : !W#W1'(" .#+I!2./+.;.) (+ "E! '022!"7(+!"70!3%3d!02".4 ("0!#; ! [??\*#!G2!L0!)#1' , !+#"!.)80(20!#18!+14U08! L."7#1"!.)'1 , .+!/!W0#W'0!;8#4 !#"708!U8(+ )702!#;!"70!4 .!". (8E!(+ , !+#+Z4 .!". (8E! .+ , .6. , 1('2I!L0! , 0). , 0 , !"#!(22./+!0608E#+0!.+!#18!( ""04 W"0 , !21W0820!"#!"7.2!/8#1W! .+2"0( , !#; !/#.+!/!"78#1/7!#18!21W0820"" .+!/W8#)0 , 180#!

K220+ . ('!4 .!". (8E!21WW#8!(+ , !212"(.+40+!"W082#++0!

- o 3%3!2.00!02".4 ("0g!i [?\*
- o : 1W0820"#!7#20!L."7!(!4 .!". (8E!XG-3 :!)# , 0!\Y>A@@?F@!# P -TZ=# : #!G84EI! Y>A@@?F>!# P -TZ=# : #!G.8!9#8)0I!Y>A@@?FS!# P -TZ=# : #!X(6EI!Y>A@@?FV!# P -TZ =# : #! P (8.+02I!!Y>A@@?F [!# P -TZ=# : #!3#(2!"B1(8 , !Y>A@@?Fi !# P -TZ=# : #!G840 , ! 9#8)02I!&8(+ )7!X#"! : W0). ; , 0 , !Y>A@@?Fa!# P -TZ P .!". (8E!50208602!R8!X(" .#+(! B1(8 , ^!L7#!7(60!+#"!U00+!(22./+0, !"#!(+E!#;!"70!(U#60!+(" .#+(!20)18."E!/8#1W2! o 5(+ , #4 'E!(22./+!i [?\*"#;!"7.2!21W0820!"#!"7.2!/8#1W!

!"#\$%#&+\*#&\*&+

804 (.+./!( )".60! , 1"E!4 .!". (8E!(+ , !0220+ .('!21WW#8!

- o 3%3!2.00!02".4 ("0g!@H[!4 .!".#+
- o ` 0!( ""04 W"0, !"#!120!"70!21W0820!"#;!"7#20!+#"(22./+0, !"#!(!7./708Z8(+\* .+!/ +(" .#+(!20)18."E!/8#1W!L7#!(80!( )".60! , 1"E!4 .!". (8E!W082#++0!"! P -T!mm!@^!R5! L7#!7(60!(!4 .!". (8E!XG-3 :!)# , 0!\Y>A@@?F@!# P -TZ=# : #!G84EI!Y>A@@?F>!# P -TZ =# : #!G.8!9#8)0I!Y>A@@?FS!# P -TZ=# : #!X(6EI!Y>A@@?FV!# P -TZ=# : #! P (8.+02I!! Y>A@@?F [!# P -TZ=# : #!3#(2!"B1(8 , !Y>A@@?Fi !# P -TZ=# : #!G840 , !9#8)02I!&8(+ )7! X#"! : W0). ; , 0 , !Y>A@@?Fa!# P -TZ P .!". (8E!50208602!R8!X(" .#+(!B1(8 , ^! J#L0608I! "7.2!20!"#+'E!80W8020+"2!>[V\*!W0#W'0!.+!"70! = : !W#W1'(" .#+I!2./+.;.) (+ "E!'022!"7(+! "70!3%3d!02".4 ("0!#; !@H[!4 .!".#+#!G2!L0!)#1' , !+#"!.)80(20!#18!+14U08!L."7#1"! .+) '1 , .+!/!+#+Z4 .!". (8E! .+ , .6. , 1('2I!L0! , 0). , 0 , !"#!(22./+!0608E#+0!.+!#18! ( ""04 W"0 , !21W0820!"#!"7.2!/8#1W! .+2"0( , !#; !/#.+!/!"78#1/7!#18!21W0820"" .+!/ W8#)0 , 180#!

!

' <9T9<9k B%/#0C4/3%k (%361''''%#k

!

!"#\$%#&#%#&\*&#&\*

- )8.) ('!+W(" .0+!"70( ""7)(80!W8#6. , 082!\ .08!@!21U".08!@!.;!;8#+"" .+0I!@!21U".08!a!.;!+#"! o 3%3!2.00!02".4 ("0g!S!>!4 .!".#+
- o : 1W0820"#!7#20!L."7!(!XG-3 :!)# , 0!#; !i>>P!PK%ZB0+08('!P0 , .) ('!G+ , !: 18/.) ('! J#2W."('2I!G+ , !: W0). ('E!\Ke)0W"!F2E)7. ("8.)!G+ , !: 1U2" (+)0!GU120^!J#2W."('2! o 5(+ , #4 'E!(22./+!S!>!4 .!".#+#;!"70!21W0820!"#!"70!/8#1W!
- o R;!"7#20!(22./+0, !+!"7.2!/8#1W!8(+ , #4 'E!(22./+!7(' ;!"#!" .08!@!21U".08!@!2! ;8#+"" .+0!+W(" .0+!"J3 ` 2!(+ , !7(' ;!"#!" .08!@!21U".08!(2!+#+Z;8#+"" .+0!+W(" .0+!" J3 ` 2#!
- )8.) ('!#1"W(" .0+!"70( ""7)(80!W8#6. , 082!\ .08!@!21U".08!V!.;!;8#+"" .+0I!" .08!@!21U".08!a!.;!+#"! o 3%3!2.00!02".4 ("0g>#i !4 .!".#+

- : 1W0820"gl"7#20!L."7!(!XG-3 :!)# , 0!#;!XG-3 :!#;!i>@! PK%ZR; ;.)02!R;!  
F7E2.).(+2!R5!i>@V! PK%ZR1"W(.0+!13(80!30+"082!R5!i>@i! PK%ZJ#40!J0("7!  
3(80!:086.)02!
- 5(+ , #4 'E!(22./+!>#i!4.'.#+!#;!70!21W0820!"#!"70!/8#1W#!
- R;!7#20!(22./+0 , !+!7.2!/8#1W!8(+ , #4 'E!(22./+!7(';!"#!".08!@!21U".08!V!(2!  
;8#+".+0!#1"W(.0+!1J3 ` 2!(+ , !7(';!"#!".08!@!21U".08!a!(2!+#+Z;8#+".+0!#1"W(.0+!  
J3 ` 2#!
- )8.).('!#+/Z"084!) (80!;().'. "E!\TM39^!W082#++0"! \ ".08!@!21U".08!a^!
- 3%3!2.00!02".4 ("0g@#i!4.'.#+!
- : 1W0820"gl"7#20!L."7!(!XG-3 :!)# , 0!#;!i>S@! PK%ZX182.+ /!3(80!9()).'. "02!  
\ : \*.'0 , !X182.+ /!9()).'. "02^!R5!i>S P! PK%Z502. , 0+ ".('!3(80!9()).'. "02!Ke)0W"  
: \*.'0 , !X182.+ /!9()).'. "02!
- 5(+ , #4 'E!(22./+!@#i!4.'.#+!#;!70!21W0820!"#!"70!/8#1W!  
W1U'.)!70("7!W082#++0"! \ ".08!@!21U".08!a^!
- 3%3!2.00!02".4 ("0gS??\*!
- : 1W0820"gl"7#20!.+!(!XG-3 :!.+ , 12"8E!.+!"70! PK%!) ("0/#8E!(+ , !7(60!+#!('80( , E!  
(22./+0 , !#!(+E!(!W806.#12!70("7)(80!/8#1W!  
! PK%!) ("0/#8Eg!ri>@!r!ri>@!r!ri>@S@r!ri>@S>r!ri>@Ss Pr!ri>@Vr!  
ri>@ir!ri>@ Pr!ri>> Pr!ri>>>r!ri>S@r!ri>S Pr!  
! M7080!2!+#!. , 12"8E!)# , 0!#;#8!W1U'.)!70("7!2#!L0!(80!8(+ , #4 'E!'(U0'' .+ /!  
404U082!#;!70!40 , .) ('! , 12"8E!(2!W1U'.)!70("7!W082#++0"!#!
- 5(+ , #4 'E!(22./+!S??\*!#;!70!21W0820!"#!"70!/8#1W!

!"#\$%&'()\*&+&

- R"708!70("7)(80!W082#++0!
- 3%3!2.00!02".4 ("0gS[?\*
- : 1W0820"gl"7#20!.+!(!XG-3 :!.+ , 12"8E!.+!"70! PK%!) ("0/#8E!(+ , !7(60!+#!('80( , E!  
(22./+0 , !#!(+E!(!W806.#12!70("7)(80!/8#1W!  
! PK%!) ("0/#8Eg!ri>@!r!ri>@!r!ri>@S@r!ri>@S>r!ri>@Ss Pr!ri>@Vr!  
ri>@ir!ri>@ Pr!ri>> Pr!ri>>>r!ri>S@r!ri>S Pr!  
○ 5(+ , #4 'E!(22./+!S[?\*!#;!70!21W0820!"#!"70!/8#1W!

!  
!  
!

' <9T90% L - (#1F%%6k1I&43\$0\$4 / #k\$'') . 603\$%6k

!"#\$%+##%#&\*%&

- )8.).('!W7(84 () .2"2!(+ , !W7(84 ()E!"0)7+.).(+2!\ ".08!@!21U".08!V^!
- 3%3!2.00!02".4 ("0ga>[\*
- : 1W0820"gl"7#20!L."7!(! : R3!#))1W(.#+!)# , 0!#;!>Y@?[@! PK%ZF7(84 () .2"2!#8!  
>Y>? [>! PK%ZF7(84 ()E!M0)7+.).(+2!!
- 5(+ , #4 'E!(22./+!a>[\*!#;!70!21W0820!"#!"7.2!/8#1W!
- )8.).('!KP :I!'(L!0+ ;#8)040+!I!(+ , !491Tm/T81694cm150403.9998-1910T72Tm/TT21Tf (!)Tj ETQq0

! >Y>?V>! P K%ZK 4 08/0+)E! P 0,.)('!M0)7+.).(+2!!  
! >Y>?VS! P K%ZF(8( 4 0,.)2!R 5!!  
! [SS?@@!M 5 XZG 4 U1'(+)0!%8.6082!G+,!G""0+, (+"2I!Ke)0W"!K 4 08/0+)E!  
P 0,.)('!M0)7+.).(+2!!  
! SS@?@@!F 5 MZ9.82"ZT.+0!: 1W086.2#82!R;!3#880)".#+( '!R;;.)082!  
! SS@?@>!F 5 MZ9.82"ZT.+0!: 1W086.2#82!R;!F#'.)0!G+,!%0"0)".602!  
! SS@?>@!F 5 MZ9.82"ZT.+0!: 1W086.2#82!R;!9.80!9./7".+!/!G+,!F8060+").#+!  
` #8\*082!  
! SSS?[?!F 5 MZF#'.)0!R;;.)082!  
! SSS?@>!F 5 MZ3#880)".#+( '!R;;.)082!G+,!q(. '082!  
! SS>?@@!F 5 MZ9.80;./7"082!

o

! >>@S>!H=MTZ



! VAIHM5XZ

)7.' ,80+!(/0!SZ@A!L."7!(!7./7Z8.2\*!40,.)('!)#+,."#+!  
o G22./+!#"7.2!/8#1W!.+, .6., 1('2!(/0!S!"#@AI!.+)'12.60I!L7#!7(60!U00+!'(U0'0,!(2!  
7(6.+/!(!7./7Z8.2\*!)#+,."#+!6.(!"70!W8#)0, 180!, 02)8.U0,!.+!"70!\$ J./7Z8.2\*!  
)#+,."#+2!(+,!"70!&59: :D!20)".#+!#;"7.2!,#)140+"H!

!"#\$%\$#&#&\*&+&

)7.' ,80+!SZ@A!L."7#1"!(!7./7Z8.2\*!40,.)('!)#+,."#+!  
o G22./+!#"7.2!/8#1W!.+, .6., 1('2!(/0!S!"#@AI!.+)'12.60I!L7#!7(60!XRM!U00+!  
'(U0'0,!(2!7(6.+/!(!7./7Z8.2\*!)#+,."#+!6.(!"70!W8#)0, 180!, 02)8.U0,!.+!"70!\$ J./7Z  
8.2\*!)#+,."#+2!(+,!"70!&59: :D!20)".#+!#;"7.2!,#)140+"H!

!"#\$%\$#&#&\*&#&

G, 1"2!@YZiV!L."7!(!7./7Z8.2\*!)#+,."#+!  
o G22./+!#"7.2!/8#1W!.+, .6., 1('2!(/0!@Y

M70!8(L!+1 4 08.)('!G%-!2)#80!#;!0()7!;( 4.'E!.2!)(')1'("0,!(!2!"70!L0./7"0,!21 4 !#;!."2!6('10!;#8!  
0()7!)#4 W#+0+"!12.+/"!70!L0./7"2!(U#60!#9#8!(;! ( 4.'E!9!"70!8(L!+1 4 08.)('!G%-!.2!(2!;#'!#L2g!  
!

: ; <=>?@ 2 A ()BC&# κ L &M N O\*# !

!` 0!"70+!(22./+!"70!8(L!+1 4 08.)('!G%-!#;!0()7!;( 4.'E!"#!0()7!4 0 4 U08!#;!70!;( 4.'E!! ` 0!  
02".4 ("0!"70!8(L!+1 4 08.)('!G%-!,.2"8.U1".#+!#;!70!0+"!80!=#:#!"80("./!0()7!#U2086("!#+!!.+!"70!  
F= P :!W082#+!, ("(!2!! 6. 7! 8!

` 0!+#"0!"7("!"70!)("!"G%-!)# 4 W1"0,!("!"70!)0+212!U'#)\*!'060!'('2#!# 4 ."2!)# 4 W1".+ /!(+!G%-!;#8!  
)0+212!U'#)\*2!L."7! 4 #80!"7(+!SS f !#;"!"70!W#W1'("#.#+!' .6.+ /!.+! /8#1W!b1(8"082!\=+.6082."E!#;!  
` .2)#+2.+!:)7##'!#;! P 0,.)+0!(+,!F1U'.)! J 0("!"7!>?@[^!#!  
!  
9#8!"7#20!' .6.+ /!.+!7#1207#', 2I!(+E! 4 .22.+ /!)# 4 W#+0+"2!L.'!U0!)#+2., 080,!?#!K608E!7#1207#',!  
7(2!("!"0(2!"!@! 4 .22.+ /!)# 4 W#+0+"I!(2!W8#W08"E!6('10!



>H R;!70!,0)0(20,!6.)".42!)#1+"0,!UE!GFP!5020(8)7!T(U2!(2!41".8()).('I!2#40!#"708!8()0I!  
#8!1+\*+#L+!8()0I!"70!W8#W#8".#+!L7#!.,0+".;,0!(2!&'()\*!#8!-+,. /0+#12!.2!0b1('!"#!  
R)\* S(O)' &Q !

M70!W8#)0,180!(+,(2214W".#+2!;#8!)(')1'(".+!/!(/OZ(,]12"0,!0("7!27(80!;#8!&'()\*!(+,!  
-+,. /0+#12!W0#W'0!(+,"70!"L#!,0("7!8("02!;#8!&'()\*!I-+,. /0+#12I!(+,"T("+#!W0#W'0!(80!  
(+'#/#12H!

!

' T9<9k ,0/0%k?Fk60/0%k)\$603\$?.0\$1''k

!

:"("0!4(W2!L080!)80("0,(2!Ke)0!;.'0,!4(W2!L."7!(!\$%.608/.+!/!\SZ)#'#8^D!)#'#8!2)7040!L."7!"70!  
\$P.,W#.+!D!\EO''#L^!6('10!20"!(!"@H?H!M70!\$P(e.414D!\800+^!(+,\$P.+414D!\80,^!6('102!(80!  
,.2W'(EO,!(!"70!"#W!(+,"U#"#4!#;"70!'0/0+,I!802W0)".60'EH!

!

M70!02".4("0,!6()).+02!80)0.60,!W08!2"("0!1+,08!"70!6(8.#12!8020860!2E2"042!L(2!)(')1'("0,!+!  
#18!4(.+!W8#)0,1802!(U#609kM70!W#W1'(".#+!W08!2"("0!L(2!)#4W1"0,!;8#4!"70!G3:!,("(!L."7!"70.8!  
LO./7"29kM70!\$;(.8!27(80D!.+,0e!80'(".60!#!W#W1'(".#+!.2!"70+!"70!8(".#!#;"70!W8#W#8".#+!#;"70!  
"#"(!6()).+02!80)0.60,!UE!(!2"("0!"#!"70!W8#W#8".#+!#;"W#W1'(".#+!".6.+/!.+!(!2"("0H!!

!

M#!)(')1'("0!(+'#/#12!;(8!27(80!.+,. )02!80'(".60!#!)(20!(+,!0("7!.+).,0+)0I!;.82!",("(!#+"#"('!  
)#+;.840,!) (202!(+,!0("72!.+!0(7)2"("0!L(2!0e"8()"0,!#+!G1/12"!@V!\3%3!>?>?U^H!M70+!"70!

".08u,04#/8(W7.)u/8(W7.+/#5!



R%I%3%"4%6&I13&0C%& ' ( (%'')\$\*&

!

GFP!5020(8)7!T(UH!>?>?H!3#'#8!#;!3#8#+(6.812g!3R<-%Z@Y!%0("72!UE!5()0!(+,!K"7+.)".EI!

G1/12"![]>?>?!% ("(!50'0(20H!50"8.060,!#+!G1/12"!@I!>?>?!;8#4!

7""W2g\_LLLH(W48020(8)7'(UH#8/\_)#6.,\_,0("72



@@I!>?>?!;8#4!7""W2g LLL>H)0+212H/#6 W8#/8(42Z

21860E2\_()2\_40"7#, #'#/E\_, 02./+u(+, u 40"7#, #'#/E\_()2u, 02./+u 40"7#, #'#/Eu)7@@u>?@VHW, ;!